2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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- **Dutch National Science Foundation (NWO)** Grant: 2024/ENW/01804456

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8TH EUROPEAN CONFERENCE OF TROPICAL ECOLOGY

36TH ANNUAL MEETING OF THE SOCIETY FOR TROPICAL ECOLOGY

(Gesellschaft für Tropenökologie, gtö)

"TIME FOR TROPICAL ECOLOGY"

24th – 28th February 2025
Hotel Casa, Eerste Ringdijkstraat 4, 1097 BC, Amsterdam

WELCOME

On behalf of all those involved in the organisation of the "Time for tropical ecology" meeting in Amsterdam, we would like to welcome you to the 8th European Conference of Tropical Ecology. It is a great pleasure, and privilege, to be invited by the Society for Tropical Ecology to host this event in the Netherlands for the first time. We believe that we have assembled a wide ranging and cutting-edge scientific program for your interest and entertainment. The meeting is truly international with delegates coming from institutions based in 35 different countries. We are also delighted for the opportunity to showcase the diversity of tropical research conducted by scientists based in the Netherlands. For this we thank the Dutch scientific community for so enthusiastically engaging with the event, especially: the Institute for Biodiversity & Ecosystem Dynamics (University of Amsterdam) for agreeing to officially host the event, the Dutch Science Foundation (NWO) for sponsorship, and the Faculty of Science (University of Amsterdam) for providing funding to bring in keynote speakers. We also thank the experts of our Scientific Advisory Committee who are drawn from research institutions across the country, namely: Katrin Fleischer (VU Amsterdam), Sancia van der Meij (University of Groningen), Renska Onstein (Naturalis Biodiversity Centre), Masha van der Sande (Wageningen University & Research), Michiel Veldhuis (Leiden University), and Joeri Zwerts (Utrecht University). We hope that you have a wonderful time at the conference and take the opportunity to enjoy some time in this historic city and country with many connections to the tropics.

William D. Gosling & Crystal N.H. McMichael

Institute for Biodiversity & Ecosystem Dynamics, University of Amsterdam, The Netherlands

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Editorial: 8th European Conference of Tropical Ecology, Amsterdam

Time for tropical ecology

William D. Gosling & Crystal N.H. McMichael

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By necessity, ecology – the study of the relations of organisms to one another and to their physical surroundings – requires a temporal context. Are the relationships being studied existing in a single moment, stable given a certain set of conditions, or dynamic through time? In the face of projected climate change and expanding human activity, the robust understanding of time, and timescales, in the tropics is becoming increasingly pressing. For example, drought and fire activity has been observed to be increasing in many tropical regions over recent decades, but to understand the potential impact of this on the organisms concerned an understanding of variance in these parameters across relevant timespans in required. For a tropical tree this may be 100s of years, while for ecosystem assembly this is likely spanning 1000s of years. Therefore, determining weather, or not, the recent drought and fire activity increase is outside the norms experience by organisms, and ecosystems, on these timescales is critical to assessing resilience and the potential for dramatic ecological change, e.g. a switch from forest to grassland. Generating datasets that include a strong temporal component is consequently critical for tropical ecology on a changing planet. These types of datasets can be generated through direct observations (e.g. long-term ecological monitoring), remote sensing (e.g. ever-growing archives of satellite data), and through seeking evidence of conditions beyond the temporal range of direct observations (e.g. from using archaeological or palaeoecological approaches). Once generated, integrating data across timescales remains a major challenge. For this to be successful a common language needs to be developed that allows researchers to see value in the different timeseries datasets and the importance of aligning them. Through the “Time for tropical ecology” meeting we hope to have constructed a program which brings together scientists from all aspects of tropical ecology dealing with many different timescales, data streams, and analytical approaches. We encourage discussion across timescales and techniques, and hope that our keynote speakers – who highlight (unseen) human ecological legacies, dynamics of plant and animal systems, and the importance of temporal observations for validating the effectiveness of policy – will promote vibrant debate and provide an inspiration to all. Only together as a broad scientific community can we develop the comprehensive understanding of tropical ecosystems that is required to manage and protect the biodiversity and ecosystem dynamics in the face of ongoing and projected future global change.

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Keynote 1

The painted forest in the deep past

Jose Iriarte

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This presentation summarises interdisciplinary, multi-proxy case studies in reconstructing past Amazonian landscapes, emphasising Amazonian anthrosols' polyculture agroforestry systems. These ancient, intensive agroecosystems show how, through soil fertilisation, closed-canopy forest enrichment, limited clearing for crop cultivation and low-severity fire management, the forest was largely preserved while providing long-term food security and nutritional diversity. The comparison of fossil and modern records shows how these millennial-scale polyculture agroforestry systems have an enduring legacy on the modern composition of the forest, including legacy stands of edible plants such as palms and Brazil nut trees. These data challenge scenarios suggesting widespread deforestation of the Amazon during pre-Columbian times. These systems demonstrate successful, sustainable subsistence strategies and underscore a rich cultural and ecological heritage with significant implications for sustainable futures in the Amazon. They serve as a reminder of the region's immense biodiversity, vividly painted on the walls of Serranía de la Lindosa in the Colombian Amazon.

Keynote 2

Long-term forest recovery in Suriname

Nina Witteveen

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The role of Indigenous and local communities in protecting Amazonia's biodiversity is increasingly recognized, but their historical impact on tropical forests remains understudied. Can we learn from past civilizations about sustainable forest management? This study travels back in time to Suriname, one of the most forested countries in the world, to examine how Indigenous and Afro-descendant communities have shaped rainforests over the last millennia. Using charcoal and phytoliths (silica microfossils), we reconstructed the vegetation and fire history of tropical forests near archaeological sites and detected various past human activities. Findings reveal the lasting ecological impact of historical Indigenous and Maroon peoples on modern Surinamese forests, through fire usage and palm enrichment. In particular, disturbance intensity and frequency seem important drivers of long-term forest recovery in the tropics.

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Keynote 3

Tropical forest productivity, element cycling and greenhouse gasses: What we've learned from a 20-year large-scale experiment

Emma Sayer

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It's surprising what we can learn by studying dead leaves: leaf litter is a vital source of nutrients for plant growth, and the high productivity of tropical forests on infertile soils is attributed to efficient cycling of nutrients via litterfall. Leaf litter also makes a major contribution to soil carbon storage and influences numerous other important ecosystem processes. In 2003, we began the Gigante Litter Manipulation Project – a large-scale experiment to test whether nutrient cycling via litterfall maintains tropical tree growth. 20 years of continuous monthly litter removal and litter addition treatments to large-scale forest plots have given us important insights into the role of leaf litter in forest productivity, nutrient cycling, and carbon storage. We have also learned some surprising things about the forest greenhouse gas balance along the way. I will present some of the advances afforded by this unique long-term experiment and highlight emerging knowledge gaps about tropical forest carbon and nutrient dynamics.

Keynote 4

Ecological interactions from an African perspective

Nokubonga Mgqatsa

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Africa supports the highest diversity of ungulates and functional carnivore guilds compared to any other continent. Large African mammals interact in a complex and powerful fashion (i.e. how herbivores structure plant communities and how predator densities are correlated with prey densities). Drawing on research conducted across South African ecosystems, I will explore how these interactions not only shape local environments but also impact biodiversity at multiple scales. My talk will highlight the importance of looking beyond direct interactions, such as those between herbivores and plants or predator and prey, to understand broader ecological networks, including interactions among herbivore species. Ideally, I aim to show how African ecosystems, particularly those in South Africa offer valuable insights into ecosystem functioning and contribute to the development of conservation strategies that reflect the complexity of these systems.

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Keynote 5

Utilizing drones and advanced technologies for mapping and protecting tropical ecosystems: The Ecuadorian model

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To achieve effective conservation at the necessary pace to protect tropical ecosystems, which are currently under significant threat, technological tools are essential. Among these tools are drones, or unmanned aerial vehicles (UAVs). Due to their ability to carry various sensors and collect substantial amounts of data from remote tropical regions, drones have become vital allies in the conservation of these ecosystems. In this presentation, Gonzalo Rivas-Torres will discuss the results and experiences from his work with drones in the Galápagos and northwestern Amazon, demonstrating how this technological tool is transforming research and conservation efforts in these critically important ecosystems.

Keynote 6

Protecting elephants in the hardware store

Joeri Zwerts

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Growing global human population and prosperity will require progressively more resources in the decades to come, further pressuring biodiversity. Simultaneously, international pledges and legislation for nature conservation are becoming increasingly ambitious. This raises the question: how can we address the challenge of combining growing resource needs with nature conservation? During this keynote I will dive into the case of tropical timber. More than a quarter of the world's, hyper-biodiverse, tropical forests are exploited for tropical hardwoods. Logging impacts biodiversity in these ecosystems, primarily through the creation of forest roads that facilitate hunting for wildlife over extensive areas. Forest management certification schemes such as the Forest Stewardship Council (FSC) are expected to mitigate impacts on biodiversity, but very little robust evidence is available about the effectiveness of FSC certification because of research design challenges, predominantly limited sample sizes. How can we determine if investing in FSC is worth the investment, and why is it crucial to quantify impacts? In my presentation, I will share the findings of an ambitious research project that explores these questions and takes you through the process of obtaining the results.

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Session 1 – Oral 1: Ecological dynamics and their impacts on tropical aquatic ecosystems

Flood pulses and fish species coexistence in tropical rivers

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Freshwater fish diversity reaches its peak in large tropical rivers. Although the origins of this diversity have been relatively well studied, the mechanisms that maintain high fish diversity in tropical rivers remain largely unknown. It has been hypothesized that the annual flood pulse, a perennial feature of many lowland rivers in the tropics, reduces competitive exclusion and consequently promotes species coexistence. During high water, superabundant allochthonous resources and relatively low fish density may reduce intra- and interspecific competition. During the low-water season, resource availability is low and predation pressure high, offsetting competitive differences between species and controlling fish population sizes. We tested the potential role of these mechanisms for species coexistence by building a food web model, where fish species exhibit strong differences in competition strength and compete for finite resources. We found that extinction rates in the simulations without a flood pulse were consistently higher when compared to those with a flood pulse, indicating more species could coexist when a regular annual flood pulse is present. If the flood pulse is a relevant mechanism for fish species coexistence, then the ongoing flood pulse change across tropical rivers could result in species extinctions and lower fish diversity.

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Session 1 – Oral 2: Ecological dynamics and their impacts on tropical aquatic ecosystems

Seasonal snail slumber & schistosomiasis: Prolonged vector dormancy disrupts transmission of neglected tropical disease

Starkloff Naima[1,2], Mahalila Moses[3], Angelo Teckla[3], Charles Jenitha[3], Kinung'hi Safari[3], David Civitello[2]

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Scientists often neglect the dry season biology of aquatic species because of the challenge of surveying cryptic dormancy locations. Yet, their capacity for endurance through these harsh conditions is fundamental to their population dynamics and disease ecology. *Bulinus* snails transmit a neglected tropical disease caused by parasitic trematodes (*Schistosoma haematobium*) and undergo prolonged dormancy yearly due to extreme rainfall seasonality. As these aquatic snails have a remarkable capacity for rebounding following dormancy, we investigated if parasite survival within snails is diminished. We surveyed 109 (drying and non-drying) ponds in Tanzania documenting snail population numbers and schistosome prevalence from August 2021 to July 2022. Using Generalized additive models (GAMs), we evaluated how these metrics varied across the seasonal cycle. Using a dataset of 30,137 snails, we found that drying ponds had a more dramatic population boom and bust following the dry season, but **schistosome prevalence was 4.6 times lower**, than in non-drying ponds. A complimentary experiment confirmed that dormancy survival of infected snails was significantly lower than uninfected snails. As harsh seasonal conditions disrupt the transmission cycle of this neglected tropical disease, harnessing this knowledge to create inhospitable dormancy conditions has the potential for improved intervention success of schistosomiasis.

Funding: US National Institute of Allergy and Infectious Diseases, R01 AI50774-01

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Session 1 – Oral 3: Ecological dynamics and their impacts on tropical aquatic ecosystems

Dwelling morphology influences diet composition of coral-dwelling gall crabs

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Tropical coral reef ecosystems are highly biodiverse, and a large portion of this diversity is provided by coral-associated invertebrates. Their role in ecosystem functioning remains largely unresearched. Increased knowledge on the trophic positions of host-associated fauna can aid in accurate constructions of food-webs on coral reefs. Currently research is largely focussed on fish and corals. This study focuses on the impact of dwelling morphology on the diet of symbiotic coral-dwelling gall crabs (Cryptochiridae), using a stable isotope approach. Specimens belonging to three crab genera (*Hapalocarcinus, Lithoscaptus* and *Opecarcinus*) and tissue from their coral hosts were collected from reefs in the central Red Sea, together with other potential food sources. For the coral samples, the algal symbionts (zooxanthellae) were split from the coral tissue and analysed separately for δC13 and δN15 signatures. Trophic analyses, using the R-packages ***simmr*** and ***SIBER***, indicate that the gall crabs feed on their hosts. The different crab species, however, show varying patterns in their consumption of the host-tissues or the zooxanthellae, which could relate to differences in dwelling morphology or between host corals. It may well turn out that coral-associated diversity is not only rich in species, but also diverse in their associations with the corals.

Funding: J.R. Claassen was funded by the NWO Doctoral Research Grant for Teachers (#023.019.038)

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Session 1 – Oral 4: Ecological dynamics and their impacts on tropical aquatic ecosystems

Regional-scale disturbances drive long-term decline of reef fish abundance

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Brazilian coral reefs are increasingly impacted by global (ocean warming) and local (e.g., fishing, pollution) stressors, leading to declines in key fish species and threatening ecosystem functions. This study analyzes 20 years (2003-2023) of underwater visual census data to assess trends in fish abundance within a multiple-use marine protected area (MPA) in Brazil (22°58'S 42°01'W), where diverse fishing and intense tourism take place. Using generalized additive models, we examined non-linear changes in the 35 most abundant species, representing 80% of total fish abundance. Our findings reveal significant declines in both large (>40 cm) and small fish species, with sharp decreases noted even among non-target species. These patterns suggest that overfishing, habitat degradation, and climate change are driving the declines. Additionally, we detected abrupt shifts in species abundance linked to extreme climate events, with varying responses depending on event intensity and species traits. While the reef remains ecologically important, the persistence of these species in the face of increasing environmental stressors is uncertain. Our results highlight the urgent need for adaptive management to mitigate the compounded impacts of global and local stressors, as safeguarding key fish species and maintaining ecosystem functions will be crucial for the long-term resilience of Brazilian reefs.

Funding: Coordenação de Aperfeiçoamento de Pessoal de Nível Superior - Brasil (CAPES) - Finance Code 001; Fundo Brasileiro para A Biodiversidade (Projeto de Apoio à Pesquisa Marinha e Pesqueira no Rio de Janeiro/2017), and Petrobras (Programa Petrobras Socioambiental/2023).

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Session 1 – Oral 5: Ecological dynamics and their impacts on tropical aquatic ecosystems

Palaeoenvironmental reconstruction of coastal French Guiana during the Late Pleistocene: A multi-proxy approach

Stéphanie Bodin[1], Carina Hoorn[2], Kees Nooren[2], Matteo Sciumbata[3], Nina Witteveen[2], Pierre-Olivier Antoine [4], Arnauld Heuret[5,6]

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Climate models forecast higher temperatures and sea-level rise by 2100 CE. Analog conditions occurred during the Last Interglacial interval (128–116 ka); yet, to date, there has been no evidence of fossil assemblages from the equatorial Atlantic, which could provide insights into future environmental conditions. However, recent palaeontological excavations in coastal French Guiana have uncovered a large community of ~230 recent foraminifer, animal and plant species dating back to 130-115 ka. Here, we present this evidence, focussing on the charcoal, pollen and phytolith records. During the Last Interglacial (130–115 ka), pollen and charcoal assemblages primarily indicate a mangrove environment, reflecting the high sea-level of that time. In contrast, during the Last Glacial (110–50 ka), the pollen and phytolith records show grass dominance, depicting savanna and dry forest environments, characterised by episodic fires, attesting to a marine retreat and dryer conditions. In more recent periods, charcoal taxa depict a mosaic of modern-like continental habitats at 47 ka, and human settlements by 2 ka. In combination with the faunal data, this plant-related evidence provides key information about the ecology and biogeography of pristine Pleistocene tropical coastal ecosystems especially relevant regarding the—widely anthropogenic—ongoing global warming and future environmental predictions.

Funding: French Agence Nationale de la Recherche (ANR), in the framework of both the LabEx CEBA (ANR-10-LABX-25-01), through the projects Source, NeotroPhyl, Timespan and Emergence, and the GAARAnti project (ANR-17-CE31-0009)

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Session 1 – Oral 6: Ecological dynamics and their impacts on tropical aquatic ecosystems

Miocene mangroves in the Amazon, more diverse than modern counterparts along the Neotropical coastline?

Carina Hoorn[1,2], Fabinay Herrera[2], Shirley Graham[3], Kathleen Gersie[4,1], Eva Westerlaak[1], Giovanni Bogotá-Angel[5], Angelo-Torres Plata[6]

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Extant true mangroves have their greatest species richness in SE Asia, while in the Neotropics they are relatively species-depleted. This is a paradox as modern plant diversity in the Neotropics is among the highest in the world. In the Miocene (23 to 5 million years ago), the coastline of tropical South America was more convolute than at present, and episodically extended deep into the Amazon, yet data on the taxonomic composition of mangroves in the Amazon drainage basin are sparse. This makes us wonder: *What characterized Miocene mangroves in the Amazon, and was their composition perhaps different and/or more species-rich than today?* To address this question, we revisited the palynological record of the Rhizophoraceae, Lythraceae, and Tetrameristaceae from selected sites across the Amazonian sedimentary record, aiming to characterize mangrove pollen types using LM and SEM photography. We compared the results with data from fossil and modern mangrove records along the Pacific and Atlantic coastlines. Our preliminary results suggest that palynological diversity within the three studied families was higher than it is today and may have included taxa from SE Asia that are no longer found in the Neotropics.

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Session 2 – Oral 1: Marine and freshwater tropical ecosystems

Monitoring a critically endangered species: Is the White-bellied Heron (*Ardea insignis*) declining in Namdapha Tiger Reserve, India?

Rohan K. Menzies[1,2], Kulbhushansingh R. Suryawanshi[2,3,4], Rohit Naniwadekar[2]

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The White-bellied Heron (*Ardea insignis*) is the rarest heron in the world with fewer than 60 individuals left in the wild. This large-bodied, range-restricted river bird is found mainly in parts of Bhutan, Myanmar, and northeast India, where the Namdapha Tiger Reserve is the last stronghold for the species. To understand the distribution of the species in this protected area over time, we compiled and mapped data from surveys between 2005 and 2024. Along with previously published data, we conducted three surveys which helped highlight the changes in the intensity of human activities in the region over time. We found a decline in the encounter rates of the species from the core zone between 2014 and 2024 with 0.2 and 0.55 individuals per km in 2015 and 2017, to 0 individuals per km in 2023-24. Interestingly, we observed a reduction in human activities between 2017-2024, particularly with fishing and human presence inside the core zone, contradictory to our expectations given the lowered encounter rates. This globally threatened species appears to be moving away from the safer core zone to more disturbed, vulnerable stretches of the river. This approach in monitoring a Critically Endangered species' distribution could benefit conservation management planning.

Funding: Rufford Small Grants for Nature Conservation, project 37739-1; Rohini Nilekani Philanthropies

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Session 2 – Oral 2: Marine and freshwater tropical ecosystems

Ecological uncertainty from drying water sources: Reviving springs for biodiversity and water security in the Himalayas

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Water scarcity resulting from drying water sources poses a significant threat to ecosystem functions and biodiversity in tropical regions, including the Himalayas. Prolonged dry spells have caused the decline and disappearance of these crucial water sources, forcing some indicator species to migrate to higher altitudes for better habitats, while others rapidly vanish from their ecosystems. Conserving biodiversity and ecosystems is nearly impossible without adequate water resources. To address this challenge, geo-lithological, hydrogeological, and environmental isotope studies were conducted from 2013 to 2023 to identify water source catchments and implement climate-adaptive revival measures. A cross-section delineating compact and soft rock zones was created to map aquifers, uncovering multiple-layered aquifer systems and spring catchments for aquifer-centric springshed development. The concentration of stable isotopes of Hydrogen (^{2}H) and Oxygen (^{18}O) was analyzed in spring water samples, alongside field parameters such as pH, electrical conductivity, total dissolved salts, salinity, turbidity, discharge, and rainfall. By 2022, spring discharge during dry months increased by 20-35% in 25 monitored springs. This research enhances our understanding of spring characteristics and recharge processes. Future rejuvenation efforts must consider climate change projections and long-term monitoring. Immediate, groundwater recharge measures are critical for sustaining ecosystem services, biodiversity and supporting human communities.

Funding: National Mission of Himalayan. Studies, MoEF&CC, Government of India

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 2 – Oral 3: Marine and freshwater tropical ecosystems

Understanding the relative importance of environmental and anthropogenic drivers on Eastern Himalayan river bird communities

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Northeast India falls within the Himalaya Biodiversity Hotspot and harbours the highest diversity of specialist riverine bird species globally; however, these rivers are largely unstudied. The state of Arunachal Pradesh has over 130 proposed dams across all river drainages which could prove detrimental to the river bird communities. We surveyed eight drainages in the region, recording all river birds, environmental (elevation, river width, flow rate, substrate) and anthropogenic (mining, fishing, human presence) variables; to understand what the main drivers are of the river bird communities. A more focussed survey was then conducted at a smaller scale to compare the regional and local drivers. We used a HMSC Analysis Framework and found that at both spatial levels, the environmental and anthropogenic variables explained similar proportions of variation: 68.6% and 64.2% at the regional and local levels, and 15.2% and 15.6%, respectively. Functional traits responded differently at each level, mainly associated with elevation and river width. A strong phylogenetic signal at the local level indicated phylogenetic niche conservatism. The strong association of the river birds at both spatial levels to certain environmental conditions suggest that changes to these habitats could disrupt the community structure in this diverse region especially impacting threatened species.

Funding: Wildlife Conservation Trust (WCT); Ravi Sankaran Foundation; Rufford Small Grants for Nature Conservation, project 23932-1; Rufford Small Grants for Nature Conservation, project 37739-1; Rohini Nilekani Philanthropies

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 2 – Oral 4: Marine and freshwater tropical ecosystems

Priority areas for conservation and restoration of Amazonian forest-fruit-eating fish interactions

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Fruit-eating (frugivorous) fish are forest-dependent fauna critical to forest regeneration via seed dispersal. Fruit-eating fish often swallow intact seeds moving them away from maternal trees. They are considered the oldest seed dispersers in South American wetlands and disperse seeds of >500 plants species. However, in Amazonian floodplain forests, this interdependency is being threatened by deforestation, hydrological and climatic changes, and overfishing. Our task is to identify target conservation and restoration areas that, under climate, land use and land cover (LULC), and connectivity change, are most likely to retain frugivorous fish diversity and affect the fish-forest interaction. We used the *prioritizr* R package to integrate data on climate refugia, LULC, and connectivity to identify and rank priority areas based on the distribution of 52 frugivorous fish species of socio-economic importance. With this approach, we selected areas that maximize species targets, minimize impacts, and meet area-based targets of the Convention on Biological Diversity commitment to protect 17% of terrestrial and freshwater areas by 2020 and the proposed target to protect 30% by 2030. Finally, we expect that the establishment of priority areas with increased frugivorous fish diversity will ensure floodplain forest conservation and restoration.

Funding: BiodivRestore ERA-NET Cofund, project ForestFisher (GA n°101003777)

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 2 – Oral 5: Marine and freshwater tropical ecosystems

Using local ecological knowledge to estimate past abundances of fish and waterfowl species in Lake Titicaca

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Lake Titicaca, shared between Peru and Bolivia, is the highest altitude lake on earth, with a surface altitude of 3814 metres. It is a continental centre of endemicity, with over 90% of the native ichthyofauna being endemic, and several of the bird and amphibian species also being endemic. Despite its importance, it suffers from several anthropogenic pressures, including climate change, overfishing, and pollution from mining. However, there is almost no historical data on the abundance and biodiversity of Lake Titicaca. Here we used Fishers' Ecological Knowledge (FEK) to determine the area's historical baselines for conservation purposes. By interviewing indigenous fishermen of the Uru ethnic group, we estimated the abundance of commercially important waterfowl and fish species over a forty year period. We compared the perceptions change in species abundance between novice, experienced, and veteran hunters and fishermen. We found evidence of shifting baseline syndrome as younger fishermen assumed that the lake has always had relatively few fish compared to older fishermen. We also found evidence of population recovery of diving birds, but not of dabbing birds, which is associated with local fishermen moving from fishing to fish farming.

Funding: British Ecological Society, SR23\1494

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 2 – Oral 6: Marine and freshwater tropical ecosystems

Drivers of intraspecific niche variation in the South American darter *Characidium schubarti* (Crenuchidae)

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Populations of generalist consumers can be formed by collections of specialized individuals. Theory and empirical work indicate that the degree to which individuals within populations differ can vary depending on local conditions. We investigated the role of resource abundance and diversity and the densities of conspecifics and heterospecifics on diet variation in the benthic invertivore C. schubarti in 11 streams in the Atlantic Forest of southeastern Brazil. We sampled invertebrate and fish communities and quantified their abundances and the diets of C. schubarti across sites. We measured the degree of diet variation in darters at different hierarchical levels using a Bayesian framework, which indicated that sites differed in their diet proportions, that there is diet specialization at the individual level within sites and that diet specialization was stronger within some sites than others. A GLM revealed that diet specialization was positively associated with prey biomass and negatively associated with the density of conspecifics, suggesting that as food becomes scarce individuals' diets converge to the same diet item. This result is in line with an optimal foraging model that assumes that individuals have distinct preferred resources but resort to the same alternative resource when the former become scarce.

Funding: FAPESP (project 2022/11287-8), CAPES.

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 3 – Oral 1: Connecting the world's dry tropical forests: A platform for understanding their socio-ecology

The Socio-Ecological Observatory for Studying African Woodlands (SEOSAW): An African-led research partnership to understand the impacts of global change on savannas and woodlands

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The Socio-Ecological Observatory for Studying African Woodlands (SEOSAW) is a long-term regional network working to understand the impacts of global change on the ecology and human use of the region's vegetation with the aim of informing sustainable management of African woodlands and savannas. The SEOSAW partnership represents >100 people across >40 institutions across 13 countries. SEOSAW has developed a suite of linked protocols to study the complex socio-ecology of African woodlands and savannas, which include measurements of trees, shrubs and the groundlayer, as well as a disturbance and human use history.

We will outline recent results from research analyses from >10 000 plots, including 372 multicensus plots on:

1. Tree species and trait diversity
2. Floristic clustering results and vegetation maps
3. Biomass change results
4. Tree growth rates

We will also outline SEOSAW's role in addressing some of the challenges identified in the African Union's Sustainable Forest Management Framework (2020-2030) to achieve sustainable management and development of forest sectors.

New quality-controlled data are continuously being added to the dataset. Use of the data is available to all – following a successful data request to the data owners. The network continues to grow and welcomes new participants.

Funding: UKRI NERC Grant, NE/P008755/1 A Socio-Ecological Observatory for the Southern African Woodlands (https://app.researchfish.com/awards/viewdetails/0?gorderby=team&filter=NERC-NE/P008755/1); NERC National Centre for Earth Observation (NCEO)

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 3 – Oral 2: Connecting the world's dry tropical forests: A platform for understanding their socio-ecology

Intrahousehold dynamics in farmer-managed natural regeneration: Insights from Baringo County, Kenya

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Farmer Managed Natural Regeneration (FMNR) is a cost-effective approach promoting socio-economic and ecological benefits, leveraging farmers' knowledge for adaptability. However, little attention has been paid to intrahousehold dynamics, such as who performs the work and who benefits from FMNR as a restoration practice.

This study aims to explore how intrahousehold dynamics influence the intensity of FMNR practice among landowners in Kenya.

Data for this study comes from a larger REACT project, which covers Baringo, Samburu, and Migori counties in Kenya, classified as sub-humid, semi-arid, and moist sub-humid zones, respectively. This paper focuses on Baringo County, where household surveys, workshops, and key informant interviews with government officials have been conducted.

Preliminary findings reveal that although men control land tenure and make land-use decisions, women are primarily responsible for managing and implementing FMNR. Benefits of FMNR, such as fodder and fencing materials, are appreciated by both men and women. Men find timber, poles, and rafters particularly useful, while women benefit more from herbal medicine, firewood, charcoal, and materials for household items like whisks.

These differences guide FMNR promotion to engage both primary household members for collective benefits. More data from Migori and Samburu counties will enable cross-site comparison.

Funding: ERC grant: 101115893

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 3 – Oral 3: Connecting the world's dry tropical forests: A platform for understanding their socio-ecology

Woody species diversity and aboveground carbon stock of Tara Gedam Church Forest, Ethiopia

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The remnants of Ethiopia's dry Afromontane forests are predominantly found around monasteries and churches. While these forests are protected for their cultural and spiritual importance, they also harbour critical biodiversity and carbon stock. This study investigated woody species diversity and aboveground carbon (AGC) of Tara Gedam Church Forest (85.65 ha) in northern Ethiopia.

Woody vegetation and environmental data were collected in 30 circular plots (r = 15m), using a systematic sampling design and assessing three strata: trees (DBH > 5cm), understory and seedlings. Multivariate analyses of species diversity, population structure and AGC stock were performed.

In total, 9,769 individuals were recorded, *Gymnosporia serrata* being the most abundant species. Although woody species showed a healthy inverted J-shape DBH distribution, the population structure of individual species indicated disturbance. Mean AGC was 94.66 ± 66.78 t/ha, with *Olea europaea ssp. cuspidata* accounting for 43 % of the total. Carbon stock varied significantly between remnants of old-growth forest and secondary forest as well as plantations.

The forest near the monastery was best conserved, as indicated by characteristic old-growth species and highest AGC stock ($p \leq 0.001$), with the remaining forest area being highly degraded. The results are used to inform local participatory forest management plans.

Local field support: Moges, Getasew (Bahir Dar University – BDU); Gedamu, Bahiru (BDU); Getahun, Addisalem (BDU); Aragaw, Kerebih (BDU); Ashagre, Wubetu (BDU); Solomon, Tedros (BDU); Biedermann, Andreas (University of Passau)

Funding: BioCult project with funds from the German Academic Exchange Service (DAAD)

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 3 – Oral 4: Connecting the world's dry tropical forests: A platform for understanding their socio-ecology

Rescuing tropical forest ecosystems: are coffee agroforestry systems a solution?

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Coffee agroforestry with native trees (CAFS) is seen as an effective approach to recover forest ecosystems while maintaining coffee production. Among others they contribute to recover and preserve biodiversity; increase carbon sequestration; improve soil health; support ecosystem services; maintain coffee yields; and provide additional income to rural communities. This approach aligns with sustainable agriculture practices and supports long-term environmental conservation efforts. In this work we assessed the contribution of CAFS to mitigate the major socio-ecological challenges faced in two biodiversity hotspots, the Gorongosa and Chimanimani National Parks, Central Mozambique, Southern Africa. For that, we analysed: (i) the native bird communities and their contribution to seed dispersal and natural regeneration of native species; (ii) the economic sustainability of coffee for the livelihoods of local communities; (iii) the contribution of CAFS to reduce carbon emissions. The results indicate that CAFS is indeed an effective approach to rescue biodiversity and accelerate biodiversity restoration programs, while providing economic benefits to local communities.

Acknowledgements: Funding from Camões, IP (Portugal); Fundação para a Ciência e a Tecnologia (Portugal): UIDB/00239/2020 (CEF), UIDP/04035/2020 (GeoBioTec), LA/P/0092/2020 (TERRA).

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 3 – Oral 5: Connecting the world's dry tropical forests: A platform for understanding their socio-ecology

Effects of tree diversity on dead wood in a young subtropical forest

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Dead wood is an important storage for carbon, while providing food and shelter to many saproxylic organisms. Multiple factors related to tree diversity and tree community composition influence saproxylic communities and in turn the wood decomposition process. Our study investigates this in a subtropical forest, in Jiangxi Province, south-eastern China, by characterizing the bottom up effects of tree diversity on amount and diversity of naturally occurring deadwood.

We measured coarse woody debris (CWD, >7cm of diameter) and fine woody debris (FWD, <7cm of diameter) in 300 plots of the BEF platform, which consists of two sites hosting an experimentally manipulated species richness gradient ranging from 1 to 24 tree species. CWD pieces were assessed and measured individually, while FWD was weighted in 5x5m subplots in each plot.

FWD showed a significant positive correlation with tree species richness in both sites, while for CWD the relation was weaker, being significant in one site only. For FWD and CWD variance of dead wood amount decreased with higher tree diversity. Thus, with higher tree species richness the amount of dead wood increases, while heterogeneity in dead wood amount among plots depends on tree species identity.

Funding: project FE631/51-1 within the DFG Research Unit Multitroph FOR5281

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 3 – Oral 6: Connecting the world's dry tropical forests: A platform for understanding their socio-ecology

Liana diversity and abundance in dry and moist tropical montane forests in Ecuador

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Lianas are increasing over time in tropical forests. Liana ongoing encroachment may limit tree growth and reduce overall forest carbon sequestration rates. How the species diversity of lianas varies along elevation gradients is less understood, but general patterns suggest that richness decreases with elevation in the tropics. Liana communities also depend on tree host dimension and soil fertility. For the moment, the concerted impact of other biotic and abiotic factors on liana abundance and diversity has not been studied in tropical montane forests. Therefore, our research examines how liana communities are structured along gradients of temperature, precipitation, soil fertility, and tree size in the Andes of southern Ecuador. We explore liana communities in seasonally dry and wet forests receiving between 500 and 4500 mm of precipitation per year. Our sites are located between 600 and 3000 m of elevation. Using 25 plots (20 x 20 m) at each elevation level (in total 125 plots) within long-term forest plots, we surveyed all lianas ≥1 cm DBH infesting trees ≥10 cm DBH. Plots were arrayed to cover areas with low or high tree basal area. Preliminary results indicated that liana abundance tends to increase with rising temperatures, showing prevalence in warmer environments compared to colder ones. Contrary to our expectations, water availability limited liana abundance, resulting in lower liana abundance in seasonally dry forest at 600 m. Our early findings suggests that both lower temperatures and reduced water availability lead to a decrease in liana infestation, and these factors also influence liana richness. This research evaluates independently the effects of water availability and temperature on liana abundance, providing valuable insights into how lianas respond to each factor, which is crucial to predict the responses of tropical montane forest ecosystems to future environmental conditions.

Funding: Reco-Andes project, VLIR-UOS, EPN, PUCE, DFG Ho 3296/6.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 4 – Oral 1: Human-wildlife coexistence

Land-use change affects nature's contributions to people in the Kilimanjaro social-ecological system

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Understanding how social-ecological systems work for people and nature is a prerequisite for reducing trade-offs and enabling synergies between Nature's Contributions to People (NCP). Assessing how NCP supply meets social actors' demands offers a means to improve this understanding. Such assessment can be made by pairing NCP supply data with information on peoples' NCP demands to calculate actor-specific NCP multifunctionality measures. In this work, we used extensive field data from the Mount Kilimanjaro social-ecological system to quantify the NCP multifunctionality of twelve land systems for four key actor groups: farmers, conservationists, tour guides, and tourists. By analysing the drivers of multifunctionality, we show how altitude and land-use change alter multifunctionality. Multifunctionality peaks at mid-altitude and in forests as well as in diverse agroforestry systems, yet important differences between NCP categories (regulating, material, non-material) and actor groups exist. These findings emphasize the need to consider multiple NCP categories as well as actors' NCP demand to improve our understanding of social-ecological systems. Our research further points to management strategies that may optimize multifunctionality.

Funding: Deutsche Forschungsgemeinschaft (Grant Number MA 7670/2-1)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 4 – Oral 2: Human-wildlife coexistence

Cultural and social features of nontimber forest products in southern African communities: A case study of *Schinziophyton rautanenii* in Zambia

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Schinziophyton rautanenii is an important source of non-timber forest products in southern Africa, with several local SMEs commercializing these products. While some view traditional techniques as rudimentary barriers to commercialization, their potential role in sustainable utilization remains underexplored. Cultural traditions preserve essential knowledge and skills that can significantly aid local development.

Research in southern Zambia, an area rich in *S. rautanenii*, involved interviews with locals who use traditional methods for nut collection and processing. These skills, passed down primarily among women, have been maintained through generations. The establishment of a collection centre allowed women to earn higher incomes by utilizing these traditional skills. The study revealed a shift in younger women's motivation; given the opportunity to process and sell nuts through the collection centre, they increased their processing activities and reported improvements in nut-cracking skills—a crucial aspect of *S. rautanenii* processing.

This initiative strengthened community cohesion, ensured the transmission of knowledge, and bridged the gap between younger and older women in using traditional skills. The collection centre successfully integrated traditional practices into commercial use, underscoring the value of leveraging cultural knowledge for sustainable development and local economic growth.

Funding: This work was supported by the Czech Embassy in Lusaka through a local development project in 2023 and 2024, grant numbers 1015-1/2023-MZV/LUSA and 1036/2024/MZV/LUSA, and by Czech Aid project "Sustainable agroforestry for improved production in the Southern Province of Zambia", grant number 281489/2024-20-CRA.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 4 – Oral 3: Human-wildlife coexistence

Governance and management of community hunting

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Within the forest ecosystems of central Africa, indigenous peoples and local communities hunt for bushmeat which plays a major role in food security but also culturally and economically. However, in many landscapes the management of hunting based on traditional governance systems is declining or no longer existing. We have previously established and tested a paraecological monitoring system on 20 villages in the north-east of Gabon. The objectives are to analyze the spatial and temporal dynamics of the origin and use of bushmeat within the villages of the study landscape, understand how these data are used (or not) in these villages when decisions are made regarding community hunting management and governance, and how gender is involved, and to identify the social and ecological conditions that facilitate or impede community-based management and governance of hunting.

Funding: CIFOR through the Ressac program

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 4 – Oral 4: Human-wildlife coexistence

Leaf-cutter ants in cacao agroforestry: Balancing pest control and exploring sustainable solutions

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Leaf-cutter ants (LCA), native to the Neotropics, are key ecosystem engineers but are considered pests in organic cacao plantations. Despite farmers' efforts to control them, the broader impact of LCAs on cacao production and their ecosystem services remains unclear. Could these ants provide benefits that counterbalance their negative effects? And also, what sustainable, farmer-friendly management options are available?

Our study was conducted in Northern Peruvian Amazon, in two valleys that present different degrees of agricultural intensification at landscape level. We assessed the impact of 13 LCA nests in cacao agroforestry systems, quantifying herbivory rates, changes in soil conditions and identifying their preferred plant species, hypothesizing that leaf-cutter ants favour shade tree leaves over cacao. Additionally, we explored the landscape and plot-level conditions that favour LCA proliferation Our results showed cacao herbivory reached 17% in some plantations, mostly near nests. However, we found LCAs preferred papaya and orange leaves over cacao, suggesting the potential for using these species as living barriers.

By understanding both the detrimental and potentially beneficial roles of LCA, our research aims to inform organic farming practices that balance pest control with ecosystem services, offering practical insights for cacao farmers.

Funding: German Science Foundation (DFG grant number TS 45/42-1, STE 957/27-1)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 4 – Oral 5: Human-wildlife coexistence

Using multilayer networks to assess ecosystem service flow in a subsistence farming community in Papua New Guinea

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Ecosystem services are rapidly degrading under anthropogenic pressure. Therefore, it is increasingly important to understand how ecosystem services flow, particularly at local scales where people directly rely on nature for livelihoods and wellbeing. Many ecosystem services are underpinned by ecological (e.g. frugivory) and socio-ecological (e.g. cultivation) interactions, connected as multiple stages of ecosystem service flow. Therefore, we use a multilayer network, constructed using local ecological knowledge, to assess how ecosystem services flow in a subsistence farming community in Papua New Guinea. Our results highlight the replaceability of plant species in providing different benefits (e.g. food, medicine etc.), as well as their role in structuring the multilayer network. Specifically, we found that the value of plants to local farmers is linked to their role in maintaining connectivity of the multilayer network, with more important (i.e. less replaceable) plants for providing specific benefits also being more important in structuring the network. We also identified variations in how individual farmers are connected to biodiversity, with a subset of farmers interacting more with specific frugivores within ecosystem service flows. The output from our study can be used to inform decision-making, directing prioritisation and exposing trade-offs in conservation or agricultural practices also supporting ecosystem services.

Funding: Natural Environment Research Council (NERC) (grant number NE/2007210/1)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 4 – Oral 6: Human-wildlife coexistence

Restoring harmony: The decline of transhumant pastoralism and its effects on human-wildlife coexistence and ecosystem resilience in the Eastern Himalaya

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In 1998, a grazing ban was implemented in forests and alpine areas due to concerns about the potential negative impacts of pastoralism on ecosystems and biodiversity. To understand the consequences of this ban, we conducted an extensive investigation into rotational grazing practices and the challenges faced by herders in the Sikkim Himalaya from 2009 to 2020. Using participatory methods, transect walks, and comprehensive surveys in forest areas, Protected Areas, and Reserved Forests, we focused on the pastoral livelihoods of indigenous communities and utilized Geographic Information System (GIS) and remote sensing tools for our analysis. Our findings revealed that the ban disrupted human-wildlife coexistence, particularly affecting regulated transhumant pastoralism and nomadic rotational grazing practices. These traditional methods have proven effective in enhancing ecosystem resilience against climatic stressors while ensuring the livelihoods of herder communities. They are crucial for maintaining the health and functionality of temperate, alpine, and trans-Himalayan ecosystems, significantly contributing to biodiversity conservation. This research provides valuable insights into the complex relationships among pastoralism, forest ecosystems, human-wildlife coexistence and conflict, and biodiversity. These insights can inform future decision-making aimed at revitalizing transhumant pastoralism and ensuring sustainable management of forest ecosystems across elevations from 600 to 5300 meter elevations.

Funding: Sikkim Forest and Biodiversity Management Project, Forest Department, Government of Sikkim, India

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 4 – Poster 25: Human-wildlife coexistence

What's on the menu? Apparency, palatability, and herbivory interactions in a human-dominated tiger landscape.

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Recent conservation efforts have increased tiger numbers in human-dominated landscapes, such as the Gangetic floodplain. A sustainable tiger population relies on the availability of sufficient prey; however, when natural prey is scarce, tigers may target domestic animals and humans, heightening human-wildlife conflicts. Prey numbers, in turn, are restrained by the availability and quality of forage, yet the interaction between these constraints and herbivory requires further investigation. Here, we examine how the apparency and palatability of plant species influence deer feeding preferences by assessing deer herbivory damage, plant cover, and vegetation chemical quality in the Nepalese lowland forests and grasslands. Our findings indicate that while deer prefer highly palatable plants over those less palatable, the former are less apparent and thus less targeted for feeding overall. In addition, grasses—though readily accessible, especially in grasslands—show low palatability; conversely, forbs and saplings—predominantly found in forests—are generally less available but significantly palatable plants. Contrasting current beliefs, deer display a diverse diet comprising plants differing in apparency and palatability levels. These results provide insights for vegetation management policies in South Asia, highlighting that, besides grasslands, forests play a crucial role in the diet of deer, which are vital prey for tigers.

Funding: Dutch Research Agenda (NWA) , project R/010331

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 4 – Poster 26: Human-wildlife coexistence

Garbage perusal, a foraging alternative for *Rhesus macaques*

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Energy, a vital currency in ecosystems, diminishes when forests degrade and shrink. Most organisms prioritize energy conservation, with strategies varying from the high-energy hummingbird to the slow-moving sloth. Easy access to agricultural fields allows animals like elephants, deer, and wild boars to conserve energy otherwise spent on foraging, while rhesus macaques benefit even more from human feeding on roadsides. Additionally, urban environments provide them with nutrition through open garbage dumps, unsecured balconies and windows, and people's altruistic feeding habits.

We studied the resource utilization and movement patterns of rhesus macaques in a village near Dehradun, India. Four adult females, each from different troops, were fitted with Lotek GPS collars weighing 100 grams and monitored for 9-12 months for better understanding of their ranging and foraging patterns.

The 90% Kernel home ranges for the four adult females were 0.078km2 , 0.03km2 , 0.07km2 and 0.026km2 respectively. The number of garbage dumps in home range of each troop was 22 (troop A), 7 (troop B), 23 (troop C) and 6(troop D). The 90% Kernel home ranges for four adult females forsummer season were 0.063km2, 0.081km2, 0.084km2 and0.022km2 and that for winter were 0.065km2, 0.030km2,0.010km2 and 0.030km2 respectively.

No seasonal variation was observed in the space-use patterns of rhesus macaques. The findings suggest that human subsidies, such as garbage dumps, may shape their ranging behaviour, contributing to conflicts in human-dominated landscapes. Therefore, understanding species movement and ranging patterns is crucial for their effective management and long-term conservation.

Funding: Ministry of Forests, Environment and Climate Change, India under National Mission on Himalayan Studies.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 5 – Oral 1: Sustainability in the tropics

The potential of Sentinel-1 to monitor fine-scale natural and logging-related disturbance patterns and associated carbon emissions

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Degradation from fine-scale disturbances such as logging and natural tree mortality is not accurately captured in state-of-the-art satellite-based monitoring systems. Our work on improved fine-scale disturbance detection using Sentinel-1 radar shadow opens up opportunities to study patterns of logging and natural disturbance that could previously not be analysed at large scales and over time. Our mapped detections were validated using two extensive, spatially explicit drone-based reference datasets in Barro Colorado Island nature reserve and five logging concessions in the Congo Basin. For disturbances larger than 200 m^2, we reach detection rates above 65% and 80% for natural disturbances and logging-related disturbances, respectively. Inspired by previous ground-based research with a limited geographical scope, we analyse logging patterns inside concessions, such as the adjacency, connectivity and patch size of intensively logged areas and relate this to influencing factors such as distance to logging roads, topology and presence of riparian areas and peatlands. Furthermore, spatially explicit reference data on harvest volumes from logging and associated carbon emissions allow us to assess to what extent integration of our fine-scale disturbance detection system with auxiliary (satellite-based) data streams can be used as a basis to monitor local carbon loss from logging. We find strong linear relationships between our estimated local carbon losses and ground data on emissions at the level of annual cutting blocks, as well as with reported harvest volumes at the concession level. Our work supports the enforcement of policies aimed at curbing forest degradation, fosters management and certification in logging concessions, and provides opportunities for improved forest monitoring in both natural and logged landscapes.

Funding: The European Space Agency (ESA) Earth Observation for Sustainable Development (EO4SD) initiative (ESA ESRIN/Contract No. 4000131862/20/I-DT); the US Government's SilvaCarbon program; the Open Domain Science project Forest Carbon Crime (Project Number: OCENW.M.21.203) of the Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 5 – Oral 2: Sustainability in the tropics

Food insecurity under global human-induced changes: Plants of the future in the Amazonian biome

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Forests provide vital food resources, especially for human populations. However, global human-induced changes threaten food security worldwide. The biodiverse-rich Brazilian Amazonian Forest is home to 19 million people, many of them depending on plants for sustenance. Here, we analyze the effects of future projected global human-induced changes in the form of deforestation and climate change on edible plants in the Brazilian Amazonia Forest. We used species distribution modelling to quantify variations in edible species richness and environmental suitability in the Brazilian Amazonia and analyze the effects of future projected climate change for 2050 on human populations based on the municipalities and protected areas. Moreover, we used projections for 2050 deforestation to estimate the effects of land-use change. We identified 235 edible species with valid distribution models. These species exhibited a broad distribution, covering an average of 60% of the Brazilian Amazonian Forest. Most of the species showed reduced potential distribution by 2050, contributing to decreased richness, particularly in the Eastern and Central parts of the Forest. Impacts are higher on the municipalities and protected areas with smaller forested areas where species richness decrease was very high. We identified sixty-three edible species potentially resilient to human-induced changes, most of them providing edible fruits and seeds. According to our projected scenarios, most edible species in the Brazilian Amazonia may be affected human-induced changes. Exploring resilient edible plant species is crucial for food security and supporting forest-dependent populations.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 5 – Oral 3: Sustainability in the tropics

Brazilian conservation policies fail to protect insect biodiversity

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Conservation policies are essential for safeguarding global biodiversity, but their ability to equitably address the needs of all threatened species remains uncertain. We previously showed that conservation policies in the UK and Ireland are inadequate for protecting insect biodiversity—a critical issue, as insects provide key ecosystem services that support food production. We now applied this analytical approach to Brazilian conservation policies. As a major food producer and tropical biodiversity hotspot, Brazil has a globally recognized environmental legal framework. We asked: are Brazil's conservation policies effective in protecting insect biodiversity? Our results show that Brazil's policies, particularly species lists guiding conservation efforts, are biased against insects. Remarkably (although not surprising), some hyperdiverse groups such as Dipterans, are completely ignored. Meanwhile, mammals and birds are well represented, demonstrating some biases towards larger and more charismatic animals. These findings align with our earlier results from the UK and Ireland, suggesting Brazil's policies are also inadequate for protecting threatened insect species. We expect this issue to be even more pronounced in countries with less comprehensive environmental laws, posing significant risks to tropical insect conservation.

Funding: JM is supported by the Biotechnology and Biological Sciences Research Council [BBSRC: BB/V015249/1]. GL is supported by the Coordenação de Aperfeiçoamento de Pessoal de Nível Superior [CAPES: 40001016048P6].

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 5 – Oral 4: Sustainability in the tropics

Socio-ecological management of multipurpose climate-resilient agroforestry for biodiversity conservation and food security in the Eastern Himalayas

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The Eastern Himalayas boast diverse agroforestry systems, such as farm-based, forest-based, cardamom-based, mandarin-based, and tea-garden-based systems, each with distinct ecological and socioeconomic contributions. These systems are crucial for food security, biodiversity conservation, and economic sustenance. This study evaluates the socioeconomic and ecological potential of these systems, focusing on their contributions to food and economic security, while also assessing their biodiversity value using participatory approaches, non-destructive biomass estimation, and field sampling methods. Tree density and biomass differ across systems, with the forest-based system showing the highest tree density (843 ± 132 trees ha^{-1}) and basal area (21.36 ± 3.66 m^2 ha^{-1}), promoting biodiversity. Conversely, the tea-garden-based system has the lowest tree density (78 ± 34 trees ha^{-1}), indicating limited habitat support. Large cardamom-based systems excel in biomass production (64.61 ± 5.81 t ha^{-1}) and energy conversion, though mandarin-based systems, despite higher tree density, show lower productivity (3.51 ± 1.26 t ha^{-1}). Farm and mandarin systems lead in crop yields, while forest-based systems contribute more through non-timber forest products (NTFPs) and fodder. Economic analysis shows varying cost-benefit outcomes. Alder-cardamom systems have high fuel-wood costs, while forest-cardamom systems require fewer inputs but yield high outputs in fuel-wood and NTFPs. Tea-garden systems, with the highest output-to-input ratio (625.00) and agronomic yield (37,500 USD), prove highly efficient despite labour costs. Agroforestry landscapes host 88 varieties of rice, 31 maize varieties, and 34 pulses and legumes, along with over 483 species of medicinal plants, 216 weeds, more than 250 species of fodder crops, 20 bamboo species, 150 timber species, and over 290 multipurpose tree species. The systems support diverse landraces and species, including 126 cereals, 132 vegetables, 34 pulses, and over 250 wild edibles, alongside 21 local breeds of domestic animals. These systems not only provide food security and socio-economic benefits but also promote ecological connectivity, soil conservation, carbon sequestration, and climate resilience, making them vital for sustainable development in the region.

Funding: The Mountain Institute India

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 5 – Oral 5: Sustainability in the tropics

Smallholder farmers' knowledge on management of *Cinchona* in the Democratic Republic of the Congo

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Cinchona tree bark is the key source of quinine alkaloids used as malaria treatment. Currently, the eastern Democratic Republic of Congo (DRC) accounts for 55% global supply of quinine. A study was conducted to obtain more insights into the context of Cinchona cultivation, its scale of farming and management and ways to deal with specific risks. Data was collected on *Cinchona* tree distribution, socio-economic variables, farm characteristics, and cultivation techniques by interviewing 185 smallholder farmers across eastern DRC. Most *Cinchona* trees are grown at elevations between 1588 and 1627 m a.s.l. Also, most farmers preferred growing *C. calisaya* in a monoculture cultivation, with in vivo propagation using their own seeds. Cassava was the dominant crop as previous cultivation and as a crop grown together with *Cinchona*. Similarly, *Eucalyptus* was the dominant tree species grown together with *Cinchona*. Most of the farmers apply a 1 × 1 m spacing but do not use any fertilizer. The most reported plant disease is linear canker. To sustainably increase the productivity of *Cinchona* in the DRC, smallholder farmers should be given appropriate training to empower them to carry out their own in vitro propagation and apply integrated soil fertility management and integrated pest management.

Funding: VLIR-OUS and the NASCERE projects.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 5 – Oral 6: Sustainability in the tropics

Landscape features shape multiple dimensions of the phyllostomid and aerial insectivorous bat assemblages in Amazonian cacao agroforests

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Bats play an essential role in tropical agricultural areas due to the ecosystem services they provide, such as phytophagous arthropod suppression. Understanding how bat assemblages respond to landscape characteristics is essential for designing multifunctional landscapes supporting high levels of biodiversity and enhancing ecosystem services provision. We sampled phyllostomids and aerial insectivorous bats (AIB) in cacao agroforests to analyze how the taxonomic, functional and phylogenetic dimensions of the bat community responded to landscape composition and configuration in two contrasting agricultural regions in the Peruvian Amazon. In addition, we estimated how these landscape features influenced the foraging activity of AIB. Phyllostomid abundance increased towards fragmented landscapes due to higher abundances of generalist species. Edge density effects on AIB functional diversity varied from positive (in the most impacted region) to negative (in the less intensive one), while the landscape tree cover had positive effects on the phylogenetic diversity of the assemblage in both regions. AIB foraging activity in cacao agroforests decreased with increasing cropland cover in the less intensive region. Overall, our results indicate that landscape effects on bats can vary depending on the regional characteristics of the agricultural area, highlighting the importance of adjusting landscape design to the regional context.

Funding: Austrian Science Fund (FWF grant number I5272) and German Science Foundation (DFG grant number TS 45/42-1, STE 957/27-1)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 5 – Poster 47: Sustainability in the tropics

Agroforestry: A model for sustainable land use and biodiversity

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In sub-Saharan Africa, where agriculture is a cornerstone of rural livelihoods, agroforestry offers a sustainable solution to address pressing challenges like food security, climate change, and biodiversity loss. By integrating trees into agricultural systems, agroforestry provides a range of benefits, from improved soil health and water conservation to increased food production and climate resilience. This study aimed to assess farmers' perceptions of agroforestry systems, analyze the adoption of agroforestry practices and evaluate the impact of agroforestry on biodiversity and yield. A multi-stage sampling technique was used to select 500 cocoa farmers in the study area. Data was collected through surveys and analyzed using descriptive and inferential statistics. Results revealed that majority of farmers (84%) were small-scale, operating farms less than 2 hectares. Over 95% of respondents recognized the multiple benefits of agroforestry, including food, fuelwood, fodder, timber, medicine, soil improvement, erosion control, and water conservation. Agroforestry was identified as a crucial adaptation strategy to counter the impacts of climate change. Agroforestry offers a promising approach to sustainable development in sub-Saharan Africa. To promote its adoption, policies must prioritize training programs and extension services to educate small-scale farmers about the ecosystem services, climate change adaptation benefits, and food and nutritional security advantages of agroforestry. By investing in agroforestry, we can create a more resilient and sustainable future for rural communities.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Oral 1: The anthropic tropics

Pre-Colombian landscape modifications in the Llanos de Moxos, Bolivia

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The Llanos de Moxos (LdM) region of Bolivian Amazonia is characterised by a network of meandering rivers and bands of forest, which grow on fluvial levees of past and present river channels. Spanning more than 150,000km^2, this vast riverscape appears to be moulded almost entirely by natural processes. However, people first started living in the LdM at least 10,500 years ago, evidenced through the accumulation of archaeological material creating "Forest Islands", patches of slightly raised ground, allowing trees to grow in the otherwise seasonally flooded savannah. While the extent to which early inhabitants of the LdM modified the landscape is uncertain, current evidence suggests it was relatively low scale. From 0-500AD, however, people started transforming the environment in more substantial ways, creating raised fields, drainage canals, ponds, causeways and monumental mounds. Significantly, drainage canals altered the landscape hydrology, reflected in shifts in the forest-savannah ecotone visible to the present day. A long-term understanding of the ecological impact of Pre-Colombian landscape management practices provides valuable insights into the legacy of human modifications on modern ecosystems.

Funding: European Research Council (ERC), project Nº 101043738

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 6 – Oral 2: The anthropic tropics

Integrative studies of earth-mound landscapes of natural and cultural origin show why ecology needs archaeology and vice versa

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Seasonally flooded savannas contain diverse earth-mound landscapes. Some are vestiges of ancient agricultural raised fields, others are raised fields being built and farmed today, and yet others are made by soil engineer animals. We studied all three situations, integrating archaeology and ecology. Human and non-human soil engineers—termites, earthworms, and ants—face similar problems in seasonally flooded savannas. Their wet environment favors plant production, and organic matter accumulates with seasonal waterlogging. But to exploit these rich sites, both humans and soil animals need islands of soil that are well-drained in the rainy season, where humans can grow their crops, earthworms can respire during foraging bouts in waterlogged sediments, and social-insect colonies can survive flooding. All these organisms move large quantities of earth to construct mounds that reach above high-water level. They live together in seasonally flooded savannas and intimately interact: farmers profit from termite mounds as ready-made raised fields, and soil animals similarly profit from human-made mounds. Non-human soil engineers have continued to interact with pre-Columbian raised fields in Amazonia in the centuries since their abandonment, re-engineering these landscapes in ways that can both obscure and preserve archaeological features. Understanding these landscapes requires archaeology and ecology working together.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 6 – Oral 3: The anthropic tropics

Sensing Maya legacies in Central American forests

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In northern Central America humans have had a discernible influence on the landscape over the Late Holocene. These tropical and subtropical areas lend vital ecosystem services to local, regional, and global communities; yet there is still a lack of understanding in the full scale of their vegetation composition and variation, as well as the role that humans played and continue to play in the creation and maintenance of environments here. Lidar remote sensing is particularly revolutionary towards quantifying the extent of intensive human influence, as well as vegetation and topography metrics at multiple scales. We quantified canopy height, variability, arrangement, and cover from airborne lidar data, and assessed correlations to anthropogenic extent with spatially-explicit and geographically weighted regression analyses, taking topographic factors into account. Overall, the presence of Maya structures and agriculture associates with increased canopy height, leaf area, and canopy cover, and the presence of Maya agriculture is related to increased canopy variability, measured as both internal and external canopy heterogeneity. Given that the Maya culture and its infrastructure spanned much of northern Central America, these findings have potentially broad-reaching implications for forest structure throughout these tropical and subtropical environments.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Oral 4: The anthropic tropics

Shea Parklands: Approaching the historical ecology of West African domesticated landscapes

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Shea parklands are misunderstood and threatened landscapes of the West African Sudanian savanna biome. Their conservation urgently requires tree planting, but savannah "reforestation" is contested, possibly due to a lack of adequate understanding of the role of humans in shaping and maintaining the woody vegetation in the form of an ancient agroforestry system. Anthracological studies – analyses of macro-charcoal from archaeological sites dating to the first two millennia CE and in various regions of central West Africa, aim to provide a different perspective on these savannas of the West African Sudanian Savanna biome - as landscapes shaped by humans cultivating (African) crops and managing useful trees as wild plant resources. Initial results indicate a constantly high number of shea trees in the surroundings of these sites in Mali, Burkina Faso, and Benin, already in the first millennium CE. The study shows that the West African Sudanian savanna biome while not anthropogenic, has been significantly shaped by millennia of shifting cultivation and tree management. Clarifying the status and history of the shea parklands is essential to protect their future, both as a cultural heritage and as an ecologically diverse economic landscape that generates sustainable income. Anthracology is one means to contribute.

Funding: Deutsche Forschungsgemeinschaft (DFG, German Research Foundation): "Cultivated Landscapes", project number 404318292; and fellowship at Merian Institute for Advanced Studies in Africa (MIASA), Federal Ministry of Education and Research, Germany, grant n° [01 UK2024A]', and co-funded by the University of Ghana, Legon-Accra, Ghana

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Oral 5: The anthropic tropics

What to expect when you're expecting? Historical human presence without lasting effects on Amazonian rainforests

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Present-day anthropogenic activities in the Amazon is threatening its survival as we know it nowadays, having an effect of global consequences. However, the contribution humans have had in shaping the ecosystems we observe today, and the long-lasting consequences of their activities has been almost neglected until recently. Even in well-studied regions from a botanical and ecological point of view, the history of the current ecosystems and the role humans have played on it during the last millennia remains patchy. Here we present the fire history of the last 5000 years in the Yasuní National Park based on the palaeoecological analysis of macrocharcoal particles from four sedimentary archives collected in palm swamps. The charcoal records show in general low values, with some exceptions: (i) a recent peak in one location often visited recently by Waorani as a hunting spot; (ii) some variation around 2500 cal yr BP that could be related to climatic instability; and (iii) scarce fire signals around 5000 cal yr BP, coeval with the presence of cultivars. Despite this ancient human presence, the reconstructed vegetation did not show any clear signal of anthropogenic legacies, raising the question of how to better detect human presence of small, mobile societies.

Funding: Catalan Agency for Universities and Research (AGAUR) and the EU programme Marie Curie COFUND (Beatriu de Pinós - Marie Curie COFUND fellowship, ref.: 2014 BP-B 00094) and the Spanish Ministry of Science and Innovation (research grant ref. PID2022-138059NB-I00). NERC NEIF Allocations for radiocarbon dating, refs. 2499.0322 & 2831.0724.

Permits granted by the Ministry of Environment, Water, and Ecological Transition of Ecuador

- Permit for Investigation: 009-2015-IC-FAU-FLO-DPAO-PNY & MAAE-ARSFC-2021-1250
- Permit for Exportation: N° 003-2022-EXP-IC-FLO-DBI/MAAE

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Oral 6: The anthropic tropics

Multiphasic periods of occupation in an Andean biodiversity hotspot

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Long histories of human occupation are emerging for the wet forests of the Andean flank, even ones that are apparently 'pristine'. The past habitations were societally and temporally complex with sophisticated cultures emerging, flourishing, and disappearing. The Upano River in eastern Ecuador supported such cultures, and yet the timing of occupation and whether their impact on the local ecosystem resulted in lasting ecological changes is not known. Here, using paleoecological reconstructions from Lake Cormorán, located immediately adjacent to the Upano Valley and within 5 km of abandoned mound complexes, we provide a timeline of human influence spanning the last 2770 years. We document the onset of maize cultivation c. 570 BCE, changes in land use within the occupation phase, with evidence of slash-and-burn, slash-and-mulch and silviculture. A gradual decline in forest exploitation presaged an apparent abandonment of the site c. 550 CE. A much later wave of land use that began about 1500 CE, coupled with a regional transition to a wetter climate, produced a distinctive forest composition unique to the last 120 years.

Funding: NSF

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 6 – Poster 1: The anthropic tropics

Soil organic matter provides insight in the building scenarios of raised fields in Central Africa.

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Raised fields (RFs) are ancient agricultural systems designed to protect crops in humid intertropical regions notably in flood-prone areas. Despite recent interest in Central African RFs, their formation remains poorly understood. This study used soil organic matter (SOM) properties determined by Rock-Eval® thermal analysis and magnetic susceptibility to reconstruct steps that drove the formation of RFs in Gabon (Oyane and Matadi sites). Preliminary carbon stock assessments suggest these soils could be significant carbon sinks (148.87 +/- 44.6tC ha^{-1}), comparable to the region's richest natural soils. No lasting human impact at the Oyane site was recorded in SOM properties as well as magnetic susceptiblity. In contrast, at Matadi, enrichment in charcoal and high magnetic susceptibility values testify for the deforestation by anthropogenic fires, as natural fires are uncommon in the region. Charcoal dating suggests that the RFs at the Matadi site were formed during the Iron Age (2000-700 BP), a period characterised by the adoption of metallurgy and changes in agriculture. The vast extent of these sites shows a large-scale transformation of the landscape by ancient Central African populations. Mapping and further study of SOM could help quantifying the transformation and the identification of past farming practices, but also to preserve both carbon and cultural heritage.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 2: The anthropic tropics

Early Holocene landscape modification in the Bolivian Amazon

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The Llanos de Moxos (LdM) region, SW Amazonia, Bolivia, has been occupied by people for over 10500 years. Since their arrival, humans have modified their environment by creating thousands of little mounds in the seasonally flooded savannah. As these mounds remain above the water level during the rainy season, trees can grow on them. For this reason, they are called "Forest Islands" (FIs), patches of trees surrounded by savannah. Understanding past-human environment interactions at a regional scale is essential to understand their legacy in modern LdM ecosystems. This paper presents the initial results of DEMODRIVERS, a project that employs a wide scale-systematic sediment coring strategy, and archaeological excavations. Our results show that the first inhabitants of SW Amazonia used a broad spectrum of resources since the very beginning. Following their arrival, they started domesticating plants more than 10K years ago and developed pottery around 4.5K years ago. Nowadays, some of these anthropic forest islands are roosting site for the Blue-throated macaw (*Ara glaucogularis*), listed as Critically Endangered by the IUCN. This research is providing a new understanding of the extent to which modern Amazonian ecosystems have been shaped by people since the beginning of the Holocene.

Funding: European Research Council (ERC), project Nº 101043738

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 3: The anthropic tropics

Local- and regional-scale land use associated with the Casarabe Mound Culture of Amazonian Bolivia

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The Casarabe Culture of the Monumental Mound Region (MMR) of Amazonian Bolivia spanned from 600 – 1600 kcal BP and is the most complex pre-Columbian society yet discovered in Amazonia. The network of monumental mounds and interconnecting canals points to low-density urbanism, but little is known about its land-use practices or its impact. Here, we present palaeoenvironmental data from sediment cores from two basins of contrasting sizes. A 62 cm core from Laguna Peroto reveals a 2,500-year history of land use at a regional landscape scale, with two phases of rapid sedimentation, which we evaluate in the context of climate change and anthropogenic earthwork construction. We find evidence for maize cultivation and anthropogenic burning of savannas, but no evidence for regional-scale changes in forest cover. A 50 cm core from the palaeo-river channel bordering the previously excavated Loma Salvatierra captures local-scale land use on this site over the past 1000 years. A high abundance of maize indicates cultivation at Loma Salvatierra and supports the hypothesis of a maize-based economy, while charcoal abundance is very low, indicating that Loma Salvatierra remained forested. Our data imply that a complex society was able to develop for a millennium without the need to remove valuable forest resources.

Funding: AHRC-FAPESP MoU research grant HERCA, reference AH/S001662/1.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 4: The anthropic tropics

Modelling maize agriculture by the pre-Columbian Casarabe Culture of Amazonian Bolivia: An agent-based approach

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Scholars have long debated how pre-Columbian (pre-1492 CE) indigenous societies shaped modern Amazonian landscapes. Compelling evidence of large-scale landscape domestication comes from the forest-savanna environments of northern Bolivia, where between 400-1400 CE, the Casarabe Culture constructed hundreds of monumental earthen mounds connected by a dense causeway-canal network. However, while recent research suggests this culture practiced low-density agrarian urbanism, little is known about how extensively they modified the surrounding rainforest/savanna ecosystems.

Here, we present the results of experiments conducted using an agent-based model of this culture, which we developed to generate hypotheses regarding their utilisation of these ecosystems under a range of scenarios. Based on our model outputs, we hypothesise that the Casarabe Culture modified only localised areas to maximise cultivation on land with 'desirable' environmental characteristics. For this reason, such land is likely to have been intensively modified. The availability of forest and savanna near most settlement mounds also likely enabled this culture to cultivate there without needing to encroach upon less desirable areas. Our model outputs will help to guide future research, identifying potential sites for archaeological and palaeoecological fieldwork. They can also be compared with future empirical data to improve our understanding of human-environment interactions in these landscapes.

Funding: NERC SCENARIO doctoral training partnership (project grant: F4114925)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 5: The anthropic tropics

Simulating impacts of climate variability on the pre-Columbian Casarabe Culture of Bolivia using palaeoclimate reanalysis and agent-based modelling

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The pre-Columbian (pre-1492 CE) Casarabe people occupied a region of forest and savannah grassland in northern lowland Bolivia between 400-1400CE. Living in clusters of settlements, they cultivated various crops, particularly focused on maize, foraged and developed complex infrastructure - monumental mounds, forest islands and networks of raised causeways. Recent studies indicate that the Casarabe Culture's settlements were abandoned prior to European colonisation, although the cause is unclear. Palaeoclimate records suggest climate change, specifically drought, may be a contributory factor.

Here, we present preliminary results of simulating Casarabe societal response to climate forcing. Using an agent-based model (ABM) and employing annual variation in maize (*Zea mays*) production as a proxy for precipitation fluctuation, we explore human-environment interactions through sensitivity to idealised climate patterns. We calibrate, using recent research, the effect of precipitation variability on crop yield before applying palaeoclimate data, from reanalysis and speleothems, to the simulation.

Palaeoclimate data uncertainty and covarying model parameters mean further work is required. However, preliminary results indicate the Casarabe society was resilient to gradual changes in precipitation but less resilient to low-yield shocks, suggesting that transient, localised, severe-drought climate forcing may have contributed to significant societal transformation prior to Europeans arriving in Amazonia.

Funding: NERC SCENARIO doctoral training partnership (project grant: NE/S007261/1)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 6: The anthropic tropics

Multi-proxy palaeoecological analysis of vegetation dynamics and fire history using the Matematico core in southern Brazil

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Tropical forests were long considered untouched barriers to human presence in the past. However, recent archaeological research indicates a long history of human occupation and management of these biodiverse habitats. Although the importance of tropical cultural heritage is well recognised, comparative information on the long-term human history of tropical forests remains limited in many key regions. The project “Comparative Legacies of Human Land Use in the Brazilian Atlantic Forest” aims to understand how long-term human land-use has impacted the Brazilian Atlantic Forest, one of the most threatened tropical forests in the 21st century. As part of the project an ongoing research effort is conducting a multiproxy analysis of the 80 cm-long lacustrine sediment core “Matematico”, dating back at least 4000 years. The analyses include pollen, NPP, charcoal, biomarker and C14 data. The study site, Matematico, is situated in the southern Brazilian highlands, specifically in the northeastern part of Rio Grande do Sul State and is surrounded by a mosaic of Araucaria Forest and natural grassland vegetation (Campos). Initial pollen and charcoal results indicate a change from Campos vegetation to a Campos/Araucaria Mosaic coupled with an increase of fire activities around 400 years before present. A comprehensive comparison of pollen and biomarker data should provide valuable insights into the vegetation dynamics of the Campos and Araucaria Forest ecosystems and disentangle their responses to human impact and/or climatic changes .

Funding: DFG

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 7: The anthropic tropics

Environmental dynamics of diatom assemblages of anthropogenic soils from the Mompos Depression (N Colombia)

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The Mompos Depression (N Colombia) is one of the largest flooding areas of South America and one of the largest perennial Neotropical wetlands. Pre-Columbian populations of the Mompos Depression modified the flooding-prone areas through the construction of earthworks such as raised fields, platforms and *canal-camellón* systems. The ancient inhabitants of this area successfully managed the territory as a complex society by exploiting the area for food production and adapting their agroforestry practices to the changing hydrological regime. After 13th century, this land was abandoned and the canals were progressively filled up with sediment. The present work aims to present for the first time in the region preliminary data on past diatom community assemblages of the *canal-camellón* systems through time and space. We analysed samples from 3 different locations in order to evaluate the diatom diversity and distribution, as well as the community changes through the recent past, to see if is there any signal related with the ancient human settlements in the area. We found single species dominance among space and time (*Diadesmis confervacea*) followed by several abundant genera (*Eunotia*, *Pinnularia* and *Gomphonema*). A large portion of the species found indicate warm and acidic conditions, similar to present conditions.

Funding: Spanish Council of Science and Innovation (ref. PID2022-138059NB-I00). We would like to thank all the local people who welcomed and helped us, the field work assistants, and the Instituto Colombiano de Antropología e Historia (ICAHN) for the permits (ref. 8793).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 8: The anthropic tropics

Human legacy on a Belizean tropical forest

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Tropical forests are revealing a deep-rooted human footprint. Recent research has transformed our understanding of long-term human/tropical forest dynamics, overturning prior perceptions of tropical forests as barriers to pre-agricultural societies, with increasing evidence of active human engagement with soils, plants and animals since the Late Pleistocene.

Although tropical forests have returned to abandoned archaeological landscapes, the extent to which past disturbance has impacted successional trajectories and the composition, structure, and genetic diversity of tropical forests, lacks long-term observations. Developing scientific baseline data on biodiversity trajectories following a range of past anthropogenic disturbance is essential for understanding fundamental aspects of human ecology and the capacity for human society to recover tropical forest vegetation through informed conservation choices.

New research in the Bladen Nature Reserve, Belize, explores the human legacy on a remote tropical forest after 12,000 years of human disturbance, which culminated in the collapse of a Classic Maya urban centre 1000 years ago. The research pairs ancient and modern records at high spatial and chronological resolution, to assess long-term human impacts related to the type, scale, and timing of past disturbance, on forest structure and composition in a tropical forest ecosystem at a landscape scale.

Funding: EPSRC Frontier Research Guarantee BLADEN (Biodiversity and the Legacy of Anthropogenic Disturbance on Ecosystems in the Neotropics; Grant Ref: EP/Y030583/1)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 6 – Poster 9: The anthropic tropics

New insights into pre-Columbian landscape disturbances in forested interfluvial regions of Amazonian lowlands: Examples from ring ditches of the Guiana Shield

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Pre-Columbian societies in lowland Amazonia were long thought to have primarily settled along rivers and coastal plains. However, recent discoveries of earthworks in forested hinterlands challenge this view, and the long-term impact of these societies on forest landscapes remains under-studied, particularly in the Guiana Shield (north-eastern Amazonia). In this study, we conducted extensive soil surveys to assess the landscape-scale extent of anthropogenic disturbances at three ring ditch sites in French Guiana. Surveys covered approximately 1 km-long transects from the ring ditches into the surrounding landscapes. Multiple indicators, including archaeological artefacts, macro- and micro-charcoal, soil colorimetry, and physicochemical properties, were analysed to reconstruct the pre-Columbian history of these sites. Our findings suggest long-term occupation from the 5th to 15th centuries CE, with darker soils and local variations in chemical indicators. Soil disturbances were also associated with local enrichments in macro- and micro-charcoals, supporting evidence of fire management. However, soil properties did not meet the characteristics of Amazonian Dark Earths, pointing the need for a broader integration of Amazonian Brown Earth into the characterization of anthropogenic soils. This study provides one of the first landscape-scale evidence of anthropogenic disturbances in French Guiana's hinterland, revealing significant pre-Columbian impacts beyond ring ditch enclosures.

Funding: European Research Council, project 101039272 DOPAMICS.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 7 – Oral 1: Leveraging living collections and biodiversity data

BIOWEB Ecuador: The biodiversity of a megadiverse country online

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With 17,500+ species of plants and 3,751 vertebrates within an area of 280,000 km^2, Ecuador is the smallest megadiverse country in the world. Exploration of Ecuador's biodiversity started centuries ago, yet new species are still described every year at an impressive rate. The lack of an effective data managing system has hindered efforts to discover, analyze, publish, and develop management and conservation policies on Ecuador's biological megadiversity. In an attempt to solve this problem, the Pontifical Catholic University of Ecuador (PUCE) in Quito created BIOWEB (bioweb.bio), a collaborative platform inspired on the idea that high-quality open access information is key to the study, conservation, and sustainable use of biodiversity. This platform currently contains over half a million images of animals, plants and natural regions. The content is contributed mostly by volunteers, students, technicians and curators. BIOWEB Ecuador features species accounts, photographs, niche models of current and future geographic distributions, dynamic field guides, call recordings, a map-based searching tool, biodiversity statistics, and more. Global participation statistics suggest that BIOWEB Ecuador has become a significant regional resource for anyone interested in Ecuador's biodiversity. Finally, we show the impact of BIOWEB on scientific publications on ecology and conservation.

Funding: Pontificia Universidad Católica del Ecuador, Secretaría de Educación Superior, Ciencia, Tecnología e Innovación (SENESCYT), JRS Biodiversity Foundation

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 7 – Oral 2: Leveraging living collections and biodiversity data

The power of living collections: Conservation and research at Kew Gardens

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Kew Gardens' Living Collection is an important resource for botanical, ecological and conservation research. Spanning 15,500 species from 311 plant families, this Living Collection supports efforts to conserve biodiversity and deepen our understanding of Earth's ecosystems. This presentation will highlight the value of the Living Collection through two distinct approaches that leverage its diversity to address conservation and ecological challenges.

The United Kingdom Overseas Territories (UKOTs) contain more unique plants and habitats than mainland UK. However, many of these habitats are heavily degraded, and numerous plant species are at risk of extinction. Kew's UKOTs team collaborates with local stakeholders to implement in situ conservation practices, using the Living Collection and the horticultural expertise of its staff to support these efforts.

Living Collections also serve as an essential source of material for scientific research. In one project, the Orchidaceae and Gesneriaceae collections have been sampled to study floral traits in both species-rich families to explore how floral trait evolution is linked to plant diversification and investigate their pollination systems.

By presenting these two initiatives, this talk aims to raise awareness of Kew's and other Living Collections, encouraging their use as valuable resources for conservation and ecological research.

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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 7 – Oral 3: Leveraging living collections and biodiversity data

The Green Ark: A model for future proof conservation and visibility of living tropical plant collections.

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Meise Botanic Garden has a long tradition in research on tropical plants, which is reflected in world level collections of Central African species, tropical woody plants such as Rubiaceae and many other families representing over 10.000 different taxa. Highly specialized staff allowed us to build one of the largest taxonomic reference collections of succulent plants with a high percentage of rare and threatened species.

Although a large part of collections are visible in the Plant Palace, planted according to a biome concept, the vast majority of our collections were hidden for the large public along with the numerous conservation and research programs of the garden. Recently we completed a new greenhouse complex named the Green Ark. Modern greenhouse technology with computer controlled climatization in combination with smart design allows future proof conservation, use and visibility of all our sensitive tropical potted plant collections.

In the pavilion amidst of the new greenhouses we installed a unique permanent exhibition and guided tours showcasing the role Botanic Gardens play in plant biodiversity research and conservation: from the safeguarding of the last specimens of species that are extinct in the wild, such as the Rizet's coffee (*Coffea rizetiana*) and the dwarf water lily (*Nymphaea thermarum*), to breeding programs on crop wild relatives such as bananas (*Musa*) that support research on food security for the future.

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 7 – Oral 4: Leveraging living collections and biodiversity data

Citizen-science based ecological modelling: The case of intermediate host snails in west-Uganda

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Schistosomiasis, a major health issue in rural sub-Saharan Africa, is ecologically driven by freshwater snails. The ATRAP project established a citizen science network in rural Uganda to map snail populations, addressing a need for reliable, fine-scale data in a region where traditional monitoring is limited. While citizen science has shown promise in producing high-resolution presence/absence data, its contribution to understanding the environmental factors that drive snail occurrence remained unclear. To evaluate this, we compared 3,677 citizen reports with 1,073 expert reports from the same sites (April 2020–February 2023), using generalized mixed-effects models in two scenarios: one assuming perfect detection to compare environmental and geographical predictors of snail presence, and another accounting for imperfect detection to assess false negatives (snail presence detected by the expert, but missed by the citizens) and unexpected observations (viceversa). Findings showed citizen data aligned closely with expert data on key environmental predictors, with models correlating by 79%. False negatives were influenced by individual performance and sampling location, while each additional sampling event increased the likelihood of unexpected detections by 10%. This study highlights how citizen science ca generate high-quality ecological data, empowering communities in disease monitoring, and enhancing schistosomiasis surveillance in vulnerable areas.

Funding: ATRAP Project: Belgium Development Cooperation (DGD) and Humanitarian aid.
Noelia Valderrama-Bhraunxs (FWO PhD fellowship –Vlaanderen 11L3223N)

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DOI: 10.30427/ecotrop202501
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Session 7 – Oral 5: Leveraging living collections and biodiversity data

How diet shapes digestion: Gland micromorphology of *Nepenthes* pitchers

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The living plant collections in botanic gardens can be used for a variety of ecological research, allowing for a broader range of observations and experiments. At Hortus botanicus Leiden, one of the National plant collections is the carnivorous plants, including *Sarracenia*, *Drosera*, and *Nepenthes*. The carnivorous pitcher plant genus *Nepenthes* (Nepenthaceae) utilizes a secondary nutrient source, absorbed through their pitchers, to supplement their growth in nutrient poor conditions. The morphology of this group has been studied extensively. However, research on the micromorphology is lacking, often only including a small number of species. In this study, the inner pitcher micromorphology is studied in detail using confocal fluorescence microscopy. The digestive glands and lunate cells were measured across different zones throughout each pitcher and tested for differences between the lower and upper pitchers. This was also used to study pitcher micromorphology in relation to their ecology by making inferences on their diet/prey. While diet was shown to result in distinctive glands in *N. ampullaria*, most of the insect-feeding species could not always be distinguished from each other. Lunate cell density was shown to clearly increase towards the pitcher opening.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 7 – Oral 6: Leveraging living collections and biodiversity data

Wetlands and global warming: What can we do as scientists?

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The local and global importance of wetlands and their ecosystem services is increasingly recognized. In Amazonian floodplains, we start to understand the complex functioning of forests at the air-water-interface. However, extreme periods of droughts and increasing fires, but also unusual flood durations affect their diversity, resilience, and functioning. Multiple adaptations to flooding of tree species from Amazonian floodplain forests are not enough to cope with the extreme events of the past years. Forests are degraded, and the recurrence of extreme fires impedes their recovery.

Today, tropical freshwater wetlands are among the fastest disappearing ecosystems in the world. Forest degradation, human pressure for water abstraction, changes in the natural flood regime, land reclamation, pollution, overuse of natural resources, dam construction and drainage are continually converting wetlands. Drought and fires completely alter the ecosystems, and the resources for sustainable use. The main challenge for scientists is to continue documenting and providing solid data to support decision-making.

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Session 7 – Poster 10: Leveraging living collections and biodiversity data

A renewed collection for the Climate House

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The Hortus Botanicus Amsterdam is one of the oldest botanic gardens in Europe and is working on sustainably renovating their main greenhouse named the Climate House, where the public will be able to learn about biodiversity, plants and how they've adapted to the climate they live in. With a renewed greenhouse comes a renewed and enhanced plant collection which will be used for education, display and science communication. For the tropical part of the greenhouse we are looking to build a collection of lowland tropical rainforest plants and are seeking to educate visitors about the vertical distribution of biodiversity in primary rainforest ecosystems, as well as several cases of co-evolution and niche construction. We will be able to leverage a canopy walk to emphasize a collection of epiphytic plants, as well as showcasing various hemi-epiphytes and lianas growing from the ground level up. Furthermore, we are looking to expand on our specialist collections (SNP) of Arecaceae and Cycadales and to showcase unique taxa to communicate the importance of conservation and habitat preservation. To build a unique and fascinating collection of tropical plants we are looking to collaborate with researchers working on tropical flora to curate and expand our living collection.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 7 – Poster 11: Leveraging living collections and biodiversity data

Filming 'Echoes of the Rainforest': Outreach and storytelling in Amazonian palaeoecology

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During our July 2024 field trip to Peru for Project PALOMA, we filmed a documentary investigating the intersection of palaeoecology, ecology, and indigenous knowledge in tackling climate change and conservation challenges in the Amazon rainforest.

The filming was undertaken by conducting interviews with a wide range of stakeholders, including palaeoecologists, ecologists, and indigenous leaders, aiming to connect our palaeoecological research with the broader conservation context for a non-academic audience. We explored themes like the threats posed by climate change and human activities, the dedicated efforts of local communities and environmental institutions to protect and restore their environment, and the essential role of palaeoecology in these conservation efforts.

The interviews reveal that understanding the ecological past provides key insights into future resilience, while local communities offer invaluable knowledge on climate change and biodiversity conservation. The film emphasizes the importance of collaboration between scientists and local populations, enabling a two-way exchange of information to improve conservation strategies that address both ecological and social challenges.

Our documentary highlights the power of storytelling in scientific outreach (particularly within palaeoecology) and calls for interdisciplinary collaboration in environmental conservation, promoting inclusive practices that empower local voices and global scientific efforts, ensuring a sustainable future for Amazonia.

Funding: Marie Skłodowska-Curie Actions (MSCA), Horizon Programme, Funded by the European Union (Grant agreement ID: 101105420). We acknowledge the support of IIAP and their field assistants during the fieldwork phase and filming (Iquitos research base, Allpahuayo Mishana research base, Quistococha forest monitoring area and Pacaya Samiria National Reserve). Research was performed thanks to the research and filming permits provided by SERNANP (AUTORIZACIÓN Nº049-2024-SERNANP-RNPSA, AUTORIZACIÓN Nº044-2024-SERNANP-RNPSA) and SERFOR (RD-000112-2024-DGGSPFFS-DGSPF).

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ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Oral 1: Mathematical and statistical models to predict and protect tropical species and ecosystems

Understanding disease-driven density dependence and coexistence

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In the 1970s, Janzen and Connell proposed that tree species coexist due to the stabilizing effects of specialized enemies. Recent research suggests that pathogens play a significant role in tropical forests, potentially driving conspecific negative density dependence (CNDD) and explaining species coexistence. However, quantifying CNDD has proven difficult, resulting in varied and sometimes contradictory macroecological patterns. In this talk, I examine the mechanisms through which pathogens influence plant survival rates. Using analytically trackable epidemic models built on first principles, we provide a mechanistic understanding of how pathogen dynamics drive CNDD. Our models incorporate host and pathogen traits such as transmission and recovery patterns and offer insights into field observations. Two key findings emerge: first, CNDD may be stronger for rare species as a hallmark of disease-driven density dependence. Second, our results challenge the assumption that heightened CNDD in rare species indicates vulnerability to pathogens. Instead, we propose that rarity may offer protection from the full effects of epidemics. This work reconciles empirical trends with the Janzen-Connell hypothesis, suggesting that stronger CNDD in rare species signals resilience rather than susceptibility. We conclude with new approaches for connecting theoretical predictions with empirical data to better understand disease-driven diversity maintenance in tropical ecosystems.

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DOI: 10.30427/ecotrop202501
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Session 8 – Oral 2: Mathematical and statistical models to predict and protect tropical species and ecosystems

Non-destructive estimation of above-ground biomass for large tropical trees using terrestrial laser scanning data

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Direct non-destructive field measurement of above-ground biomass (AGB) is often challenging; hence, allometric models based on empirical data are utilised. The models employ mathematical functions that correlate tree biomass with quantitative tree parameters, including diameter, total height, and wood density. However, many of these models are highly generalised and fraught with uncertainty, especially for large tropical trees. This study aimed to generate site-specific multi-species allometric equations for estimating tree height and volume. We employed a terrestrial laser scanner (TLS) to collect data from selected parts of the selectively logged Budongo forest reserve in Uganda. Based on three-dimensional point clouds obtained from TLS data, we derived tree structural metrics for total tree height, crown base height, and crown projection area. We also developed quantitative structural models (QSM) to obtain tree volume, for allometric equations to estimate biomass without destructive sampling. Our presentation will first show how site-specific allometric equations for biomass estimates compare to other commonly used pan-tropical equations. Secondly, we will provide findings on the biomass recovery of the study site based on a set of 403 surveyed plots along a time-since-logging gradient. We will conclude with insights on the limitations of TLS-based approaches to quantify biomass and carbon stocks.

Funding: The Federal Ministry of Food and Agriculture (BMEL), Germany, project (NA)

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Oral 3: Mathematical and statistical models to predict and protect tropical species and ecosystems

How much time until extinction? An agent-based model assessing the impact of logging on an endangered primate in the Ecuadorian Choco

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The Chocó rainforest in north-western Ecuador is a biodiversity hotspot under severe threat from anthropogenic activities. The brown-headed spider monkey (*Ateles fusciceps fusciceps*), which is endemic to the region, is among the affected species and is classified as 'Endangered' by the IUCN. Their slow life history and ecological specialization in consuming ripe fruits make spider monkeys particularly vulnerable to habitat degradation, especially since many of their feeding trees are selectively targeted for timber extraction. To assess the impact of deforestation and selective logging on their population, we developed an agent-based model (ABM) that integrates field data, satellite imagery, logging permits, and management plans. The model represents each spider monkey as an agent with characteristics such as age, sex, reproductive status, and energy fluxes, interacting with a dynamic landscape. Such habitat is described based on the habitat suitability (based on deforestation status) and food availability (fruit-bearing trees and phenology). We simulated various deforestation and logging scenarios to predict their effects on the spider monkey population. Our findings will provide critical insights for Ecuadorian authorities, logging companies, and conservation organizations to enhance conservation strategies and mitigate the impacts of habitat loss on this endangered species.

Funding: Heinrich Böll Foundation; Eva Mayr-Stihl Foundation; DFG, research unit FOR 5207

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Oral 4: Mathematical and statistical models to predict and protect tropical species and ecosystems

Beyond retroactive adjustment: A novel score-based approach for proactively mitigating confounding through optimised ecological sample selection

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Confounding can hinder ecological research by obscuring relationships between variables of interest, complicating causal inference. While existing techniques mostly adjust for confounding post-data collection, we introduce a novel framework that optimises site selection, minimising variation in confounding variables before data is collected. Using a systematic scoring algorithm, our approach evaluates possible selections of research sites, aiming to minimise variation in covariates across sites while preserving variation in variables of interest. Applied to a case study on the effects of forest fragment size on wildlife in Central Kalimantan, Indonesia, our method reduced variation in covariates by 77% across selected sites and by 87% with a matched pairs approach, compared to random selections of the same number of sites. By pre-selecting sites more comparable in key covariates, our framework streamlines data collection and reduces the need for post-hoc adjustments, facilitating data analysis. Its adaptability allows for application across various ecological contexts, such as assessing land-use changes or conservation policies. The framework complements existing statistical methods, collectively forming a comprehensive approach to controlling confounding in ecological research throughout all stages of the process. Ultimately, it contributes to more robust and reliable conclusions across a wide range of ecological studies.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Oral 5: Mathematical and statistical models to predict and protect tropical species and ecosystems

Projected impacts of climate change on ecosystem services provided by terrestrial mammals in Brazil

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Climate change threatens biodiversity and ecosystem services (ES). This study assessed the climate risk to 11 ES provided by Brazilian terrestrial mammals, mapping their potential distributions using ecological niche modeling. We evaluated species richness (for each ES) and ES richness (for ES overlapped) under current and future conditions. While most species are projected to experience distribution contractions, individual ES and their overlap are expected to be less at risk (i.e., an increase in redundancy or supply area). The Amazon stands out as an ES hotspot, with high redundancy and, in some cases, expanded supply. However, this surplus will not benefit a lot of people due to the region's low population. Conversely, the densely populated Atlantic Forest and areas of the Cerrado and Pantanal are expected to lose ES. We emphasize the importance of mapping ES providers to guide decision-making, conservation, and restoration efforts, especially in regions like the Atlantic Forest that face significant ES loss. Additionally, further research is needed for regions with knowledge gaps, such as the Caatinga and Pampa.

Funding: LT received a fellowship from the Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq, grant 381795/2021-7) and from Fundação de Amparo à Pesquisa do Estado de São Paulo (FAPESP, grant #2022/07192-1). DB, MMV, received a fellowship from the CNPq (grants 307810/2022-4, 304309/2018-4). MMV received a fellowship from the Fundação de Amparo à Pesquisa do Estado do Rio de Janeiro (FAPERJ, grant E-26/202.647/2019).

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Oral 6: Mathematical and statistical models to predict and protect tropical species and ecosystems

Topological methods in computational ecology

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The ecological niche is arguably the most important concept in ecology. One of the most widely used representations of the niche is through hypervolumes, designed to represent how a species interacts with its environment and with other species in communities and ecosystems. Popular methods to compute hypervolumes and estimating their properties rely on kernel density estimators (KDEs), which we and others have criticised due to the tendency of KDE to lose detail and distort hypervolume topology such as filling holes which may have ecological significance. In this talk, I present a new method to compute hypervolumes, comparable in inference density and computational complexity to the state of the art, but with an additional guarantee of preserving topologically important features of the sampled data. I will introduce the use of topological data analysis as a new way to model niche hypervolumes in n-dimensional space, to become a primary tool for ecologists working with big data. The method presented here builds on recent advances, spearheading new ways to study how species interact with the environment, helping us extend the concept of niche hypervolumes to model species' vulnerabilities to climate change and invasion, particularly insidious factors for tropical species.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Poster 48: Mathematical and statistical models to predict and protect tropical species and ecosystems

Allometric model and carbon sequestration rates in *Paulownia tomentosa* (Thumb.) plantations at ICIMOD's living mountain lab in central Himalaya

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Allometric equations are important for estimating species-specific tree and forest biomass and carbon stocks. *Paulownia tomentosa* (Thunb.) is a fast-growing tree species native to central and western China and Southeast Asia. This species has recently been introduced in Nepal for agroforestry systems, its allometric equations have not yet been developed. This study used a destructive sampling method to develop allometric equations considering seven tree components (Bole, Branches, Leaves, Twigs, Tap roots, Lateral roots and Fine roots) in the ICIMODs Living Mountain Lab representing the central Himalayan region. An equation for estimating total biomass as a best fit for tree was y=14.228xDBH - 120.81, r^2=0.973. Using the allometric model we calculated the mean biomass 150.42 t ha-1 in 2014 and 429.81 t ha -1 in 2022. The mean carbon stock was found to be 149.81 tC ha-1 in 2014 and 202.01tC ha-1 in 2022. The carbon sequestration rate based on the annual increment rate in *Paulownia tomentosa* was found to be 5.87 tC ha-1yr-1. The allometric equations assisted to estimate the biomass and carbon sequestration rates which could be helpful to address global climate change through mitigation. The allometric equations have potential application to similar physiographic and climatic zones as well as to smallholders and communities who intend to participate in climate change mitigation programs.

Key words: Biomass and carbon; fast-growing species; carbon sequestration; smallholders; small-scale plantation; re-vegetation

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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Poster 49: Mathematical and statistical models to predict and protect tropical species and ecosystems

Canopy laser scanning to study complex tropical trees and its biodiversity

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Large trees are keystone structures in forests, significantly contributing to biomass and biodiversity. Their complex architecture supports many epiphytes on both stems and branches. To understand the relationship between tree architecture, epiphytes, and microclimate, detailed 3D information on the tree structure is essential. Current methods, such as terrestrial and drone-based laser scanning, face limitations. Only scanning from the ground or above the canopy results in incomplete 3D information, as plant material blocks the view of the scanner. We introduce a novel approach, Canopy Laser Scanning (CLS), which places a static laser scanner within the tree canopy to obtain high-resolution structural data. Using the RIEGL VZ-400(i) scanner, we scanned four complex tropical trees in rainforests across Colombia, Brazil, and Peru, as part of biodiversity programs such as Life On Trees and Araçá. This presentation will cover the operational aspects of CLS, assess its value in characterizing epiphyte cover and above-ground biomass (AGB), and demonstrate how CLS enables new research opportunities for multi-disciplinary teams investigating large, complex trees.

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 8 – Poster 50: Mathematical and statistical models to predict and protect tropical species and ecosystems

Using AI to uncover "hidden" species interactions: using incomplete data on tropical seed-dispersal networks underestimates robustness to extinctions

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As species move in response to climate and land-use changes, natural communities will change in both composition and interactions between species. However, we rarely have complete information on all realized interactions in ecological networks, hindering our ability to assess vulnerability of communities to environmental perturbations, especially in future climates.

Here we present an Artificial Intelligence based framework to fill these gaps of "hidden" potential interactions. We trained a Random-Forest machine-learning model to predict mutualistic interactions between Afrotropical figs (*Ficus*) and seed-dispersing frugivores on a database of 4807 observed interactions (among ~100 fig and ~500 frugivore species), functional traits of plants and animals and phylogenetic relationships. We simulated non-random extinction scenarios using observed versus inferred interactions to evaluate extinction robustness in local networks across the African continent.

Our machine-learning model was able to classify interactions with high fidelity. We found distinct spatial patterns in the number and nature of inferred interactions, and that using only observed interactions underestimates the robustness towards extinction of local networks when compared to using inferred potential interactions.

Predicting potential trophic interactions is an emerging approach that can provide fundamental insights how climate change and loss of keystone species can have unforeseen cascading effects on community stability.

Funding: Faculty of Engineering and Science, Aalborg University, Denmark (project 61504)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 9 – Oral 1: Monitoring wildlife populations in tropical forests

Comparative analysis of vertebrate communities along a disturbance gradient in a Guianan forest

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The study compared the presence and frequency of terrestrial vertebrates living in three tropical forest ecosystems of French Guiana with different levels of human pressures. Data has been collected between 2017 and 2023 using camera traps, an effective and non-invasive method for monitoring biodiversity. The study sites are the Nouragues Natural Reserve (control), the Bonaventure eco-touristic camp (old logged areas close to a gold mining area), and forest patches near National Road 2. We used mixed and generalized linear models to compare biodiversity metrics, species abundances, and community compositions between study sites. We observed a trend for a decrease in the community's species richness as anthropogenic pressures increase. Overall, vertebrate diversity is similar between Nouragues and Bonaventure, suggesting a resilience potential for the regenerating forest after the exploitation ceased. Moreover, we observed differences in the composition of vertebrate communities between forests, providing information on species sensitivity to disturbance. Since animal-mediated seed dispersal is critical for the dynamics of ecosystems, measuring the health of vertebrate communities in tropical environments is essential to implementing appropriate conservation programs and ensuring the resilience of forests to human pressures.

Funding: Labex DRIIHM/IRDHEI and ANR-11-LABX-0010, and the UMR MECADEV 7179 CNRS-MNHN, OFB

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 9 – Oral 2: Monitoring wildlife populations in tropical forests

Stressed-out primates? The interplay between habitat quality, diet, and stress in black lion tamarins

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Forest loss and fragmentation can alter habitat quality, with direct consequences on wildlife. Among forest species, neotropical primates show large dietary plasticity and are able to change their food items according to resource availability. However, little is known about how diet changes affect the long-term survival of primate populations. One way to evaluate how species cope within their environment is through the measure of physiological stress (cortisol level). We tested the influence of habitat quality (fruit productivity and arthropod biomass) on the trophic position and cortisol level of black lion tamarins (*Leontopithecus chrysopygus*), an endangered species which feeds mainly on fruits and arthropods. We used the hairs of 33 individuals from six populations to estimate arthropod contribution to the diets and physiological stress using isotopic analyses ($\delta^{15}N$ values) and cortisol levels, respectively. Arthropod consumption and cortisol levels were higher in areas with lower fruit productivity. Our results indicate that tamarins are able to shift their diets to a less preferred food in low-quality areas, but that this strategy might negatively affect their long-term survival by increasing chronic stress. This result alerts us on the fact that the presence of a species in low-quality fragments does not guarantee its long-term persistence.

Funding: FAPESP 2021/06668-0, Research Productivity Fellowship from CNPq (#314964/2021-5), FRS-FNRS

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 9 – Oral 3: Monitoring wildlife populations in tropical forests

Lurking in the leaves: How native trees and leaf litter enrich amphibian diversity in Malagasy agroforests.

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Shifting cultivation is the primary land-use practice driving deforestation in tropical regions. Agroforestry, promoted as a sustainable alternative, may balance human needs with biodiversity conservation. However, its effectiveness for amphibian conservation remains under-assessed, particularly around Madagascar's largest protected area complex, where old-growth forests are rapidly disappearing and amphibian endemism is high.

We surveyed amphibian diversity across a landscape mosaic of old-growth and agroforests and recorded habitat characteristics to analyse how agroforestry practices influence species richness, abundance, and community composition.

We recorded 54 amphibian species of which 10 are potentially new to science. Our results indicate that old-growth forests support higher species richness and abundance than agroforestry systems, with distinct species compositions observed in each habitat. While agroforestry systems can host unique amphibian communities, these are generally less abundant and species-rich than those in old-growth forests. A high percentage of native trees and dense leaf litter increased the conservation value of agroforests. Implementing management practices that improve habitat complexity can therefore optimize agroforestry systems for amphibians.

This study shows the critical role of old-growth forests in preserving diverse and unique amphibian assemblages and highlights the potential of agroforestry to contribute to biodiversity conservation with appropriate management strategies.

Funding: Schlumberger Stichting Fund, Swiss Government Excellence Scholarships

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 9 – Oral 4: Monitoring wildlife populations in tropical forests

Edge effects on the population density and distribution of two species of mouse lemurs in northwestern Madagascar.

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Forest loss and fragmentation create edge effects, which result from the penetration of abiotic and biotic conditions from the surrounding non-forest matrix into the forest interior. Edge effects can alter the structure and function of both plant and animal communities. We used Spatially Explicit Capture-Recapture (SECR) models to determine spatial patterns of density for two species of mouse lemurs (*Microcebus murinus* and *Microcebus ravelobensis*) in two forest landscapes in NW Madagascar. The goal of our study was to determine if mouse lemurs displayed spatially variable responses to edge effects. We trapped animals using Sherman live traps in the Mariarano Classified Forest (MCF) and in the Ambanjabe Forest Fragment Site (AFFS) site within Ankarafantsika National Park (ANP), northwestern Madagascar. We trapped 126 *M. murinus* and 79 *M. ravelobensis* at MCF and 78 *M. murinus* and 308 *M. ravelobensis* at AFFS. For *M. murinus*, our top model predicted a positive edge response, where density increased towards edge habitats. In *M. ravelobensis*, our top model predicted a negative edge response, where density was low near the forest edges and increased towards the forest interior. Our study contributes a new understanding of complex responses of lemurs to edge effects in Madagascar.

Funding: Biodiversa+ Grant/Award Number 2015-138, German Federal Ministry of Education and Research Grant/Award Number 01LC1617A, Natural Sciences and Engineering Research Council of Canada, Idea Wild, Association Canadienne d'Anthropologie Physique, Sigma Xi, Primate Conservation, Inc.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 9 – Oral 5: Monitoring wildlife populations in tropical forests

Assessing the role of forest fragments for bird communities using passive acoustic monitoring in northern Costa Rica

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Tropical forests are among the most biodiverse ecosystems, yet they face severe threats from anthropogenic activities, particularly deforestation and habitat fragmentation. These disturbances have profound effects on bird species, which play essential roles in ecosystem functioning. This study investigates the impact of forest fragmentation on bird species richness in the tropical lowlands of northern Costa Rica using passive acoustic monitoring and automated species recognition software. Our results showed no significant difference in overall bird species richness between forest fragments of varying sizes. However, bird community composition differed significantly across recording locations. Forest interiors were dominated by specialist species, which depend on stable microclimatic conditions and dense vegetation, whereas forest edges and surrounding landscapes supported generalist species adapted to more variable environments. Interestingly, frugivorous bird species richness was higher at forest edges, likely due to the abundance of fruiting trees. These findings emphasize the importance of maintaining and enhancing fragment size and connectivity to support bird diversity. Additionally, the study underscores the need to preserve both forest interiors and edges to conserve the distinct bird communities they harbor. Finally, we highlight the potential of automated species recognition as a powerful tool for large-scale biodiversity monitoring.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 9 – Oral 6: Monitoring wildlife populations in tropical forests

Addressing the Amazonian biodiversity knowledge deficit: The Amazon biodiversity and carbon expeditions

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The Amazon suffers from a severe biodiversity knowledge deficit. Overcoming this deficit requires targeted work in data-scarce regions and a more systematic effort to simultaneously cover multiple taxonomic groups. To address this, we established the Amazon Biodiversity and Carbon Expeditions – a series of quantitative multi-taxa inventories targeting remote and undersampled regions of the Brazilian Amazon. We sample 20 different plant and animal taxa and have performed 15 expeditions to date. This talk outlines our sampling design, field methodology and preliminary results. We have measured, mapped and identified >30.000 trees from at least 281 genera in 68 families and recorded 31 large vertebrate species. The first seven expeditions have revealed 297 dung beetle species – 172 of which are unknown – and 177 termite species from 66 genera. Other beetles processed from just three expeditions include 56 families and >1,200 species. The ongoing identification work for many other groups is tedious and downstream taxonomy hampered by scarce personnel and infrastructure. Our results highlight how far we remain from describing and understanding patterns of species richness in the Amazon. We urgently need more taxonomists and investment in basic biodiversity science across Amazonia and need to resolve the chronic underfunding of taxonomy and field collections.

Funding: Research Council of Norway (project 288086)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 9 – Poster 27: Monitoring wildlife populations in tropical forests

A random encounter model for wildlife density estimation with vertically oriented camera traps

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The Random Encounter Model (REM) estimates animal densities from camera-trap data by correcting capture rates for a set of biological variables of animals and characteristics of camera sensors. The REM has been widely used for horizontal oriented camera trapping setups. Here we modify the REM formula to accommodate an alternative field of view acquired with vertically oriented camera traps, a type of deployment used to avoid camera theft and damage. We find that the effective detection area can be close to a rectangle with dimensions influenced by the properties of the Fresnel lens of the camera's motion sensor, the body mass of species, and the height of the camera. We tested the modified REM (vREM) by applying it to wildlife data collected with vertically camera traps in Bardia National Park, Nepal. We further validated that the effective detection area for the camera model used was best approximated as a rectangle. Density estimates obtained broadly matched independent density estimates for nine species from previous studies in Bardia with varying body sizes. We conclude that these modifications allow the REM to be effectively used for mammal density estimation for species with a wide range of body sizes with vertically oriented camera traps.

Funding: Himalaya Tiger Foundatioin; Wildlife Ecology and Conservation Group, Wageningen University & Research

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 9 – Poster 28: Monitoring wildlife populations in tropical forests

First direct evidence of terrestrial feeding in Central American fruit bats revealed by camera traps

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Behavioural flexibility is an important aspect of individual fitness as it allows animals to respond adaptively to fluctuating environmental conditions. For frugivores who inherently rely on a patchy and ephemeral resource base, behavioural flexibility can reduce feeding competition, allowing coexistence within and among species. However, it can be difficult to directly observe the behaviours of certain frugivores, highlighting the potential utility of camera traps to document new fruit feeding behaviours. To demonstrate this, we share the first known evidence of terrestrial fruit feeding by Central American fruit bats. We deployed camera traps in the canopy and on the ground at fruiting trees as part of a larger study of frugivore community ecology in the tropical dry forest of Sector Santa Rosa, Costa Rica. On the nights of February 8th, 16th, and 17th 2024, we recorded 5, 10-second videos of fruit bats feeding on fallen fruit of two species: *Ficus obtusifolia* and *Manilkara chicle*. We suggest that terrestrial fruit feeding may allow these bats to avoid competition with individuals foraging in the canopy. These observations demonstrate how camera traps can be used to document previously unknown behaviours that may be important for individual survival and species coexistence.

Funding: Leakey Foundation Research Grant, American Philosophical Society Lewis & Clark Exploration Grant, Vanier Canada Graduate Scholarship, University of Calgary Eyes High Doctoral Recruitment Scholarship

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 10 – Oral 1: Tropical vegetation dynamics

Rapid conservation assessment of the frankincense tree in Oman

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The frankincense tree *Boswellia sacra* is an iconic dryland tree in southern Arabia and Somalia. It is a source of frankincense resin, used since antiquity for its aromatic and medicinal qualities, and a cultural keystone species. Multiple species of *Boswellia* show population declines and unsustainable exploitation. We conducted a broad-scale rapid assessment of the *B. sacra* populations in the Dhofar mountains of Oman, to map the extent of the species, identify major threats, and predict if a similar population collapse occurs as seen in other species.

Based on field surveys and distribution mapping, *B. sacra* likely occupies a range of at least 4000 km^2 in Oman. Natural regeneration occurred in most populations, but population patterns were variable. Threats varied geographically, and included grazing, resin harvesting, mining, insect/pest attacks, and wind/flooding. Grazing pressure was prevalent across many populations, while harvesting pressure was concentrated in specific areas.

We found no widespread declines in *B. sacra* in Oman, but improved socio-ecological management systems are needed to maintain this status. Key priorities for improving long-term conservation include further research to elucidate drivers of population patterns observed, improved rangeland management, enhanced monitoring and management of resin tapping, and identification of potential additional natural reserves.

Funding: Environment Society of Oman with funds from Foreign and Commonwealth Office in Oman, and Shell Development Oman.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 10 – Oral 2: Tropical vegetation dynamics

Rainforest fragmentation decreases the stability of plant-frugivore interaction networks

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Tropical rainforests are biodiversity hotspots providing a multitude of ecosystem functions and services. Seed dispersal by frugivorous birds, a vital process for tropical rainforest regeneration, is increasingly under threat from widespread deforestation, resulting in forest fragments of different sizes and degrees of isolation. Here, we examined the effects of forest fragmentation on species richness of frugivorous birds, and structure of their trophic interaction networks with fruit bearing trees in the tropical forests of Costa Rica. We found that bird richness increased significantly with increasing forest fragment size and landscape connectivity. Network modularity and robustness significantly increased with increasing fragment size and landscape connectivity, while network specialization (H2´) significantly increased only with increasing landscape connectivity. The study demonstrates that deforestation and disturbances along forest edges result in vegetation simplification, especially reducing food sources for birds, and thereby decreasing bird diversity in smaller fragments. However, while the conservation of large fragments is essential, it is recommended to also protect the remaining small fragments (<40 ha) as they may improve landscape connectivity and still harbor a considerable diversity of birds. Furthermore, conservation measures should focus on the key species that enhance network structure and consequently increase the stability of these trophic interaction networks.

Funding: Herzog-von-Württemberg scholarship (DB), German Academic Exchange Service (DB; AG; ERM), ATBC for the Seed Research Grant (AG), Marie Curie Postdoctoral Fellowship (MGRV).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 10 – Oral 3: Tropical vegetation dynamics

Seed dispersal networks in regenerating forest fragments are influenced by surrounding forest cover, not fragment age

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Despite the recognition of animal-mediated seed dispersal as a critical component for forest regeneration, studies on forest regeneration have largely neglected the role of plant-frugivore interaction networks in this process. This research investigates how landscape connectivity influences these networks across a chronosequence of eight secondary and two old-growth forest fragments. By employing camera traps and focal observations over two years, we documented over 10,000 plant-frugivore interactions. Our findings reveal that fragment age does not significantly affect seed dispersal networks; instead, surrounding forest cover plays a crucial role in shaping interaction quantity and structure. As forest cover expands, networks become more specialized, favoring rarer species' interactions and enhancing seed dispersal functions, as evidenced by higher H2' specialization, reduced nestedness, and increased modularity. We show that a modest 5% increase in forest cover can boost the number of interactions by up to 22%. Using centrality metrics, we identified key frugivore species, highlighting their vital role in maintaining network integrity and functionality. Our findings stress that natural regeneration alone might not lead to recovery of plant-frugivore interactions, especially not in isolated fragments. More attention should be paid to connecting secondary forest fragments to restore seed dispersal processes essential for long-term forest resilience.

Funding: NWO-Biota Research Grant # 2018/19011-6

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 10 – Oral 4: Tropical vegetation dynamics

Nature based solutions for tropical plant invasions

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Invasive alien plants are a well-known leading cause of biodiversity loss and we have growing evidence that they are driving human wildlife conflict and increasing capacity of disease vectors (two exciting new projects will be briefly introduced on these topics). Biological control – reuniting alien invasive plants with their natural predators – is an effective, safe and sustainable nature based solution that has the capacity to mitigate their impacts and transform degraded landscapes. South Africa has pioneered the use of biological control not only to combat alien invasives but also to empower communities, what lessons can be learnt? How can we apply these multi-faceted benefits to other alien invaded regions in the tropics?

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 10 – Oral 5: Tropical vegetation dynamics

Effect of elevated CO□ and shade on the growth and photosynthesis of Black locust (*Robinia pseudoacacia)* and Honey locust (*Gleditsia triacanthos).*

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Studies have shown that aggressively invading species are associated with specific plant traits like rapid growth, early sexual maturity, asexual reproduction, high seed numbers, easily dispersed seeds and nitrogen fixation. Most C_3 plants have positive responses to elevated CO_2, which contribute to overall growth and photosynthetic rates. However, the effect of elevated CO_2 on the growth of invasive plant species remains under studied. The aim of this study is to determine the effects of future climate on growth and photosynthesis of the invasive trees Honey locust (*Gleditsia triacanthos*) and Black locust (*Robinia pseudoacacia*). A pot experiment was conducted where both species were grown at ambient (400ppm) and elevated (700ppm) CO_2 in opentop chambers, with some individuals shaded (80% light reduction) and others non-shaded. Growth and photosynthetic responses to CO_2 and light variations were measured. Photosynthetic measurement results across all treatments show reduced photosynthetic rates in shaded treatments compared to non-shaded treatments. Relative growth rate results show that for both specis non-shaded individuals grown at both CO_2 levels have significantly higher relative growth rates compared to shaded treatments. Significant differences in photosynthetic rates were found in the interaction between CO_2 level, species and treatment, with both species displaying higher photosynthetic rates in the unshaded conditions, but differences were larger for Black Locust grown at 700ppm, which may highlight the invasion potential of this species under future climate scenarios.

Funding: NRF Thuthuka awarded to T. Pillay TTK230503101532

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 10 – Oral 6: Tropical vegetation dynamics

Seedling germination, growth and non-structural carbon allocation patterns of invasive *Robinia pseudoacacia* and *Gleditsia triacanthos*

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Robinia pseudoacacia (black locust) and *Gleditsia triacanthos* (honey locust) are two widespread range-expanding species in the eastern USA and invasive aliens in South Africa other parts of the world. Interestingly, only black locust is capable of biologically fixing nitrogen, therefore, despite both species being facultative resprouters, there may be differences in resource allocation between sexual reproduction (seed production) and vegetative reproduction (resprouting) during invasion. To successfully control these species in the introduced range it is important to understand trade-offs in reproductive strategy, measured in the currency of non-structural carbohydrates (NSCs). The aim of this pot experiment was to quantify and compare the seedling germination, growth rates and NSC of these species. Both species were grown from seed and germination rates and weekly stem and height growth rates were measured. At the end of the growing season total biomass and NSC was quantified. We found that HL had higher germination and relative growth rates, despite significant seed damage, compared to that of black locust. However, black locust had significantly higher root: shoot ratios and NSCs. These findings suggest that honey locust is invading mainly via seed production, while black locust relies on resprouting. This is an important consideration for the selection of biological control agents for these species.

Funding: National Research Foundation, Thuthuka Grant TTK230503101532

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 12 – Oral 1: Mutualisms in the (changing) tropics

Causes and consequences of flexibility in trait-matching: A plant perspective

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In plant-hummingbird networks, trait matching between hummingbird bills and plant corolla length often influences species interactions, yet hummingbirds often visit poorly matched flowers. Here, we examined how plant traits and context-dependent factors influence this variation in bill-to-corolla matching (flexibility) and its impact on proxies of plant fitness. We quantified flexibility based on ~67,051 interactions across 211 plant species distributed in 32 sites in Brazil, Costa Rica, and Ecuador and evaluated whether plant traits and community factors (species dominance, flowering temporal extension, and community functional richness) predicted flexibility. We also assessed how flexibility influences visitation rates and cheating proportion. Traits and context-dependent factors influence flexibility; the effect of corolla length on flexibility is contingent upon the width of the corolla opening. Flexibility is greater in species co-occurring in functionally diverse communities, suggesting a key role of the neighborhood. Moreover, our results show that dominant plants that flower in short pulses displayed greater flexibility than less dominant plants with a more continuous flowering pattern. Finally, flexibility showed a hump-shaped relationship with visitation rates. Initially, flexibility increases visitation rates, but beyond a certain point, visitation declines sharply, accompanied by a rise in the proportion of cheating.

Funding: ERC grant (787638), Swiss National Science Foundation (173342)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 12 – Oral 2: Mutualisms in the (changing) tropics

Functional diversity of woody species used by birds across a disturbance gradient in high elevation Andean forests

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Agropastoral land use has shaped Andean high-elevation landscapes, reducing forest cover and fragmenting ecosystems. This study evaluates how species and functional diversity of woody plants used by birds vary along a disturbance gradient, from pasture to mature forest, in five widespread Andean forests in southern Ecuador. We conducted surveys in 75 plots, recording 8061 individuals from 93 species. For each species, we measured pollination-related traits of flowers, as well as bird dispersal-related traits of fruits/seeds. Species diversity and functional dispersion indices were calculated for all species, as well as for bird-pollinated and bird-dispersed species separately. These indices were calculated across the disturbance gradient.

Results indicated higher species richness and functional dispersion at the forest edge for both trees and shrubs. However, bird-pollinated species showed greater functional dispersion in forest interior for trees, while shrubs exhibited higher functional dispersion at the edge and pasture. For bird-dispersed species, no clear gradient pattern was found. These results suggest that disturbance promotes flowering shrubs and small-seeded trees at the forest edge, while limiting seed dispersers to less disturbed areas. This highlights the contrasting effects of habitat fragmentation on mutualistic interactions, with potential benefits for pollinators but constraints for seed dispersal and forest regeneration in pastures.

Funding: Swiss National Fund (grant number IZSTZ0_199379).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
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Session 12 – Oral 3: Mutualisms in the (changing) tropics

Hummingbird niche packing in the tropical montane Andean forest of Southern Ecuador

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In species rich environments, niche packing and niche expansion can influence species coexistence. In plant-hummingbird pollination networks, resource composition, abundance and relevant interaction floral traits, limit hummingbird presence, and shape niche structure. In this study, we investigate how resources influence niche structure in plant-hummingbird communities in Azuay province, at 3000-3800 m.a.s.l. in high-Andean montane forests in Ecuador. We used plant-hummingbird interaction data, as well as floral traits (corolla opening, length and floral aggregation), to quantify hummingbird interaction niche space and overlap. As a resource proxy we used plant richness and flower abundance. To quantify community functional divergence we used plant traits and hummingbird bill length. We found niche packing resulting from high niche overlap in high-Andean hummingbird communities. We found a positive relationship between plant richness and niche size, suggesting that hummingbird communities are efficiently using all resources. We also found less hummingbird interaction niche overlap in more functional divergent plant communities. Niche packing seems to be common in species rich environments, however, the niche overlap seems to be influenced by resource use in high-Andean communities.

Funding: Swiss National Science Foundation SNSF, Exper-Net IZSTZO_199379, European Research Council ERC, 787638.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 12 – Oral 4: Mutualisms in the (changing) tropics

Human-induced downsizing of animal communities disrupts plant-frugivore trait matching in the tropics

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Defaunation of large-bodied frugivores threatens essential ecosystem functions, such as seed dispersal. However, how this downsizing impacts plant-frugivore trait matching—the alignment of frugivory-related plant traits (e.g., fruit size) with frugivore traits (e.g., body mass)—remains poorly understood at macroecological scales. Here, we assess how human disturbance and environmental variables influence trait matching in plant-frugivore networks across seven tropical biogeographic realms. We integrated data on fruit size and frugivore body mass for 1,927 plant and 1,120 animal species, along with a dataset of 12,708 interactions across 102 plant-frugivore networks. Fourth-corner analyses and structural equation models (SEMs) assessed how human disturbance and environmental factors affect trait matching across networks. SEMs revealed that human disturbance and environmental variables significantly impact trait matching through indirect pathways. Notably, human disturbance reduces trait matching by decreasing the range of frugivore body masses within networks. This study reveals that plant-frugivore trait matching is a widespread macroecological phenomenon, but that its strength varies across networks. Human disturbance, particularly size-selective defaunation, has a more pronounced impact on current trait matching than environmental factors. These results raise concerns regarding the ecological consequences of trait mismatches, particularly as the disruption of seed dispersal interactions may disproportionately affect large-fruited plant species.

2025 VOL. 27:202501
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Session 12 – Oral 5: Mutualisms in the (changing) tropics

Defaunation destabilizes the seed dispersal network of the Guianas

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Seed dispersal by animals is fundamental for tropical forest biodiversity and ecosystem services, but dispersal processes are disrupted due to declines in frugivore populations. By studying seed dispersal networks, the impact of defaunation on network stability and tree species dispersal can be evaluated. We constructed the first cross-country, multi-order seed dispersal network in the Neotropics, encompassing 2,462 interactions between 237 frugivore and 675 tree species in the Guianas. We analyzed the roles of threatened frugivores in the network and simulated their functional extinction to understand the impacts on network stability and diversity. We found that threatened frugivore species in the Guianas contribute more to network stability and diversity than non-threatened dispersers. The extinction of threatened dispersers—10% of all frugivore species— decreased network nestedness, indicating reduced network stability. Moreover, 39% of tree species lost all of their dispersers, while another 27% experienced a reduction in disperser species. Thus, threatened frugivores are vital for the dispersal of nearly half of the tree species in Guianan forests. The seed dispersal network of the Guianas can serve as a valuable baseline for understanding the effects of defaunation on forest biodiversity.

Funding: Trésor foundation, Alberta Mennega foundation, Stichting Het Kronendak, FONA foundation, Miquel foundation

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 12 – Oral 6: Mutualisms in the (changing) tropics

Differences in seed-dispersal networks and functions between tropical montane forest edges and bracken-dominated areas

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Over 90% of tropical plant species rely on animals for seed dispersal, which is crucial for forest regeneration. However, deforestation can disrupt animal-plant interactions. In this study, we analyzed the effects of deforestation on the composition of functional traits of birds and bats and on their seed dispersal networks and functions. In the tropical montane forest of Bolivia, we captured birds and bats at forest edges and in deforested areas dominated by bracken fern (*Pteridium*) and analyzed their droppings. We found a similar composition of functional traits in both habitats in terms of animal size, bill shape and degree of frugivory. The seed-dispersal network in the bracken area was less specialized than the network at the forest edge. The loss of specialization was related to a greater dispersal of early-successional species in deforested areas compared to forest edges. Deforestation seems to promote generalized interactions, increasing the dispersal of small-seeded pioneer species. Although seed dispersal is maintained in bracken areas, seeds of pioneer species are unlikely to establish in this habitat as it is very shaded, making the natural regeneration process of these deforested areas very slow.

Funding: German Research Foundation DFG, grant He 3041/23-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 12 – Poster 12: Mutualisms in the (changing) tropics

Vertical stratification and niche differentiation in the flowering ecology of *Marcgravia longifolia* in the Peruvian Amazon

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Vertical stratification is a defining feature of tropical forest structure. We investigated flowering ecology and vertical stratification of biological interactions in the liana *Marcgravia longifolia* in the Peruvian Amazon. The liana produces flowers and fruits from the forest floor to the canopy. In this system, we studied vertical niche preferences of interacting species with focal observations, camera trapping and mist-netting. Also, we monitored flowering phenology and studied pollen flow distances using genetic markers.

We observed a clear seasonality and a moderate degree of synchrony among flowering individuals. In plant–nectarivore interactions, nectarivorous bats and hummingbirds foraged preferentially in the midstory, driven by flower availability and nectar quality. For hummingbirds, we also observed taxon-specific foraging strategies. Nectar-inhabiting bacterial communities were most diverse in the midstory. We detected pollen flow distance between 18 and 1350 m.

In conclusion, we found strong patterns of vertical stratification despite the availability of the same resources across strata. The observed patterns highlight the importance of vertical niche differentiation in shaping biodiversity and ecosystem functioning in tropical forests. Understanding these dynamics enhances our knowledge of niche partitioning in tropical forests and underscores the need for conservation strategies that consider vertical habitat structure.

Funding: German Research Foundation (Deutsche Forschungsgemeinschaft, DFG) to K.H. (HE 7345/5-1), E.W.H. (HE 1870/27-1), and M.T. (TS 81/14-1). K.H.& M.G. were also supported by the Eva-Mayr-Stihl foundation.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 12 – Poster 13: Mutualisms in the (changing) tropics

The dark side of bananas: A novel method for quantifying climacteric fruit ripening in tropical ecosystems

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Fruits are classified as climacteric (CL) or non-climacteric (NCL) based on their ripening pattern. CL fruits exhibit a climacteric peak, *i.e.*, a spike in respiration, and can still mature after detachment from the tree (banana), unlike NCL ones (lemon). While the distinction is well-studied in agriculture, its significance in evolutionary ecology remains largely untested because, so far, no suitable, appropriate method for field work with wild species exists. Here, we present a novel method adapted from food science and developed to experimentally evaluate CL behavior in ecological contexts. A portable CO_2/Ethylene analyzer is used to monitor fruit respiration *in situ* to calculate respiration rates. This experimental design was developed to investigate whether the CL trait is linked to scent-oriented seed dispersal in Madagascar and was validated and optimized using two datasets: one of commercial fruits in the lab and another of wild fruits in Brazil associating the CL trait with ground-dwelling vs. arboreal frugivores. Our method successfully identified >50% of the investigated wild fruit species (n=20) as CL, including in some cases classification of CL subcategories. The success of this method quantifies fruit ripening in ecological context for the first time, leading to a better understanding of how fruit maturation physiology affects fruit traits and is a driver of animal-plant interactions and hence seed-dispersal networks.

Funding: Life Connect FSU Jena, DFG NE 2156/3-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 12 – Poster 14: Mutualisms in the (changing) tropics

Effect of intraspecific variation in fruit traits on animal sensory ecology

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Seed dispersal by animals is a critical to both animal feeding ecology and plant reproduction. Fleshy fruits show a tremendous diversity of traits such as color, scent, and texture. Much of this diversity is attributed to selection pressures exerted by frugivore behavior. While much attention has been given to trait variance among species, recent studies demonstrated a significant intraspecific variation in fruit functional traits as well. This may play a critical role in both animal application of their sensory ecology, but also be a driver of trait evolution. Yet data on the role of intraspecific variation in fruit traits on animal behavior is all but absent. We combine functional trait analysis of fruits of six wild plant species and the sensory behavior of wild lemurs in eastern Madagascar to test to what degree intraspecific variation in fruit traits drives animal sensory ecology. We show that (a) Intraspecific variation in fruit traits per se is informative to animals; and (b) traits correlated with fruit quality within a species drive animal sensory behavior.

Funding: PROMOS; DAAD; DFG

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 12 – Poster 15: Mutualisms in the (changing) tropics

Indirect fitness effects of key plant species extinctions in plant-hummingbird networks

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Hummingbirds are important high-elevation pollinators and in plant-hummingbird networks, both interaction partners affect each other's fitness. Generalist plant species that interact with many hummingbird pollinators (key species) are important to pollination network stability and if they become extinct, extinction cascades can occur. We lack empirical knowledge on key plant species extinctions in plant-hummingbird interaction networks and especially how they indirectly affect the remaining plant community. Here, we investigated the effects of a key plant species extinction on the pollination-related fitness of the remaining plant community in terms of hummingbird visits, pollen deposition and pollen tubes, a proxy for seed production. In a field experiment in the Tropical Andes in Ecuador we covered the flowers of a local key plant species. After the experimental extinction, flowers of the remaining plants received a significantly lower percentage of conspecific pollen, but the number of pollen tubes was not significantly reduced. These results suggest that the extinction of a key plant species negatively affects the pollen aspect of pollination-related fitness of the remaining plants, but that this may not result in a reduction in seed production. This indicates that plants might be more resilient to key plant species extinctions than previously thought.

Funding: Swiss National Science Foundation SNSF, Exper-Net IZSTZO_199379, European Research Council ERC, 787638.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 13 – Oral 1: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

Overview of the Reassembly project: Studying the species interactions network for resistance resilience and functional recovery in an Ecuadorian Chocó rainforest.

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The rapid deforestation of rainforests due to agricultural activities, followed by land abandonment, has created a mosaic of forests at different successional stages. While the successional dynamics of various communities—particularly trees—have been well studied, the species interactions driving key ecosystem processes remain poorly understood. In this context, the Reassembly Project, launched in 2021, was developed to investigate the disassembly and reassembly of species interactions within Ecuador's tropical lowland rainforest ecosystem. The project is an international collaboration between Ecuadorian and German universities and Nature conservation NGOs to create a comprehensive picture of the ecosystem's natural recovery. To achieve this, we examine various ecological communities (bacteria, plants, and animals) and their species interactions along a chronosequence and through a perturbation-recruitment experiment. We represent the first project that simultaneously studies species interaction networks across secondary succession, including pollination, herbivory, seed dispersal, decomposition, and food webs. Additionally, we are working on multiple synthesis efforts, comparing the dynamics of the studied communities and their interactions and developing new methodological approaches. Our research reveals significant differences in the successional dynamics, species recovery, and ecosystem processes following land abandonment, highlighting the critical need for holistic approaches to understanding the natural recovery of ecosystems.

Funding: Deutsche Forschungsgemeinschaft (DFG), Research Unit 5207

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 13 – Oral 2: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

Recovery of phylogenetic diversity and structure in trees and animals along a chronosequence of forest regeneration

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Tropical forests are highly threatened habitats that have the capacity to recover after disturbance. Integrating evolutionary (phylogenetic) information in the study of diversity recovery would provide a more complete picture of forest regeneration and community assembly. We used published mega-phylogenies along with community data of trees and animals to study the recovery of phylogenetic diversity (PD) and structure along a chronosequence of forest regeneration in the Ecuadorian Chocó. The recovery of PD was mainly driven by regeneration time and was fastest for ants and birds (12–17 years), took longer for trees and frogs (50–52 years), and was slowest for beetles and bats (85–91 years). Only birds showed an increase in phylogenetic overdispersion with regeneration time, as theory suggests. Surprisingly, frogs showed the opposite pattern, while trees, bats, ants, and beetles showed random or unclear patterns of structure. These results suggest that PD can recover under natural forest regeneration, and that environmental filtering and biotic interactions shape together phylogenetic structure patterns at early and late stages of forest regeneration for most of the groups. The studied communities are resilient to disturbance from an evolutionary perspective, which ensures their permanence and correct functioning in the future.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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Session 13 – Oral 3: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

Forest regeneration and recovery of leaf-litter frogs in the Chocó forest

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Amidst the alarming loss of tropical forests and its impact on biodiversity, recent studies have highlighted the role of secondary forests in amphibian conservation. Using a space-for-time substitution approach, we studied leaf-litter frog diversity across a forest regeneration gradient in the lowland Chocó Forest, northwestern Ecuador. We established 38 plots in active cacao plantations, pastures, secondary forests regenerating naturally after agriculture (0–37 years), and old-growth forests. We investigated whether forest age, historical land-use, forest cover around plots, and distance to old-growth forest affect leaf-litter frog richness and diversity. Additionally, we examined changes in community composition across forests at different recovery stages. Results indicated that both species richness and diversity increase with forest age, while historical land-use, surrounding forest cover, and distance to old-growth forests showed no significant effects. Notably, community composition shifted between early and late regeneration stages. Our findings highlight how factors linked to forest age—such as increased structural complexity and reduced thermal variability—influence frog community recovery. Additionally, we discuss landscape parameters that may play a key role in supporting this recovery. Regenerating forests are essential for the long-term preservation of local frog communities.

Funding: DFG-funded Research Unit REASSEMBLY, project FOR 5207; sub-project SP2, grant RO 3064/5-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 13 – Oral 4: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

How seed-dispersal interactions drive the recovery of tropical forests

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Seed dispersal is essential for the natural recovery of tropical forests, where 90% of plant species rely on animal-mediated seed dispersal to recolonize degraded habitats. Here, we investigate how seed dispersal drives and recovers with forest recovery. First, we developed a framework to assess how animal movement determines the diversity of seeds dispersed into habitat patches. Our framework helps identify factors limiting the connectivity of plant across fragmented landscapes. Then, we investigated the recovery time of seed-dispersal interactions after deforestation. We recorded plant-frugivore interactions at 62 plots, ranging from active agricultural land to recovering forests and undisturbed old-growth forests. Using a space-for-time substitution, we studied changes in the functional diversity of these interactions over time by comparing plots with different ages of forest recovery. Our results show that the functional diversity of seed-dispersal interactions needs about 20 years to recover, although plant functional diversity recovered more quickly due to the persistence of remnant trees. Finally, we aim to build on these studies and test whether models of seed-dispersal interactions and animal movement can predict the seed rain reaching recovering forests. Together, these studies provide insights relevant to improving tropical forest restoration, highlighting the benefits of seed dispersal for natural recovery.

Funding: Deutsche Forschungsgemeinschaft (DFG), Research Unit REASSEMBLY (FOR 5207; sub-projects SCHL 1934/5-1 and NE 1863/4-1)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 13 – Oral 5: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

Diversity and host networks of saproxylic beetles along a natural forest recovery gradient in a lowland tropical forest

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This study examines the recovery of saproxylic beetle communities along a forest recovery gradient from active agriculture to old-growth forest in the Ecuadorian Chocó. We exposed logs of five tree species with varying wood traits across 62 plots to test beetle abundance, species richness, and network complexity. We collected beetle specimens from more than 300 logs and identified approximately 90 species by DNA barcoding. Results showed that beetle abundance and species richness increased significantly along the recovery gradient, especially from agricultural to forested areas. Taxonomic and link diversity also increased, particularly in recovering forests. However, network specialization was inconsistent, being higher in agricultural and late-stage forests but lowest in old-growth and early regeneration forests. Fast-decomposing wood had fewer individuals but higher species diversity, particularly rare species. The study suggests that agricultural environments exhibit reduced diversity, but recovery occurs rapidly within a few decades. This recovery mirrors trends seen in vertebrates and trees and highlights potential interactions between beetles and other taxa mediated by wood traits.

Funding: Deutsche Forschungsgemeinschaft (DFG) funded Research Unit REASSEMBLY (FOR 5207; subproject SP7, with grants FE631/13-1 and MU3621/10-1).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 13 – Oral 6: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

How biodiversity recovers from perturbation: Resistance and resilience of a tropical rainforest

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2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Tropical rainforests are currently being cleared on a large scale and converged to agricultural landscapes. In some regions, there are attempts to reverse biodiversity loss by promoting regeneration of rainforests on abandoned land.

Natural recovery of rainforests in the neotropics can be surprisingly fast, particularly in landscapes with larger intact forests in the surrounding and pronounced seed dispersal by animals.

We examine rainforest regeneration and underlying processes in detail within the Research Unit "Reassembly" (reassembly.de). Our research takes place in a lowland forest reserve in North-Western Ecuador (Reserva Canandé, protected by Fundación Jocotoco). We study a chronosequence of 62 plots including active cacao plantations and pastures, secondary forests of different ages and old-growth forests. Here, we quantify the recovery trajectories of the biodiversity of multiple animal taxa and bacteria alongside trees. We do this by calculating recovery times and disentangling recovery time into two independent stability dimensions – resistance and resilience - that quantify the ability to withstand perturbation and the speed of recovery back to reference conditions. Our research provides unique insights into fundamental aspects of tropical forest stability to disturbance and provides an unprecedented set of time-scales for natural biodiversity recovery for various taxa in tropical forest ecosystems.

Funding: DFG FOR 5207, Grant number DR300-17

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 13 – Poster 29: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

Riparian herpetological diversity along a regeneration gradient in a Chocoan forest in northwestern Ecuador

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The tropical forests of the Chocó in northwestern Ecuador are renowned for their high herpetological diversity, yet they face significant threats from human activities. Amphibians and reptiles, closely linked to freshwater environments, are in decline. This research explores how herpetofaunal communities associated with streams change, recover, and reassemble with habitat regeneration in the Ecuadorian Chocó. We analyzed the taxonomic and functional diversity of amphibians and reptiles across cacao plantations, pastures, secondary forests at different regeneration stages, and primary forests. Standardized visual and acoustic surveys were conducted along transects over 136 hours during two climatic seasons in 2023 and 2024 in the Canandé Reserve, Esmeraldas, Ecuador. Secondary (old recovery) forests exhibited the highest species richness and shared similar diversity indices with primary forests, while activley used and young generation sites showed the lowest diversity. The species assemblages of old secondary and primary forests were similar, contrasting with the distinct composition of altered/young sites. We also report the recovery of functional diversity and its association with environmental variables. Our results underscore the critical role of secondary forests in recovering herpetological communities by maintaining the environmental conditions necessary for amphibian and reptile survival, emphasizing the need to prioritize them in conservation efforts.

Funding: Research Unit ‘REASSEMBLY’ (FOR 5207; sub-project SP-2, grant RO 3064/5-1)‘ funded by the ‘Deutsche Forschungsgemeinschaft’ (DFG); Pontificia Universidad Católica del Ecuador, Research project "DELIMITATION OF NEOTROPICAL REPTILE SPECIES" (Research Budget code QINV0432-IINV529010100).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 13 – Poster 30: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

Alkaloid profiles in poison frogs across a land-use chronosequence in the Ecuadorian Chocó

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Alkaloid defences in poison frogs are tightly linked to ecological gradients, with variation driven by prey availability, habitat type, and forest regeneration. We review current knowledge of alkaloid profiles in three poison frogs—*Oophaga sylvatica*, *Epipedobates* aff. *espinosai*, and *Hyloxalus toachi*—from the lowland Ecuadorian Chocó, incorporating some preliminary data. While research on *O. sylvatica*'s and sympatric species' diet and alkaloid profiles exists, studies along a chronosequence are limited. Evidence suggests alkaloid diversity and abundance are influenced by coloration, arthropod community, and habitat conditions. We hypothesize that *O. sylvatica* shows greater alkaloid diversity and abundance due to its conspicuous coloration compared to the cryptic *E.* aff. *espinosai* and *H. toachi*. Additionally, *O. sylvatica*'s preference for early-regeneration cacao plots may affect its chemical defences. Moreover, the state of the art on the presence and abundance of alkaloids in the two cryptic species presents conflicting results, necessitating further investigation, which we aim to clarify. We present recent data from 38 study plots across regenerating forests in Esmeraldas, Ecuador, examining how poison frog defences persist in fragmented landscapes. This synthesis also identifies research directions, linking arthropod prey availability to alkaloid profiles, and offering insights into the resilience of these interactions amid habitat conversion.

Funding: DFG-funded Research Unit REASSEMBLY, project FOR 5207

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 13 – Poster 31: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

River meanders drive dung beetle beta diversity in lowland Amazonian rainforests

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In western Amazonia, meandering rivers and annual flooding combine to create riparian beaches in which successional vegetation begins to grow. This seasonal pattern of sediment erosion/deposition creates a forest succession gradient spanning from the riparian beaches to the mature floodplain forests. Variations in plant and animal communities along this gradient have been described before, but despite their importance on ecosystem functioning, no previous studies have analyzed how dung beetle assemblages respond to this natural forest succession. We set up dung and carrion pitfall traps in transects along successional gradients created by four different river meanders in southern Peru to analyzed variations in taxonomic and functional diversity of the dung beetle community accros six forest successional habitats. Taxonomic alpha diversity stabilized in early stages of forest succession, but beta diversity kept increasing with distance between successional habitats due to species turnovers. However, changes in beta functional diversity were driven by the reduction of the functional space from mature forests to early successional habitats. Riparian beaches had unique assemblages composed of specialized species. Understanding beta diversity drivers may yield pragmatic insights of conservation utility for management of protected areas in these Amazonian forests threatened by artisanal gold mining.

Funding: Andes Amazon Fund (AAF), the International Conservation Fund of Canada (ICFC) and the Gordon and Betty Moore Foundation (GBMF)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 13 – Poster 32: Tropical ecosystem recovery: Reassembly of species diversity, communities, and interactions

Shifts in secondary seed dispersal by dung beetles with forest recovery

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Seed dispersal is a vital process in forest regeneration. While terrestrial vertebrates play a major role in seed dispersal, smaller animals like dung beetles may also be crucial as secondary seed dispersers. Across 32 sites along a forest recovery chronosequence, we quantified the removal of two types of seeds: one assumed to be subject to seed predation and the other assumed to undergo secondary seed dispersal by dung beetles. To quantify seed predation, we placed Petri dishes containing 40 seeds—20 with protective shells and 20 without. We assessed secondary seed dispersal by dung beetles using 12 seed morphospecies, ranging in length from 2 mm to 36 mm, mixed with 100 grams of pig dung. In each of the 32 sites, there were eight replicates: four replicates with mesh enclosures excluding dung beetles, and four open to dung beetles. Seeds with protective shells were removed at a much lower rate than those without. Seed removal, both by seed predators and secondary dispersal by dung beetles, increased with forest recovery. When dung beetles were excluded, seed dispersal was significantly reduced. This suggests that dung beetles may play an increasingly important role in protecting seeds from predators as the forest recovers.

Funding: Deutsche Forschungsgemeinschaft (DFG) in the framework of the collaborative Research Unit FOR 5207 REASSEMBLY: subproject BL 960/13)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 14.1 – Oral 1: Tropical ecosystem functionality

Eddy covariance measurements of a tropical forest in the Congo Basin

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The CongoFlux climate site in the Yangambi UNESCO biosphere reserve (0°48'52.0N, 24°30'08.9"E) hosts the first Eddy Covariance (EC) flux tower in the central Congo Basin. With this research site, we aim to provide long term, high quality observations from the understudied Central African region. Four years of EC measurements have been processed into net ecosystem exchange (NEE), latent heat and sensible heat time series, taking into account the processing challenges that arise from the tropical forest ecosystem. Partitioning the NEE into gross primary productivity (GPP) and ecosystem respiration (Reco) with established methods is hardly feasible for tropical sites due to the limited dependency of the fluxes on air temperature and due to the small temperature range at night. Therefore, new methods such as artificial neural networks are used to improve the partitioning. We here present four years of NEE, GPP and Reco data from a tropical forest in the Congo Basin, together with their main environmental drivers and the uncertainty of EC measurements in a tropical forest site.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 14.1 – Oral 2: Tropical ecosystem functionality

Sources of variation in plant chemical diversity

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Plants produce a wide range of secondary compounds essential for interactions with other species and adapting to environmental changes. This chemical diversity is influenced by factors like defense, pollinator attraction, tissue-specific needs, and phylogenetic history. However, the relationship between these factors remains unclear, as most studies focus on single organs, primarily leaves, or a limited number of species. This study investigates the roles of phylogeny and tissue-specific function in explaining chemodiversity in wild figs from Madagascar. Using untargeted metabolomics on unripe fruits and leaves from eight species, we analyzed their chemical profiles and reconstructed their phylogeny. We found a moderate phylogenetic effect on fruit chemodiversity, but none on leaf chemodiversity. Interestingly, fruit and leaf metabolomes were more similar between species than within the same species. These results suggest that, while phylogeny influences chemodiversity, tissue-specific functional convergence plays a key role.

Funding: DFG- NE 2156/3-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.1 – Oral 3: Tropical ecosystem functionality

Elevational shifts in tree community composition in the Brazilian Atlantic Forest related to climate change

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Climate change induces shifts in species distributions, ultimately changing community composition. The diversity and complexity of tropical and subtropical systems limits our understanding of climate-induced responses in mountain forests. We investigated migration trends in tree community composition along an elevational gradient, and between the transition from lowland to montane forests in the Brazilian Atlantic Forest. We used thermal affiliations of 627 tree species to calculate community temperature scores (CTS) for different life-history stages of trees in 96 permanent plots. We compared CTS of different life-history stages across space and time. Upward migration was more common in montane forests, and downward migration in lowland forests. Our temporal analysis shows significant changes in CTS values for juvenile communities with 0.36 °C decrease in lowland forests and 0.34 °C increase in montane forests. Contrasting results between lowland and montane forests communities indicate that the transition zone influence migration patterns and may reflect differences in species thermal limitations, as well as by non-thermal factors such as biotic interactions. Our findings provide the first evidence of climate change-induced community shifts in the Brazilian Atlantic Forest. The thermophilization of montane forests may suggest an increased risk of reduction for cold demanding species under climate change scenarios.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.1 – Oral 4: Tropical ecosystem functionality

Influence of the environment on the functional diversity of tropical dry forest trees

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Tropical dry forests are unique ecosystems with high levels of endemism containing many species found nowhere else. These forests are characterized by a pronounced dry season during part of the year, which provokes a variety of adaptations in plants. We have installed six permanent one-ha plots in the Laipuna natural reserve in southern Ecuador, three at around 600m asl and three at around 1200m asl. The basic forest inventory of all stems (with diameters of ≥ 10cm) with their diameters and species identity [1] was followed by height measurements of all individual trees and measurements of functional leaf and wood traits of all tree species.

Plots at the upper elevation level contained more evergreen tree species and were more species-rich compared to the drier lower elevation plots. Our results show how facets of functional diversity (functional richness and community weighted means) of the compared tree communities are affected by their environments.

Funding: Deutscher Akademischer Austauschdienst, DFG Ho3296/6.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.1 – Oral 5: Tropical ecosystem functionality

The role of rare tree species regarding functional diversity and biomass of tropical montane forests

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Tropical forests are composed of many tree species differing in their functional properties. In the presented project, we explore the functional composition of premontane, lower montane and upper montane forests. Within nine permanent 1-ha plots in southern Ecuador we recorded all trees (dbh ≥ 10cm) with their species and determined functional leaf and wood properties of ~500 tree species. Tree diameters and heights were determined to calculate aboveground biomass for each tree.

Our main questions were how a tree species' contribution to stand biomass, productivity and functional diversity is related to its abundance and if rare species are functionally distinct from more abundant tree species.

Funding: DFG Ho3296/6)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.1 – Oral 6: Tropical ecosystem functionality

Lianas cool down tropical forests understories by increasing evapotranspiration

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Lianas are an iconic feature of tropical forests whose abundance is increasing pantropically. They have been undoubtedly linked to negative effects on forest carbon storage. However, their influence on the energy balance of the forest, and the forest understory microclimate in particular, is poorly understood. To fill this gap, we installed 180 TMS-4 microclimate sensors and 112 light sensors (PAR-sensors and pyranometers) in an ongoing liana removal experiment in Gigante, Panama. We used generalized additive mixed models to estimate the impact of lianas on the understory temperature and light regime and we accounted for the impact of forest structure on microclimate using airborne and terrestrial lidar scanning data. Our findings revealed that, in liana present plots, the average maximum temperature was 0.25°C lower all year round whereas there was more light reaching the forest floor in the wet season. To explain this apparent contradiction, we hypothesized that lianas reduce understory temperatures by increasing plot-level evapotranspiration, which was confirmed by simulations from the Soil Canopy Observation, Photochemistry and Energy fluxes (SCOPE) model. These results suggest that lianas play a critical role in regulating forest microclimates, with potential implications for ecosystem resilience to climate change.

Funding: Research Foundation Flanders (FWO), research program G094115N

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.2 – Oral 1: Tropical ecosystem functionality

Water use efficiency in threatened tropical montane forests of Ecuador: Insights from herbarium data

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Water-use efficiency (WUE), a critical measure of carbon-water dynamics, remains understudied in tropical montane forests, leaving a significant gap in understanding how these ecosystems respond to climate change. This study investigates differences in water-use efficiency estimated by stable carbon isotope composition ($\delta^{13}C$) measured in historical herbarium collections of four common tree species distributed along a 3000 m altitudinal gradient in the Andes of Ecuador.

We compiled eight decades (1940–2020) of data, analyzing leaf samples from herbarium collections for *Alnus acuminata, Myrsine coriacea, Guarea kunthiana*, and *Vallea stipular*is. We targeted at least one individual per altitudinal level and decade for each species, working with 235 samples. Preliminary results indicate high variation in species $\delta^{13}C$ and intrinsic water-use efficiency (iWUE). Our findings reveal a decrease in $\delta^{13}C$ over the years, suggesting a decline in iWUE, potentially driven by changing environmental factors such as rising temperatures. Conversely, $\delta^{13}C$ and iWUE increase with elevation in line with previous research.

Understanding water-use efficiency in different species from tropical montane forests is essential for predicting their responses to climate change. Our findings reveal intriguing patterns of $\delta^{13}C$ that require further investigation and underscore the value of herbarium data in analyzing both past and future ecological trends.

Funding: Vlir-uos TEAM PROJECT

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.2 – Oral 2: Tropical ecosystem functionality

Global patterns of insect herbivory across forest canopies and understories: Insights from a tropical case study and a global comparison

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Several studies have examined global patterns of insect herbivory, revealing variations with latitude, elevation, and temperature. However, less attention has been given to herbivory patterns at smaller spatial scales, particularly the comparison between forest canopies and understories. This study investigates insect herbivory in forest canopies and understories across different forest types in southern Ecuador. Herbivory was measured as leaf area loss (%) in 918 plants from montane dry forest (MDF) and montane rainforest (MRF), at elevations ranging from 600 to 3000 m. Results showed higher herbivory in the MDF understory, while in the MRF, the canopy exhibited greater herbivory. To broaden this analysis, a literature review of 64 studies was conducted to compare the herbivory pattern between the two strata in a multi-study approach, revealing no significant difference in herbivory between canopy and understory across different ecosystems. Interestingly, neither latitude (proxy for temperature) nor precipitation had significant effects on herbivory. Both the global and case study suggest that the variation between forest types may outweigh general strata differences. The study underscores the need for additional direct comparisons of herbivory between canopies and understories to develop more comprehensive understanding of herbivory patterns across diverse forest ecosystems.

Funding: This research was funded by the German Research Foundation (DFG) as part of the Research Unit FOR2730

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.2 – Oral 3: Tropical ecosystem functionality

The importance of every tree: Rare tree species and multifunctionality in a tropical forest

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An important, but easily overlooked component of diversity is rare species. However, rare species may be key to the stability of tropical forests. We used functional trait and abundance data from a 50-ha plot in Panama to evaluate the contribution of rare species to, and their relationship with, community functional diversity. Thierer contribution was also compared the most abundant species as well as randomized groups. We found the rarest species contributed significantly more to functional diversity than an equivalent percentage of a randomized group, and the equivalent abundant group. Rare tree species contribute substantially to functional diversity in this lowland moist forest, attributable to their unique traits and trait combinations. This enables differing responses to disturbances, potentially mitigating the overall impact of extreme climatic events on the ecosystem. They also have moderately high levels of functional redundancy, through which they can act insurance for certain functions and help maintain ecosystem stability. Our results suggest that the long-term stability of tropical forests is safeguarded by their diversity. Attention should be paid to the management and understanding of rare species as they are likely to bolster the resilience of these communities to the effects of climate change.

Funding: CENTA (NERC/UKRI)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.2 – Oral 4: Tropical ecosystem functionality

Amazonian timber species show distinctive ecological attributes

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Amazonian forests provide multiple ecosystem services. However, these forests are under threat mainly due to unsustainable forestry and agriculture practices. Moreover, little is known about the ecological attributes of timber species, particularly when compared to non-timber tree flora. This study aimed to classify all identified Amazonian tree species according to their use as timber, and then to assess whether there are differences in several ecological attributes between timber and non-timber species. To do so, the *timberness index* relating each ecological attribute to the timber feature was created, and exhaustive analyses were carried out using a newly created database by combining different sources such as research networks (ForestPlots and ATDN), international institutions (IUCN, CITES) and national Amazonian forest authorities. Our results suggest that timber species represent 17.6% of Amazonian tree flora. In addition, there is a clear tendency to identify a species as “timber” if such species are common at local level (hyperdominant), are less threatened (IUCN), are in forest types easier to access (by terrestrial or aquatic transportation), have past or present uses in agroforestry practices, and have a wide range of wood density. Our results could provide information to design more sustainable forest policies in the Amazonian region.

Funding: Government of Navarre (Spain), Public University of Navarre (Spain)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.2 – Oral 5: Tropical ecosystem functionality

Burrowing facilitated the distributional success of mammals and imposed contrasting responses to climatic stability

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Species' ability to cope with climatic instability varies greatly, influenced by factors like dispersal, physiological adaptations, and phylogenetic conservatism. Here, we investigate how burrowing behaviour, a key component of species' endurance strategies and ecosystem-functioning, shaped the contemporary patterns of species richness and range size as well as the diversification of mammalian lineages. Analysing 4,407 terrestrial mammal species combined with novel trait data on 3,096 species, we reveal different responses to climatic factors between burrowing and non-burrowing species. Burrowing lineages are disproportionately species-rich at lower temperatures and productivity levels. Both range size and species richness steeply increase with climate seasonality in burrowing species, as opposed to non-burrowing species. Constituting 47% of all terrestrial vertebrates, the proportion of burrowing species increases latitudinally. Particularly regions with greater Pleistocene temperature changes are almost exclusively composed of burrowing species. Trait conservatism, higher diversification rates, and Eocene peak diversification provide the evolutionary context to these contemporary patterns, underscoring the role of burrowing for mammalian radiations into cold-temperate climates. Our study highlights the potential of readily available behavioural information in improving forecasts of species' responses to climatic changes and showcases divergences of broad importance for climate change responses.

Funding: German Research Foundation, DFG Priority Program SPP 1803 BR 1293/18-1, FA 925/12-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14.2 – Oral 6: Tropical ecosystem functionality

Rainforest conversion to monoculture reduces parasitoid wasp diversity and shifts host preferences in Indonesia.

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Tropical rainforest in Indonesia was largely converted to oil palm and rubber plantation. Parasitoid wasp provides vital role in ecosystem as biological control. This function may be disrupted by massive rainforest conversion. We sampled canopy parasitoid wasp using canopy fogging in four land-use system in Sumatera Indonesia: Rainforest, jungle rubber, and monoculture of rubber and oil palm. Rainforest conversion to oil palm and rubber monoculture has led to a double loss of parasitoid species richness and abundance. Parasitoid richness and abundance can be retained in agroforestry designs, such as in jungle rubber. Parasitoid biomass was found highest in rainforest and lowest in oil palm plantation. Parasitoid community differed from rainforest and monoculture. We found that parasitoid in oil palm plantation prefer to host Lepidoptera than others. On other hand, Coleoptera parasitoids are found more abundant in rainforest, jungle rubber, and rubber plantation. Our study showed that rainforest conversion in Indonesia strongly reduce parasitoid wasp diversity and shift the community structure. These community changes are thought to be caused by the availability of host resources.

Keywords: agroforest, Braconidae, jungle rubber, Lepidoptera, oil palm, rubber, Southeast Asia

Funding: DFG, German Research Foundation, project number 192626868-SFB990

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14 – Poster 16: Tropical ecosystem functionality

Functional traits of leaf and fine root depending on the tree species adapted to different topography in a subtropical evergreen forest

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Identifying functional traits of trees associated with topography gives us insights into the prediction of environmental response of tree species induced by global warming. The objective of this study was to elucidate leaf and fine root traits as well as their relationship in tree species adapted to ridge (ridge species) or valley (valley species) in the northern part of Okinawa Island, Japan. We measured four leaf traits and four fine root traits in 10 ridge species and 6 valley species. Leaf traits significantly varied between ridge and valley species. Ridge species exhibited low leaf area, low specific leaf area, high leaf thickness and low leaf nitrogen concentration compared with valley species. On the other hand, fine roots traits did not significantly vary between ridge and valley species. Furthermore, nitrogen concentration was the only trait that showed association between leaves and fine roots, and this was seen only in valley species. Our results suggest that leaves show conservative traits in ridge and acquisitive traits in valley, and the relationship between leaf and fine root traits depends on leaf resource acquisitive strategies.

Funding: JSPS Core to Core Program: Asia-Africa Science Platform FY 2021. Interdisciplinary Research of Coexist of People and Nature in Subtropical and Tropical Asian Islands

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14 – Poster 17: Tropical ecosystem functionality

Functional erosion in Annonaceae: Implications for global tropical rain forest conservation

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Protecting tropical rain forests (TRFs), home to half of the world's plant diversity, is essential for mitigating the global biodiversity crisis. TRFs not only exhibit an impressive taxonomical diversity but are also renowned for their diverse morphological traits, indicating high functional diversity. Over the past 50 years, one third of TRFs have been destroyed, yet the impact of these extinctions on their functional diversity remains largely unknown. To address this gap, we assembled the most complete morphological traits datasets within Annonaceae (~2,200 out of 2500 species known), a diverse and ecologically important pantropical family to characterize their functional space. Our results reveal a marked unevenness in how species occupy the functional space, with hotspots showing high functional redundancy clustering in small extent, and areas of low redundancy dominated by single species. We mapped extinction risk onto the functional space, identified ecological strategies at risk, and assessed functional vulnerability under various simulated extinction scenarios. Finally, by integrating these findings with a well-resolved species-level phylogeny and extensive distribution data, we present an integrative framework that highlights the multidimensional nature of biodiversity loss within Annonaceae and proposes strategies for optimizing conservation efforts in TRFs worldwide.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14 – Poster 18: Tropical ecosystem functionality

Scale-dependent impacts on multidiversity and multifunctionality within rainforest transformation landscapes

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Multidiversity and multifunctionality are strongly scale-dependent. However, most studies have focused on local effects when assessing multidiversity or multifunctionality. We lack a mechanistic understanding of how they are mediated by different plot-, field- or landscape-scale factors, a prerequisite to upscale the biodiversity-ecosystem service relationships to regional scales. Here, we address this gap by leveraging the extensive dataset from the EFForTS-Landscape Assessment, collected across 124 plots situated in the lowlands of Sumatra. Specifically, we use structural equation models (SEMs) to estimate the direct and indirect effects of different factors on local multidiversity and multifunctionality. As factors, we consider various plot-level (local land-use, plot vegetation complexity), field-level (management), and landscape-level variables (landscape composition, configuration), evaluating the relative magnitude of influence that each of these factors exerts on local multidiversity and multifunctionality.

Funding: DFG (German Research Foundation)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14 – Poster 19: Tropical ecosystem functionality

The meta-analytic evidence for growth-reproduction trade-offs in woody plants

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Many plants, including tropical species, exhibit irregular patterns of reproduction, with years of intense seed production and years when little or no seeds are produced. Theory predicts that some species experience trade-offs in resource allocation; for instance, masting species are likely to reproduce at the cost of growth. In our study we aimed to conduct a global meta-analysis looking for the trade-offs between tree growth and seed production. We screened over 4500 articles that studied both plant reproduction and tree growth and extracted effect sizes from more than 100 studies that correlated tree growth with reproductive effort across multiple years. We found that increased reproduction generally leads to reduced tree growth, but the effects are highly species dependent and non-universal. The meta-analysis included several tropical species despite a strong geographical bias towards temperate forests. We hypothesize that certain groups of tropical trees, such as dipterocarps and podocarps, may show negative growth trends during years of high seed production. Our findings contribute to the long-lasting discussion about trade-offs in plant reproduction and highlight the need for further studies on these trade-offs, especially in overlooked tropical species.

Funding: National Science Centre (NCN) Poland, SONATA 15

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14 – Poster 20: Tropical ecosystem functionality

Community composition of invertebrates associated to coarse woody debris and leaf litter substrates in the Western Amazon: A case study in Ecuador

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Coarse woody debris (cwd) and leaf litter play a critical role in tropical forests. Its decomposition is essential for regulating soil carbon dynamics and nutrient cycling. Given the importance of this process, a better understanding of the invertebrate community associated with these substrates is needed. The objective of this research was to describe this community in the Western Amazon (Ecuador). We collected a total of 180 samples of cwd (decay class 1-5), and 81 samples of leaf litter in three forest types of the Ecuadorian Amazon: evergreen Andean - Amazonian forests, evergreen Piedmont Forest, and evergreen Lowland Forest. We found a total of 49 and 57 taxa (family level) in cwd and leaf litter, respectively. The decay classes 3 and 4 reported a higher richness, followed by decay classes 1, 2 and 5. Regarding decay classes, the main functional groups of cwd were consistent in richness and abundance (detritivore> predator> omnivore> herbivore> generalist). However, this pattern was different in leaf litter for richness and abundance (omnivore> detritivore> herbivore > predator). Our findings suggest differences between cwd and leaf litter in invertebrate colonization patterns in these Ecuadorian Amazon forests.

Funding: The Secretary of Higher Education, Science, Technology, and Innovation SENESCYT–ENSAMBLE Financing Program (Grant/Award No. PIC-17-BENS-002) for the development of the project “Carbon Storage for Three Types of Forest in the Ecuadorian Amazon Region”, and Public University of Navarre, Spain.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 14 – Poster 21: Tropical ecosystem functionality

Establishing a 'Central African tree trait database'

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The Congo Basin, the second largest tropical rainforest in the world, harbors a high biodiversity. However, the Congo Basin's biodiversity is threatened by rapidly changing climate conditions including regional warming and drying, potentially leading to biodiversity loss and severe dieback of trees. Yet, despite being crucial for understanding the sensitivity of Congo Basin forest communities, functional turnover rates in old-growth forests have never been studied in the Congo Basin because of a lack of trait data.Here, we propose a standardized field and lab protocol to measure tree functional traits in Central Africa. Firstly, we perform traditional measurements of leaf traits such as SLA, LDMC, chemical composition, and thickness,. Secondly, we cover a part of the wood economics spectrum by measuring wood density, (volumetric) water content, and chemical composition, and bark thickness. Furthermore, we measure vessel characteristics using a novel, semi-automated pipeline. Using this protocol, we already collected functional trait data for 330 tree individuals covering 57 tree species in remote regions in the central Congo Basin such as Yangambi, Djolu, and Salonga. Our standardized trait protocol facilitates establishing a 'Central African tree trait database', enabling the prediction of the fate of central African rainforests under increased anthropogenic pressures.

Funding: Excellence of Science program (EOS O.0026.22)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 14 – Poster 22: Tropical ecosystem functionality

Seasonal patterns and drivers of forest transpiration in a subtropical montane forest

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Forest transpiration is crucial in global water cycles but its quantification is challenging. Forest-level transpiration can be measured by upscaling direct sap flux measurements from the tree-level to forest-level (TSF), while such studies are limited. A partitioning method that partitions transpiration from eddy-covariance measured evapotranspiration (TEC) could contribute to this knowledge gap. However, validation of the TEC estimates is very limited and hence urgently needed. We quantified forest transpiration with sap flux measurements (TSF) in a subtropical forest and used this to validate the TEC. We compared these two set of transpiration rates across seasons with high versus low vapor pressure deficit (VPD). TEC matched TSF during the season with high VPD, but overestimated than TSF during the season with low VPD. Analysis on the source of variability in forest transpiration estimates indicated the overestimates of transpired fraction of evapotranspiration during the season with low VPD, which therefore led to the overestimated TEC. This difference in temporal patterns induced different responses to climatic variations – TEC was determined mainly by temperature and solar radiation (partly due to the role of gross primary production (GPP) in partitioning TEC), while TSF was found driven by VPD. Therefore, We call for caution when applying the partitioning method at sites where GPP and VPD are decoupled during the year, and call for replicates of our study at other sites experiencing a similar climate to test whether these findings generally hold among different forests.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 15 – Oral 1: Tropical molecular ecology

Comparative phylogeography of Microcebus in a centre of endemism in northeastern Madagascar

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Madagascar has high potential to study the diversification of species due to its numerous endemic radiations and steep environmental gradients. Here, we employ comparative phylogeographic modelling in three mouse lemur species (*Microcebus jonahi, M. macarthurii, M. lehilahytsara*) inhabiting rainforests in northeastern Madagascar to understand the relative importance and interaction of different factors driving the diversification and distribution of mouse lemurs in Madagascar. Based on restriction site associated DNA sequencing across 305 individuals sampled in 14 different inter-river systems, we use isolation-by-resistance models to understand the combined effects of elevation, rivers, landscape heterogeneity, and climatic niche suitability on population structure in the different study species. In addition, we infer intraspecific divergence, genetic diversity, and rates of gene flow among populations to shed light on the colonization history of these species. We find that species differ significantly in biogeography, population connectivity, and the relevance of rivers and elevation to restrict gene flow in these heterogeneous landscapes. Recent diversifications of the study species in this region support a role of late Pleistocene climatic events in shaping current phylogeographic patterns of mouse lemurs in Madagascar.

Funding: German Research Foundation (RA 502/23-1,2), German National High Performance Computing Alliance (nib00015)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 15 – Oral 2: Tropical molecular ecology

Bat gut microbiota responses to short and long-term diets in fragments of Papuan rainforest

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The mammalian microbiota is dynamic, with community composition able to change rapidly in response to the host environment (e.g., diet). It plays a crucial role in host health, influencing nutrition, immunity, and behavior. While recent decades have seen a significant increase in studies on the effects of habitat fragmentation on mammals, little is known about its impact on their feeding ecology or microbiomes. Using metabarcoding and isotope analyses of fecal, rectal, and fur samples from bats in both fragmented and continuous rainforests in Papua New Guinea, this study aimed to explore the relationships between microbiota and short- and long-term diets, and the extent to which habitat fragmentation disrupts these relationships. We found that both short- and long-term diets influence gut microbiota composition. Additionally, within the same species, differences in certain core bacteria were observed between study sites, which may have downstream effects on host health. This study underscores the importance of incorporating microbiota analysis into fragmentation research, with future studies advised to use shotgun metagenomics to investigate gene-level microbiota changes in response to habitat quality.

Funding: Bat Conservation International scholarship, project SS2312; European Research Council, project BABE 805189.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 15 – Oral 3: Tropical molecular ecology

Peering into the black box of Amazonia soil microbial structure and function

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Despite recent substantial contributions to soil microbial ecology as an integral part of tropical rain forest structure and function, our understanding is still rather bitty. Here we summarise work done in central and eastern Brazilian Amazon to characterise the baseline natural variability of highly dynamic belowground communities and the assessment of significant divergence in ecosystem function in response pressure and pulse type perturbations.

First, we report the response of the soil fungal communities to precipitation seasonality and long-term experimental throughfall exclusion over a 1-ha plot in the eastern Amazon, where short-term precipitation seasonality is accentuated by the prevalence of sandy soil. Second, we report the results on fungal and bacterial communities of a nitrogen deposition experiment with urea that simulated the local input of mammals via urine. The two experiments represent contrasting temporal and spatial scales and offer some preliminary insights into climate and biotic controls of the structure and functioning of rain forest soil microbial communities and their contribution to ecosystem processes.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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Session 15 – Oral 4: Tropical molecular ecology

Seed and pollen dispersal in both hunted and intact forests in the lower canopy African rainforest tree, *Coula edulis* Baill (Coulaceae)

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Trees in tropical rainforests are subject to habitat change due to anthropogenic disturbance, which may affect their population and evolutionary dynamics. We aim to study these phenomena on *Coula edulis* Baill (Coulaceae), a common tree species in the Guinea-Congolese forests producing an edible fruit known as "African walnut", which is an important food and income resource for rural communities. We compared gene flow and potential dispersers and predators in two populations in Cameroon with similar tree densities (1.01-1.39 ind ha^{-1}) but contrasted levels of human perturbations. Using nuclear microsatellite markers (nSSRs), we genotyped adult and juvenile trees in two plots to 400 ha, and we also added camera trap in each one. We used parentage analyses and the neighborhood model to estimate outcrossing rates and seed and pollen dispersal distances. Juveniles outcrossing rates were high (t ≈ 1) in all plots. Parentage analyses revealed short mean dispersal distances for seeds (ds: 131 and 105 m) and for pollen (dp: 211 and 173 m), which decreased from disturbed to the intact forest. Camera observations revealed a low presence of dispersers and predators such as rodents (*Cricetomys emini* and *Artherurus africanus*) in the disturbed forests. In contrast, these rodents were more important in the intact forest, in addition to the large fauna species (*Loxodonta cyclotis* and *Mandrillus sphinx*), which are considered only as predators.

Coula edulis appears to be a resilient species, probably because its spread depends on rodents, which are to some extent more resistant to human pressure.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 15 – Oral 5: Tropical molecular ecology

Mating system shift following a range expansion of the African timber species *Pericopsis elata* and consequences for inbreeding depression

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Most flowering plants are hermaphroditic, leading to a remarkably diversity of selfing rates, ranging from self-incompatible outcrossing species to highly selfing species. Most long-lived perennials (e.g. trees) are predominant or obligate outcrossers, while predominantly selfers are mostly annuals. However, the African rain forest tree *Pericopsis elata* (Fabaceae) is an exception. This endangered tree, exploited for its timber, has a fragmented distribution in Central Africa where it exhibits a high selfing rate. Furthermore, an east-west neutral genetic diversity gradient observed in its western populations reveals a recent range expansion. The resulting serial founders events can potentially affect the selfing rate, which is expected to increase because selfing provides reproductive assurance, and the inbreeding depression, which is expected to decrease through the elimination or fixation of deleterious recessive alleles. In this study, we assess selfing rate and inbreeding depression in five populations along the recolonization pathway of *Pericopsis elata*. We found a mean selfing rate of about 80% in western populations (Republic of Congo and Cameroon), where it was reported to be 54% in eastern populations (Democratic Republic of Congo). Within western populations, higher selfing rates are observed in populations at the margins of the species range. An ongoing provenance and progeny trial under controlled conditions will allow us to assess whether inbreeding depression shows a similar geographic pattern. Our results have implications for the sustainable management of this threatened species.

Funding: FNRS, project TREEGENOME

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 15 – Oral 6: Tropical molecular ecology

Evolutionary history of an endangered African timber legume with a mixed mating system, *Pericopsis elata* (Fabaceae)

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Quaternary climatic oscillations likely influenced the genetic diversity patterns of tropical African tree species. We investigated these effects on *Pericopsis elata*, a timber species showing a fragmented distribution in the Guineo-Congolian rainforests with three main populations, a remarkably high selfing rate (55-85%), and a deficit of natural regeneration in close-canopy forest. Our dated plastome phylogeny indicates a recent origin of *P. elata*, which evolved from a savanna species (*P. angolensis*), as West and Central African populations diverged for 210 Ka, and western and eastern Central African populations diverged for 99 Ka. Furthermore, the western Central African population displays a signature of range expansion in the last 20 Ka, confirmed by nuclear microsatellites displaying a westward decay of diversity and an increase in inbreeding (F_{IS} = 0.13 to 0.5 from east to west). The whole-genome analysis revealed longer and a higher number of runs of homozygosity in the expanding population. Our findings suggest that *P. elata* underwent recurrent range expansion – fragmentation since the Mid-Pleistocene, where fast range expansion would be facilitated by selfing ensuring reproductive assurance after long-distance seed dispersal events. The genetic peculiarities of the different populations must be considered to manage this species sustainably, through assisted regeneration or plantations.

Funding: F.R.S-FNRS (Fonds de la Recherche Scientifique)

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ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

Session 15 – Poster 51: Tropical molecular ecology

Biodiversity effects on leaf and litter volatiles composition

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Leaf metabolome is dynamic and is constantly changing according to different interactions and environmental conditions. Plant diversity level in a plant's surrounding community has been proven to also affect the leaf metabolome. What is not usually considered is that these leaves will then senesce and form the litter layer bellow the trees, in a way that changes in the leaf metabolome could reflect in the composition of volatiles emitted by the litter. We hypothesized that leaf and leaf litter volatiles composition are influenced by the diversity in their surroundings. To test this hypothesis, we studied the volatiles from shrubs in BEF China in plots with both shrubs and trees and shrub monocultures. We studied the leaf litter volatiles from trees at the MyDiv Experiment in plots with different diversity levels. We trapped leaf volatiles using PDMS tubes and litter volatiles through solid-phase microextraction and analysed them through GC-MS. When looking at the leaf volatiles we could see an effect in both compound class richness and intensity for sesquiterpenoids, fatty acyls and monoterpenoids, while in the litter volatiles this effect was seen mostly in sesquiterpenoids. These results show that diversity can affect volatiles emission which could later influence plant interactions.

Funding: Deutsche Forschungsgemeinschaft (DFG, German Research Foundation), project 319936945/GRK 2324

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 15 – Poster 52: Tropical molecular ecology

Inbreeding depression, functional traits and phenotypic plasticity in an endangered tree species from Congo basin with a mixed mating system

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Most tree species can suffer from inbreeding depression (ID), which they escape by reproducing predominantly through outcrossing. A remarkable exception is *Pericopsis elata*, an African timber species naturally producing 54% of self-fertilized seeds in the eastern Congo Basin. While selecting good genetic material can increase the value of plantations, we lack fundamental biological knowledge on the effect of inbreeding and competition on growth potential, variability in leaf traits and phenotypic plasticity. We hypothesize that ID in *P. elata* could result from the expression of deleterious mutations affecting functional traits, or from a reduction of adaptive phenotypic plasticity in inbred genotypes. To test our hypotheses, 540 *P. elata* seedlings were monitored for 4 years in a Nelder-type device located in the DRC, in which trees were planted along concentric circles to generate a density gradient. Nine leaf morphological traits, eight leaf chemical traits, diameter, and total height were measured regularly, while paternity analyses allowed distinguishing inbred and outbred plants. To explain the observed ID on growth, we tested whether inbreeding affected leaf traits and/or their plasticity expressed across years, across the density gradient or across sunlight exposure. Outbred plants grew faster than inbred ones, demonstrating ID for each level of competition. Despite the significant correlation found between specific leaf area and growth, and the impact of planting density, plant age, and leaf exposure to sunlight on multiple traits, mean leaf trait values did not differ according to inbreeding. However, a few leaf traits (chlorophyl content, maximum stomatal water vapor conductance, and leaf fresh mass) showed significantly higher plasticity in outbred than inbred plants.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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Session 16 – Oral 1: Climate change impacts on tropical ecosystems

Holocene climatic and vegetation changes in the Brazilian semi-arid

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Climatic variability directly impacts human activities. In Brazil the changes that affected the ecosystems and their resources impacted the populations and forced them to migrate at decadal to millenial-scales. Northeastern Brazil (NEB) is rich of a 40,000 years history with phases of occupation and abandonment of the archeological sites distributed all over its territory. The Brazilian semi-arid represents the extreme of aridity of the South-American tropical lowlands. The shifts of the intertropical convergence zone (ITCZ) and of the south atlantic convergence zone (SACZ), the intensity and amplitude of the south american summer monsoon led to environmental and climate changes during the Holocene. We will present a serie of paleoecological records distributed along a longitudinal gradient and discuss the different vegetation responses to convergence zone reorganisations. We show the existence of a precipitation gradient between eastern and western NEB which controls the distribution of vegetation. Our research shows that the extreme aridity that prevails today in eastern NEB results from the influence of both orbital parameters and shifts of the convergence zones (ITCZ and SACZ). Our interpretations are based on the TraCE-21k model data and will place the changes observed during the Holocene in the context of global warming.

Funding: IRD grant South-North, CAPES/PRINT/UFC 88881.311770/2018-01, Campus France and UMR ISEM.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 16 – Oral 2: Climate change impacts on tropical ecosystems

Impacts of Holocene land use and climate change upon Brazil's iconic Araucaria Forests

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Southern Brazil's highland Araucaria Forests are an ancient, unique and heavily threatened part of the Atlantic Forest, a global biodiversity hotspot. >80% of their natural vegetation has been lost, with climate change a growing concern.

Conserving their biodiversity and ecosystem functioning in the future demands an understanding of their relationships with humans and climate through time. Palaeoecological evidence shows some *Araucaria* Forest areas expanded rapidly around 1000 years ago, but the drivers – whether indigenous peoples or climatic shifts – are debated.

Using novel integrations of new palaeoecological data, agent-based modelling, and existing archaeological data, I will assess how pre-Columbian indigenous peoples, climate change, and fire interacted and shaped these landscapes throughout the last 12,000 years. My results should provide important insights into likely responses of these globally important ecosystems to current and future anthropogenic and climatic changes, helping inform conservation strategies for these iconic forests.

Funding: SCENARIO DTP, NERC

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 16 – Oral 3: Climate change impacts on tropical ecosystems

Climatic drivers of carbon stock dynamics in the Brazilian Atlantic forest

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Tropical forests play a crucial role in the global carbon storage and cycle, yet the carbon dynamics of the Brazilian Atlantic forests remain largely unknown. However, rising temperatures and drought events are expected to modify the forest structure, leading to disruptions in forest functions. Here, we analysed data from 1,542 permanent plots along the Atlantic Forest (14-29°S, 43-54°W), monitored from 1987 to 2024, to assess changes in carbon stock dynamics over time and identify key drivers, such as mean temperature, annual rainfall, potential evapotranspiration, and census year. We applied a generalized linear mixed-effect model to evaluate the influence of environmental factors and census year on aboveground carbon stock dynamics per hectare. We included plot identity as a random effect to control for site-specific variations. Our results showed an overall increase in carbon stocks over the years (0.11 Mg C ha^{-1}). On the other hand, carbon stocks are declining in sites that are experiencing higher rates of rising temperatures. The results of our study suggest that increasing temperatures negatively affect aboveground carbon stocks in the Brazilian Atlantic Forest, highlighting the vulnerability of these forests to rising temperatures in the context of climate change.

Funding: Leuphana University of Lüneburg

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 16 – Oral 4: Climate change impacts on tropical ecosystems

Tree species diversity stabilizes the Amazon forest across multiple spatial scales

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Local and regional disturbances may be shifting the Amazon forest from a carbon sink to a carbon source, impacting the global carbon cycle. Greater tree diversity might increase the Amazon's stability to disturbances by providing varied species responses to environmental changes. Yet, this diversity-stability hypothesis remains untested within the Amazon forest. Moreover, given the variability of diversity patterns across different spatial scales, we anticipate that its relationship with stability in the Amazon operates across multiple scales as well. This study explores the diversity-stability relationship in the Amazon across multiple scales, using modelled tree species diversity and satellite-derived stability data. Stability is quantified using temporal autocorrelation patterns in vegetation productivity, which indicate critical slowing down. We find significant positive relationships between tree species diversity and stability at both alpha (local) and beta (asynchrony among local communities) scales, but not at the gamma (regional) scale. Our research also shows that regional stability increases with higher alpha and beta stability, suggesting that both higher alpha and beta diversity indirectly support regional stability, through their enhancements of alpha and beta stability, respectively. This highlights the critical role of biodiversity conservation at multiple spatial scales to maintain ecosystem stability within the Amazon forest.

Funding: Research Foundation Flanders (FWO) (grant number G063420N)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 16 – Oral 5: Climate change impacts on tropical ecosystems

Global increase of lianas in tropical forests

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Lianas profoundly affect tropical forests dynamics, reducing productivity and carbon storage. While increasing liana populations are documented within the Neotropics, the global consistency of these patterns is questioned and remains to be determined. We synthesized data from published longitudinal studies examining liana trends across the tropics and applied a Bayesian hierarchical meta-analytic model to the rates of change, accounting for publication bias. Our analysis reveals an overall pan-tropical increase in lianas, occurring at an average rate of 1.7 ± 0.7 SE% per year (~10% to 24% per decade). This trend extends beyond Neotropical regions, indicating a widespread phenomenon. Significant local variation exists, attributable to differences in life cycle stages, abundance metrics, forest successional stages, and biogeographical realms. Notably, increases in stem density of saplings and biomass of canopy lianas in old-growth forests, point to global climatic drivers and heightened turnover rates as factors promoting sustained liana growth in the canopy and clonal colonization in the understory. These trends suggest that the rise in liana abundance may not only persist but could also intensify under climate change. Our findings confirm growing concerns about lianas' expanding impact on pan-tropical carbon storage, highlighting their significant potential effect on global carbon dynamics.

Funding: COLCIENCIAS (Departamento Administrativo de Ciencia, Tecnología e Innovación), Impact Fund of the Institute of Environmental Sciences (CML, Leiden University).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 16 – Oral 6: Climate change impacts on tropical ecosystems

Employing canopy time-lapse cameras to unravel the climatic drivers controlling phenological transitions in tropical forests

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Understanding tree phenology is crucial for assessing how forest ecosystems respond to climate change, as it affects species interactions and ecosystem processes. Although tropical forests are highly impacted by climate change, the environmental cues that trees use to synchronize phenological transitions remain unclear. This study employed digital repeated photography to depict tree phenology in an Ecuadorian Andean cloud and a lowland dry forest. Cameras were installed in canopies to track leaf, flower, and fruit phenology at daily resolution. Leaf phenology was analysed using Green Chromatic Coordinates (GCCs), while the start and duration of flower and fruit phenology were determined by visually inspecting photos. We derived indices for the synchrony within species and used univariate Bayesian GLMM models to identify the climatic drivers. In the dry forest, higher flowering and fruiting synchrony was observed compared to the cloud forest, linked to more pronounced seasonality. First results indicate solar irradiance as the main driver of phenology in the cloud forest and rainfall in the dry forest, with activity peaking shortly after the first rain. These results highlight the different responses of these species to climatic drivers, which is essential to understanding how tropical forests might respond to future climatic shifts.

Funding: This research was funded by the Emmy Noether project “Phenology of tropical tree species – environmental cues, molecular mechanisms, and consequences for plant-animal interactions” (HE 7345/9-1). In addition, KH, AM and CV were supported by the Eva Mayr-Stihl Foundation.

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2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 16 – Poster 33: Climate change impacts on tropical ecosystems

Assessing climate vulnerabilities and resilience strategies in the Teesta River Basin: Insights from critical climate-stress moments

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Critical Climate-Stress Moments (CCMs) occur when households, communities, and livelihoods face vulnerabilities to climate-related risks and hazards. This study examines CCMs in the Teesta River Basin (TRB) of the Eastern Himalaya (2012-2023) focusing on climatic and biophysical factors. CCMs help convey community vulnerabilities, sustainable living challenges, and link vulnerability assessments with adaptation policies. The TRB was categorized into high-altitude (>2000–5300 masl), mid-hills (1000–2000 masl), and floodplains (<50–500 masl) for the study. We used qualitative and quantitative surveys, focus group discussions, case studies, key informant interviews, and household surveys (490) via a mobile application. High-altitude CCMs include glacier melt, cloud bursts, Glacial Lake Outburst Floods (e.g., Lhonak Lake, October 4, 2023), varying temperatures, frostbite, farm pests and diseases, new diseases in humans/animals, and unpredictable snowfall causing livestock deaths. Mid-hill CCMs involve forest fires, river-flooding during monsoon, community displacement, riverbank erosion, landslides, erratic rainfall, water scarcity, prolonged drought and crop loss. In floodplains, challenges include waterlogging, health hazards, farmland loss and environmental refugees. Adaptation strategies include community-based forest management, Integrated watershed management, protection and revival of water sources, ecosystem restoration, reintroducing traditional agroforestry, land-use/livelihood diversification, highland-lowland seed/commodity exchange, and nomadic rotational pastoralism. Upscaling these practices is essential for reducing CCMs.

Funding: International Centre for Integrated Mountain Development, Kathmandu Nepal

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 16 – Poster 34: Climate change impacts on tropical ecosystems

Beyond survival: Physiological recovery of Amazonian rainforest trees following El Niño in 2023/24

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The Amazon rainforest is a complex ecological system characterized by a warm and wet tropical climate. The entire Amazon basin contributes significantly to the global carbon cycle, storing around 150-200 billion tons of carbon. However, there are early signs that Amazonia's carbon storage capacity is weakening due to intensifying droughts. Although tree responses to drought have been examined, potential legacy effects remain poorly understood and could critically determine tolerance to climatic extremes.

The 2023/24 El Niño triggered an exceptional drought in the Amazon, providing an opportunity to quantify drought responses and recovery in tropical trees. We measured hydraulic parameters related to water status, storage, and transpiration and quantified water-use conservatism and hydraulic resilience before, during, and after the drought. During the drought, trees strongly conserved water, resulting in reduced sap-flow and hydraulic conductance. Upon drought release, water potential and stem water content recovered quickly. However, water flow in emergent trees recovered only partially, despite reduced stomatal control. This suggests reduced resilience at the leaf level, likely due to lower leaf area, and that continued drought could risk xylem damage. Our findings imply that while trees protect their hydraulic systems through leaf-level adjustments during drought, ongoing droughts may increasingly compromise resilience.

Funding: Society of London Wolfson Fellowship [RSWF\211008 & DP17010409] & NERC grant [NE/W006308/1]

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 16 – Poster 35: Climate change impacts on tropical ecosystems

Climatic implications of vegetation dynamics in the Nile River basin

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Changes in vegetation dynamics can significantly influence hydro-climatic processes by altering the energy and water balances at the land surface. The Nile River Basin (NRB) has experienced shifts in vegetation structure and composition over several decades, yet the extent of its contribution to local climate variability remains unclear. This study investigates the impact of vegetation dynamics on climate and the biophysical mechanisms driving vegetation-climate feedbacks over the past 39 years (1982–2020) in the NRB using a coupled land-atmosphere global climate model (GCM) combined with long-term remote sensing data. Results reveal that approximately 37% of the basin's vegetated areas have shown a significant increase in annual-averaged Leaf Area Index (LAI). We find that 76% of the vegetated areas exhibit a negative sensitivity of land-surface air temperature to LAI increases, particularly in regions dominated by trees and shrubs. Significant LAI trends ($P \leq 0.05$) have cooled 28% of the basin's vegetated land. However, the effect of vegetation changes on precipitation patterns remains weak. Non-radiative processes emerge as the primary factor controlling climate responses to vegetation changes. These findings highlight the critical role of vegetation dynamics in shaping local climate and emphasize the need to integrate them into climate mitigation and adaptation strategies.

Funding: Alexander von Humboldt Foundation, 2023

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 16 – Poster 36: Climate change impacts on tropical ecosystems

Understanding the diversity and composition of sap-sucking communities (Auchenorryncha: Hemiptera) along an altitudinal gradient in Papua New Guinea.

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The insect communities of tropical forests are difficult to study and are only beginning to be known. This is particularly the case for forests of Papua New Guinea, where there is scarcity of datasets to quantify the diversity patterns of insects, particularly along elevational gradient. Most studies have shown that the number of species decreases with elevation due to unfavorable environmental (biotic, abiotic) conditions at high elevations. This study focuses on community parameters of Auchenorrhyncha, based on 3642 individuals from 418 species distributed among eight elevations, ranging from 200-3700m asl at 500m intervals. Adult Auchenorrhyncha were collected by sweeping forest understorey vegetation, using 10 000 sweeps per site. The species density per 10 000 sweeps and per 200 individuals decreased monotonously with increasing elevation. The similarity of adjacent communities separated by 500m band did not change with altitude. Communities were characterized into three clustered groups, based on their species composition, corresponding to low, mid and high elevation forests. Most of the Auchenorrhyncha species had narrow altitudinal ranges. Climate change is likely to cause upward range shift in insects, resulting in reorganization of insect communities. This study provides a baseline for monitoring these changes in the future.

Keywords: diversity, composition, Auchenorryncha, altitudinal gradient, Papua New Guinea

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 17 – Oral 1: Drivers of recovery in restored tropical forests

A trait-based approach for restoring tropical bracken-dominated areas

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Fire-deforested areas in the tropics are often dominated by bracken fern (*Pteridium* spp.) for a long time, hindering forest succession. Due to the abiotic and biotic characteristics of bracken-dominated areas, only some tree species are capable to overcome the bracken filters. By using a trait-based approach, we investigated which functional traits and species are likely to overcome the bracken filters and whether the predicted species are common in the forest community. We conducted a seed addition experiment with 23 common tree species. We monitored seedling recruitment, survival and growth for 36 months. We related seedling performance to their functional traits and modelled the most important filters. Eight functional traits improved tree seedling performance, showing that only a few tree species have the traits needed to overcome the bracken filters. Most of the selected traits correspond to conservative strategies, and large-seeded bird-dispersed species were the most likely to overcome the bracken filters. After applying the filters to a larger community, we found that the selected species are not common in secondary forests due to seed limitation. Our approach can be used in restoration projects throughout the tropical region to select the species with the highest probabilities of establishment in bracken-dominated areas.

Funding: German Research Foundation (DFG), grant He 3041/23-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 17 – Oral 2: Drivers of recovery in restored tropical forests

Forest transition revealed: tropical tree cover dynamics and the role of mature forests, second-growth forests and tree plantations

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Forest Transition (FT) theory postulates that countries first go through a deforestation phase, before forest cover increases through planting and natural regrowth. Yet, FT literature often overlooks variations in tree cover dynamics across forest types, regions, and climatic zones. We therefore analyzed tropical tree cover changes in eight 20-20 km regions across four tropical countries. To decsribe tree cover dynamics we combined Landsat data from 1990 to 2020 with land cover data (i.e., mature forest, second-growth forest, plantations). Our findings showed that Ghana and Mexico were in early and late forest transition (pre-inflection), while Brazil and Australia were in post-transition (post-inflection). Between 1990 and 2020, half of mature forest (MF) cover was lost. In 2020, second-growth forests (SF) and tree plantations contributed 23% and 12% to the total tree cover, respectively. SF cover increased steadily but lasted only 10 years on average, which limits biodiversity and climate benefits. MF cover was lower in dry regions (from 55% to 23%) than in wet regions (from 73% to 35%), although SF gains were higher in dry areas. Our study indeed confirms that distinguishing tree cover types, assessing SF persistence and considering climatic variations are crucial for assessing forest restoration and reforestation efforts.

Funding: FAPESP, grant 18416-2; NWO, grant 17418; European Research Council, grant 834775; Wageningen University graduate school Production Ecology and Resource Conservation; NWO, grant 86315017; DGAPA-PAPIIT, grant IN217620.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 17 – Oral 3: Drivers of recovery in restored tropical forests

Canopy cover not tree richness influences predator ant recovery in young plantations

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The influence of variables controlling arthropod community recovery has only partially been investigated, and integrated taxonomic and functional information can be used to gain a more sophisticated understanding.

Here, by analyzing ant taxonomic and trait data collected in a subtropical tree diversity experiment in China (BEF-China), we tested for the effect of experimentally-manipulated tree species richness on ant community recovery. Based on the habitat heterogeneity hypothesis, we expected that plantations with more tree species have ant communities that more closely resemble those found in secondary forests. This relationship may be facilitated by tree productivity, assuming that more productive plantations may be structurally more similar to secondary forests.

Contrary to expectations, no relationship between tree species richness and ant variables was found. Instead, a profound community shift depending on canopy cover as a proxy for productivity was observed. Litter ant prevalence increased with canopy cover. This was accompanied by relatively more predator ants that converged towards young stands in a nearby secondary forest, and an increase in functional traits that hint a predatory lifestyle.

We conclude that in young tree plantations productivity overrides heterogeneity to recover predator ants. This may enhance ant-mediated ecosystem functions like predation and scavenging.

Funding: DFG, project FOR 5281

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 17 – Oral 4: Drivers of recovery in restored tropical forests

Primary and secondary forest cover promote frugivory in a restored tropical landscape

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Forest restoration is a crucial activity for the conservation and regeneration of native tropical forests. Two primary strategies are commonly employed: assisted and passive natural regeneration. While these approaches often emphasize recovering species diversity, they sometimes overlook the broader objective of restoring ecosystem functions and biotic interactions. In this study, we investigated how frugivore interactions vary across a landscape undergoing assisted and passive restoration in the Buenaventura Reserve, El Oro, Ecuador. Using geographic information systems and experimental dummy fruits, we assessed how factors such as restoration strategy, elevation, landscape composition, and fruit size influenced the frequency of frugivory-related attacks on the dummy fruits. Our findings indicate that, beyond the type of restoration strategy implemented, forest cover and secondary forest cover explain the observed variation in attack frequency. Since secondary forest cover enhances frugivore activity and is a direct outcome of both assisted and passive restoration efforts, both strategies contribute to the recovery of frugivory dynamics. Notably, most attacks were attributed to birds, suggesting that highly mobile frugivores play a key role in frugivore activity within restored landscapes. These findings emphasize that restoring native forests helps maintain the ecological services provided by frugivores.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 17 – Oral 5: Drivers of recovery in restored tropical forests

Matching of restoration strategy to soil and other environmental conditions matters for forest landscape restoration: evidence from Ethiopia

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Matching restoration strategies to environmental conditions is crucial for forest landscape restoration success. This study evaluates the performance of restoration strategies in Ethiopia under various environmental conditions, including soil, elevation, and climate. We hypothesized that fertile sites with favorable climates would yield better results. Using soil samples (0-10 cm depth) from 279 points across southern and central Ethiopia, along with precipitation and temperature data from WorldClim, we conducted cluster analyses and identified four unique environmental clusters. We compared stand-level performance within each cluster to find the best-performing strategies. Cluster 1 represented high clay and precipitation, cluster 2: sandy and bulky soils, cluster 3: fertile soils with high cation concentrations, and cluster 4: high organic matter soils. Comparative results show that active strategies outperform exclosures across all clusters, with fertile clusters being particularly favorable for young stands. Carbon sequestration consistently increased with age in plantations. These findings have important implications for restoration planning, and monitoring as we show that strategies vary in performance depending on the environmental cluster under which they are implemented. They also have policy implications, emphasizing the need to include non-forest restoration strategies like boundary plantings in forest policy and management due to their role in productivity-related goals.

Funding: Thünen Institute, FLESRA project

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 17 – Oral 6: Drivers of recovery in restored tropical forests

Evaluating ecological recovery: A comparative study of active and passive restoration strategies

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To optimize tropical forest restoration, it is essential to understand how active restoration and natural regeneration contribute to the recovery of native forests. Evidence on the effectiveness of both strategies is mixed, as each contributes to vegetation restoration in different ways and could be complementary. For this reason, in this study, we evaluated how plant richness and biomass vary in a tropical cloud forest in Ecuador, where restoration strategies combine both approaches along a chronosequence. Our results indicate that plant richness in restored forests is higher in areas with longer restoration periods and at lower elevations, rather than being influenced by the strategy implemented. While plant richness is greater in active restoration during the initial stages, over time, both active and passive restoration reach similar plant richness. This suggests that age and environmental changes in elevation are key factors explaining the variation in plant community richness Moreover, we observed that both restoration strategies lead to similar plant communities, with some sites achieving a composition similar to primary forest, especially in older areas. This highlights that restoration age is a key factor in the recovery of tropical forests, showing that both restoration strategies contribute significantly to this process.

Funding: Funded as a Research Unit (FOR 5207) by the Deutsche Forschungsgemeinschaft (DFG), Uniscientia Stiftung

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 17 – Poster 37: Drivers of recovery in restored tropical forests

The role of bracken fronds and litter on the performance of tree species: facilitative or competitive effects?

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Tropical montane forests are diverse ecosystems increasingly threatened by land-use change and fires. After fire, bracken fern (*Pteridium*) commonly dominates the landscape, hindering forest succession. We evaluated the facilitative and competitive role of bracken components: fronds and litter, on seedling establishment, recruitment success, and growth, and how these effects vary in relation to seed size. We conducted a seed addition and a seedling transplant experiment across eight bracken-dominated areas, following four treatments: (a) fronds and litter intact, (b) fronds intact, litter removed, (c) fronds removed, litter intact, and (d) fronds and litter removed. A total of 46,640 seeds from 24 species were sown, and 1,070 seedlings transplanted. After 36 months, our results show that fronds facilitate seedling establishment, recruitment, and growth across all seed size categories, while litter negatively affected small-seeded species, particularly during establishment, and had a neutral to beneficial effect on medium- and large-seeded species. Litter also negatively affected the growth of small- and medium-seeded species, indicating that litter acts as both a physical barrier and a light-limiting factor. These findings suggest that restoration strategies in bracken-dominated areas should prioritize medium- and large-seeded, shade-tolerant species, and that planting soon after fire, before litter accumulation, could enhance tree establishment.

Funding: German Research Foundation DFG, project He 3041/23–1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 17 – Poster 38: Drivers of recovery in restored tropical forests

Understory bird and dung beetle community responses to artisanal small-scale gold mining

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Artisanal small-scale gold mining is a major driver of environmental change in the Northern Amazon, yet little is known about its impact on biodiversity or the potential for ecological recovery after mines are abandoned. We quantified understory bird and dung beetle assemblages in 16 abandoned gold mines at varying stages of recovery. We sampled three locations at each mine: mine centre, mine-forest edge, and 100m into the forest. Mist nets were used for bird surveys, and pitfall traps for dung beetles. Results showed that both bird and dung beetle communities were affected by mining, but in different ways. Dung beetles had lowered overall richness, whereas birds displayed a turnover in species composition with an influx of generalist species, alongside a reduced richness of forest-dependent species. Across the mining landscape, birds were not affected 100m into the forest from the mine edge, whereas dung beetles were. We additionally show that a lack of canopy cover was a key factor influencing both taxa. While bird communities showed signs of recovery following abandonment, dung beetles showed no signs of recovery even after 20 years. These findings highlight that, despite two decades of natural regeneration, biodiversity recovery in mining areas remains limited.

Funding: Natural Environment Research Council and the ARIES Doctoral Training Partnership [grant number NE/S007334/1] and Birds on the brink grant.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 17 – Poster 39: Drivers of recovery in restored tropical forests

Long-term dynamics of diversity-interaction network relationships in a controlled forest tree diversity experiment

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Plant diversity influences food web structure via bottom-up effects that propagate across trophic interactions, affecting associated ecosystem functions. Yet, little is known about how diversity effects shape interaction networks through time, as plant communities undergo succession. Most studies concerning the relationship between plant diversity and trophic networks lack a temporal framework, while time-series food web studies tend to focus on co-occurrence data, missing empirical quantitative interaction records. We investigated temporal dynamics of diversity-interaction network structure relationships using a long-term, highly resolved quantitative multi-trophic interaction dataset from the largest controlled forest tree diversity experiment worldwide. We studied host-parasitoid interaction networks of cavity-nesting bees, wasps, and natural enemies along a tree richness gradient in subtropical South-East China over the span of twelve years (2011-2023). We found that interaction networks increased in complexity across the tree species richness gradient and over time. Tree diversity was less important than canopy closure in early years of forest establishment, but its effect increased over time as the forest matured, and had a stabilizing effect on the networks. Our results highlight how plant diversity shapes food web recovery over time, underscoring its importance in designing restoration strategies that foster resilient and functional ecosystems in the long run.

Funding: Deutsche Forschungsgemeinshaft (DFG)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 17 – Poster 40: Drivers of recovery in restored tropical forests

Early tree survival in a restoration experiment is influenced by plant functional traits and tree diversity

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Combining trees and farming, agroforestry can contribute to ecosystem restoration on degraded lands. To study the effects of tree diversity and tree spacing in agroforestry on biodiversity and ecosystem functions, we established the SAVA-Biodiversity Enrichment Experiment (SAVA-BEE). The experiment is located in the humid tropical SAVA region in north-eastern Madagascar, a global biodiversity hotspot. Before establishment, the vegetation was primarily degraded grassland (*Imperata cylindrica*) mixed with traveller palms (*Ravenalla* sp.) and woody plants. On a total of 45 plots with a size of 40 m x 40 m each, one to six native tree species in spacings between 8 x 8 m to 2 x 2 m were planted. Agricultural crops include vanilla, pepper, cacao, coffee, banana, pineapple and watermelon. One year after planting, the average tree survival rate was 75%, ranging from 20% to 100% per plot. A logistic model revealed that the probability of individual tree survival was significantly associated with former vegetation type, specific leaf area, leaf C- and N-content as well as planted tree diversity where mixtures outperformed monocultures. We therefore conclude, that on a given degraded land, tree species selection as well as tree diversity are important factors for successful agroforestry establishment in restoration efforts.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 18 – Oral 1: Ecosystem resilience to altered fire regimes

Vegetation evenness predates ecosystem tipping point linked to high fire activity in East Africa over the past 16 000 years

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Fire plays a key role in tropical ecosystems, especially in fire-prone environments like savannas and Miombo woodlands, which rely on frequent burning for their functioning and biodiversity. Despite its significance, high resolution data on how fire regimes influence vegetation changes over extended periods are rare in tropical Africa, limiting the ability to predict future shifts in ecosystem structure and composition. This study aims to address this gap by examining fire activity over the last 16,000 years at Lake Masoko, SW Tanzania, through high-resolution sedimentary charcoal analysis, and correlating it with pollen-based vegetation reconstructions. Two major tipping points were identified. First, 12,000 years ago, a shift from tropical forest to Miombo woodland was associated with increased biomass burning, likely climate-driven by increased seasonality despite high rainfall during the African Humid Period. Second, 1,500 years ago Miombo woodland transitioned into a more open savanna associated with high biomass burning activity and coinciding with a period marked by Early Iron Age artifacts. Both transitions were preceded by peaks in evenness and declines in pollen richness, signaling critical ecosystem shifts. Understanding these past dynamics helps anticipate how future changes in fire activity may alter tropical ecosystems, particularly in the face of increasing human influence and climate variability.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 18 – Oral 2: Ecosystem resilience to altered fire regimes

Spatio-temporal analysis of fire hotspots to assess ecological vulnerability of forest cover in Tolima, Colombia

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Forest ecosystems in the tropics have been affected in their floristic composition, structure and ecosystem function by disturbances such as fire. The department of Tolima, Colombia, is a clear example of the occurrence of such events where extreme temperature changes affect the forest cover. Therefore, this study aimed to create a wildfire risk overview to assess the ecological vulnerability of forest ecosystems based on the analysis of vegetation cover from satellite images and hot spots, captured by two types of satellite sensors (VIIRS and MODIS) in a time series (2016-2023). Open data from *Corine Land Cover* were used to identify 13 types of forest cover, then the raster image was reclassified for three types of forest fire risk (susceptibility of the type of cover, burning time of the cover and total load of combustible biomass) which through algebraic calculation obtained an image of total susceptibility of the vegetation, This outcome was reclassified according to the IDEAM (*the Institute of Hydrology, Meteorology and Environmental Studies*) risk protocol to identify the areas with the greatest ecological vulnerability. Finally, the map obtained was compared with the analysis of hot spots estimated by *Kernel density* where the ecological areas most susceptible to damage by forest fires were determined.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 18 – Oral 3: Ecosystem resilience to altered fire regimes

Lightning-ignited fires in the Brazilian Amazon

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The Amazon rainforest is of critical importance for preserving biodiversity and regulating climate. However, deforestation, droughts and fires, threaten the functioning and integrity of these rainforests. It is often assumed that all fires in the Amazon have a human origin, ignoring the possible role of lightning-ignited fires. Here, we combined remotely sensed active fire detections, a published dataset of individual fire events, and the Global Lightning Dataset (GLD360) to match fire ignitions to recent cloud-to-ground lightning strikes using temporal and spatial probabilities of overlap. We estimated that in the Brazilian Amazon, approximately 7% of all fires and 6% of the burned area between 2019 and 2023 were caused by lightning. In addition, we found that lightning-ignited fires on average start later in the dry season compared to human fires. Lightning fires are spatially concentrated in the western Amazon, and near the tributaries of the Amazon river. We provide the first spatiotemporal quantification of lightning fires in the Amazon rainforest. While lightning fires currently represent a minority of all fires in the Amazon, they may gain importance in the future as regions within the rainforest are becoming drier due to climate and land use changes.

Funding: China Scholarship Council

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 18 – Oral 4: Ecosystem resilience to altered fire regimes

Fire resistance in Amazonian wet and seasonally dry tropical forests

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As fire disturbances increase in frequency and intensity across the Amazon due to climate change and land-use shifts, the long-term impact on its forests remains uncertain. While seasonally dry tropical forests may show some evolutionary adaptation to fire, wet tropical forests are historically fire-free and thus not likely to have developed resilience to such disturbances. Here, we investigate how fire resistance differs between dry and wet tropical forests in the Bolivian Amazon, hypothesizing that seasonally dry forests will show higher survival rates, as explained by traits like bark thickness and tree height. Using 146 permanent forest plots (20x20m), spread across burned and unburned plots in seasonally dry (1300 mm/y) and wet (2300 mm/y) forests, we test how functional traits interact with fire intensity in these ecosystems. Our findings inform how tropical forest resilience to fire may vary under changing environmental conditions. Although traits like bark thickness and tree height play a role, our findings also suggest that these traits alone do not fully explain the observed patterns of fire resilience, indicating the need for a more integrated approach to understanding functional traits in tropical forest resilience.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 18 – Oral 5: Ecosystem resilience to altered fire regimes

Post-fire recolonization of dry deciduous forests by lemurs in northwestern Madagascar

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Wildfires pose a significant threat to biodiversity, particularly in tropical regions like Madagascar, where unique ecosystems are experiencing continuous habitat loss, fragmentation, and degradation. This study assessed the impact of forest fires on lemur abundance and their potential and latency to recolonize burnt vegetation in Ankarafantsika National Park (ANP), the largest protected dry deciduous forest of northwestern Madagascar. ANP hosts eight lemur species including one diurnal (*Propithecus coquereli*), two cathemeral (*Eulemur* spp.), and five nocturnal species of the genera *Avahi, Lepilemur, Cheirogaleus*, and *Microcebus*. We surveyed 18 sites with varying fire histories (1 to >35 years post-fire) using diurnal and nocturnal distance sampling. Transects covered both burnt (700 m) and unburnt (500 m) sections. Abundances and species richness were modelled using GLMMs whenever possible. A complete lemur community was observed only in areas with long post-fire recovery (>23 years). Species richness was higher in unburnt zones and areas with fewer than three fires. Fires negatively influenced the abundance of large and medium-sized lemurs, while smaller nocturnal species were more resilient. These results provide valuable insights into fire-induced dynamics of lemur communities and species-specific responses to fire as a major driver of landscape transformation.

Funding: Kreditanstalt für Wiederaufbau (KfW), Madagascar National Parks (MNP), Kölner Zoo

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 18 – Oral 6: Ecosystem resilience to altered fire regimes

Assessing fire risk and land use impacts for the preservation of indigenous sacred landscapes in Santa Marta

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Effective fire management strategies can significantly mitigate the impact of forest fires, particularly in regions where environmental, cultural, and socioeconomic factors intersect. This study examines fire probabilities in the Santa Marta region from 2014 to 2023, employing the Random Forest model with MODIS fire data to assess the effects of climate, topography, vegetation, and land use variables on fire occurrences. Key factors analysed include slope, elevation, curvature, flow accumulation, the Normalized Hotspot Index (NHI), land cover changes from 2014-2023, and bioclimatic metrics such as annual precipitation and precipitation of the driest quarter.

The Random Forest model outperformed Multiple Linear Regression in predictive accuracy, with residual analysis affirming its superior performance, underscoring the model's suitability for broad-scale fire risk assessment. Results highlight critical fire-prone areas and influential environmental drivers, providing crucial insights for culturally attuned fire management. This is particularly relevant in Santa Marta, where the *Línea Negra*—a network of sacred sites around the Sierra Nevada—holds profound significance for indigenous communities, supporting cultural, environmental, and cosmic balance. By identifying high-risk zones and projecting fire probabilities, this study advances strategies that not only protect ecological assets but also honour and preserve sacred indigenous landscapes, offering a comprehensive foundation for targeted fire management in the region.

Keywords: Fire risk, prediction, modeling, Land Use, Human Impact, Indigenous Heritage

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 18 – Poster 23: Ecosystem resilience to altered fire regimes

Public information seeking, place-based risk messaging and wildfire preparedness in Ghana

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Research highlights that effective communication of risk increases public awareness and influences information use and action during disasters. This study explores how geographically specific threat indices can be incorporated into public information dissemination, focusing on wildfire preparedness in Ghana. Using primary data from 500 households in Ghana's transition landscape, the research was part of a broader initiative to create a wildfire threat forecasting tool for fire volunteers and the public. The results demonstrate a link between residents' wildfire knowledge, experience, readiness actions, and their preferred media channels for receiving information. Frequency, means tests, and correlations show that community information centers are the most frequently used sources for both daily news and wildfire information, with most respondents intending to use the same sources in future wildfires. Wildfire knowledge, past experiences, and preparedness actions significantly impact the number of information sources people rely on. Notably, there are regional variations in information-seeking behavior, with rural residents primarily depending on radio and personal networks, such as friends and family, for wildfire updates. The findings suggest that while reliable sources may not always provide the latest information, a multimodal, two-way communication approach, complemented by one-way sources like television, is most effective.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 18 – Poster 24: Ecosystem resilience to altered fire regimes

Detection wildfire dynamics using satellite remote sensing technologies

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Wildfires have been recognized as an imminent threat with biological, ecological, and environmental ramifications. The overwhelming majority of wildfires begin via both nature and human beings. The size and intensity of fire depend on factors such as climate, elevation, topography, type of fuel, and source of ignition. Climate change would exacerbate the risk of wildfires due to prolonged drought periods and high winds. Despite the multiple benefits of the forests in terms of their economics and other ecosystem services, the forest landscape is threatened by wildfires. There is little information regarding wildfires, and available data is too general. This study creates a burn severity map for the assessment of the areas affected by wildfires. This study used the Landsat five satellite images on Google Earth Engine (GEE), Quantum Geographic Information System (QGIS) platform for calculation of bands and vegetation indices namely NBR, NDVI, dNBR, dNDVI, RBR, RdNBR, GDVI dGDVI, and BAI. Using near-infrared (NIR) and shortwave-infrared (SWIR) wavelengths, it shows the burned areas and burn severity of Ghana's forest and transition landscape. According to the evaluation, thirty-two percent of forest fires are classified as moderate, low, high, or higher severity, while thirty-two percent are classified as low severity and remain unburned. It shows how fire is significantly on the rise in the transitional landscape. Generally speaking, the new method for assessing the severity of wildfires at higher elevations and identifying their locations has taken less time and money. Important stakeholders, communities, and decision-makers can make educated decisions with the use of such useful information.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 19.1 – Oral 1: Succession and restoration of tropical forests

Tropical forest succession: theory, a conceptual framework, and a cross-site analysis

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Tropical forest disappear rapidly because of conversion to agriculture, but they also have the ability to regrow on abandoned agricultural fields during secondary succession. To advance the successional field, we first summarize 100 years of successional theories, then present a conceptual framework to analyze drivers and mechanisms of forest succession, and apply the framework to five dry and wet forest sites in Australia, Ghana, and Mexico, to assess commonalities and differences in succession. In terms of commonalities, we found that species performance is central to early succession because it fuels community assembly, productivity and vegetation dynamics. Early succession on abandoned agricultural fields is most strongly driven by the effects of previous and current land use intensity. In terms of differences, we found that in dry areas water and current land use intensity are relatively important for succession. In contrast, in wet areas seed plants and biotic dispersal are more important as they underly species arrival. We conclude that the conceptual framework is a useful tool to identify the key drivers and mechanisms for succession at a given site and allows therefore to come up with site-specific solutions for ecosystem restoration.

Funding: This research is supported by European Research Council Advanced Grant PANTROP (nr 834775) to LP.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.1 – Oral 2: Succession and restoration of tropical forests

Forest ecological succession and restoration along an elevation gradient in Papua New Guinea.

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Tropical forest landscapes are changing at an unprecedented rate due to increasing growth in population and economies. In a healthy landscape, the disturbed forest undergoes natural secondary succession, leading to secondary and then primary forest vegetation. We survey and monitor such successional regrowth of vegetation within a 30m wide and 292km long corridor for an underground pipeline, cleared in a continuous primary forest between 0 and 2,800m asl. in Papua New Guinea. We monitored successional trends in 63 vegetation plots, 0.1 ha each in 2-year intervals for 10 years, from 2015-2023. The succession progressed at the annual rate of 3 new tree species and 13 new stems (DBH≥5cm) per plot, increasing basal area by 0.3m^2. The fastest successional increase was observed at 0-1,200m, also for species richness, at 800-1,200m asl. for tree stems and at 500-1,200m for basal area. Ground plant cover decreased linearly with elevation in early succession but has become independent from elevation after 5 years of succession. The canopy is closed after 10 years at low and middle elevations but decreases linearly to zero above 2,000m asl. We have shown large difference in the rate of secondary succession along a long rainforest elevation gradient which should be taken into account in rainforest restoration plans.

Keywords: tropical forest, secondary forest, ecological succession, forest disturbance and restoration, community composition, elevation, Papua New Guinea

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.1 – Oral 3: Succession and restoration of tropical forests

Using functional traits to maximize restoration success in tropical forests

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Tropical forests are hotspots of global biodiversity, but are highly threatened by human activities. The restoration of degraded forest is thus key to maintain diverse tropical forest ecosystems. Despite the vast efforts to restore tropical forests, we know only little on how we can optimize active and passive restoration success. In this talk, we will present some of the research we have been conducting in the past years in the tropical Andes of Southern Ecuador, where we studied how seed traits and environmental conditions shape forest restoration potential across land use gradients. Specifically, we investigated experimentally how abiotic and biotic filters affect seed rain and seedling recruitment in natural and degraded forests. We found that natural seed rain was generally high in degraded forest, but species composition differed greatly to natural forests, with a lack of large-seeded and animal-dispersed species in degraded habitats. Seedling recruitment was mediated by the interacting effects of seed size and abiotic and biotic filters, and was limited by the harsh abiotic conditions in degraded forests. Overall, our studies emphasize that selecting species for restoration should be based on traits and their interactions with the abiotic and biotic environment which would help to maximize forest restoration success in tropical forest ecosystems.

Funding: DFG (German Research Foundation), RESPECT project (FOR2730)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.1 – Oral 4: Succession and restoration of tropical forests

Between pasture and canopy: Diverse dependencies of tropical pollinators on old forests reveal contrasting patterns of resistance and resilience

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Tropical forests account for most of the global Biodiversity Hotspots and are among the last enclaves of complex insect communities, but their dependence on pristine, vertically stratified forests and the rules that underlie the colonization and usage of the canopy are poorly understood. We thus sampled a diverse range of pollinators in order to assess the speed of their recovery trajectories and canopy usage through a trait-based perspective. Within the REASSEMBLY chronosequence in the endangered Ecuadorian Chocó, we sampled 62 plots spanning active disturbances, secondary and old-growth forests. Recovery patterns varied: moths, stingless bees, and nocturnal bees showed increased canopy diversity and abundance, independent of forest legacy. Canopy species were smaller, slower flyers, and short-tongued, suggesting that structural (vegetation clutter, light) and resource-related (floral availability, nesting sites) factors influence canopy use. Conversely, the long-tongued orchid bees avoided the upper stratum, and soil-nesting diurnal halictid bees were associated with disturbances. These findings suggest that responses to forest regeneration are not unimodal and shaped by species-specific traits. Nonetheless, structurally complex forests, including secondary forests, are critical for supporting pollinator diversity, underlining the success of passive regeneration as a measure to mitigate biodiversity loss and ensure the reassembly of insect communities over time.

Funding: Deutsche Forschungsgemeinschaft (FOR 5207)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.1 – Oral 5: Succession and restoration of tropical forests

Trajectories of above-ground biomass and diversity recovery in secondary forests of the Tshopo province, DRC

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Tropical forests are threatened by deforestation and degradation mainly caused by the expansion of agriculture onto forest land. Once the land's fertility is exhausted, these areas are abandoned and left to be reforested through natural succession. This study aims to assess the trajectories of above-ground biomass (AGB) and diversity recovery in secondary forest of the Tshopo province and identify factors that influence recovery rate. 80 plots of 0.25 ha were installed in secondary forests aged 5 to 60 years and 27 in old-growth forest. In a Bayesian framework, we modelled the recovery trajectories of AGB, diversity and composition, and tested the influence of local variability on recovery rate, including the distance from large city, remnant trees, number of rotations and pioneer species. Results show that recovery rate of diversity and AGB is faster than that of composition. AGB of plots located far from large cities recover faster than those close to them. Number of rotations and installation of some pioneer species like *Musanga cecropioides* have a negative influence on the diversity recovery rate. Remnant trees positively influence recovery rate of diversity and composition. These results are of extreme importance to guide forest management, conservation and reforestation strategies in the province.

Funding: Agence belge de développement (Enabel), Programme de renforcement des capacités organisationnelles par l'octroi des bourses (PRECOB)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.1 – Oral 6: Succession and restoration of tropical forests

Growth form replacement during early tropical forest succession: Drivers and mechanisms

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Secondary succession after agricultural land abandonment in human modified landscapes is the result of social-ecological processes and can be highly unpredictable. Understanding the drivers of plant growth form replacement in the first phase of succession, the phase where the successional pathway is defined, incorporating social-ecological variables in a landscape context can shed light on the course and speed of succession. Therefore, we analysed how plant growth form replacement at the initial phase of succession is driven by soil characteristics, previous land use history, landscape forest cover and climate across dry and wet tropical forests at three continents. Vegetation line transects were performed 2 to 4 subsequent years, soil samples were analysed, interviews were conducted, and landscape forest cover was defined with satellite images for the in total 103 plots in Mexico, Ghana and Australia. The results of the linear mixed models indicate that soil characteristics, previous land use history, landscape forest cover and seasonality in temperature and moisture influence the vegetation cover and biomass change in grasses, herbs and trees during the early phase of succession. These results underline that succession is a process influenced by previous management practices and ecological factors, and both should be included in restoration planning.

Funding: This research is supported by European Research Council Advanced Grant PANTROP (nr 834775) to Lourens Poorter.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.2 – Oral 1: Succession and restoration of tropical forests

Drivers and mechanisms of ecosystem multifunctionality in secondary tropical forests

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Global change strongly modifies environmental conditions and disturbance regimes, leading to widespread loss of vegetation and ecosystem functioning. Yet, ecosystems can recover naturally through secondary succession. Here, we assessed how environmental conditions and forest attributes determine ecosystem functioning in young secondary tropical forests. We compared 36 young secondary forest stands that differed in the time since agricultural land abandonment (2.3–3.6 years) from dry and wet regions in Ghana and quantified 16 ecosystem functions related to carbon, water, and nutrient cycling. We used structural equation models to evaluate how macroclimate, soil physical properties and nutrients, and forest attributes (structure, diversity, and functional composition) affect ecosystem functioning. Climatic wetness most strongly influenced ecosystem functions (12 functions), followed by forest structure (9 functions) and soil physical properties (7 functions), with lesser influence from taxonomic diversity (6 functions), functional composition (4 functions), and soil nutrients (3 functions). This indicates the greater role of environmental conditions and vegetation quantity over vegetation quality. While climatic wetness influenced ecosystem functions across three cycles, carbon functions were additionally shaped by all forest attributes, water functions by soil conditions, and nutrient functions by soil conditions and forest structure, indicating that multiple drivers and mechanisms together shape ecosystem multifunctionality.

Funding: the European Research Council Advanced Grant PANTROP 834775

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.2 – Oral 2: Succession and restoration of tropical forests

Impacts of climate on regrowth trajectories of Afrotropical forests

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Tropical forests are experiencing rapid conversion due to increasing land-use change, crucially impacting global carbon sequestration, water cycling, and biodiversity conservation. In Africa, slash-and-burn agriculture remains the primary driver of forest disturbances, a trend set to worsen with the predicted tripling of the population by 2100. Natural regrowth forests globally now cover a larger area than primary forests, making the effective management of secondary forests essential for mitigating the effects of land-use change and guiding restoration efforts.

Despite their vast extent, the recovery of Afrotropical secondary forests is poorly understood. This study is the first to compile ground-based measurements of aboveground carbon (AGC) stocks across 600+ sites in 13 African countries, spanning diverse climatic zones. We quantified AGC recovery trajectories in a Bayesian framework, showing that recovery to 75% of old-growth AGC stocks can take decades to centuries, driven primarily by regional climate factors. These findings allow us to produce the first African map of potential secondary forest recovery rates.

By offering a comprehensive framework for AGC recovery in Afrotropical secondary forests, this research addresses key knowledge gaps and informs both management practices and the improvement of global vegetation models that have historically lacked sufficient data from Africa.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.2 – Oral 3: Succession and restoration of tropical forests

Drivers of ant and termite alate distributions during nuptial flights along a tropical forest recovery gradient

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Tropical forests face many threats such as deforestation and climate change. As many reassembly processes take time, research on forest recovery can be challenging and requires long-term experiments. Chronosequences, or space for time substitutions, can help to overcome these challenges. So far, little is known about potential dispersal limitations of tropical social insects especially under anthropogenic influence. We investigated the distribution of flying ant and termite sexuals along a forest recovery gradient ranging from pastures and cacao plantations to naturally regenerating forests of different ages and old-growth forests, in a lowland tropical rainforest in northern Ecuador. We collected flying insects with light traps and identified dispersing sexuals of ant and termite species using metabarcoding. We explore how species diversity and composition change along the chronosequence in comparison to workers from established nests. Our results show that species richness and alpha-diversity of flying ants do not change along the chronosequence whereas termite species richness increases towards old-growth forest. Beta-diversity was highest within old-growth for both taxa. Based on our results we explore potential dispersal limitations and habitat filtering due to anthropogenic disturbances that already apply during nuptial flights before potential colony foundation.

Funding: Deutsche Forschungsgemeinschaft (DFG) funded Research Unit REASSEMBLY FOR 5207, sub-project SP7, with grants FE631/13-1 and MU3621/10-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.2 – Oral 4: Succession and restoration of tropical forests

Perturbation- recovery experiment (PREX) along a tropical chronosequence in the Ecuadorian Choco-forest

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Nowadays 60% of the tropical forests are considered secondary forests due to deforestation, followed by natural regrowth on the abandoned land. This recovery is modulated by abiotic conditions such as light availability, landscape heterogeneity and land-use legacy, and by biotic conditions, as species interactions. Experimental re-disturbance can contribute to understanding the contribution of (a)biotic conditions on natural recovery. We therefore conducted a perturbation experiment along a chronosequence of 32 recovering plots. The plots had recovered from cattle pasture or cacao plantation for 0 – 37 years. We implemented a full-factorial design to test the influence of (1) removal of seedlings and leaf litter and (2) the exclusion of terrestrial mammals on the tree seedling communities.

We predict that mammal exclusion will enhance tree seedling recovery in older forests, due to protection from trampling and herbivory, while perturbation of the first soil layer will decrease establishment of seedling. Furthermore, we expect the tree seedling community to recover more quickly on cacao plantations compared to pastures, particularly in younger stages, where pastures are dominated by invasive grasses that hinder seedling growth.

Our study sheds light on the mechanisms of forest succession and the resilience of recovering forests, providing insights for post-disturbance conservation strategies.

Funding: Funded as a Research Unit (FOR 5207) by the Deutsche Forschungsgemeinschaft (DFG)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.2 – Oral 5: Succession and restoration of tropical forests

Impacts of selective logging on structure, species taxonomic and functional diversity of East African tropical rainforest: Recovery of Budongo forest reserve, Uganda

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While the short-term impacts of logging on tree diversity and forest structure are well studied, the long-term impacts remain unclear. We therefore aimed to assess how selective logging impacts dynamics of residual forest structure, tree species, and functional diversity of East African tropical rainforests, with Budongo central forest reserve in Uganda as a case study. We hypothesised that selective logging demotes species diversity and intricates forest structure by decreasing large tree abundance, enhancing recruitment and tree density, which ultimately elevates vertical stratification and structural complexity. We surveyed 300 plots in three selectively logged compartments (100 each) along time-since-logging gradient (30, 50, and 70 years ago). We additionally surveyed 100 more plots from an unlogged-old-growth compartment. Our preliminary results demonstrated higher taxonomic diversity in logged than unlogged compartments and decreased with time-since-logging. The results also revealed significant forest structure variations within and between compartments. We will present more findings on the relationship between taxonomic and functional diversity along time-since-logging gradient and how logging drives forest structural variabilities. Our end goal is to ascertain whether selectively logged East African rainforests can recover on a trajectory that sustains ecosystem structure and biodiversity akin to that of old-growth or pursuing a whole divergent course.

Funding: The Federal Ministry of Food and Agriculture (BMEL), Germany, project (NA)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19.2 – Oral 6: Succession and restoration of tropical forests

The pioneer's paradox: how pioneer species balance drought tolerance and fast growth during early tropical forest succession

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Due to conversion to agriculture, tropical forests worldwide are transforming into dynamic, regenerating systems. Here pioneer tree species play a crucial role, particularly in enduring harsh post-disturbance conditions. This study assessed survival and growth strategies of pioneer species in young tropical forests, focusing on functional traits related to drought tolerance and gas exchange. We collected data on 12 functional traits for 30 pioneer species from dry and wet forest in Ghana. We tested differences between forest types (dry vs wet) and leaf habits (deciduous vs evergreen) using two-way ANOVA, and assessed trait coordination using Principal Component Analysis. Dry species showed higher drought tolerance and leaf nutrient concentrations, whereas wet species had faster gas exchange and tougher leaves. Deciduous and evergreen species generally had similar trait values. Furthermore, we found two trait trade-offs: between drought tolerance and gas exchange, and between leaf structure and leaf nutrients. Based on this, pioneer species can be divided into four strategic groups: (1) tolerant and tough, (2) fast and tough, (3) tolerant and nutrient rich, and (4) fast and nutrient rich. Our results show that tropical pioneer species have different strategies to balance survival and growth, influenced primarily by forest type rather than leaf habit.

Funding: This research is supported by European Research Council Advanced Grant PANTROP (no 834775) to Lourens Poorter.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19 – Poster 53: Succession and restoration of tropical forests

Exceptional dryness affects the internal clock of Amazonian bamboos

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In a typical life cycle of a bamboo, there is a several years long period of growth after which the individual flowers simultaneously with thousands of other neighbouring individuals. Additionally, all these individuals die after shedding their fruits. The prevailing evolutionary explanation of this gregarious semelparity is that the production of large quantities of fruits in intervals of several years makes it practically impossible for seed predators to increase their population sizes so big that they would be able to destroy the bamboo reproduction. We tested this explanation with field and remotely sensed data from southwestern Amazonia where *Guadua* bamboo dominate about 180,000 km^2 of rain forest. Our results show that this explanation cannot hold because the bamboos of any given locality do not flower all simultaneously. The trigger that can change the flowering year of a bamboo is an exceptionally dry year and those years have occurred very rarely.

Funding: Research Council of Finland, project 296406

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19 – Poster 54: Succession and restoration of tropical forests

Overstory-understory relationships of a Ugandan rainforest suggest declining tree diversity and shifting composition.

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Long-term studies of forest dynamics show changing compositions in tropical forests. Whether such compositional shifts hold in several Afrotropical forests remains largely unknown. With no long-term data on forest change, overstory-understory relationships constitute a suitable framework for investigating the potential for change in forest composition. Using forest inventory data covering 40.6 ha within Budongo Forest Reserve Uganda, we examined tree overstory-understory relationships to test the hypothesis that tree species diversity and composition differ between the canopy and seedling layers, indicating shifting composition. We found a strong uncoupling between the overstory and regeneration layer. Species diversity and richness were significantly higher in the overstory than in the regeneration layer. Tree species composition showed significant separation between forest overstory and regeneration layers. Some dominant adult trees were rarely represented as seedlings in the regeneration layer. In contrast, other species had many seedlings in the understory despite their low frequencies as adults in the overstory. Other species were well represented as adults in the canopy and seedlings. Overall, our results suggest that tree species richness in Budongo Forest appears to be declining and that there is a high potential for a shift in forest composition.

Funding: German Federal Office for Agriculture and Food, grant No. FKZ:28105701.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 19 – Poster 55: Succession and restoration of tropical forests

Bird perches and artificial bat roosts increase seed rain and seedling establishment in deforested tropical areas dominated by bracken

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Tropical forests are becoming smaller and smaller due to human activities. The use of fire to expand agriculture leads to the creation of areas dominated by the bracken fern *Pteridium*, where forest regeneration is slow. This can be caused by seed limitation, especially of animal-dispersed seeds, and requires restoration strategies to support forest succession. We installed bird perches and artificial bat roosts to assess their effects on the density, species richness and composition of animal-dispersed seeds and seedlings in bracken-dominated areas the tropical montane forest of Bolivia. We found that perches and bat roosts increased the density and species richness of animal-dispersed seeds and seedlings. Perches had higher density and species richness of seeds and seedlings compared to bat roosts, suggesting that the use of perches as a restoration tool in bracken-dominated areas could be a better option. Our results demonstrate that seed limitation hinders forest succession in bracken-dominated areas. The use of bird perches accompanying other restoration techniques is a promising restoration strategy to accelerate forest succession in tropical areas dominated by *Pteridium*, which are widely distributed.

Funding: German Research Foundation DFG, grant He 3041/23-1

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 19 – Poster 56: Succession and restoration of tropical forests

Effects of elevation, shading, and exotic pastures on the early performance of native species in Andean forest reforestation

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High tropical montane forests (HTMFs) in the Andean region provide essential ecosystem services but have been disturbed by human activities, leading to biodiversity loss and the degradation of ecosystem services. Although several reforestation initiatives have been launched to restore these areas, limited information exists on how native Seelings respond to elevation gradients, pasture competition, and shading after planting. To address this, we established a network of experimental reforestation plots across three elevations (2200, 2800, and 3200 m above sea level) in southern Ecuador. A randomized block factorial design was implemented with eight blocks at each elevation, comprising four treatments: (1) pastures without shade (control), (2) mowed pastures without shade, (3) pastures with artificial shade, and (4) mowed pastures with artificial shade. The objective was to assess the survival and growth rates of five native species during the early phase of reforestation in degraded areas. The results indicated that elevation had a significant negative effect on the survival of three species, while it positively influenced the two other species. Shading consistently improved survival across all species, though the effect varied over time. A significant positive interaction between shading and elevation was also observed. Elevation negatively impacted the relative height growth rate (RHGR) across all species, but shading improved it, with the effect depending on the monitoring period. However, pasture competition and its interactions with elevation and shading did not significantly affect survival or growth. In conclusion, elevation, radiation reduction through shading, and careful species selection are critical factors for the initial success of reforestation efforts in degraded HTMFs areas in the Andes. These findings provide valuable insights for designing more effective restoration strategies in similar ecosystems.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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Session 21 – Oral 1: Tropical island ecology: An integrative approach to bridging the past and present

Past human settlements in the tropical forest of Borneo reveal distinct climate, soil, and settlement patterns

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Humans have inhabited Southeast Asia's tropical forests for at least 45,000 years, selecting suitable places to establish and develop land use practices. The impact of proximity to resources and climatic conditions on persistence of human settlement and its effects on the forest remains unclear. We compiled an archaeological dataset of 73 sites in Borneo, focusing on 47 with radiocarbon or radiometric records from the past 6,000 years. We compared these sites against randomly selected locations using climate, soil, and terrain variables, and contrasted this data with a historical land-use model. Also, sites were clustered by spatial location, and the timing and duration of inhabitation were described.

Our results reveal that human settlements were consistently located in areas with higher temperatures, lower precipitation, and lower elevations near coasts and rivers. These sites also exhibited distinct soil properties and paleoclimate patterns that differ from the current climate. The timing and duration of inhabitation varied, likely influenced by resource availability. By integrating archaeological, ecological, and climate data, our study provides key insights into the long-term interactions between humans and tropical forest ecosystems. This can inform future models for undiscovered archaeological sites in Borneo and the study of human legacies in tropical forests.

Funding: European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie (MSC) Grant Agreement No. 847585 and the University of Zurich, University Research Priority Program in Global Change and Biodiversity.

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DOI: 10.30427/ecotrop202501
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Session 21 – Oral 2: Tropical island ecology: An integrative approach to bridging the past and present

Conservation of eleven endemic *Boswellia* species: Case study from Socotra Island

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Traditional silvo-pastoral agroforestry system has been practiced by local herders on Socotra Island for centuries. One of the most endangered forest type is frankincense woodland. The local inhabitants are not used to taking care of trees and forests regeneration because trees used to regenerate naturally in the past. However, after World War II, a growing human population hindered forest regeneration due to overgrazing. The entire island inventory of frankincense trees was carried out. Almost 20 thousand trees of 11 endemic frankincense species were found and their threat evaluated. IUCN Red list re-assessment has been carried out. In 18 community forests, reforestation areas were established, local communities were trained in seed collection, seed germination, seedling production and natural regeneration protection. Value chains with non-timber forest products were improved to increase benefits from forest and motivation to take care of forest regeneration. Local certification system has been developed to ensure compliance with the rules of sustainable forest management.

Funding: Franklinia Foundation

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 21 – Oral 3: Tropical island ecology: An integrative approach to bridging the past and present

Reconstruction of the fire history for Ankarafantsika National Park in northwestern Madagascar over a 35 year-period

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Ankarafantsika National Park (ANP) contains the largest remaining block of dry deciduous forest (1,037 km²) in northwestern Madagascar. In recent years, forest fires have been frequently reported from this region, posing a threat to habitat integrity and connectivity inside ANP. This study reconstructs its fire history over a 35-year period by assessing fire-related changes using Landsat satellite images. The Normalized Burn Ratio (NBR) and the Differenced NBR (dNBR) were applied to annual images from 1988 to 2023. We find that 30% of the forests did not burn during that time, while 70% experienced at least one fire, with 18% burning more than three times. Fires were more frequent in the northern part of ANP, whereas most unburnt forest remained in the south, though patchily distributed. The extent of burnt areas fluctuated over the years, peaking in 2016 with 229 km² (22.09%) being burned. Fires recurred after intervals from one to 34 years, but more frequently than expected at 3-5 year intervals. Our study highlights areas requiring urgent conservation attention and provides a baseline for developing fire management strategies, while also contributing to a deeper understanding of fire dynamics in Madagascar's western dry deciduous forests.

Funding: KfW, Madagascar National Parks, Kölner Zoo

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 21 – Oral 4: Tropical island ecology: An integrative approach to bridging the past and present

Preliminary results of the palaeoecological investigations of the sediment cores from Curaçao's Saliña Sint Marie

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As part of the "Curaçao Cultural Landscape Project (CCLP)", palaeoecological reconstruction were used to examine long-term interactions between humans, fire and vegetation from geochemical, palynological and charcoal data. To explore these dynamics, two parallel sediment cores were collected in 2022 from Saliña Sint Marie (SSMA), a site adjacent to the island's oldest dated rockshelter. This unique location offers a rare opportunity to examine human-environment interactions across pre-colonial, colonial, and modern periods. This study presents preliminary geochemical, palynological and charcoal data in conjunction with regional archaeological and palaeoclimatological evidence, providing new insights into natural and anthropogenic drivers of landscape change on Curaçao.

The SSMA core, extending 155 cm in length, was dated using 21 radiocarbon samples, with basal ages ranging from 786 to 1059 cal BP. analysis revealed alternating freshwater and marine conditions, indicated by elevated levels of iron (Fe) and titanium (Ti) in freshwater layers (ca. 0–20 cm and 60–85 cm), and chlorine (Cl) and sulfur (S) in marine layers (ca. 20–60 cm and below 85 cm), corresponding with the abundance of marine microfossils, particularly *Paracytheroma* sp. Preliminary pollen analysis identified the consistent presence of *Zea mays* (maize) throughout the core, providing evidence of agricultural activity since the pre-Colonial period. These data suggest ecological transitions by both natural processes and human influence, highlighting distinct environmental changes associated with Indigenous, colonial and modern human use.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 21 – Oral 5: Tropical island ecology: An integrative approach to bridging the past and present

Montane isolation is not the main driver of plant community assembly in the ancient mountains of eastern South America

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The high diversity and endemism of montane ecosystems may result from frequent immigration of lineages and/or high diversification rates. We tested this hypothesis for the ancient mountains of eastern South America harboring the *campos rupestres*. These mountains are geographically isolated but surrounded by a mix of lowland vegetation types. We combined phylogenetic and distribution data for 54% (316 species) of the predominantly Neotropical genus *Mimosa* L. (Leguminosae) to examine transition rates between *campos rupestres* and other biogeographical regions, infer ancestral range probabilities, and estimate frequency and direction of biogeographical events. We also used state-dependent speciation and extinction models to assess whether lineages in the *campos rupestres* had higher diversification rates than those elsewhere. Our results indicate that the *campos rupestres* are a sink for *Mimosa* lineages from adjacent savannas, seasonally dry tropical forests, and rainforests. Additionally, lineages in the *campos rupestres* showed higher diversification rates than those in other regions. These findings suggest that the high diversity of *campos rupestres* results from frequent immigration of lineages, followed by increased diversification. While the diversity of ancient Neotropical mountains depends on surrounding vegetation as a source of lineages, unique features of the *campos rupestres* play a key role in driving lineage diversification.

Funding: FAPESP project 2023/16170-4

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 21 – Oral 6: Tropical island ecology: An integrative approach to bridging the past and present

Larger tree islands enhance the evapotranspiration in an oil palm landscape

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To study how enriching oil palm plantations with native trees can alleviate some negative ecological consequences of forest conversion, tree islands varying in area and diversity of planted trees were established in an oil palm landscape on Sumatra. Ten years after establishment, we assessed the partitioning of energy into latent and sensible heat fluxes across these tree islands using UAV-based thermography. We found that increasing island area enhanced the conversion of energy into latent heat flux. Evaporative fraction (the ratio of latent heat flux to available energy) around noon increased by 17% from an average of 0.65 in the smallest islands (25 m²) to 0.76 from the largest islands (1600 m²). A structural equation model was used to evaluated the direct and indirect effects of the experimental treatments and other variables thought to affect evaporative fraction (i.e., observed woody plant diversity, stand structural complexity, tree height variability, and vegetation health). We observed direct positive effects of island area and stand structural complexity on evaporative fraction, other potential paths affecting evaporative fraction were not significant. These findings suggest that larger islands likely developed more forest-like structure, which contributed to increased evapotranspiration. Overall, our findings highlight that establishing large tree islands in a sea of oil palms shifts energy use towards evapotranspiration instead of heating the environment.

Funding: DFG (Deutsche Forschungsgemeinschaft, German Research Foundation), project IDs 192626868 (CRC990 EFForTS), 532776526 (EFForTS-BEE), and 532868192 (ClimReg).

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 22.1 – Oral 1: Tropical biogeography and palaeoecology

Floristic patterns in Amazonia: Scaling up and down

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Considerable floristic turnover is known to take place across Amazonia. Several studies have linked this to variation in soil properties, especially nutrient concentrations, which in turn are determined by past and present geological processes. There is still much to learn about the specifics, however. At the local scale, plant species occur in patches that may be determined by local edaphic variability, biotic interactions, and local dispersal limitation. At the broadest scale, Amazonia can be subdivided into a few geochemically different regions, and diverging edaphic preferences of species can thereby be reflected in different distributional patterns at biogeographical scales. I will explore how local floristic-edaphic relationships scale up to the entire Amazon basin using understory ferns as an example group. The data reveal both similarities and differences in how the fern flora relates to soil gradients in different regions, and additional patterns related to climatic heterogeneity within the rain forest realm.

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DOI: 10.30427/ecotrop202501
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Session 22.1 – Oral 2: Tropical biogeography and palaeoecology

Disentangling the 'odd man out' tropical rain forest tree diversity with a global perspective of Annonaceae evolution and assembly

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The longitudinal distribution of tropical rain forest tree diversity presents a distinct 'odd-man-out' pattern: Neotropical and Asian tropical forests are more biodiverse than their African counterparts. Understanding the present and historical processes driving this pattern has remained challenging for decades, but promises to give important insights into the evolution, ecology and conservation of the highly diverse tropical flora.

Focusing on the ubiquitous pantropical family Annonaceae with about 2500 species, we leveraged a novel pipeline to curate, clean and merge herbarium specimen records from natural history collection databases, taxonomic revisions and publicly available biodiversity datasets. With these family-wide occurrences we produced species range estimates on a global scale allowing the generation of species richness maps across its distribution.

We combine this spatial data with a new species level phylogeny of Annonaceae, modern methods of biogeographical inference and spatialized paleoclimatic data to test present and historical determinants of Annonaceae species richness. Within this framework, we investigate longstanding questions on the evolution and assembly of tropical rain forest floras, and get one step closer to understanding the processes leading to the 'odd man out' pattern.

Funding: ERC grant agreement No. 865787

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.1 – Oral 3: Tropical biogeography and palaeoecology

Ecological stability facilitates Annonaceae and tropical rainforests diversification patterns

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The macroevolutionary drivers of tropical rainforest (TRF) diversity have long been debated through two contrasting hypotheses: the museum hypothesis, where low extinction rates drive steady species accumulation, and the cradle hypothesis, where rapid diversification results from increased speciation rates. Recent studies have introduced neutral theory to describe species turnover in these ecosystems. These hypotheses hinge on ecological stability, with the museum representing stable conditions and the cradle reflecting dynamic, shifting niches.

We present the first near-complete species-level dated phylogenetic tree for the TRF family Annonaceae Juss to test these ideas. (ca. 2,000 of 2,450 species). We examine shifts in diversification rates and geographical clade distributions, considering effects of time, temperature, sea level, and continental connectivity. Our results show that Annonaceae species accumulation aligns with the museum hypothesis, but paleoclimate factors, particularly temperature, also shape variations in diversification patterns. This suggests that, rather than time alone, the stability of the tropical biome, is a key driver of diversification in Annonaceae and broader TRF diversity.

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Session 22.1 – Oral 4: Tropical biogeography and palaeoecology

Niche evolution in the ancient tropical fern genus Danaea (Marattiaceae)

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When, where and, most interestingly, why have species diverged? These questions are especially tantalizing in the tropics, where an exceptional diversity of species coexists. One potential explanation for this diversity is the specialization of species into different niches.

Our research focuses on niche evolution within the Neotropical fern genus *Danaea* from the early diverging family Marattiaceae. Previous studies have suggested that species in this genus have varying preferences for soil fertility. Several closely related species coexist in Amazonia, and we hypothesize that these have diverged through soil specialization. Additionally, we propose that the rise of the Andes promoted speciation in some lineages, whereas lineages that were confined to lowlands diversified less.

We compiled occurrence data from over 4000 specimens from ~80 species across the Neotropics, collected through fieldwork and herbarium records. For each species, we estimate niche optima for soil and climate features based on occurrence points. Using the ecological data and a robust phylogenetic framework, we model the historical biogeography of *Danaea* to examine where and when lineages have diverged, how soil and climate niches have evolved within the genus, and to what extent these factors have driven speciation.

Funding: Aarhus University

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.1 – Oral 5: Tropical biogeography and palaeoecology

How plant-herbivores interactions change along an altitudinal gradient in tropical forests: unique patterns for different plant clades

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Plant-insect herbivore interactions play a key role in the origin and maintenance of species diversity. While studies have documented variations in plant and herbivore diversity across latitudes, little is known about how these interactions shift along elevational gradients. This study examines the interactions between three abundant tropical forest plant groups—Inga, Miconia, and Piper—and their lepidopteran herbivores across an elevational gradient (200-2500 masl). Results show that species and interaction diversity (alpha and beta) vary with altitude, but patterns differ among the taxa. For *Inga*, alpha diversity of host plants, herbivores, and interactions peaked at low elevations. In contrast, for *Miconia* and *Piper*, plant community diversity peaked at mid-elevations, though herbivore diversity remained highest at lower altitudes. Beta diversity analysis revealed high species and interaction turnover, driven mostly by herbivore turnover, except for Miconia. These findings suggest taxa-specific dispersal patterns and host preferences, supporting the idea that herbivores are a major driver of tropical forest diversity.

Funding: Universidad de las Américas grant number FGE.JGA.23.13.02

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.1 – Oral 6: Tropical biogeography and palaeoecology

Is the fleshy fruit an overlooked key innovation that underpins the species richness of flowering plants?

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Angiosperms (flowering plants), with over 300,000 species, represent one of the most spectacular and enigmatic evolutionary radiations on Earth. A potential explanation for this evolutionary success may be found in the unique functional traits (i.e. “key-innovations”) of angiosperms, which allowed them to explore new ecological opportunities for diversification and trait evolution. A key but understudied innovation is the evolution of fleshy fruits, a feature whereby angiosperms entice animals to swallow and distribute their seeds.

Here, I quantify speciation, extinction, and net diversification rates on an 80,000 species phylogeny of plants using a novel diversification inference method, to examine the impact of fleshy fruit upon these rates. Results suggest there are very few differences in the diversification dynamics of dry and fleshy fruited species in our sample of ~7800 species, with the exception of the Rosales, where fleshy fruited species possess a clear speciation rate advantage over dry fruited species. We are working to double the size of this trait dataset to learn whether these findings are truly representative, but as things stand, testing of this question using a binary character suggests fleshy fruited species do not possess a diversification advantage despite their high prevalence in diverse tropical ecosystems.

Funding: Flexpool at the German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.2 – Oral 1: Tropical biogeography and palaeoecology

The role of late Pleistocene human arrival and megafauna extinction on Amazonian tree composition

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At the end of the Pleistocene, tropical forests in South America underwent three drastic changes: the climate warmed, people populated the region and started to use and domesticate of part of the native forest plants, and the abundance of seed-dispersing megafauna collapsed. Here, we evaluate the impact of these three changes on tree populations in South America, using pollen time series of >80 tree and palm genera across 10 sites collected over a 100,000 yr period spanning the end of the Pleistocene and Holocene, and linking this to genus-specific traits that are indicators of climate responses, usefulness to humans, and dispersal by megafauna. We find no support for consistent effects of climate warming, and find that megafauna-dispersed tree genera increased –instead of decreased– in abundance after megafauna decline, indicating that climate warming and megafauna decline were no major drivers of changes in tree populations. However, we find that edible tree and palm species increased in abundance. This is consistent with the idea that people favoured tree taxa that were useful for consumption of their large seeds and fruits, and in this way took over the role of lost seed dispersers and artificially increased the abundance of previously megafauna-dispersed tree taxa.

Funding: Veni research program from the Dutch Research Council (NWO), project number NWO-VI.Veni.192.027

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.2 – Oral 2: Tropical biogeography and palaeoecology

Tree diversity patterns along an elevational gradient in Durango, Mexico.

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Broad-scale diversity patterns have been widely studied, yet the mechanisms determining biodiversity remain debated. In this study, we investigate the effect of environmental factors shaping plant diversity patterns along a subtropical elevational gradient. For this, we aimed to assess diversity patterns along a gradient of elevation, and to identify the main environmental factors driving these diversity patterns. We used a database of 800 permanent inventory plots distributed along an elevational gradient of 1300-3000 m in Durango, Mexico. Then, we calculated Hill-Chao numbers for both taxonomic and phylogenetic diversity, and used generalized linear models to test soil, topographic, and climate variables as drivers of diversity. We identified climatic factors as the main forces driving diversity across the elevational gradient. Hence, we infer that climate factors have shaped forest structures by creating conditions that drove evolutionary adaptations and specific taxonomic diversity patterns. However, the variance explained by our models is low, suggesting the possibility of other factors influencing diversity, such as anthropogenic disturbance, and the incapacity of our scale-dependent environmental data to fully capture specific regional variations. Therefore, it's crucial to recognize forest management as a significant factor in shaping diversity patterns and incorporate it into future research.

Funding: Katholischer Akademischer Ausländerdienst (KAAD)

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.2 – Oral 3: Tropical biogeography and palaeoecology

Utilising multi-proxy datasets to understand long-term drivers of change in the lowland forests of the north-western Amazon

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Understanding long-term vegetation dynamics and drivers of change in hyper-diverse tropical systems is critical as climate and anthropogenic pressures intensify. Here we present the results of pollen, non-pollen palynomorph, charcoal, leaf-wax biomarker, portable optically stimulated luminescence (POSL), micro-X-ray fluorescence (µXRF), mineral grain size, and loss-on-ignition analyses to assess and track vegetation and environmental change over the last millennium within a seasonally inundated *igapó* system in the Yasuní National Park, Ecuador. Our results indicate the formation of the modern Laguna Froilán system around 500 years ago evidenced by shifts in tree and fungal community composition and the initiation of organic matter conservation in the sediments. Abrupt peaks in the IRSL and post-IR blue OSL signals, not captured by µXRF data, most likely reflect the influx of a feldspar source during larger flooding events. The formation of the modern lake system and the onset of flood layers at Laguna Froilán is synchronous to wetter phases noted in other regional records and could be related to the onset of the Little Ice Age. This study contributes to an emerging pattern of dynamic wetland systems within north-western Amazonia over the course of the Holocene, and the importance of multiproxy datasets to help tease apart drivers of change.

Funding: National Environmental Research Council (NERC) PhD studentship (NE/S00713X/1). NERC NEIF Allocations: 2499.0322 (radiocarbon) and 2680.1023 (hydrogen isotope analysis).

Permits granted by the Ministry of Environment, Water, and Ecological Transition of Ecuador

- Permit for Investigation: MAAE-ARSFC-2021-1250
- Permit for Exportation: N° 003-2022-EXP-IC-FLO-DBI/MAAE

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.2 – Oral 4: Tropical biogeography and palaeoecology

Impact of atmospheric relative humidity on a forest-savanna transition reconstructed using the 17O-excess of phytoliths from sediments of Lake Ngofouo (Republic of Congo, central Africa)

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Vegetation changes during the late Holocene in central Africa were marked by forest-savanna transitions. The drivers behind these shifts, whether climatic or anthropogenic, remain unclear, leading to an ongoing debate around the drivers of the central African forest block opening. Here, we compared past climate and vegetation reconstructions, focusing on atmospheric relative humidity, used to estimate the vapor pressure deficit, a variable that controls soil evaporation, plant transpiration, and ecosystem productivity. We reconstructed vegetation changes and past RH using phytoliths morphological assemblages and their ^{17}O-excess, from 24 sediment samples from Lake Ngofouo, covering the past 2000 years. Our results show a decoupling between RH and vegetation changes. A forest-savanna transition occurred between c. 1530 and 1500 BP, following a rise in fire activity c. 1540 BP. Despite this transition, RH remained relatively constant, with an estimated annual average of 77%. The abrupt increase in fire activity likely opened the forest cover around the lake (phytoliths d/p ratio shifting from >2 to <2), establishing the current forest-savanna mosaic. Subsequent vegetation remained more open, with frequent fires. These results suggest that fire, potentially of anthropogenic origin, was the main driver of this ecosystem shift, rather than changes in RH.

Funding: French ANR PAST-17 project (ANR-22-CE01-0027), European Union's Horizon 2020 research and innovation program under the Marie Sklodowska-Curie grant agreement No 101026211, and EPHE-PSL PhD scholarship

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.2 – Oral 5: Tropical biogeography and palaeoecology

Late Holocene vegetation and environmental dynamics in Tripa peat swamp Forest, Leuser ecosystem, Aceh, Indonesia

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The Tripa Peat Swamp Forest (TPSF) is a part of the Leuser Ecosystem in Aceh Province, Indonesia. It is known as one of the largest peatland carbon stocks in Sumatra and a biodiversity hot spot that provides environmental services to the community. The ecosystem is now threatened by land use change, especially for oil palm plantations. Peatland conversion has already fragmented the primary peat swamp forest which is a habitat for the critically endangered Sumatran Orangutan (*Pongo abelii*). Vegetation and environmental dynamics since the Holocene period in this region are poorly studied. In 2022, a 2.5 m long peat core was obtained for palaeoecological investigations. Pollen, fern spores, NPPs, and micro- and macro-charcoal were analysed. The chronology of the peat core was determined by radiocarbon dating of 5 samples. Between 2240 and 1580 cal yr BP, occurred first a lowland dipterocarp-mixed swamp forest in the study area followed by a *Pandanus*-dominated peat swamp forest. In the second period after 1580 cal yr BP, the study area was dominated by a more stable and climax plant community of the family Anacardiaceae, Myrtaceae, and Fagaceae (Fago-Myrtaceous Forest). At the TPSF, natural disturbances such as volcano eruption affected the vegetation and ecosystem in the first period and human activity acts as a disturbance factor in the second period.

Funding: LPSDM Aceh – DAAD (2022 – 2026)

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22.2 – Oral 6: Tropical biogeography and palaeoecology

Regional and sub-regional plant use for palm-leaf manuscript production in the South and South-East Asia: Literature review and palaeoecological findings

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Aiming to reconstruct the regional and local historical production of Indian and South-East Asian palm-leaf manuscripts (PLM), preliminary dated from the 14th to the 20th cent. CE, we faced a vast volume of publications that briefly describe the manuscript creation process and/or are focus on PLM conservation but lack details on the process. There are currently neither thoroughly documented practices of PLM creation nor publications focusing on ethnobotanical aspects of these practices. Even the lists of plants regionally used for PLM production and conservation are lacking. To start filling this gap, we conducted the first comprehensive analysis of literature and online sources covering approximately 270 years (from 1753 to 2024) and compared the results of our palaeoecological and plant DNA-based reconstructions. The lists of plant names mentioned in the analysed publications range from as few as three for Nepal and Malaysia to as many as 79 in India. However, these lists differ significantly from the plant lists we have obtained so far based on palaeoecological findings, with only 15-30% matching. Possible reasons for such a discrepancy are discussed in this study. This work will enhance our understanding of traditional and modern plant usage related to the PLM cultures of South and Southeast Asia.

Funding: Grants RFA16 of the German Research Foundation (DFG, Deutsche Forschungsgemeinschaft) to 'Palm-Leaf Manuscript Profiling Initiative' (PLMPI) and RFA04 'Paleogenomic Studies of Written Artefacts of Different Origin' given to the Cluster of Excellence (DFG EXC 2176) 'Understanding Written Artefacts' at the Centre for the Study of Manuscript Cultures (CSMC), University of Hamburg, Germany.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22 – Poster 41: Tropical biogeography and palaeoecology

Climate change and human influence during the Holocene at the Andean forests and páramos of Oña, Southern Ecuador

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The pollen record from Oña, southern Ecuador, reflects the influence of climate change and human population on vegetation dynamics during the last 1300 years. This time window includes climatic events as the Medieval Climate Anomaly (MCA) and the Little Ice Age (LIA), as well as human population migrations of the Cañari people and the successive Inca and Spanish conquest of these territories. We analysed a fossil pollen sediment taken from a glacial lake at 3300 m a.s.l. at the southeastern Ecuadorian Andean highlands. According to our data, the composition of paramo and forest vegetation is a simultaneous response to climate change and human land use. In this case, prior to the local effects of the MCA the area was dominated by paramo vegetation, the greater human presence coincides with the MCA, with high fire frequencies and pollen taxa considered human indicators. During the period between the 700 to 400 cal yrs. BP, there was a rapid increase of the vegetation of the UMF and charcoal particles decrease suggesting human abandonment of the location, coinciding with the arrival of the Inca conquerors (487 yrs. BP) and the Spanish conquest (418 yrs. BP). During the LIA epoch we observed a predominance of paramo vegetation and a drastic decrease of human indicators relatable to the posterior effects of the Inca and Spanish invasions.

Funding: PUCE, Reco-Andes project

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22 – Poster 42: Tropical biogeography and palaeoecology

Relative importance of abiotic and biotic factors in driving local adaptation: Divergence in resource acquisition and herbivore defense traits in the hyperdiverse rainforest tree genus, *Inga*

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A fundamental challenge in biology is to understand why there are so many species and to identify the evolutionary processes that promote ecological differentiation. Niche evolution is fundamental to the origin and maintenance of biological diversity. Nonetheless, niche evolution in tropical rainforests, the most diverse terrestrial biome on Earth, remains largely unexplored. As a model for Amazon tree diversification, we are examining adaptive responses to abiotic and biotic stresses within and between species in a diverse genus of trees, *Inga* (Fabaceae) in Amazonian Ecuador. To a set of focal species that show a range of phylogenetic divergence and habitat association, we are extensively quantifying defense and resource acquisition traits, including physiological responses to light, water, and nutrients. We are also measuring key defensive traits including secondary metabolites using untargeted UPLC and MS-MS. Herbivores feeding on leaves are sequenced to determine host choice. Reciprocal transplant gardens have been performed to assess whether trait differences are genetic or environmentally determined. This unique comparison of both defenses and abiotic adaptations will test for synergy between herbivory and habitat heterogeneity in shaping niche evolution and local adaptation in plants.

Funding: Universidad de las Américas, Ecuador, project FGE.MEB.21.06

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22 – Poster 43: Tropical biogeography and palaeoecology

Understanding the environmental conditions that favored early human occupation in Northeastern Brazil

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While the presence of humans in America during the late Pleistocene is still cleaving, the evidence disclosed from the Serra da Capivara archaeological complex (north-eastern Brazil) support several human occupation phases throughout at least the last 30,000 years. However, the environmental and climatic requirements for human presence in this context remain unclear. This study aims to assess the paleoenvironmental conditions and the availability of resources in north-eastern Brazil over the last 40,000 years. A thorough review of the existing data was undertaken in order to understand the paleoenvironmental evolution and associate climatic conditions from the late regional Pleistocene to the late Holocene. We examined vegetation and climatic proxies as well as archaeological findings from selected high-resolution and well-dated studies. The compilation of the data highlights the general evolution of the paleoenvironments depicted by changes of the vegetation forms present in north-eastern Brazil over the last 40,000 years. The dry climatic conditions of the last glacial era were punctuated by humid intervals which led to changes in spatial distribution and floristic composition of the vegetation. The mosaics of vegetation of the biomes (Caatinga and Cerrado) were enriched with more forested vegetation forms which probably provided valuable resources for human settlements.

Funding: ANR SESAME

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22 – Poster 44: Tropical biogeography and palaeoecology

Pollen signal of modern vegetation registered in surface soil samples along an elevation gradient from Iztaccíhuatl volcano, Central Mexico

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Characterising the vegetation-pollen signal is essential for improving the interpretation of fossil pollen records. This study examines twenty-eight surface soil samples from Iztaccíhuatl volcano, ranging from 2650-4020 m asl. Pollen Zones and Ordination Analysis were assessed to establish a qualitative connection between the pollen signal and the distribution of plant communities along the elevation gradient. Findings indicate that: (i) *Pinus* predominates the pollen assemblage; (ii) *Quercus* and *Alnus* pollen persist throughout the elevation gradient, even at altitudes where the parental plants are not found; (iii) samples between 2650-3340 m asl, elevations dominated by Fir Forests, display higher *Abies* pollen values compared to samples from higher elevations; (iv) the locally-dispersed pollen of the hemiparasite *Arceuthobium* relates closely with Pine Forests; and (v) pollen from Apiaceae, *Eryngium*, Valerianaceae, and Caryophyllaceae are associated with higher elevations, specifically where Pine Forest and Alpine Grassland are present. These results suggest that the pollen signal is useful in characterising the main plant communities (Fir Forest, Pine Forest, and Alpine Grassland) of the study site and may aid in reconstructing past vegetation through pollen analysis. Furthermore, variations in *Abies* pollen percentages indicate a decline in Fir Forest communities due to recent anthropogenic activities.

Funding: This research was partially supported by grants from the Universidad Nacional de México (programme PAPIIT-DGAPA-UNAM refs. IN110223 and IN114019) to L. Vázquez-Selem, and the Spanish National Research Council (ref. 202230I146) to E. Montoya. A Consejo Nacional de Humanidades, Ciencias y Tecnología (CONAHCYT) PhD studentship (CV 659880) has funded Erandi Rodríguez-Pérez's work. We want to express our gratitude to the authorities and staff of Iztaccíhuatl-Popocatépetl National Park for granting us access to the field sites. We also thank Alma Bella López López, Mireya Vázquez Ríos, Arturo Godínez Tamay, Norma López Castañeda and Marco Antonio Pablo Pablo for assistance in the field.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22 – Poster 45: Tropical biogeography and palaeoecology

Did north-south antiphase climate fluctuations influence past ecological changes in Madagascar?

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Madagascar is widely recognized for its exceptional species richness and endemism. The island's long-term geological isolation associated with heterogeneous physical geography has contributed to species diversification. Climatic fluctuations over geological timescales have been also suggested as a crucial mechanism for species diversification. Specifically, cycles of dry/cold and humid/warm climates, such as with the glacial-interglacial cycles through the Quaternary, would have influenced ecosystem range contractions and expansions, thereby impacting diversification. Although species diversification extends well beyond the Quaternary, phylogeographical studies have also stressed the role of Quaternary climate fluctuations in Madagascar's species diversification. However, recent studies in the tropics reveal that precipitation variability does not always align with the multimillennial climate trends observed at high latitudes. Monsoon variability, for instance, can cause dramatic precipitation changes within a single glacial period, sometimes creating opposite precipitation patterns within the same continent. Only two long-term vegetation records in Madagascar, derived from lakes in the northern and central regions, extend beyond the Holocene. Comparing these records aims to evaluate how insolation-driven hydrological changes may have differentially influenced ecosystems across regions. This synthesis seeks to explore whether past ecological changes, driven by climate fluctuations, have shaped biogeographic patterns in Madagascar.

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DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 22 – Poster 46: Tropical biogeography and palaeoecology

Biogeography and diversity of agroforestry trees in the tropics: The BigDATAF initiative and call for collaboration

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The expansion of agricultural land is a significant driver of deforestation and rapid biodiversity loss in tropical regions. To halt this trend, the *circa situm* conservation of biodiversity in agroforestry systems (AFS) appears promising. AFS are home to a multitude of tree species, some of which are planted for various purposes. However, these species may fail to represent the local forest flora accurately. Non-native species are increasingly dominant, rare and/or big-sized species are scarce, and the phylogenetic and functional components of tree diversity remain unexplored. We present our BigDATAF initiative, which seeks to assess the relevance of AFS to biodiversity conservation. We evaluate the global diversity and distribution of agroforestry tree species. We investigate regional specificities and recent changes in AFS biodiversity. We believe that advancements in eco-informatics and artificial intelligence tools present new opportunities to gather, integrate and make FAIR (Findable, Accessible, Interoperable, and Reusable) large amounts of information on AFS trees from diverse heterogeneous sources. We started with over 1,000 articles and unformal databases from CIRAD covering various AFS in different tropical biomes. We call now for the largest collaboration to feed the initiative and contribute to answering the question: is agroforestry a refuge for tropical tree biodiversity?

Funding: CIRAD, AMAP lab

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 23 – Oral 1: Open session

Interplay of intraguild predation and environmental drivers shapes the spider community of a tropical rain forest

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Spiders are key arthropod predators, feeding on insects and thus influencing trophic cascades. However, spiders themselves are preyed upon by other predators, namely ants and flying invertivorous vertebrates. Nevertheless, the effects of these predators and environmental factors, e.g. elevation and seasonality, on spider communities remain understudied. To address these gaps, we excluded ants and birds with bats, both separately and in combination, from saplings in Papua New Guinea. We conducted the experiment over two 6-month periods, representing wet and dry season, using 560 saplings across 8 evenly spaced locations along a rainforest elevational gradient (from 200 to 3700 m a.s.l.). We analyzed changes in spider densities and their body size. We found that spider densities were highest during wet season and at mid-elevations. Spider body sizes declined marginally with increasing elevation, and they were not influenced by season. Both spider density and body size increased when at least one of the other two predator groups was excluded, peaking when both groups were absent. However, spider density increased more, when ants were excluded, while spider body size showed the opposite. In summary, ants primarily reduce spider densities by preying on numerous smaller spiders, while birds and bats lower mean spider body size by targeting larger spiders.

Funding: Grant Agency of Czech Republic Junior Star 22-17593M

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Oral 2: Open session

Mechanisms influencing the network topology in plant-hummingbird pollination networks

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Ecological communities, a result of complex interactions among co-occurring species, are often summarized in terms of network structure. Network structure, often described by a series of network metrics, can provide valuable insights for community resilience, dynamics, and ecosystem functioning; however, the mechanisms shaping network structure remain poorly understood. Network metrics may vary across communities due to changes in species composition and environmental conditions. However, if species linkage rules are driven by traits independent of species composition and environmental conditions, network characteristics may remain invariant. We investigated whether changes in taxonomic, phylogenetic, and functional diversity along elevation gradients influence network modularity, nestedness, connectance, and specialization across 32 sites in Brazil, Costa Rica, and Ecuador. Despite the clear impact of elevation on all aspects of diversity, we found little effect on network structure, which remained similar across elevations. Instead, trait-based mechanisms—specifically the matching of hummingbird bills and flower corollas—emerged as a consistent driver of network structure. Species showing strong trait matching, of both plants and hummingbirds, contributed most to higher modularity and specialization, while reducing nestedness and connectance. These results suggest that species reassembly may also be influenced by somewhat persistent mechanisms leading to invariant network structure and associated robustness.

Funding: ERC grant (787638), Swiss National Science Foundation (173342)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 23 – Oral 3: Open session

Changes in functional traits and resources reduce the specialization of hummingbirds in fragmented landscapes

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Pollinator specialization, crucial for the stability of plant-pollinator interactions, can be affected by habitat loss and fragmentation; however, the pathways that induce these changes are poorly understood. We aim to understand the underlying factors by which habitat loss, fragmentation, and vegetation structure change species specialization of hummingbirds and consequently influence community robustness in tropical montane forests of southern Ecuador. We used a piecewise structural equation model to simultaneously analyze the influence of functional traits of pollinators and resource availability as pathways driving the changes in specialization, resulting from an increase in habitat loss, fragmentation, and simplification of vegetation structure. We found that fragmentation reduces hummingbird specialization by filtering out hummingbirds with long bills. In addition, we observed that forest edges have greater floral diversity associated with a decrease in hummingbird specialization. The observed shift towards generalization in hummingbirds, related to the transformation of landscapes, appears to promote more robust communities capable of sustaining hummingbird populations. However, morphologically specialized pollinators can be highly sensitive to fragmentation and even become locally extinct when fragmentation increases in a landscape. We conclude that while fragmented habitats may maintain robust communities, specialist species, often with unique ecological functions, may not be maintained.

Funding: Swiss National Science Fundation, grant number IZSTZ0_199379

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Oral 4: Open session

Tropical rainforest fragmentation drives contrasting patterns of functional and phylogenetic diversity in bird assemblages

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Tropical forests are facing widespread loss of continuity due to deforestation. However, impacts of fragmentation on ecosystem functions are not yet sufficiently understood. In particular, little is known about the drivers of avian community assembly in different types of human-modified forests. We introduce a case study from Papua New Guinea that is uncovering variation in functional and phylogenetic diversity of birds in primary and secondary lowland rainforests under different levels of fragmentation. We combine intensive long-term monitoring in field surveys with a null model analysis framework. Our results show that secondary forests can host increased functional and phylogenetic diversity of birds when forest continuity is maintained. A phylogenetically conserved increase in functional trait variation has been observed due introduction of open-habitat species to continuous secondary forests. However, a contrasting pattern is observed in fragmented secondary forests, which have significantly decreased phylogenetic diversity that is decoupled from functional traits. Changes in edge effect and microclimate caused by forest fragmentation have led to disappearance of phylogenetically unique clades. We stress the importance of maintaining forest connectivity as a part of environmental policies leading to conservation of biodiversity components, thus protecting avian functional roles within forest landscapes undergoing secondary succession.

Funding: Czech Science Foundation, Junior Star No. 22-17593M

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 23 – Oral 5: Open session

Uneven ecological research effort on birds community ecology point to conservation challenges in Africa

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Ecological research effort changes across space and time bringing potential consequences for conservation science and practice. However, it is not well understood how ecological research effort varies across Africa, and whether this variation drives challenges for conservation practice in the continent. We quantitatively assessed research on bird community ecology in sub-Saharan Africa to explore the spatial, temporal and ecological distribution of research effort in the continent, and to evaluate how this distribution brings a range of challenges for conservation practice and science. The pattern that emerges is an uneven distribution of research effort across Africa, represented by a high concentration of research in Eastern and Southern Africa during the last twenty years, mostly on lowland evergreen forests, montane forests, and open Acacia savanna. Only some biodiversity hotspots and a few diversity metrics were covered. These patterns reveal conservation challenges in Africa including 1) ecological knowledge geographically highly biased for informing conservation practice, 2) reduced regional understanding of how human factors impact functional and phylogenetic diversity, 3) overemphasis of ecological research in a few habitats and biodiversity hotspots, 4) limited historical baseline data to compare conservation interventions and 5) inability to compare biodiversity trends among African regions.

Funding: German Research Foundation (DFG), project 509315005

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DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Oral 6: Open session

Terrestrial ecosystems push African rainforest countries towards carbon neutrality

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Despite their global importance in climate regulation, carbon fluxes remain poorly quantified in forest-rich African countries, making it challenging to design environmental policies. Here, we filled this gap by quantifying national-level net carbon fluxes for 18 West and Central African rainforest countries for 2010-2019 comparing bottom-up and top-down approaches. We found that carbon removals offset emissions in African rainforest countries, making the whole region close to net carbon neutral. The largest carbon sources were the Democratic Republic of the Congo and West Africa at a national- and regional-level, respectively. Yet, relative differences in national-scale bottom-up and top-down net carbon fluxes were on average 11 ± 376%, indicating that tropical Africa's carbon balance still remains highly uncertain due to data scarcity. Our findings underscore the importance of conserving intact African tropical ecosystems to limit carbon emissions and biodiversity loss.

Funding: Excellence of Science program (EOS O.0026.22)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Poster 57: Open session

Biodiversity and conservation of a megadiverse South American region

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The La Plata Basin, one of the largest and most biodiverse river basins in South America, harbors a high proportion of endemic species. Our objective was to identify the processes that could generate high levels of phylogenetic diversity (PD) within this basin for woody species and to highlight biodiversity hotspots that may provide crucial information for conservation planning. We compiled a database of 3,102 woody species from 1,165 community inventories. We calculated evolutionary history using species richness, PD, and their standardized equivalents (ses.PD), as well as evolutionary distinctiveness (ED) and biogeographically weighted evolutionary distinctiveness (BED). While all areas are important for conservation, special attention should be given to the intersections of biodiversity hotspots in future conservation efforts. Hotspot grids identified by three or more metrics are mainly located in the southeastern region of the La Plata Basin, particularly in the states of Paraná and Santa Catarina, indicating the need for an expansion of protected areas. The intersections between hotspots identified by mean ED and ses.PD are primarily concentrated in the Andes. Our results underscore the urgent need to expand protected areas in the La Plata Basin to prevent the loss of valuable and endemic species with unique evolutionary histories.

Funding: FUNDECT (317/2022 and 916/2022). MLB holds a Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) productivity fellowship (313179/2022-0)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 23 – Poster 58: Open session

Disentangling the evolutionary history of the woody species in Earth's most diverse tropical savanna

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We investigate the evolutionary structure of vegetation assemblages in the Cerrado Domain, the largest savanna in the American Tropics, to understand the role of ecological and geographical factors in shaping plant diversification and biogeographic patterns. We used a phylogenetic ordination analysis followed by K-means clustering to identify major evolutionary groups. To assess how environmental variables distinguish these groups, we implemented classification tree approaches. We quantified both unique and shared phylogenetic diversity among groups and used indicator analysis to identify lineages strongly associated with each group. Our results reveal a clear evolutionary divide between savanna and forest assemblages, driven by fire and water availability. Forests were further split into deciduous and evergreen/semideciduous subgroups, indicating distinct dry and moist environments. Evergreen and semideciduous forests harbor the highest phylogenetic diversity, but savannas also contain significant unique angiosperm diversity. We found that tree species in fire-prone savannas belong to restricted phylogenetic lineages, giving savannas a unique evolutionary identity. This marked evolutionary variation across the Cerrado Domain highlights the need to address specific conservation challenges for savannas, evergreen/semideciduous forests, and tropical dry forests to preserve this biodiversity hotspot.

Funding: FUNDECT (317/2022 and 916/2022), MLB holds a Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) productivity fellowship (313179/2022-0)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Poster 59: Open session

Birds across forest layers: Community structure, diet, microbiome, and predation impact

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Despite existing research on bird diet and its associations with bird's ecological roles, there is a limited understanding of how vertical stratification and seasonality influences these roles in tropical forests. Using a canopy crane in Papua New Guinea, we surveyed bird communities along a vertical gradient in primary and secondary forest. From mist-netted birds, we collected samples for diet analysis and gut microbiome profiling, comparing different diet identification methods and examining the impact of diet on the gut microbiome. Additionally, we surveyed insects along the vertical gradient, investigating seasonal effects on insect populations and the resulting herbivory damage to various plant species. To calculate what role the birds play in the trophic interactions within the forest strata, we conducted a predator removal experiment in the canopy and understory. First, we found differences in the accuracy of the diet identification methods, similarities and differences in diet of species between forest types, and some associations of specific food items with gut bacterias. We found rather strong seasonal change in the density of the insect in the forest, and surprisingly shallow pattern of vertical stratification, yet we find understory to be more ecologically important for insectivorous birds.

Funding: Grant Agency of Czech Republic Junior Star 22-17593M

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 23 – Poster 60: Open session

Is fruit ripening under selection by seed dispersers? Insights from the Brazilian savanna

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Fleshy fruits exhibit two ripening strategies: climacteric, when fruits can ripen after detachment from the parent plant, and non-climacteric, when they cannot. While evidence suggests that seed dispersers may have influenced the evolution of these patterns, the hypothesis connecting ripening strategy to seed dispersal syndrome remains unresolved, as does the evolutionary function of one of the most important fruit traits. Here, we investigate whether fruit ripening is under selection by seed dispersers using native fruits from the Brazilian Savanna. We employed a novel method to classify species by ripening pattern and collected data on other traits under selection by seed dispersers. Using existing data on plant-frugivore interactions, we estimated missing links to construct a dispersal network. We then tested whether (1) climacteric fruits tend to be dispersed by ground-dwelling animals; and (2) climacteric fruits tend to be large, dull-colored, and emit a distinct scent when ripe. Preliminary results challenge the hypothesis, showing that most fruits are climacteric, even if not dispersed by ground-dwelling animals. This project explores, for the first time, how fruit ripening differs in a community of native species and to what degree this is an adaptation to dispersers' behaviors and thus part of plants' seed dispersal strategy.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Poster 61: Open session

Living on the edge: Understanding herbivory patterns in a fragmented landscape

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Studies have found that associational resistance may not fully explain the observed effects of herbivory in mixed-forest stands. Incorporating intraspecific variation in physical and chemical leaf attributes across different spatial neighborhoods, might be critical to understand such patterns. In the Aravalli Range of India, we studied how the local spatial neighborhood and agricultural edge effects interact to explain plant-herbivore interactions in an agricultural-mosaic system. We i) characterized plant-herbivore interactions using a network-approach, ii) analyzed the impact of agricultural edges on herbivory, iii) quantified intraspecific variations in plant defense traits, iv) assessed the diversity and composition of plant local-neighborhood. We laid out plots along interior and edge transects, recording plant and herbivore composition, defense traits, percentage herbivory and 5 nearest-neighbors of each plant in each plot (72 plots). Preliminary analysis showed higher variation in plant composition in interior plots while the edge was more homogenous. Both networks have similar connectance, but the interior network showed higher nestedness. Species-specific variations in plant and leaf-damage were observed. Physical defense traits negatively impacted herbivory levels, but species-wise patterns of deterrent compounds suggested a distinct role of edge-effects. Our results demonstrate how external factors (neighborhood, edge) and intrinsic factors (plant traits) explain herbivory patterns.

Funding: Core Research Grant, Science and Engineering Research Board, India (CRG/2019/003297) and Ashoka University, India.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Poster 62: Open session

Mapping of environmentally suitable areas for the occurrence of endemic, threatened and poorly known species in rupestrian grassland in the state of Minas Gerais, Brazil

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The rupestrian grassland are recognized for their remarkable plant diversity and high endemism, but despite their uniqueness, collection efforts to inventory this richness are unevenly distributed. One of the greatest challenges for conservation projects is the lack of knowledge about the geographic distribution of many species, a problem known as the Wallacean Shortfall. This project aims to identify potential areas for expanding the distribution of *Brunfelsia rupestris*, *Cinnamomum erythropus*, *Mikania glauca* and *Minaria refractifolia* — endemic, threatened and poorly known species in the state of Minas Gerais, Brazil. We used six ecological niche modeling algorithms and four selected bioclimatic variables, via the SDM package in R. The models indicated rupestrian environments outside their known distributions, highlighting the effectiveness of the methodology in guiding efforts toward locations with high environmental suitability but no previous records. These species, often restricted to specific geographic areas, are particularly vulnerable to habitat loss and environmental disturbances. Therefore, identifying suitable areas for their occurrence, allowing for field validation, is crucial for planning more effective conservation strategies.

Funding: CSN - Companhia de Siderurgia Nacional - Mineração S.A., Brazil.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 23 – Poster 63: Open session

Tree flora of the La Plata Basin: Centers of diversity, endemism and conservation status

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The La Plata Basin (LPB) is one of the most important regions in the world in terms of biological diversity, as it hosts major biomes and ecoregions. We identified centers of species richness and endemism for tree species and assessed the effectiveness of protected areas (PAs) for LPB conservation. The records were extracted from online databases. To quantify the occurrence of threatened and endemic species in relation to PAs, occurrence values for each PA were extracted. Data on the occurrence of 3,102 tree species, distributed across 127 families and 653 genera, were compiled. The areas with the highest species richness are located in southeastern Brazil, within the core area of the Atlantic Forest. The endemism results indicated three important centers of endemism, located in the Atlantic Forest and Cerrado. These regions, with high species concentrations, are restricted to mountainous areas, which exhibit a high degree of heterogeneity. The level of protection for tree species in the LPB was low, with 15.11% of species remaining unprotected. We suggest protection measures for areas within the Atlantic Forest biome, which shows the greatest species diversity, and for areas in the Cerrado, which stand out for being regions of high endemism.

Funding: FUNDECT (317/2022 and 916/2022); MLB holds a Conselho Nacional de Desenvolvimento Científico e Tecnológico (CNPq) productivity fellowship (313179/2022-0)

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Poster 64: Open session

Hind wing tails of Neotropical Skipper butterflies, geographical and ecological patterns

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Hind wing tails have evolved multiple times across different butterfly taxa, yet most studies have focused on the Papilionidae family. In contrast, skippers (Hesperiidae, Eudaminae) offer a unique case with distinct adaptations. These butterflies are widespread across the Neotropics, including the Caribbean and Galapagos islands, and employ diverse defence strategies. Primary defences include high flight speed and aposematism (dorsal iridescence and white bands), while secondary defences involve hind wing tails, unpalatability, and brittle wings. Using geometric morphometrics and phylogenetics, we examined the evolution of hind wing tails within the Eudaminae lineage. Our results show that hind wing tails are more common in tropical regions, where predation pressure is likely higher. Moreover, the presence of tails affects fore wing morphology, suggesting possible aerodynamic constraints. We also found that island populations, particularly in the Lesser Antilles and Galapagos, exhibit a notable reduction in relative tail length compared to mainland species. The study highlights the adaptive significance of hind wing tails and their influence on the morphology and distribution of Eudaminae skippers, providing broader insights into the evolutionary dynamics of butterfly defence mechanisms.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
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INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

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Session 23 – Poster 65: Open session

Preliminary evidence of changing fire activity in the Dahomey Gap, Ewe-Adakplame forest, Benin

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The Dahomey Gap is c. 200 km dry savanna corridor in western Africa flanked tropical rain forest to the east and west. The modern configuration of the Dahomey Gap emerged around 4500-3400 years ago at the end of a relatively more humid climatic period, however, the origins of this savanna remain ambiguous. Today fire, from both a natural and human ignition, is an important component of the landscape dynamics and helps to maintain the predominance of grassland ecosystems. Preliminary data derived from a 2-meter-long sedimentary core from a swamp near the Ewe-Adakplame forest in Benin provides the first evidence of changing landscape and fire dynamics in the Dahomey Gap. The abundance of organic carbon within the sediments was found to be low (<10% dry weight) throughout the core, but the abundance of charcoal highly variable (0-193 particles per cm^3). Peaks in charcoal abundance occur sporadically throughout the core suggesting significant changes in fire activity. Changes in fire activity could be related to human activity in the region related to metallurgy, agriculture and pastoralism and the rise and fall of various Dahomey Kingdome. Further analysis and dating of the core is required to establish a clear chronology for the changing fire activity.

Funding: INQUA Fellowship Award 2024

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

Session 23 – Poster 66: Open session

Perceptions of crop-raiding among hunter-gardener Maroons in Suriname

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Human forest-dwelling communities live in close contact with crop-raiding species, leading to high potential for human-wildlife interactions (HWI). Crop-raiding, a common type of HWI, can lead to food insecurity and financial and emotional damage. Resulting retaliatory killings can threaten crop-raider populations. Studying perceptions regarding crop-raiding is necessary to understand locally specific perceived causes and effects of crop-raiding, which are crucial when designing mitigation measures. Yet, human perceptions of crop-raiding remain understudied, especially in South-America.

We studied local perceptions of human-wildlife interactions in Suriname. Semi-structured interviews were conducted in two Maroon villages belonging to the tribes of Saamaka and Matawai in March-May 2023. Crop-raiding by peccaries, deer, agouti and birds was experienced in both villages, with peccaries garnering the most negative perceptions. Most people branded crop-raiding impact as severe, although women perceived crop-raiding more negatively than men. The majority of people perceived crop-raiding as a growing problem, either through an increase in damage or in animals (or both). Logging was frequently cited as an important factor contributing to the perceived rise in crop-raiding. It is thought to increase raiding of cultivated food through loss of fruiting trees in the forest. Other perceived causes were changes in climate and weather, which are likewise linked to a decrease in wild food for crop-raiders.

Our findings show that HWI in the interior of Suriname are perceived to be influenced by landscape-scale factors leading to wild food loss for animals. Mitigation measures in the Matawai and Saamaka territory as well as similar tribal and indigenous communities in the larger Amazon basin should address these perceived causes of problematic crop-raiding.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

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An index of structural complexity: Application and evaluation in forests of Puerto Rico

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Structural complexity is key to forest ecosystem productivity and function, but techniques for quantifying structural complexity remain an area of active research. Reineke's Stand Density Index (SDI) is often used in even-aged monocultures; an alternative version (ASDI) has been developed for irregular forests. The quantity SCI=1-ASDI/SDI has been proposed as a measure of stand structural complexity, but it has not been evaluated in tropical forests. Here, I describe empirical relationships using data from Puerto Rico. SCI is highly correlated with, but not identical to, other measures based on the diameter distribution. SCI is theoretically "scale free," but remains correlated with measures of dominant tree size such as the basal-area weighted mean DBH (r=0.75) and Lorey's height (r=0.61). Correlations with taxonomic diversity (e.g. Shannon's diversity, r=0.22) are modest. Thus, SCI reflects the development of structural complexity with increasing forest stature. Modelling using mixed-effects Random Forests and Bayesian Additive Regression Trees, accounting for possible nonlinear interactions while controlling for the repeated-measures nature of the FIA data, confirms these general patterns. Direct modelling of the effects of wind damage and harvesting on SCI further indicated that disturbance effects are mediated through impacts on the largest trees in a stand.

Funding: Support for this project was provided by the USDA National Institute of Food and Agriculture McIntire-Stennis Project 00106-M, Accession Number 7003549 and the State of New Hampshire.

2025 VOL. 27:202501
DOI: 10.30427/ecotrop202501
ECOTROPICA
INTERNATIONAL JOURNAL OF TROPICAL ECOLOGY

EUROPEAN CONFERENCE OF TROPICAL ECOLOGY 2025

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