Poster sessions

17:30 - 19:00 Tuesday, 24th March, 2026
Room Mañío (1st Floor Hall) and Tepa (2nd Floor Hall)
Pillar All pillars
Session type Poster presentations

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13 Facilitative Root Associations of the Endemic *Indopiptadenia oudhensis*: Implications for Biodiversity Restoration and Forest Ecosystem Services in Central Himalayan Riverine Forests

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Abstract

Species capable of forming positive ecological associations often display enhanced adaptability, enabling persistence in fragmented and resource-limited landscapes. In the Anthropocene, where climate change and anthropogenic pressures continuously redefine ecological thresholds, such facilitative interactions offer an alternative pathway to classical “survival of the fittest,” promoting niche expansion, structural complexity, and ecosystem resilience.

This study reports a novel commensal ecological association involving the endemic and endangered tree *Indopiptadenia oudhensis* (Fabaceae), *Murraya koenigii*, and *Celtis tetrandra* within the Terai region of Sohelwa Wildlife Sanctuary (SWS), Uttar Pradesh, India. Field investigations conducted in December 2024 revealed the emergence and establishment of *M. koenigii* and *C. tetrandra* seedlings from the lateral root zones of a mature *I. oudhensis* individual, indicating a stable, non-parasitic interaction in which the host tree provides a favourable microsite for germination and early growth without observable detriment to its vitality.

Microscopic examination of *I. oudhensis* root samples, following Trypan Blue staining, confirmed the presence of arbuscular mycorrhizal fungi (AMF). This finding suggests that AMF-mediated Common Mycorrhizal Networks (CMNs) may facilitate nutrient transfer, moisture availability, and physiological support to associated species, thereby enhancing seedling survival under stressful edaphic and climatic conditions. These processes underscore the importance of integrating microecological interactions into biodiversity restoration and forest management frameworks. These belowground networks can strengthen forest ecosystem services, such as nutrient cycling, soil stabilization, and climate resilience, thereby contributing to adaptive, science-based restoration strategies in rapidly changing subtropical forest landscapes.

26 Green Area Index in Urban Environmental Quality: A Decade-Long Analysis in Southeastern Brazil

Cecilia Uliana Zandonadi[1], Alexandre Rosa dos Santos[1], David Brunelli Viçosi[2], Sayara Beatriz dos Santos Silva[1], Fernanda Santos Ferreira[1], Roberta Aparecida Fantinel[1]
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Abstract

The Green Area Index (GAI) represents the amount of green space available per capita per

inhabitant, constituting an important indicator of urban environmental quality. This study aimed to analyze the spatial and temporal variation of the GAI in Vitória, the capital of Espírito Santo, from 2013 to 2023, considering the 82 neighborhoods that comprise the municipality.

The methodology was based on photointerpretation of images provided by the Espírito Santo Integrated Geospatial Base System and on the use of population data from the Demographic Census (2010; 2022). The GAI was calculated based on the ratio of green space to the number of inhabitants per neighborhood.

The results indicated that vegetation cover showed a slight reduction, from 28.47 km² (32.98 % of the municipal area) in 2013 to 28.37 km² (32.86 %) in 2023. In the same period, the population increased from 319,043 to 322,869 inhabitants, causing a decrease in the municipal GAI from 89.23 m²/inhab in 2013 to 87.86 m²/inhab in 2023. The spatial analysis highlighted strong heterogeneity between neighborhoods: Goiabeiras stood out in 2013 (464.03 m²/inhab), but showed a significant reduction in 2023 (428.56 m²/inhab), due to the expansion of the airport and the loss of restinga areas. In contrast, neighborhoods such as Fradinhos and São José registered an increase in the index.

The results reinforce that, although the municipality of Vitória has high average levels of green space, there is inequality in access and distribution between neighborhoods, with direct implications for environmental quality and urban equity.

28 Land Surface Temperature Variations Related to Land Use and Land Cover Changes in the Largest Municipality of the Amazon

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Abstract

The Amazon is essential for climate balance, but changes in land use and land cover (LULC), such as the conversion of forests for other purposes, can cause variations in land surface temperature (LST). In this context, the municipality of Altamira, Pará, despite having more than 90 % forest cover, has led the deforestation ranking for several consecutive years.

The aim of this research was to evaluate LST variations as a function of LULC changes in a time series between 2002 and 2022. For this purpose, LST was obtained from images captured by the TM, ETM+, and TIRS/MSI sensors of the Landsat mission. LULC data were obtained from MapBiomas, Collection 8, with 12 classes identified in the study area.

To assess the temporal trend in each LULC class, the Seasonal Mann–Kendall test and STL (LOESS) decomposition were applied. The Seasonal Mann–Kendall test did not indicate statistically significant trends ($p > 0.05$) in LST across the LULC classes. However, through STL decomposition it was possible to identify peak and drop patterns in LST that coincide with El Niño events. During these periods, the Amazon rainforest experienced vulnerabilities and severe droughts that intensified the dry season, especially in areas with lower vegetation cover, such as agricultural lands and pastures.

Studies show that areas with forest cover present lower temperature variation, which may explain why no significant trends were found in the studied area, given that the municipality has more than 90 % forest cover, which can mitigate overall temperature effects.

93 Carbon Sequestration Potential in Secondary Forests and Land Uses in the Atlantic Forest

Daisy Christiane Zambiazi[1], Federico Alice-Guier[2], Alfredo Celso Fantini[1], Alexandre Siminski[3], Daniel Piotto[4], Daniel Caetano Oller[5], Ricardo de Vargas Kilca[6], Catarina Jakovac[1], Eduardo Delgado Assad[7], Abdon Luiz Schmitt Filho[1], Sandro Luis Schlindwein[1], Arcângelo Loss[1]
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Abstract

Land use change and environmental degradation contribute substantially to global greenhouse gas (GHG) emissions, placing Brazil among the world's largest emitters due to deforestation. Secondary forest regeneration and sustainable land-use practices are critical strategies for increasing carbon sequestration.

This study quantifies carbon stocks in secondary forests along successional chronosequences (2–80 years) and in soils under different land uses across the Atlantic Forest biome. Aboveground biomass was estimated from forest inventory data from 188 plots across multiple forest typologies using species-level allometric equations implemented in the biomass R package and converted to carbon using the IPCC factor (0.47), while soil carbon stocks were quantified from 289 soil samples collected to 30 cm depth under different land uses. Linear models were applied to analyse spatial and temporal patterns of carbon accumulation.

In secondary forests, carbon stocks ranged from 18.3 Mg/ha (shrub phase) to 44.5 ± 5.9 Mg/ha (intermediate stages) and 119.2 ± 17.0 Mg/ha (mature forests), reaching 128.4 Mg/ha after 80 years. Accumulated carbon increased from 2.35 Mg/ha at early succession to 201.4 Mg/ha after 100 years, with rapid initial gains.

Soil carbon stocks varied from 52.7 ± 18.3 Mg/ha (silviagropastoral) to 88.9 ± 11.7 Mg/ha (AFLOU), with native vegetation averaging 60.4 ± 5.2 Mg/ha. Projections indicate that restoring agricultural areas to forest could increase soil carbon stocks by up to 30.66 Mg/ha over 30 years.

These results highlight the strong potential of secondary forest regeneration for ecological restoration and climate mitigation in the Atlantic Forest.

94 Spatiotemporal Carbon Stock Dynamics in the Atlantic Forest under Land-Use Change and Secondary Forest Regeneration (1992–2022)

Daisy Christiane Zambiazi[1], Alfredo Celso Fantini[1], Alexandre Siminski[2], Federico Alice-Guier[3], Daniel Piotto[4], Daniel Caetano Oller[5], Ricardo de Vargas Kilca[6], Catarina Jakovac[1], Eduardo Delgado Assad[7], Abdon Luiz Schmitt Filho[1], Sandro Luiz Schlindwein[1], Arcângelo Loss[1]
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Abstract

The Atlantic Forest has undergone intense fragmentation and conversion of native forests into agricultural and pasture lands, resulting in substantial carbon losses from vegetation and soils. This study estimated the spatial and temporal dynamics of average carbon stocks across forest types and land-use classes over a 30-year period (1992–2022).

The analysis was based on annual land-use and land-cover maps derived from MapBiomas remote sensing imagery, processed in R using spatial workflows and vegetation and soil carbon stock coefficients to estimate carbon stocks, emissions, and sequestration associated with land-use transitions. Over this period, land-use classes exhibited divergent trends.

Deforestation of mature forests reduced remaining carbon stock from 176.1 to 47.8 Tg CO_2e, generating emissions of 657.0 Tg CO_2e, while total mature forest carbon stocks

declined from 3,818.3 to 3,007.6 Tg, corresponding to emissions of 2,975.2 Tg CO_2e. Emissions from deforestation in secondary vegetation increased from 8.3 to 32.5 Tg CO_2e.

In contrast, secondary vegetation increased carbon stocks from 82.7 to 417.2 Tg, resulting in 1,227.7 Tg CO_2e sequestration. Pasture carbon stocks decreased from 2,523 to 1,994 Tg, whereas agricultural areas expanded, with stocks increasing from 533 to 754 Tg.

Overall, deforestation remains a major source of carbon emissions in the Atlantic Forest, only partially offset by secondary forest regeneration. Despite sequestration gains, a net carbon deficit of 1,747.6 Tg CO_2e persists relative to mature forest losses, highlighting the urgent need for large-scale conservation of remaining forests and expanded restoration strategies to sustain carbon balance.

107 Effects of Mixed Plantation of Typical Coniferous Species on Soil Properties and Understory Vegetation in Southern China

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Abstract

Pinus massoniana and *Cunninghamia lanceolata* are predominant plantation species in southern China. However, long-term monoculture practices led to the degradation of soil quality and ecosystem functions. In this study, the effects of mixed plantations on the soil environment were investigated by comparing the pure and mixed stands of *P. massoniana* and *C. lanceolata*.

Results indicated that mixed cultivation significantly affected soil physical structure, with a marked reduction in soil bulk density and a significant increase in soil porosity. Soil organic carbon, total nitrogen, and total phosphorus contents were also significantly higher in mixed stands than in pure stands. Soil pH increased significantly in mixed *C. lanceolata* stands and exhibited an increasing trend in mixed *P. massoniana* stands.

In terms of ecological functions, both litter production and tree biomass were significantly greater in mixed stands. Correlation analysis revealed a significant positive relationship between stand density and litter accumulation, which was positively correlated with soil water content. This suggests that mixed plantations may enhance water conservation by promoting litter accumulation.

Additionally, the understory diversity index and biomass were significantly higher in mixed stands than in pure stands. However, stand density suppressed understory diversity, indicating that appropriate density regulation could further optimize ecological benefits.

118 Assessing Forest Aboveground Carbon Storage in Northeastern Portugal Using Remote Sensing and Machine Learning

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Abstract

Aboveground biomass is a fundamental carbon storage compartment within forest ecosystems. This compartment is highly dynamic due to disturbance (e.g., wildfires, pests and diseases) and management followed by regeneration and growth. There is currently a

worldwide effort in mapping forest biomass taking into account these dynamics across multiple spatial and temporal scales. Such mapping relies on constant updates of forest inventory data, which are often unavailable. However, machine learning models have been demonstrated to overcome this limitation by enabling the integration of more readily available datasets, particularly those derived from remote sensing sources that are used as proxies of forest biomass.

The objective of this study was to produce a wall-to-wall map of forest aboveground biomass and carbon in Northeastern Portugal for the 2024–2025 period. A database was assembled using data collected in this period from our own field campaign, complemented by datasets from other research teams within the institution. Environmental covariates such as canopy height, vegetation indices and terrain attributes were used as proxies of forest biomass.

Machine learning models were then applied to establish predictive relationships based on ground-truth data and environmental variables and to generate spatially continuous estimates of forest aboveground carbon for the respective years. Preliminary results indicate that our approach produces reliable models and accurate spatial biomass predictions for the region. The results also indicate a strong contribution of canopy height to biomass prediction, which increases the possibilities of updating biomass distribution in the region based on regular Light Detection and Ranging (LiDAR) surveys.

144 The Effect of Fire Severity on Soil Physico-chemical Properties in Temperate Forests of Argentine Patagonia

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Abstract

Forest fires alter soil properties, causing nutrient loss, changes in structure, and erosion risk. In the Andean Patagonia, fires are frequent disturbances, yet their effects on soil are poorly understood.

We evaluated the impact of the La Cuesta del Ternero fire in Río Negro—four years after the fire—on the physical and chemical properties of the soil in forests of *Austrocedrus chilensis*, *Nothofagus pumilio*, *Nothofagus antarctica*, and exotic conifer plantations, under three levels of severity: unburned, moderate, and high.

In all forests, we observed a significant loss of soil organic matter (SOM) and an increase in bulk density (BD) at high severity sites compared to unburned sites. These conditions leave the soil vulnerable to erosion, with lower nutrient reserves and water retention capacity.

pH and electrical conductivity showed no differences between severity levels; however, other studies indicate that changes in these variables are usually temporary, so they may have recovered four years after the fire.

On the other hand, regardless of severity level, *Nothofagus* forests always had higher %MOS and lower DA than *Austrocedrus* and plantations, buffering the post-fire response.

These patterns suggest that areas with higher fire severity may present limiting conditions during the initial phases of vegetation recovery, making it crucial to plan restoration strategies.

152 Multi-Year Throughfall Reduction Enhanced the Growth and Non-Structural Carbohydrate Storage of Roots at the Expense of Aboveground Growth in a Warm-Temperate Natural Oak Forest

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Abstract

The more frequent occurrence and severer drought events resulting from climate change are increasingly affecting the physiological performance of trees and ecosystem carbon sequestration in many regions of the world. However, our understanding of the mechanisms underlying the responses and adaption of forest trees to prolonged and multi-year drought is still limited.

To address this problem, we conducted a long-term manipulative throughfall reduction (TFR; reduction of natural throughfall by 50%–70% during growing seasons) experiment in a natural oak (*Quercus aliena* var. *acuteserrata* Maxim.) forest under warm-temperate climate.

After seven years of continuous TFR treatment, the aboveground growth in oak trees started to decline. Compared with the control plots, trees in the TFR treatment significantly reduced growth increments of stems. The TFR-treated trees allocated significantly more photosynthates to belowground, leading to enhanced growth and nonstructural carbohydrates (NSC) storage in roots.

There were clear trade-offs between the aboveground growth and the fine root biomass and NSC storage in oak trees in response to the multi-year TFR treatment. A negative correlation between the fine root NSC concentration and soil water suggested a strategy of preferential C storage over growth when soil water became deficient; the stored NSC during water limitation would then help promote root growth when drought stress is released.

Our findings demonstrate the warm-temperate oak forest adopted a more conservative NSC use strategy in response to long-term drought stress, with enhanced root growth and NSC storage at the expenses of aboveground growth to mitigate climate change-induced drought.

163 Fire Intensity, Forest Type, and Recovery Time Shape Soil and Root Fungal Communities: Lessons Learned from the Largest Wildfire in Slovenia

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Abstract

Large wildfires are reshaping forest ecosystems, yet their effects on belowground fungal communities remain understudied. After the 2022 megafire in sub-Mediterranean Slovenia, we examined how fire intensity (control, ground, crown), forest type (coniferous *Pinus nigra* and deciduous *Quercus* species), substrate (soil and roots), and time since fire interact to shape fungal diversity and composition. Using ITS2 metabarcoding on 198 samples and multilevel statistical analyses, we assessed whether post-fire patterns reflect true diversity loss or mainly compositional change.

Across all years, soils were richer and more diverse than roots, and deciduous stands exceeded conifers. Crown fire caused the strongest declines in richness, Shannon diversity and evenness, especially in conifer soils and roots, while ground fire effects were moderate early on and declined by the final sampling. Community structure was driven mainly by substrate and then by vegetation, with fire intensity producing clear shifts within each forest type along ash-associated gradients, including pH and base cations. Burned plots showed higher beta dispersion and persistent separation from controls, most evident under crown fire.

Genus-level responses revealed two contrasting trajectories. Early successional Ascomycota such as *Pyronema*, *Neurospora*, *Venturia* and *Coniochaeta* increased after fire, often regardless of severity. In contrast, ectomycorrhizal Basidiomycota including

Tomentella, *Sebacina* and *Amphinema* were most sensitive to crown fire, with some taxa peaking under ground fire. These patterns suggest that severe burning suppresses ectomycorrhizal fungi, whereas moderate disturbance can allow recovery.

Overall, fire intensity shaped the magnitude of post-fire change, while substrate and vegetation remained the main determinants of community structure.

195 Tree Dynamic Trajectories of Urban Forest Fragments over 11 Years: The Influence of Land-Use History on Beta and Alpha Diversity

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Abstract

Urban forest fragments work as important refuges for biodiversity; however, their successional dynamics are strongly influenced by the history of land-use disturbances.

In this study, we investigated the structure and temporal dynamics of four fragments of seasonal semideciduous forest in the Atlantic Forest region, southeastern Brazil, with distinct disturbance histories: agriculture, pasture, forest remnant, and land grading.

Forest censuses were conducted in 40 permanent plots (20 × 20 m) over intervals of 7 to 11 years, recording all individuals with DBH ≥ 5 cm. We quantified changes in species richness, diversity, diameter structure, recruitment, mortality, and basal area increment.

To evaluate floristic and structural changes, we used Hutcheson's t-test, ANOSIM, and DCA, as well as rarefaction curves.

Fragments with lower disturbance histories exhibited higher species richness and greater structural complexity, while fragments previously used for agriculture showed higher recruitment rates (>3.8% year^{-1}). In contrast, highly impacted fragments displayed lower richness, simplified structure, and elevated mortality rates (>3.5% year^{-1}).

Diversity differed significantly among the study areas but did not vary over time, suggesting stability within the evaluated interval. These findings highlight land-use history as a key driver of forest dynamics, shaping regeneration, recovery, and the pace of succession.

Continuous monitoring is essential to track these trajectories and inform management and restoration strategies in highly anthropized tropical landscapes. Funding: FAPEMIG.

216 Historical Changes in the Environmental and Spatial Patterns of Threatened Tree Species in the Atlantic Forest of Espírito Santo, Brazil

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Abstract

Understanding spatio-temporal patterns of occurrence and environmental patterns of threatened tree species is essential to support conservation planning in highly impacted biomes. The Atlantic Forest of Espírito Santo, Brazil, has undergone severe habitat loss,

and many of its key forest species remain poorly known regarding temporal trends and niche stability.

Here, we evaluated four priority threatened tree species—*Dalbergia nigra*, *Ocotea ciliata*, *Apuleia leiocarpa*, and *Machaerium fulvovenosum*—through three integrative analytical components: (i) temporal trends in sampling frequency (1985–2023), (ii) temporal changes in environmental niche based on principal component analysis (PCA) of 19 bioclimatic variables, and (iii) dynamics of geographic distribution measured by the Convex Hull method over time.

Georeferenced occurrence records were compiled from SpeciesLink, and bioclimatic data were associated with the species' collection year. We assessed decade-level patterns to infer stability or directional changes in ecological space and spatial occupancy.

Results indicate distinct temporal trajectories among species. *Dalbergia nigra* shows an increase in the number of records over time, suggesting an increasing sampling effort. Environmental niche dynamics revealed changes for all species, with a smaller magnitude for *Ocotea ciliata*.

Estimates of geographic distribution varied across decades, reflecting both sampling biases and potential contraction signals. Our findings emphasize the need for improved monitoring and targeted field surveys for undersampled species.

The combined analyses provide a robust baseline for future ecological niche models and conservation actions, particularly by identifying species with restricted niches that may be more vulnerable under ongoing climate change and habitat fragmentation.

223 Edge-to-interior Carbon Stocks Variability in Brazilian Cloud Forest Patches

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Abstract

Cloud forests (CFs) are rare and threatened ecosystems that play a crucial role in maintaining biodiversity and providing essential ecosystem services. Here, we aim to estimate the aboveground carbon (AGC) stocks and assess interspecific variations in AGC within CF patches of Serra do Papagaio National Park, southeastern Brazil.

Wood density (WD) samples from hyperdominant tree species were collected between 2014 and 2018 in permanent plots established along edge and interior habitats of ten CF patches. WD was determined as the ratio between oven-dry and fresh mass of wood samples, and carbon stocks were estimated using allometric equations. Significant differences in AGC were observed between habitats, with forest interiors storing 6919 tC, nearly twice the carbon accumulated at the edges (3599 tC).

At the edges, six species accounted for 51% of the total carbon stock, notably *Myrcia retorta* Cambess. (822 tC), *Myrceugenia bracteosa* (DC.) D.Legrand & Kausel (720 tC), and *Siphoneugena crassifolia* (DC.) Proença & Sobral (391 tC). In contrast, four species contributed to 49% of the carbon stock in the interiors, with *Myrcia retorta* being the most representative (2081 tC). These differences reflect a structural and functional shift from light-demanding pioneer species at the edges (characterized by lower wood density and smaller stem diameters) to late-successional species in the interiors, which present higher wood density, larger diameters, and greater shade and moisture tolerance. The findings highlight the importance of CFs as significant carbon sinks and reinforce the urgency of their conservation given their high vulnerability to climate change. Funding: FAPEMIG.

224 Evaluation of Planting Methods for Ecological Restoration in Brazilian Savanna Woodland

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Abstract

One of the bottlenecks for ecological restoration in the Brazilian Savanna Woodland is the scarcity of effective and economically viable techniques and methods. This study assessed planting techniques for woody species in Brazilian Savanna Woodland through a field experiment.

We conducted an experiment in March 2024 using a completely randomized design with eight replicates and two factors: five species (*Astronium fraxinifolium*, *Cecropia pachystachya*, *Dipteryx alata*, *Qualea grandiflora*, and *Tabebuia aurea*) and three treatments—transplanting seedlings germinated in plastic trays (TBJ), transferring paper cup-germinated seedlings (TCP), and direct sowing (TSD). Emergence was evaluated after 30 days, and survival after 12 months. Data were subjected to analysis of variance, following normality and homogeneity of variances tests.

Responses were species-specific, reinforcing the need for individualized approaches. TCP emerged as a technique while its logistical advantage and low cost make it extremely attractive for large-scale use, its reduced substrate volume (8.18 cm³) resulted in lower average survival (16.7%). This does not invalidate TCP but highlights the need for optimizations such as increasing substrate volume (40–100 cm³), adjusting container size, and testing alternative materials. *A. fraxinifolium* stood out as a generalist species with a high establishment rate (85.2%) and stability across treatments. *D. alata* behaved as a specialist, achieving higher establishment in TSD (91.3%). *Q. grandiflora* benefited from TBJ with a 73.7% establishment rate. Restoration in Brazilian savanna woodland should adopt flexible techniques, including optimized TCP and alternative materials, to maximize efficiency.

237 Vulnerability of Mangrove Soils to Copper Contamination in Climate Change Scenarios

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Abstract

This study addresses the growing concern over climate change and its impact on mangrove ecosystems, which are vital, highly biodiverse environments with a substantial carbon sequestration capacity due to their anaerobic soils. Mangroves are increasingly threatened by metal contaminants, such as copper Cu.

The primary objective was to determine how a predicted climate change scenario—specifically increases in temperature and salinity—alters the dynamics of Cu contamination in mangrove soils across different regions of Brazil (Espírito Santo and Ceará).The methodology involved collecting soils and subjecting them to three treatments simulating tidal conditions: 1) Control (30 PSU salinity), 2) Increased Freshwater Input, and 3) Increased Salinity (both at 40 PSU). Cu concentration was measured using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES).

The results showed a statistically significant difference in Cu adsorption compared to the Control 25.82 mg/g. Both increased freshwater input (reducing adsorbed Cu by 13.33mg/g and increased salinity (reducing it by 11.25 mg/g significantly lowered Cu adsorption.The

conclusion is that the climate change scenario will shift geochemical cycles, leading to lower Cu immobilization in the soil. This reduced immobilization threatens to decrease primary productivity and the mangrove's carbon stock. The study emphasizes the critical need for conservation actions, environmental education, and ecological restoration to maintain the resilience of these ecosystems.

241 Is Brazil Prepared for Local Climate Governance? A National Analysis of Municipal Laws

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Abstract

Local Climate Governance is the set of guiding policies that enable municipalities to address climate change and its impacts, implemented through specific legislation (laws, resolutions, normative instructions, etc.). Brazil has been facing frequent climate-related disasters, which challenge its local climate governance. In this study, we analyze the landscape of Brazilian municipal legislation related to Local Climate Governance.

We selected the 96 municipalities with the largest populations (>300,000 inhabitants) and examined their legislation up to the year 2024 (December). We collected legislation from official city hall websites and from the Brazilian municipal law database, using the keywords "climate change", "climatic change", and "climatic", excluding those that had been repealed.

In total, 1,401 laws were recorded, of which only 81 (5.8%) specifically addressed instruments of Local Climate Governance. Of the 96 municipalities analyzed, 41 (42.7%) had at least one law applied to Local Climate Governance. The main cities with such laws were highly populated capitals: São Paulo (n=11), Rio de Janeiro (n=5), Belo Horizonte (n=4), and Recife (n=4).

The Southeast region concentrated the largest number of laws (58.5%), with the state of São Paulo standing out with the highest number of laws (36.5%). Our results reveal a country that is not legally prepared to deal with the challenges of climate change, with Local Climate Governance policies being scarce, regionally unbalanced, and concentrated in major capitals. This highlights the need for a federal effort to encourage and consolidate Local Climate Governance policies. Funding: CNPq, CAPES, Fapemig.

247 Mechanisms and Stability of Soil Carbon Dynamics in Pure and Mixed Forests: a Review

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Abstract

Understanding how forest plantation composition influences soil carbon stability is critical for assessing the potential of managed forests to contribute to climate-change mitigation. Mixed-species plantations are increasingly promoted as a nature-based solution for enhancing productivity, biodiversity, and long-term carbon sequestration, yet evidence on their effects on soil carbon dynamics remains fragmented.

This work synthesizes current knowledge on the mechanisms governing soil carbon stabilization in pure versus mixed forest plantations, with particular attention to organic matter inputs, microbial processing, and soil physicochemical interactions. Using a systematic approach based on PRISMA guidelines, the review identifies studies that quantify soil

organic carbon stocks, fractions, turnover rates, and indicators of stability, including isotopic markers, respiration assays, and physical–chemical fractionation.

Emerging patterns suggest that mixed plantations often enhance carbon stability by increasing the functional diversity of litter and root inputs, promoting more complex microbial networks, and supporting the formation of mineral-associated organic matter. However, results vary across climatic zones, plantation ages, and species combinations, and methodological inconsistencies limit broad generalizations.

Knowledge gaps include the scarcity of long-term experiments, limited integration of microbial functional data, and insufficient differentiation between stable and labile carbon pools. The review highlights the need for standardized protocols and multidisciplinary approaches to better understand how tree diversity modulates soil carbon fate. Ultimately, it provides guidance for designing forest plantations with greater potential for durable carbon sequestration and informs policy and management strategies aimed at maximizing climate mitigation benefits.

267 Translocación de Cobre y Zinc entre Suelo y Agua en Zonas Ribereñas de Puyo, Pastaza, Ecuador

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Abstract

La translocación de elementos entre el suelo y el agua influye en las características de las fuentes superficiales de agua. El presente trabajo tuvo como objetivo determinar la variación de cobre y zinc en suelos cercanos a fuentes de agua superficial en la ciudad de Puyo, Pastaza, Ecuador. Se realizaron cuatro muestreos a profundidades de 0–15 cm y 15–30 cm en julio y septiembre de 2025, en suelos aledaños a los ríos Plata, Pambay y Pindo Chico. Se determinó la concentración de cobre y zinc mediante absorción atómica. Además, se realizaron cuatro muestreos de agua para determinar la concentración de estos metales.

Se realizó un análisis de varianza para determinar si existieron diferencias significativas entre sitios, profundidades y períodos de muestreo. Los resultados reportaron diferencias para $p \leq 0,05$ en los sitios y épocas de muestreo en la concentración de cobre y zinc. Las muestras tomadas aledañas al río Pindo Chico reportaron mayores valores, mientras que las obtenidas en el primer período de muestreo fueron mayores que las del segundo período.

Las muestras de agua reportaron mayores concentraciones de cobre y zinc en el río Pindo Chico y mostraron una disminución en las diferentes épocas de muestreo. Se concluye que existe movilidad de las concentraciones de cobre y zinc en el suelo según las fechas de muestreo, generándose un movimiento de estos metales hacia los cuerpos de agua, donde los sectores aledaños al río Pindo Chico y su cuerpo de agua mostraron mayores concentraciones de los metales señalados.

275 Xylopodia as “Underground Forests”: Growth Dynamics and Their Role in Subterranean Woody Carbon Accumulation

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Abstract

In savanna-like ecosystems such as the Cerrado, subterranean woody biomass contained in structures like xylopodia plays a fundamental role in the resilience of forest and shrubland formations against disturbances such as fire and drought. Referred to as “underground forests,” these perennial structures function as reservoirs of carbon and nutrients, enabling rapid resprouting after the aboveground biomass is burned. However, the growth dynamics and formation rates of this subterranean woody biomass remain poorly understood.

In this study, we investigated the annual patterns of woody biomass formation and carbon accumulation in the roots of *Campomanesia adamantium*, a Cerrado shrub. To achieve this, we calculated the Current Annual Increment (CAI) and the accumulated biomass per centimeter of root length. In 2023, six *C. adamantium* plants were collected from the Santa Bárbara Ecological Station, SP, Brazil. Transverse sections 1.5 mm thick were cut using a double saw and conditioned (stable humidity 12%). X-ray images were taken to extract density profiles and ring widths (WinDENDRO®). We analyzed growth data spanning 25 years (1998–2022).

On average, the roots accumulate 6.4 ± 3.4 g/cm of root length (or 3.0 ± 1.6 g C/cm of root length), at an average annual growth rate of 0.36 ± 0.10 $g \cdot cm^{-1} \cdot year^{-1}$. Although exploratory and based on X-ray density data and root disc diameters to estimate biomass and carbon accumulation per centimeter of length, assuming root cylindricity, the study acknowledges methodological limitations, such as diametric variation along the root. Nonetheless, the results highlight the high carbon storage potential in these subterranean organs.

276 Multidimensional Wood Density Variation Better Shapes Tropical Trees’ Lifetime Biomass Estimates

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Abstract

Accurately quantifying long-term aboveground biomass (AGB) in tropical forests is a challenge due to their high taxonomic diversity. Specific wood gravity (SWG), a key functional wood trait and strong AGB predictor, is constrained by limited species-level datasets. In the Amazon forest, where AGB estimates are important for climate–carbon feedbacks, forest inventories, and carbon markets, SWG is often estimated using community or species means from literature values. Such simplifications overlook intra- and interspecific variation linked to anatomical changes during tree growth. The extent to which this variation affects AGB estimates remains unclear.

Here, we examine radial SWG variation along the trunks of seven Amazonian tree species, sampling four radial directions at three trunk heights. Using high-resolution X-ray densitometry, we (i) quantified how species, individual trees, trunk height, and radial position contribute to total SWG variability; (ii) modeled SWG changes along the stem; and (iii) identified the main anatomical drivers of this variation. Species explained most of the SWG variation (88%), but individual trees and height position also contributed substantially at the species-specific level.

SWG followed polynomial trends both from pith to bark and from the base to the upper stem, though the steepness of these profiles differed among species. These species-specific radial patterns reflect anatomical shifts from juvenile to mature wood, driven by contrasting proportions of fibers and axial parenchyma. Overall, SWG variations are linked to species-specific xylem composition and growth strategies. This multidimensional variability in AGB models may better represent wood formation and carbon accumulation

over a tree's lifetime.

284 Amazonian Anthropogenic Soils as a Carbon Sequestration Strategy Against Climate Change, analysis in the Ecuadorian Amazon

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Abstract

Carbon dioxide emissions caused by deforestation and fires are creating a negative feedback mechanism in which soils shift from being carbon sinks to becoming sources of emissions, thereby exacerbating climate change. Amazonian Dark Earths (ADEs) are anthropogenic soils characterized by their high carbon content, which is chemically and microbiologically stable and can persist in the soil for centuries. The objective of this study is to quantify the amount of carbon that anthropogenic soils in the upper Ecuadorian Amazon can store in comparison with non-anthropogenic soils.

Three soil profiles ($\bar{x}$ = 2 m) with evidence of past human settlement were analyzed. Total organic carbon (TOC) was measured using the Loss on Ignition (LOI) method, and bulk density was determined using the core method. Carbon stocks of the ADEs were calculated, and physicochemical characteristics were also assessed, including elemental content of Ca, Mg, K, and P by X-ray fluorescence, as well as pH and electrical conductivity (σ).

The results indicate that ADEs exhibit a 15.5% enrichment in total organic carbon (TOC), and soil organic carbon (SOC) values show that this soil can store up to 64.55 Mg C/ha. A positive correlation was found between electrical conductivity and elemental concentrations, demonstrating the influence of human activity on nutrient enrichment in these soils. This research highlights the capacity of ADEs to sequester and preserve carbon over long time scales. Further studies on carbon dynamics and its interaction with ADEs are recommended.

286 What Controls Soil Organic Carbon in Patagonian Forests? Roles of Climate, Topography, Vegetation, and Management

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Abstract

Forests store a large share of soil organic carbon (SOC), yet the relative roles of climate, site conditions, vegetation attributes, and management remain unclear in high-carbon regions. We quantified SOC stocks (0–30 cm; tons ha^{-1}) across Chilean Patagonia, spanning forest types (*Nothofagus pumilio*, *N. antarctica*, *N. dombeyi–N. betuloides*, evergreen, and mixed broadleaved forests), soil types (Andosols, Entisols, Inceptisols, and Spodosols), and human impacts (unmanaged, burned, harvesting, livestock, and harvesting + livestock). SOC drivers included climatic, topographic, and above- and below-ground variables. We tested group differences using ANOVAs and generalized linear models (GLMs), and explored multivariate controls with principal component analysis (PCA).

SOC stocks differed among forest types, soils, and impacts ($p < 0.001$). Evergreen, *N. pumilio*, and *N. dombeyi–N. betuloides* forests showed higher SOC (>119 tons ha^{-1}) than mixed broadleaved and *N. antarctica* forests (~100 tons ha^{-1}). Spodosols and Inceptisols presented the greatest SOC among soil classes. Unmanaged and harvested forests had similarly high SOC (>125 tons ha^{-1}), and the *N. pumilio* × harvesting combination was associated with particularly high SOC stocks.

PCA separated (i) a climate–topography gradient driven by temperature seasonality and elevation, and (ii) local drivers including soil pH, canopy cover, decaying wood, vascular plant cover, and lichen cover. Together, these results show that SOC variability reflects both regional environmental gradients and within-stand biotic and edaphic conditions in temperate Patagonian forests. Overall, in this high-SOC Patagonian region, harvesting can maintain SOC stocks comparable to unmanaged stands; however, harvested systems integrating livestock warrant targeted management to safeguard soil carbon.

291 Interception of Photosynthetically Active Radiation in Forest Management Areas with Different Post-Harvest Ages in the Brazilian Amazon

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Abstract

Timber harvesting in Brazilian native forests notably alters floristic composition, primarily due to the creation of clearings that increase light availability for light-demanding species. However, studies on light interception in forest management areas are scarce. This study investigates the interception of photosynthetically active radiation (PAR) by the canopy in forest management areas of different post-harvest ages: 2, 5, 16, and 25 years. It was conducted in Itacoatiara, Amazonas, covering 646 hectares divided into five plots, one of which was left unharvested.

PAR interception (iPAR) was measured using two LP-80 ceptometers: one monitored constant light in an open area (PARt) and the other recorded measurements beneath the canopy (PARi) at grid points of 250 m by 250 m. The iPAR was calculated using the formula iPAR = (PARt − PARi) / PARt. Results were as follows: 0.939 for 25 years, 0.902 for 16 years, 0.925 for 5 years, and 0.886 for 2 years post-harvest.

The correlation between post-exploration age and iPAR showed a positive but weak and non-significant relationship (Spearman $\rho = 0.17$; $p = 0.14$). Older areas tended to have higher light interception, and the lack of significance is likely attributed to the spatial heterogeneity of light interception, which is common in reduced-impact logged tropical forests, as well as the limited age range sampled. Moreover, light interception in the understory differed significantly between the control forest and the logged areas (Wilcoxon test $p = 0.005$), indicating changes in canopy structure. Further studies should assess canopy changes and biodiversity data.

309 Evaluation of Agroforestry Restoration and Ecological Quality of a Riparian Zone in the Aysén Region

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Abstract

This study evaluated the ecological condition of a riparian site restored in 2008 in the Simpson River sub-basin, Aysén Region, Chile, using a combined approach of remote analysis and field ecological indices. Satellite images (Landsat-7 and Sentinel-2) and Google Earth Pro were used to analyse the evolution of vegetation cover and primary productivity at the site during the years 2008, 2018, and 2024, by calculating the Normalized Difference Vegetation Index (NDVI).

In addition, the Riparian Forest Quality Index (QBR) was applied in the field to assess the quality of riparian vegetation in the restored area and in a non-intervened downstream section. The results indicate a progressive improvement in the primary productivity of the restored area, reaching values close to 1 in 2024, especially in sectors near the stream, suggesting a functional recovery of the ecosystem.

The QBR index yielded a value of 55 (medium quality), influenced by the coexistence of native and exotic species such as *Salix* spp., which, although they fulfill important ecological functions, pose risks due to their invasive behaviour. In contrast, the non-restored riparian area obtained a QBR score of 25, indicating a degraded condition.

The study concludes that ecological restoration, even on a small scale, can significantly promote vegetation regeneration and ecological processes in riparian ecosystems. It is recommended to replace exotic species with native ones and to complement monitoring with biological indicators that allow for a comprehensive evaluation of the effectiveness of the restoration process.

24 20-Year Spatiotemporal Analysis of Land Use and Land Cover in a Southeastern Brazilian Watershed Reveals Forest Conservation Decline

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Abstract

The spatiotemporal dynamics of land use and land cover make it possible to understand landscape transformation processes and to verify compliance with current environmental legislation. This study aimed to analyze the spatiotemporal dynamics of land use and land cover over a 20-year period in the Benevente River Basin, Espírito Santo State, Southeastern Brazil. Land use and land cover maps from 2002, 2012, and 2022 were obtained from the MapBiomas Project (Collection 9) and processed using QGIS software.

The results revealed landscape transformations throughout the analyzed period. Between 2002 and 2012, there was an increase in the classes Forest Formation (+1,180.62 ha), Forest Plantation (+311.94 ha), Wetland (+193.05 ha), Mangrove (+56.25 ha), Mosaic of Uses (+3,926.61 ha), and Urban Area (+71.28 ha), along with a decrease in Pasture (−4,876.47 ha) and Coffee (−908.55 ha). From 2012 to 2022, Forest Formation (−625.95 ha), Forest Plantation (−14.04 ha), Wetland (−89.28 ha), and Pasture (−2,280.87 ha) decreased, whereas Mosaic of Uses (+2,398.95 ha), Urban Area (+67.41 ha), Mangrove (+13.23 ha), Coffee (+409.77 ha), Other Perennial Crops (+20.88 ha), and Wooded Sandbank Vegetation (+2.16 ha) increased.

These results highlight the intense landscape transformation in the region, with a marked reduction in Forest Formation and an expansion of agricultural areas, even after the enactment of the New Brazilian Forest Code in 2012 (Law No. 12,651/2012). Such transformations reinforce the need for advances in the enforcement of Brazilian forest legislation and for management strategies that reconcile socioeconomic development with environmental conservation.

19 Influence of GEDI Vegetation Penetration on Canopy Height Estimation

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Abstract

In tropical regions, moist forests play a major role as carbon storage reservoirs. Accurate measurement of aboveground biomass (AGB) within these forests is crucial for assessing their carbon sequestration potential. Light Detection and Ranging (LiDAR) technology is well-suited for characterizing forest height and structure. The Global Ecosystem Dynamics Investigation (GEDI) is a spaceborne LiDAR system specifically designed to measure vegetation's vertical structure at a global scale. In the tropical context, GEDI encounters difficulties in characterizing forest parameters due to dense and complex canopy structures. GEDI's capability to accurately measure canopy height is directly linked to the signal ability to penetrate the canopy and detect the ground. Beam GEDI tends to underestimate high heights, since this height range is generally associated with denser canopies that are more challenging for the signal to penetrate.

This study evaluates GEDI's canopy height estimation accuracy in dense tropical forests located in Mayotte Island. It examines GEDI's ability to penetrate canopies and detect the ground, which is crucial for reliable estimates. In the context of our study, GEDI tends to underestimate heights above 15 meters. LiDAR beam penetration capability is strongly dependent on forest characteristics and penetration depth can differ between forests with the same height and biomass levels. This study shows that the use of GEDI data for estimating forest characteristics (height, biomass) may prove insufficient in some cases with high uncertainties for high biomasses.

25 Geospatial Techniques Applied to the Mapping and Prevention of Wildfire Risk in Altamira, Pará

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Abstract

In Brazil, forest fires are a recurring phenomenon, and the state of Pará is one of the most impacted, with 106,012 hotspots recorded between 2021 and July 2023. Given this scenario, this study aimed to propose a forest fire risk mapping model for the municipality of Altamira, in the state of Pará, Brazil.

The following variables were considered: biological (Land Use and Cover and Normalized Difference Vegetation Index), socioeconomic (proximity to roads and population density), meteorological (Earth's surface temperature), and physical (altitude, slope, and relief orientation). The methodology adopted was the Analytic Hierarchy Process, and validation occurred through the analysis of fire scars (burnt area and hotspots). Accuracy was assessed by intersecting these variables with the combination of high- and very-high-risk area classes, resulting in Forest Fire Risk (FRI) modelling, processed in QGIS version 3.22.

The Total Residual Scale, the Mean Absolute Error (MAE), and the Normalized Residual Index (NRI) were calculated by comparing the fire risk estimates from the National Institute for Space Research (INPE) with the FRI values. The best scenario with the highest accuracy was T5 (69.30 %), while for hotspots it was T4 (21.52 %). To validate hotspots against INPE estimates, the MAE was 0.38 and the NRI was 0.55. The AHP method proved

effective in distinguishing scenarios within the risk classes, demonstrating efficiency in estimating forest fire risk.

Thus, mapping risk areas in Altamira contributes not only to reducing the environmental and socioeconomic impacts of fires but also to strengthening preservation and conservation efforts in the Amazon.

45 The Impacts of Biolegacy Management on Forest Restoration, Succession, and Future Disturbance

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Abstract

Forests and forest restoration play a critical role in combating climate change, environmental degradation, and biodiversity loss. Global initiatives such as the Bonn Challenge and the Trillion Trees project aim to restore millions of hectares of deforested and degraded landscapes. However, the current approach of mass tree planting has proven ineffective in achieving restoration goals.

This study explores the potential of biological legacy management as an alternative and effective strategy for forest restoration. Biological legacies, including living organisms and organic debris left after a disturbance, have been shown to enhance ecological recovery. This study aims to analyze the effects of biological legacies on native tree regeneration, understand their influence on forest succession, and examine their role in limiting future disturbances.

Three hypotheses are proposed, focusing on the increased presence of biological legacies leading to enhanced regeneration, natural succession, and reduced future disturbances. The study will be conducted in locations affected by severe disturbances, collecting data on tree growth, species composition, and post-disturbance events. The findings will contribute to the growing understanding of biological legacies and their management in forest restoration, providing valuable insights for effective restoration practices.

67 Effect of Selective Harvesting on Richness and Diversity of a Secondary Forest in the Brazilian Atlantic Forest

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Abstract

Secondary forests (SF) are largely considered ecologically impoverished and limited for timber production. However, recent studies are changing this notion, although the impacts of logging are still unknown. This study analysed short-term impacts of selective timber harvesting on the tree diversity of a 41-year-old SF.

Over a 12-year study period, 15 plots (1,600 m² each) were monitored, comparing the dynamics of diversity before and after tree logging. We analysed changes in species richness, Sørensen similarity (Ss), and importance value (IV) as a function of post-harvest residual basal area (RBarea) and harvesting intensity (HarvInt; 18–56%), using non-linear models.

We measured 6,095 trees representing 220 species; initial species richness was strongly correlated with forest density ($\beta = 26.35$, $p = 0.009$). Before harvesting, richness increased from 168 to 189 species. The 2014 harvest removed 806 individuals from 98 species. Seven years later, richness increased to 193 species, a change more correlated with RBarea ($\beta = -15.58$, $p < 0.001$) than with HarvInt ($\beta = 0.047$, $p < 0.001$).

Sørensen similarity (Ss) ranged from 0.90–1.00 in the pre-harvest period and 0.72–0.93 after harvesting, with positive correlation with RBarea (β = 0.229, p < 0.001) and negative correlation with HarvInt (β = -0.003, p = 0.004). A group of 16 species dominated the forest over the 12-year period, with emphasis on *Hieronyma alchorneoides* and *Euterpe edulis*.

Harvesting promoted an increase in species richness and heterogeneity while maintaining the dominance of a few species, reflecting resilience and modest turnover.

68 Drivers of Forest Dynamics After Selective Harvesting of Tropical Secondary Forests in Brazilian Atlantic Forest

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Abstract

Tropical secondary forests (SF) can produce quality timber, but the effects of selective harvesting on forest dynamics remain insufficiently understood. This study evaluated whether timber harvesting stimulates higher growth rates of residual forests and assessed the roles of residual basal area (RBArea) and harvesting intensity (HarvInt) as drivers of post-harvest dynamics.

A 41-year-old SF was monitored over a 12-year period using 15 permanent plots, including pre- and post-harvest periods. We examined density, recruitment, mortality, tree dbh growth (RDGR), and periodic annual increment (PAI) of basal area (BA) and stem volume (SV), relating them to RBArea and HarvInt (18–56%) using non-linear models.

Pre-harvest tree density (1642 to 1765 tree ha^{-1}) changed to 1437 to 1653 tree·ha^{-1} after harvesting, with an increase rate of 31 tree·ha^{-1}. Density was negatively correlated with RBArea and was better explained by HarvInt. Recruitment and mortality increased after harvesting, both driven by RBArea.

Harvesting also promoted a higher RDGR (0.017 cm·cm^{-1}·$year^{-1}$), which was correlated with RBArea and HarvInt. PAI (BA and SV) were driven only by HarvInt. PAI-BA rose from 1.17 to 1.87 m^2·ha^{-1}·$year^{-1}$, and PAI-SV from 9.04 to 13.19 m^3·ha^{-1}·$year^{-1}$ after harvest.

Harvesting had a positive impact on the residual forest, suggesting the potential of secondary forests to replenish harvested volumes for a subsequent cutting cycle. RBArea and HarvInt are key drivers of forest dynamics and may become useful indicators in harvesting prescriptions.

78 The Poor Governance of Forest Zones in North-East Nigeria: A Nexus of Environmental Degradation and Security Challenges

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Abstract

Poor governance of forest zones in North-East Nigeria has created ungoverned spaces, significantly exacerbating security challenges and intensifying the impacts of climate change. This crisis is of concern, as rampant deforestation contributes directly to local climate vulnerability and environmental degradation, while insecurity has resulted in the loss of numerous lives, including civilians, security personnel, and government workers.

A review of recent literature and data reveals Nigeria's substantial loss of tree cover—1.44 million hectares (Mha) between

2001 and 2024, representing a 14 % decrease. The North-East region is particularly vulnerable due to its semi-arid climate and heavy reliance on forest resources. Forest destruction accounts for 93 % of this loss, underscoring the severity.

This paper investigates the interplay between poor governance, human environmental impact, and escalating security threats in Nigerian forest zones, focusing on local realities. Employing a mixed-method approach—including oral interviews, newspaper reviews, and pictorial evidence—the study identifies key drivers of insecurity such as illicit logging and agricultural expansion. These activities are often driven by extreme poverty and ineffective government policies.

Findings indicate that outdated forest management policies, weak enforcement, and the marginalization of local communities have allowed criminal gangs and insurgents to exploit forest areas as safe havens. To address this, the paper advocates for a multi-faceted corporate social responsibility model that underscores the critical roles of NGOs and security agencies in strengthening governance. Proposed solutions include the deployment of well-equipped Forest Guards and the implementation of community-inclusive management strategies.

181 Beyond Demographics: Socio-Environmental Profiles Based on Relational Values for Sustainable Territorial Management around Cerro Castillo National Park / Más allá de los datos sociodemográficos: Perfiles socioambientales basados en valores relacionales para la gestión territorial sostenible en los alrededores del Parque Nacional Cerro Castillo

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Abstract

Land use change is the main direct driver of terrestrial biodiversity loss and a critical threat to temperate forests. Around Cerro Castillo National Park, in Aysén, Chilean Patagonia, rural subdivision intensified rapidly between 2011 and 2023. This threatens native forest continuity through habitat fragmentation and change in local socioecological dynamics.This exploratory study analyzed the contribution of relational values in the differentiation and interpretation of socioenvironmental profiles of landowners surrounding the PNCC, constructed from sociodemographic variables and property-related patterns, in the context of intensified rural subdivision. Multiple Correspondence Analysis and Hierarchical Clustering were applied to 120 cases, using purposive sampling, comparing two models: (A) one based only on sociodemographic variables and property-related patterns, and (B) another that also incorporated relational value as variables. Model A identified four profiles structured by socioeconomic variables and property acquisition. In contrast, Model B revealed three different configurations according to property acquisition and a relational values axis. These findings suggest that relational values provide a relevant interpretive dimension for understanding landowners' motivations and socio-ecological orientations. If confirmed in studies with representative samples, they could inform participatory forest conservation and management strategies aimed at reducing threats to native forests, including wildfires, invasive species, livestock pressure, and emerging urbanization impacts in mixed public-private landscapes.

208 Land Governance and Deforestation in Undesignated Public Forests in Southern Amazonas

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Abstract

We investigated the relationship between land governance and deforestation in Undesignated Public Forests (UPF) in Apuí, Boca do Acre, Canutama, Humaitá, Lábrea, Manicoré, and Novo Aripuanã, municipalities in Southern Amazonas, during the period of 2019–2024.

We performed intersections between land data (CNFP, SIGEF, Federal Public Land Database) and deforestation data (PRODES/INPE). There is a lack of conceptual standardization, with a negative impact on deforestation combat strategies.

We identified 5.773 land regularization titles issued (733.775.21 hectares). 3.4% of public land has been titled, with 95.3% of titled parcels allocated to smallholders; this distribution highlights the socioeconomic vulnerability of the beneficiaries of the land regularization policy, mainly attributable to the lack of an adequate technical assistance framework.

The peak of deforestation occurred in 2022, with 223,341.08 hectares deforested. PPCDAM reinstatement as an enforcement mechanism resulted in a significant reduction in deforestation.

However, the municipalities of Apuí, Boca do Acre, Lábrea, and Manicoré showed an increase in the percentage of deforestation within FPND (National Forest Protection Area). Humaitá and Novo Aripuanã showed a decrease.

The municipality of Canutama, where we identified the highest presence of privately owned properties certified in SIGEF within FPND, showed the largest percentage decrease, as well as the lowest rate of deforestation within FPND (28.08%).

Of the total hectares deforested in the region, approximately 60.29% is within FPND, linking land tenure control absence to deforestation increase.

209 Fine-Scale Climates Shape the Behavioural Flexibility of the Red Fox in Mediterranean Urban Forests

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Abstract

Urbanisation profoundly transforms ecological dynamics, yet the influence of fine-scale urban microclimates on wildlife behaviour remains poorly explored.

In this work, we investigated how Local Climate Zones (LCZs) structure the temporal and behavioural patterns of red foxes *Vulpes vulpes* within the metropolitan area of Florence, central Italy. Using camera-trap data collected across 22 stations from 2023 to 2024, we quantified activity rhythms, behavioural budgets, and inter-zone overlap.

Foxes displayed marked spatiotemporal plasticity, with some LCZs exhibiting activity peaks at sunset and others during the late night, reflecting differing levels of human disturbance, artificial lighting, and microclimatic conditions. Activity overlap among LCZs ranged widely (37–95%), highlighting the heterogeneity of behavioural strategies across the urban mosaic.

Compared with a natural reference site, urban foxes increased vigilance and locomotion while reducing resting and foraging behaviours, indicating heightened environmental unpredictability and the need for constant scanning in built environments.

Behavioural refuge zones, located in particularly suburban LCZ forests, supported more diverse activity. Our findings showed that LCZs may offer a powerful framework for linking microclimatic structure with wildlife behavioural responses.

Integrating LCZ mapping into urban planning may enhance coexistence by identifying areas that buffer behavioural stress

and promote biodiversity within rapidly warming cities.

211 Comparative Evaluation of Five Drought Models for Tracking Vegetation Moisture Content in Two Mediterranean Broadleaf Forests

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Abstract

Vegetation water content is a key indicator of plant physiological status and ecosystem functioning, and it plays a critical role in determining vegetation flammability and wildfire dynamics.

In Mediterranean environments, moisture content of live fine fuels (LFF)—including shrub vegetation and live foliage—is strongly influenced by meteorological variability and drought, yet field-based datasets that capture local adaptation and phenotypic plasticity remain scarce.

This study presents two years of field measurements of moisture content in several fine-fuel species within two forest stands in Tuscany (Italy): a *Quercus ilex* L. plot and a mixed broadleaved forest. The selected species represent two vegetation groups (shrubs and trees) characterized by marked seasonal and interannual variability typical of Mediterranean ecosystems.

Meteorological data from nearby weather stations were collected for each study area and used to compute fuel-moisture indicators, including the Drought Code (DC) from the Canadian Forest Fire Danger Rating System.

Results show that during the summer period the slow response of live fine fuel moisture content (LFMC) to meteorological forcing—particularly to precipitation—is effectively captured by the DC.

The analysis further highlights the potential of the DC to represent vegetation drought stress in live fuels when supported by locally observed moisture data. Empirical relationships between LFMC and DC are proposed for each species and site, offering useful insights for improving fuel moisture estimation and wildfire danger assessment in Mediterranean landscapes.

215 Land Governance and Spatial Overlaps: A Challenge for Brazilian Amazon Conservation

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Abstract

Land use and designation as Conservation Units (UC), Indigenous Lands (TI), and Quilombola Territories (TQ) reduces deforestation compared to private land use. Type B Public Forests (TBF) are federally acquired lands that remain undesignated. These encompass Federal Public Lands (FPL) awaiting formal designation as UC, TI, or TQ, rendering them susceptible to land grabbing and illegal deforestation.

This study quantifies the spatial overlap among FPL, TBF, and Rural Environmental Registry (CAR) areas in all municipalities in Pará state, Brazil. We used Land Management System (SIGEF/INCRA) data and geoprocessing to assess the overlaps in all municipalities in the state of Pará, Brazil.

82 municipalities showed 63,903 km² of overlap between TBF/PFL, representing 6.10% of the municipalities' total area. Six municipalities exhibited overlaps exceeding 20%, with two surpassing 40%.

Additionally, 223,000 km² of CAR/PFL overlap was identified in 85 municipalities, corresponding to 21.31% of their total area. Average municipal overlap of CAR/PFL was 35.13% (SD=28.4%). 27 municipalities showed overlaps > 50% of their area, including two with > 90%.

As TBF is a land registry, and not necessarily illegally deforested standing forest, these overlaps biases the classification of what constitutes illegal deforestation and deforestation within political, legal, and environmental legality.

These overlaps may lead to analytical errors by duplicating overlapping areas within federal databases, and potentially incentivize deforestation within FTB, where 36.5% of Amazon deforestation in 2023 was registered.

Addressing these spatial overlaps is critical for enhancing land governance, improving deforestation monitoring, and strengthening conservation policies.

220 Efectos de un Incendio Forestal en la Dinámica del Material Leñoso de Gran Tamaño en el Corredor Fluvial de la Cuenca de Pichún, Nacimiento

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Abstract

En febrero de 2023 miles de hectáreas de bosque fueron afectadas por incendios forestales en el centro de Chile. Estos eventos modelan la geomorfología, modificando los regímenes de agua, sedimentos y madera. El Material Leñoso de Gran Tamaño (LW) es clave para la dinámica fluvial y perturbaciones como los incendios pueden alterar su distribución, almacenamiento y transporte. Sin embargo, en Chile y el mundo limitados estudios abordan la respuesta inmediata de las dinámicas de madera posterior a incendios forestales.

En el corredor fluvial de la cuenca de Pichún (431 ha), ubicada en la región del Biobío, se analizó la respuesta en los patrones de LW tras haber sido afectada por los incendios de alta magnitud de febrero de 2023. Mediante campañas anuales (2017–2024), se caracterizó el LW presente en un segmento de 1 km, registrándose diámetro, longitud y agregación. Asimismo, se monitoreó la movilidad y distancia recorrida.

En el período pre-incendio, las acumulaciones de LW variaron entre 1 y 5 por año y las dimensiones de las piezas se mantuvieron relativamente estables. En el período post-incendio, el número de piezas disminuyó inicialmente un 36.7% respecto a 2022, pero aumentó 73.2% en 2024. Ese año se registraron 13 acumulaciones y un volumen total de 33.6 m³, equivalente a un incremento del 130.1% respecto al período pre-incendio.

Comprender estas dinámicas es fundamental para la gestión de cuencas, pues las acumulaciones de LW no solo influyen en el riesgo hidráulico, sino que también generan hábitats, retienen sedimentos y aportan heterogeneidad ecológica.
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231 Light Quality on the Forest Floor in Harvested *Nothofagus pumilio* Forests: Differences at the Microsite Level

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Abstract

Forest harvesting generates a significant increase in solar radiation reaching the ground, altering environmental conditions at the understory level. In *Nothofagus pumilio* forests, seedling regeneration performance are influenced, among other factors, by available light. In this context, management of the factors that determine light availability and quality is essential for optimizing regeneration under different environmental conditions. The objective of this study was to evaluate the variation of light wavelengths reaching the forest floor in the presence or absence of different understory species, to identify whether differences in coverage could potentially affect regeneration.

In 36 plots, canopy cover was measured using hemispherical photographs taken in January above the understory layer; in addition, UVA and UVB radiation, red to far-red ratio (R:FR), photosynthetically active radiation (PAR), and global radiation were recorded. The understory was visually classified as low cover, high cover, or no cover (controls). We assessed correlations and fit generalized linear models.

Results showed that when understory vegetation was absent, canopy cover was negatively related to PAR, UVA, and UVB radiation, and positively related to the R:FR. This pattern changed in the presence of understory cover: global radiation, PAR, and UVA in vegetated microsites resembled values found in unharvested forests with high canopy cover more closely than those measured in harvested sites without understory ($F > 3.46$; $p < 0.028$), while UVB and the R:FR did not show significant differences. This information allowed us to characterize light conditions under different understory covers, which could be manipulated to favour regeneration.

234 Transporte de Materia Orgánica Durante Tormentas: El Rol de los Bosques Templados en Patagonia Norte

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Abstract

Los bosques templados son la principal fuente de materia orgánica (MO), en sus formas de particulada gruesa (MOPG) y disuelta (MOD), para los ecosistemas fluviales, regulando los ciclos de carbono, nutrientes y la calidad del agua. Se evaluó la exportación de MO durante diez eventos de tormenta (septiembre 2022 – agosto 2023) en una cuenca de la Patagonia norte dominada por bosque nativo (79,2%). La MOPG se recolectó mediante trampas tipo Bunte en el cauce, mientras que la MOD, el carbono orgánico disuelto y los nutrientes (N, P) se analizaron en muestras de agua.

Los resultados indicaron una alta estacionalidad, donde las tormentas de otoño favorecieron el ingreso de MOD, mientras que las de invierno movilizaron mayores cargas de MOPG. Hidrológicamente, el transporte mostró una respuesta inmediata al pulso del caudal, evidenciada por un índice de histéresis cercano a cero. Estos valores bajos indican que la disponibilidad de MO se agota rápidamente o que el transporte está limitado por la capacidad de transporte del flujo más que por la oferta de fuentes terrestres, manteniendo concentraciones bajas en ambas fases del hidrograma.

Se concluye que el bosque nativo actúa como un regulador crítico del flujo de carbono y nutrientes hacia los ecosistemas acuáticos. Este rol es esencial para el soporte de las funciones ecológicas fluviales y la provisión de servicios ecosistémicos, asegurando la resiliencia de las cuencas hidrográficas frente al incremento de eventos extremos derivados del cambio global.

251 Ganancia Genética Esperada de *Dipteryx ferrea* (Ducke) en Plantaciones de Ucayali, Perú

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Abstract

El presente estudio de investigación tuvo como objetivo la estimación de ganancia genética de la especie *Dipteryx ferrea* (Ducke), de plantaciones forestales de la Estación Experimental Alexander Von Humboldt del INIA (7, 10, 15, 21 y 22 años) y de la empresa Bosques Amazónicos BAM (17–20 años), ubicadas en Ucayali, Perú.

La metodología se basa en la selección fenotípica de los árboles plus, a través del método de comparación de mejores árboles vecinos en un radio de 20 m, en relación al diámetro a la altura del pecho (DAP), altura comercial, volumen comercial y calidad de fuste.

El estudio permitió seleccionar a 23 y 139 árboles más para el INIA y BAM respectivamente, de los cuales 7 y 23 pertenecen a la lista “A”, siendo árboles comerciales superiores en volumen y calidad en comparación a sus vecinos), y 16 y 116 pertenecen a la lista “B”, árboles superiores para la población de mejoramiento.

En relación a la ganancia genética esperada, se obtuvo un promedio de 7.5% y 8% para DAP, 30.8% y 31.8% para volumen y 0.9 y 1.4% para Calidad de la madera, para el INIA y BAM respectivamente. Estos resultados constituyen una primera aproximación para el establecimiento de un futuro Programa de Mejoramiento Genético de la especie en el Perú.

258 Community Participation in the Spatial Prioritization of Ecosystem Services for Climate Adaptation in Socioecological Systems

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Abstract

Central America faces increasing challenges from climate change. In northern Guatemala, the Lachuá Ecoregion confronts high climate vulnerability compounded by limited availability of local and technical data for ecosystem service based adaptation planning. This study employs participatory methodologies to identify ecosystem service provision areas with potential for Nature-based Solutions (NbS), integrating community knowledge with technical analysis.

Nine participatory workshops were conducted across three communities encompassing tropical humid forests and wetlands, combining qualitative and quantitative methods, including community mapping exercises, with remote sensing analysis to assess climate vulnerabilities and identify priority areas for NbS implementation.

Results revealed differentiated vulnerability patterns by ecosystem type providing ecosystem services. Soils without vegetation cover showed the highest sensitivity during drought events, while karst areas were affected by the combination of high temperatures and water deficit. Wetlands and freshwater systems proved especially vulnerable to torrential rainfall and extreme events, with water recharge emerging as a priority adaptation target.

Communities prioritized agroforestry, silvopastoral systems, riparian forest restoration and reforestation with native species, whose intervention areas were spatially mapped emphasizing water regulation and landscape connectivity. These findings demonstrate that participatory spatial pre-screening is a necessary step prior to NbS implementation in data-limited contexts, and that integrating community knowledge into technical prioritization frameworks is essential to secure ecosystem services in the face of climate change.

280 Rodalización Forestal mediante Uso de Algoritmo Random Forest en la Reserva Nacional Coyhaique, Región de Aysén

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Abstract

La rodalización es el proceso de dividir áreas heterogéneas en unidades más pequeñas que comparten características similares, tales como composición de especies, estructura del bosque y topografía. Esta constituye una etapa clave para la planificación y gestión en áreas protegidas, especialmente en territorios heterogéneos como la Reserva Nacional Coyhaique, donde la variabilidad ambiental y estructural dificulta la delimitación de unidades homogéneas mediante métodos tradicionales. En este contexto, los métodos de clasificación de rodales basados en *machine learning* han demostrado un alto potencial para la delimitación objetiva y consistente de unidades homogéneas en grandes extensiones, permitiendo integrar diversas fuentes de información espacial.

Con el objetivo de realizar una rodalización efectiva en la Reserva Nacional Coyhaique, se utilizó el algoritmo Random Forest como método de clasificación supervisada, empleando variables espectrales derivadas de imágenes satelitales Sentinel-2. Este algoritmo permite clasificar unidades del territorio a partir de la combinación de múltiples reglas de decisión, mejorando la estabilidad y precisión de los resultados frente a la heterogeneidad ambiental presente en el área de estudio. La validación de los resultados se realizó mediante visitas a terreno y fotointerpretación de imágenes de alta resolución, confirmando una concordancia entre rodales modelados y condiciones observadas, lo que demuestra que Random Forest es una metodología confiable para apoyar la gestión y monitoreo forestal en zonas de gran extensión como lo es la Reserva Nacional Coyhaique.

281 Bosques Fiscales Productivos Puestos en Valor a través de los Planes de Ordenación Forestal, un Plan Piloto para la Región de Aysén en el Sector Lago Frío de la Comuna y Provincia de Coyhaique

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Abstract

El objetivo es mejorar la gestión forestal de los bosques fiscales en la región de Aysén a través de la ordenación forestal. En la región existen 35 arriendos de terrenos fiscales, con una superficie involucrada de cerca de 2.800 ha; de esta superficie, los bosques representan cerca del 90%. El Plan de Ordenación Forestal, como instrumento de planificación de mediano plazo, permitirá manejar de forma sustentable y sostenible el patrimonio forestal fiscal, permitiendo que los interesados conozcan el recurso al cual postulan, sepan cuáles serán sus ingresos económicos y puedan planificar sus inversiones, así como conocer de antemano sus responsabilidades y deberes con el recurso forestal que intervendrán.

Por otra parte, el Fisco, a través del Ministerio de Bienes Nacionales, conocerá o podrá fijar de manera más acertada el valor del arriendo del bosque al conocer los volúmenes y plazos en los que se deben obtener. En general, los bosques fiscales en Aysén se ubican en las cabeceras de cuencas y en sitios de baja accesibilidad, por lo que es primordial que el manejo permita obtener de forma sostenida madera de alto valor.

Por otra parte, esta innovación en la gestión de los bosques fiscales asegura la mantención

de los servicios ecosistémicos que estos bosques prestan en la actualidad y que estos sean acrecentados a través de una gestión técnica en la que el Estado se encuentra presente.

288 Virulence Variability on Ash Branches and Rachises among Hymenoscyphus fraxineus Populations from the Italian Peninsula

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Abstract

Ash dieback caused by the invasive fungus *Hymenoscyphus fraxineus* poses an escalating threat to European ash forests, particularly in the Italian peninsula. However, the adaptive potential of the pathogen in southern European regions remains poorly understood under fluctuating environmental conditions. This study aimed to quantify the virulence variability among Italian populations of *H. fraxineus* across different host tissues. Samples were collected from symptomatic *Fraxinus excelsior* along the distribution of ash populations, and fungal strains were identified by nuclear and mitochondrial loci sequencing.

Controlled inoculations were conducted using isolates originating from the Italian peninsula on two key tissues: detached ash branches and leaf rachises of *Fraxinus excelsior*. Virulence was assessed by measuring lesion elongation, necrotic tissue development, and symptom progression over time. The phenotyping results revealed substantial variability in virulence among isolates. This variation provides critical information on trait means and ranges for characteristics relevant to pathogen adaptation.

The performance observed on branches and rachises suggests potential tissue-specific adaptation, which may influence natural infection dynamics. This phenotypic variability observed within and among populations from Italy could reflect underlying evolutionary processes and may be associated with the genetic diversity of these southern populations. Understanding this virulence landscape is essential for developing accurate models of pathogen spread and impact, and for assessing the specific risk posed to conservation-priority ash populations in southern Europe. Consequently, phenotypic diversity represents a key factor for predicting and managing the future ecological impact of ash dieback under ongoing environmental change.

297 Precision Nutrition to Reduce Nitrogen Pollution in the Climate–Biodiversity–Water–Food Nexus: Metabolomics-Based Insights from Livestock Systems

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Abstract

In the Anthropocene, nitrogen emissions from livestock production are a major source of environmental pollution, threatening soil and water quality and reducing the capacity of forest–agricultural landscapes. Within the Climate–Biodiversity–Water–Food Nexus, improving nutrient-use efficiency in food production systems is essential to reduce environmental trade-offs while sustaining food security.

This study investigates the potential of precision nutrition, supported by untargeted metabolomics, to mitigate nitrogen losses through refinement of the ideal protein concept. Rabbits were used as a model livestock system to evaluate metabolic responses to amino acid imbalance. Two experimental diets were tested: a methionine-balanced diet and a methionine-limiting diet. Blood samples were collected under contrasting feeding conditions to capture both dietary and temporal effects on systemic metabolism, and plasmatic urea nitrogen was measured as an indicator of nitrogen-use efficiency.

Diet composition and feeding dynamics significantly modulated the metabolomic profile, with clearer differentiation between diets. Several metabolites, including pseudourine, citric acid, pantothenic acid, and enterolactone sulfate, emerged as promising biomarkers associated with improved amino acid utilization and reduced nitrogen waste. By supporting the development of nutrient-efficient feeding strategies, metabolomics-based precision nutrition offers a pathway to reduce diffuse nitrogen pollution from livestock systems. Such approaches can contribute to safeguarding soil and water-related ecosystem services, supporting biodiversity, and enhancing the sustainability of multifunctional landscapes where food production and forest conservation coexist within the Climate–Biodiversity–Water–Food Nexus.

298 Non-Invasive Metabolomics Identifies Potential Biomarkers for Nutritional Monitoring in Wildlife

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Abstract

Assessing the nutritional status of wild animals is difficult because traditional sampling methods are invasive and stressful. In this study, we explored the use of urinary metabolomics as a non-invasive approach to monitor protein status, using rabbits as a controlled model. Two diets were tested: one providing optimal protein levels and another slightly below the recommended level.

Urine samples (n = 40) were collected from 20 animals after a brief period of food restriction and subsequent refeeding. Metabolomic analysis revealed clear differences between diets, with several metabolites—including enterolactone sulfate—emerging as potential markers of protein utilization. These metabolites reflected subtle changes in systemic metabolism associated with dietary protein intake, demonstrating that urine can provide a sensitive, non-invasive measure of nutritional status.

This work highlights the potential of urinary metabolomics to develop simple biomarkers that could be applied to wildlife. By enabling the monitoring of protein status without

handling animals, this approach can support conservation efforts, inform ecosystem management, and help maintain the health of animal populations in landscapes where wildlife coexists with human activities. Urinary metabolomics offers a practical path to link nutrition, health, and ecosystem monitoring in multifunctional landscapes.

306 Management and Monitoring of Riparian Forests and Biological Refuges Surrounding the Itaipu Binacional Reservoir

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Abstract

The riparian forest and biological refuges surrounding the Itaipu Binacional Reservoir form one of the most important continuous ecological corridors in Latin America, connecting Iguaçu National Park to Ilha Grande National Park in Brazil. The restored forest plays a key role in maintaining ecological processes that protect the reservoir from erosion, ensuring both water quantity and quality for multiple uses, in addition to supporting the generation of clean and renewable energy.

On the Brazilian side, the management of approximately 34,000 hectares of forest distributed along a 1,397 km perimeter combines continuous field presence, close engagement with neighboring communities, and the use of advanced geotechnologies. Key tools include mobile real-time data collection systems, drones for mapping and monitoring, and spatial analysis platforms that enhance diagnostic and response capabilities.

In 2025 alone, monitoring teams covered 1,730 km on foot and 7,100 km by vehicle and boat around restored areas, conducting more than 2,400 georeferenced site inspections. Over more than four decades of restoration and corridor management, the integration of these technologies has increased monitoring effectiveness, improved the detection of sensitive areas, and strengthened wildfire prevention and suppression strategies, among other important outcomes.

Beyond technological advances, accumulated experience demonstrates that direct engagement with more than 2,700 neighboring landowners remains essential. This relationship fosters trust, promotes appropriate land use, and helps prevent boundary-related impacts. The integration of technology, field-based management, and community participation therefore consolidates effective environmental governance, contributing to water security and biodiversity conservation within the Atlantic Forest biome.

307 Land Governance and Territorial Overlap in Conservation Units in the State of Rondônia

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Abstract

This study analyzes the governance challenges and inter-institutional articulation gaps that compromise the management of land tenure overlaps in Conservation Units (Unidades de Conservação - UCs) in the state of Rondônia. The region faces a scenario of legal uncertainty, territorial conflicts, and environmental degradation stemming from a historically

unequal agrarian structure. The research is based on legal frameworks, such as Law No. 9,985/2000 (SNUC) and Law No. 11,952/2009, in addition to the mapping of official geospatial data.

In the state, 81 UCs were identified, totaling approximately 6 million hectares. Of this total, the overlap of 1.2 million hectares of Indigenous Territory within UCs stands out, creating a legal incompatibility between the Strictly Protected regime and the original rights of indigenous peoples. As a consequence, this situation compromises the effectiveness of environmental enforcement.

The scenario is aggravated by the absence of Management Plans in 55% of federal Strictly Protected UCs, which prevents effective zoning and conflict mediation, making the development of an enforcement and monitoring plan unfeasible. This legal uncertainty not only impedes effective management but also generates an environment of fear and uncertainty for local communities, severing their affective and traditional connections to the territory.

It is perceived that legal loopholes, conflicting legal regimes, lack of planning, and institutional disarticulation produce territorial misgovernance, legal insecurity, and socio-environmental vulnerability, pointing to the need for boundary revisions, reclassifications, institutional strengthening, and integrated management arrangements to reconcile conservation, territorial rights, and sustainable development in Rondônia.

308 Governance of Undesignated Public Forests: Challenges of Land Overlap and Conservation in the Legal Amazon

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Abstract

The existence of Undesignated Public Forests (FPNDs) generates legal uncertainty, land and environmental conflicts, land grabbing, and advancing deforestation. The study investigated the implications of overlaps between Federal Public Land Units (GPFs) and FPNDs in the state of Pará, Brazil, mapping overlapping areas in the databases of SIGEF, SNCR, CNFP, and PRODES/INPE, and analyzing land tenure situation data found in 49,544 property title documents issued in the state, covering an area of 5.6 million hectares.

The overlap between GPFs and FPNDs directly affects land and environmental management, as the absence of FPND designation is a vector that demonstrates legal insecurity and harm in combating deforestation. Analyzing land tenure data indices with PRODES, approximately 30% in 2023 and 36.5% in 2024 of total deforestation in the Legal Amazon is in Pará and FPND.

The data cross-references showed a 20.04% reduction in the overlapping area between the forest registry and GPFs between 2022 and 2024, demonstrating fragility in the designation of public forests and in the land regularization process. However, there are still 6.12 million hectares of overlap in 2024, which reveals a scenario with significant potential for conflicts, land grabbing, environmental protection weaknesses, and difficulties in local communities' access to sustainable development policies.

In this scenario, it is concluded that the overlap between GPFs and FPNDs is the manifestation of a normative impasse that prevents the consolidation of land governance. There is a need for coordinated and urgent action for the destination of these areas, strategic and evidence-based, to strengthen land governance.

311 A Municipality-Scale Decision-Support Framework for Restoration and Conservation Prioritization in the Atlantic Forest of São Paulo State, Brazil

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Abstract

Forest landscapes in Brazil's Atlantic Forest have undergone intense historical degradation, resulting in highly fragmented remnants embedded within human-dominated matrices. São Paulo State, the most industrialized and densely populated region of the country, concentrates strong land-use pressures while also hosting extensive areas of secondary vegetation, making it a strategic territory for restoration and conservation planning.

We developed a municipality-scale decision-support framework using annual land-use and land-cover maps and vegetation trajectory layers from the MapBiomas Collection. We integrated the proportion of total native vegetation (primary and secondary forests), the proportion of secondary vegetation, and recent loss of primary forests. From these components, we derived two complementary normalized indices using min–max scaling: the Restoration Opportunity Index (ROpI), defined as the product between the inverse proportion of total native vegetation and the proportion of secondary vegetation, and the Conservation Risk Index (CRI), calculated as the product between the current proportion of remaining primary forests and their recent suppression.

All variables represent current conditions and were calculated relative to the municipal area within the Atlantic Forest domain. ROpI increases in municipalities with low native forest cover but high dominance of secondary vegetation, reflecting vegetation composition rather than absolute area and serving as a proxy for restoration potential. In contrast, CRI highlights municipalities where remaining primary forests are under active pressure.

Municipalities were classified into four management-oriented categories based on the 75th percentile of both indices: Hotspot, Restoration, Conservation, and Low priority. This classification identified 18.37% of municipalities as Conservation priorities, 18.37% as Restoration priorities, 6.71% as Hotspots, and 56.54% as Low priority. Restoration municipalities exhibited the highest dominance of secondary forests (median = 0.416), followed by Hotspots (0.327), whereas Conservation municipalities were predominantly dominated by primary forests (0.172). By linking vegetation trajectories to operational spatial categories, our framework provides decision-support information for prioritizing restoration and conservation actions in highly fragmented tropical landscapes.

314 Implementing Web-Based Geographic Information System (GIS) Tools in Socio-Ecological Studies in Western Patagonia, Chile

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Abstract

Web-based geographic information systems (GIS) have become key communication technologies in socio-ecological studies. GIS advancements strengthen the socialization and democratization of scientific knowledge and, ultimately, have the potential to influence decision-making. However, researchers still lack an integrated vision of how to use web-based GIS tools.

Against this background, and building upon the ArcGIS Online software package, we developed an internal data systematization strategy, along with a tailored set of applications in the form of StoryMaps. StoryMaps were built as part of our long-term socio-ecological research program (PATSER) at the Centro de Investigación en Ecosistemas de la Patagonia, Chile. The development of StoryMaps served as an interactive platform designed to explore and disseminate the spatial dimensions of our scientific research.

Our web-based digital infrastructure provides the basis for data management and knowledge exchange, thus enabling an efficient and effective use of scientific information. We contend that our efforts represent an active contribution to advancements in web-based GIS applications, particularly as cross-boundary tools in interdisciplinary research programs.

327 Estudio Iberoamericano de Largo Plazo sobre el Depósito de Nitrógeno

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Abstract

La alteración antrópica del ciclo del nitrógeno ha incrementado la presencia de nitrógeno reactivo en el ambiente, con posibles efectos sobre suelos, aguas y biodiversidad. En este contexto, este estudio evaluó el depósito atmosférico de nitrógeno inorgánico en una red de diez sitios distribuidos a lo largo de Chile, desde Atacama hasta Magallanes, incluyendo un punto urbano en Santiago como referencia de mayor carga potencial.

Se utilizaron colectores con resinas de intercambio iónico para retener amonio y nitrato aportados por lluvia y niebla, con tres réplicas por sitio, corrección mediante colector control y ajuste de los valores según el tiempo de exposición, con el fin de obtener una métrica comparable entre sitios. Los resultados preliminares muestran un patrón espacial heterogéneo: la mayoría de los sitios presentó valores bajos de depósito, mientras que unos pocos, especialmente Senda Darwin y Bosque San Martín, exhibieron valores más altos, dominados por amonio.

Esta señal sugiere aportes asociados a fuentes agropecuarias o de residuos y plantea que ecosistemas forestales tradicionalmente considerados limitados por nitrógeno podrían estar recibiendo entradas tempranas de nitrógeno reactivo de origen antrópico. En conjunto, estos resultados aportan una línea base para Chile y destacan el valor de una red multinacional estandarizada para distinguir señales locales y regionales y evaluar tendencias futuras en el contexto iberoamericano.