TECHNISCHE UNIVERSITÄT DRESDEN

INREM
ALUMNI EXPERT NETWORK

UNU FLORES

Online Symposium on

Mangrove restoration and integrated management in the age of climate change

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AT 14:00 CET

WEDNESDAY | 04 | DECEMBER

2024

DAAD Deutscher Akademischer Austauschdienst
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TABLE CONTENT

Mangrove restoration and integrated management in the age of climate change

Growing in tidal marshes and estuaries, mangroves emerge at the interface of water, land, and forests. Their complex ecology makes them a biodiversity hotspot and provides essential environmental goods and services that support human well-being and contribute to achieving the Sustainable Development Goals (SDGs).

This symposium will explore the vital role of mangroves in coastal ecosystems, highlighting their benefits for biodiversity, local communities, and climate protection through blue carbon sequestration. We aim to showcase effective restoration techniques, successful integrated management models, and emerging challenges impacting mangrove conservation and sustainable use in the face of a changing climate.

PROGRAM **SCHEDULE**

Time (CET)	Program	by	Institution
14:00	Welcome words	Dr. Marolyn Vidaurre	Coordinator of International Education, Faculty of Environmental Science, TU Dresden
14:05	Introduction of the INREM - Alumni Expert Network	Dr. Simon Benedikter	Institute of International Forestry and Forest Products, TU Dresden
14:15	Long-term monitoring of community-based adaptive mangrove restoration in a coastal lagoon in the Gulf of Mexico	Dr. Jorge López-Portillo	Instituto de Ecología, A.C. (INECOL)
14:30	Adaptive Strategies for Managing Sea Level Rise Impacts on Mangrove Ecosystems	Dr. Michael Jenke	Department of Silviculture, Faculty of Forestry, Kasetsart University
14:45	Q&A	Dr. Marolyn Vidaurre	TUD

15:00	Mini Buoys enhance our understanding of mangrove hydrodynamic tolerance thresholds for Nature-based solutions	Dr. Alejandra Vovides	CoVe Lab, IBU, University of Oldenburg
15:15	Innovative Microplastic Separation Technology: A Crucial Tool for Enhancing Mangrove Restoration and Resilience Against Climate Change	Dr.-Ing. Mitra Nikpay	SATOORNIK
15:30	Q&A	Dr. Marolyn Vidaurre	TUD
15:45	Feedback of the symposium!	Dr. Simon Benedikter	TUD
16:00	Final remarks & Closure	Dr. Marolyn Vidaurre	TUD

Jorge Alejandro López-Portillo Guzmán

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Doctorate in Ecology, Centro de Ecología/Colegio de Ciencias y Humanidades (now the Instituto de Ecología at UNAM), 1993. Emeritus Researcher at the Instituto de Ecología, A.C. (INECOL) and National System of Researchers. My research is on the effect of natural and anthropogenic disturbances on the structure and composition of the mangrove communities and tree architecture. I coordinated a study on the current state of the mangroves and coastal dunes of the state of Veracruz to propose an environmental planning program for the sustainable use of the coastal zone. I coordinated a long-term study of mangrove forest ecosystems in Veracruz and several projects concerning restoration through hydraulic rehabilitation of an impaired mangrove forest in the North of Veracruz, Mexico. Finally, I also research the ecophysiology of mangrove species, specifically hydraulic architecture (design and function of plant xylem, which allows water transport along the soil-plant-atmosphere continuum).

LONG-TERM MONITORING OF COMMUNITY-BASED ADAPTIVE MANGROVE RESTORATION IN A COASTAL LAGOON IN THE GULF OF MEXICO

Abstract:

With almost 9000 km2, Mexico ranks fourth to sixth in world mangrove cover. However, loss due to human activities and their interaction with global change requires adaptation and restoration efforts. A frequent cause of mangrove damage is connection loss between freshwater and tidal seawater. In the Tampamachoco Lagoon, the construction in 1987 of three dikes interrupted water flow, causing (by 2010) massive mortality and sediment erosion in 30 ha and chronic damage in 60 ha north of the dikes. We started a restoration project in April 2011, distributing seventy 1.5 m deep PVC wells slotted every 5 cm over 300 ha. We have monitored salinity, pH, redox potential, and temperature monthly in flood waters, interstitial waters, water table, and at 1.4 m depth. During the dry season of the first (reference) year, porewater salinity was higher than 120‰ in the dead zone versus 65‰ in the reference zone. We excavated channels on each dike to restore water flow, widening them from two m in 2012 to 15 m in 2015. Although salinities decreased significantly, they were still higher in the dead zone, and regeneration was poor. In 2019, following the maximum slope of a microrelief model and with a federal grant, community engagement, and a medium-sized excavator, we excavated channels (2.7 km, 1 m deep and 3 m wide) to connect the dead mangrove to the lagoon, which improved tidal dynamics, reduced salinity and ameliorated other biogeochemical variables. We leveled the excavated sediments along the channel edges to reference mangrove elevations (+40 cm) and created 750 islets (five meters in diameter and 40 cm high) from surrounding sediments and dead wood to facilitate the establishment of trees, which were up to two m tall and reproductive by 2023. We present indicators of success, including biogeochemical data, biodiversity, and increased cover.

Dr. Michael Jenke

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Dr. Michael Jenke is a Lecturer at the Department of Silviculture at Kasetsart University in Bangkok, Thailand, where he has been teaching since early 2024. He holds a doctoral degree in Forest Sciences from Technische Universität Dresden, specializing in community forestry. Following his doctorate, he completed postdoctoral research at Kasetsart University, focusing on mangrove adaptation strategies in response to sea level rise. His current research interests have shifted inland, centering on the sustainable management of valuable tropical timber species, while continuing to encompass adaptive forest management practices.

ADAPTIVE STRATEGIES FOR MANAGING SEA LEVEL RISE IMPACTS ON MANGROVE ECOSYSTEMS

Abstract:

Coastal ecosystems, such as mangroves, are increasingly threatened by relative sea level rise (RSLR), which is anticipated to intensify over this century. Their loss has the potential to diminish the provision of essential ecosystem services, including coastal protection, food security, livelihood support, carbon sequestration, and sustaining biodiversity. Despite advances in mangrove conservation and restoration over the last decades, managers are not yet fully equipped to deal with this new challenge. This review compiles knowledge on mangroves' adaptive responses to RSLR and on interventions aimed at enhancing their adaptive capacity. We explore four response mechanisms: toleration and acclimation to more prolonged hydroperiods; vertical adjustment through sediment accretion and belowground biomass accumulation; landward expansion into upland areas and land-use systems; and evolutionary adaptation enabled through genetic diversity and connectivity. The impact of vegetation, biophysical, and geomorphological drivers on each response mechanism is analyzed. A conceptual model is proposed to evaluate their effectiveness under various RSLR scenarios. In many regions, a passive management approach might result in a complete loss of mangrove ecosystems. Thus, interventions will become necessary to enhance adaptive capacity through resistance-oriented actions to ecosystem transformations along the entire intertidal zone, from low-lying fringes to back mangroves expanding into higher-elevated areas. Due to the complexity and uncertainty of these dynamic responses, an adaptive management approach is needed to develop, implement, monitor, and adjust site-specific strategies. Success of such interventions depends on the availability and accuracy of monitoring tools to assess local RSLR, mangrove health, surface elevation gains, landward expansion, and the supply of demanded ecosystem services. As RSLR will reshape mangrove ecosystems throughout the century, their management must transition from restoration and conservation to embrace flexible and proactive approaches. Without ensuring their adaptability, climate mitigation and adaptation strategies—including nature-based solutions, nature climate solutions, and ecosystem-based approaches—

Dr. Alejandra Vovides

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Dr. Alejandra Vovides is a Mexican-British researcher with a bachelor's degree in biology and a doctoral degree in Ecology and natural resources management. She has worked in several topics related to mangrove functional ecology and restoration; from microbial function and positive plant interactions to plastic responses to environmental change and hydrodynamic control of vegetation establishment. In 2013 she joined Prof. Dr. Uta Berger at the institute of forest growth and forest computer science of TUD for four years, here she contributed to the development of a mangrove growth model that explains tree morphology in response to water availability, which has now today expanded to a full modular modelling platform (pyManga). During her time at TUD she also developed a methodology to track mangrove cable roots and further used it to describe, for the first time in mangrove records, the patterns of root graft formation and its implications for forest resilience. After 7 years at the University of Glasgow (UK), she has now returned to Germany to continue her research on ecosystem responses to environmental stress and development of nature-based solutions with Prof. Thorsten Balke, at the University of Oldenburg.

MINI BUOYS ENHANCE OUR UNDERSTANDING OF MANGROVE HYDRODYNAMIC TOLERANCE THRESHOLDS FOR NATURE-BASED SOLUTIONS

Abstract:

Despite mangrove restoration practices are not a new topic, globally we still face an overall success rate of ~20%. In fact, it's estimated that 80% of mangrove gains between 2000-2020 are due to natural establishment rather than restoration. Hydrology is a corner stone to coastal wetland ecosystem health - great progress has been achieved by implementing hydrological restoration to our practices. However, there is still a gap of knowledge in understanding environmental thresholds to seedling establishment in bare mudflats. Specifically, we lack information to identify the optimal environmental conditions required by seedlings to successfully germinate, produce roots and, sufficiently anchor to sediments to tolerate currents without dislodging. Here, we use the Avicennia genus (a known mangrove pioneer species) as an example that depicts the relevance of windows of opportunity (WoOs, periods without disturbance) for successful mangrove colonization and, present a low-cost hydrological monitoring tool (The Mini Buoy) to aid ecological restoration planning. The Mini Buoy is composed of a low-cost accelerometer fitted in a float and tethered to the sediments. With an accompanying R-shiny application, tilt data are readily interpreted into hydrodynamic data (Inundation duration and frequency, current and wave orbital velocities as well as max. WoOs duration). The Mini Buoy is demonstrating useful applications to predict erosion conditions, monitor current velocity attenuation by vegetation and understand environmental drivers of coastal habitats across coastal and temperate regions, including: mangroves of Indonesia, Bangladesh and Mexico and; salt marshes, seagrass and shellfish habitats of UK, Germany and the Netherlands.

Dr.-Ing. Mitra Nikpay

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Dr.-Ing. Mitra Nikpay holds a B.Sc. in Environmental Engineering from Iran University (IUMC), an M.Sc. in Hydro-science and Engineering, and a Ph.D. in Wastewater Infrastructure from TU Dresden. Prior to joining TU Dresden, she has served in technical and consulting roles for water and wastewater companies. She completed postdoctoral research at the Helmholtz Center in Dresden, focusing on the mitigation of microplastics and micropollutants in water/wastewater systems. Dr. Nikpay holds several patents in microplastic and climate change mitigation technologies, underscoring her commitment to innovative environmental solutions. Currently, she serves as the Managing Director of SATOORNIK, a company dedicated to solving complex environmental challenges through technology.

INNOVATIVE MICROPLASTIC SEPARATION TECHNOLOGY: A CRUCIAL TOOL FOR ENHANCING MANGROVE RESTORATION AND RESILIENCE AGAINST CLIMATE CHANGE

Abstract:

Mangroves are vital, carbon-rich forests that provide essential ecological services, including coastal protection, biodiversity support, and nutrient cycling. However, urbanization and industrial activities are increasingly contaminating these environments, thereby threatening their ecological integrity and resilience. Mangroves have evolved distinct physiological adaptations to the intertidal zones of coastlines, which are regularly flooded with seawater at high tide. Given the high concentrations of microplastics present in these areas, it is crucial to implement targeted management programs to address this pollution threat.

Microplastics, defined as particles smaller than 5 mm, are found in various forms, including pellets, fibers, and fragments, and have been detected even in protected ecosystems, indicating an urgent need for intervention. Primary sources of microplastics in coastal and offshore areas include desalination systems, urban runoff, and wastewater outlets.

This presentation introduces SATOORNIK Gen-I, an innovative microplastic separation technology engineered to effectively remove microplastics from polluted water and wastewater at high volumes, making it particularly suitable for use in sensitive mangrove environments. The objective is to integrate this technology into existing restoration practices to strengthen the resilience and health of mangrove ecosystems while addressing the critical challenges posed by microplastic pollution and climate change.

COORDINATION

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INREM

ALUMNI EXPERT NETWORK

The professional alumni network "Integrated Natural Resources and Environmental Management (INREM)" was founded in 2022 as a global network of experts. Located at the Faculty of Environmental Sciences of Technische Universität Dresden (TU Dresden), INREM unites international educational programs with developmental relevance in environmental sectors: CIPSEM, M.Sc. Ecosystem Services, M.Sc. Hydroscience, M.Sc. Tropical Forestry and UNU-Flores. As an interdisciplinary North-South-South expert network, INREM brings together alumni in a transnational initiative. It aims to facilitate regular exchange of experiences, joint, social learning, and international networking among its members.

Interdisciplinary and integrative thinking and acting constitute the leitmotif of INREM. Both are essential for sustainable development in the sense of the Agenda 2030 and the Sustainable Development Goals.