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I. SESSION DESCRIPTION

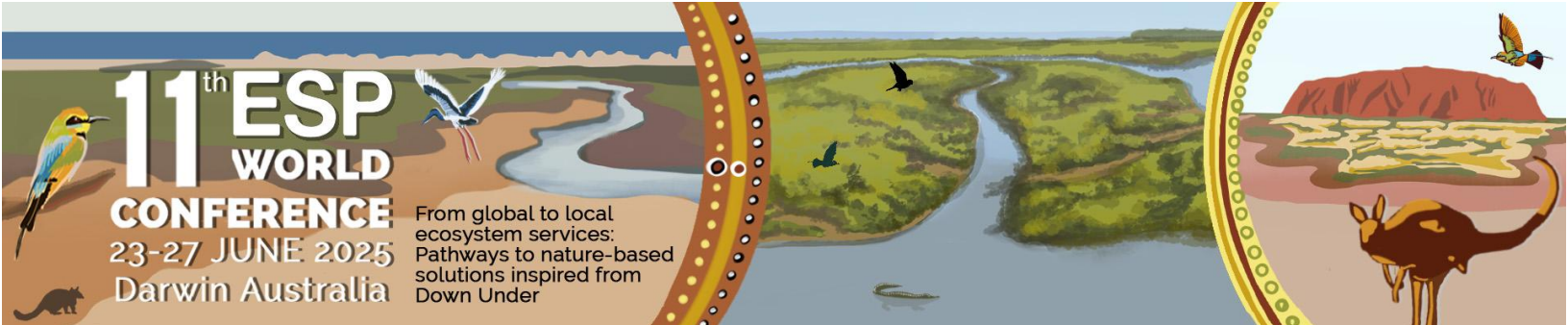
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Importance of Nature-based Solutions (NbS) in forest sustainable development of rural communities: livelihoods, biodiversity conservation, and nonmaterial values

	Name	Organisation	E-mail
Host:	Ignacio J. Diaz-Maroto	University of Santiago de Compostela, Spain	ignacio.diazmaroto@usc.es
	Anthony O'Grady	Commonwealth Scientific and Industrial Research Organisation, Australia	Anthony.O'Grady@csiro.au

Abstract:

Our aim is to promote a debate, through assessment and analysis, about the key role that Nature-based Solutions (NbS) play in sustainable development of rural communities. The issue is complex because it involves social, economic, political and environmental aspects, making it essential for the coordination between all administrations and stakeholders involved. For one hand, the human population is growing at a rate, so that it will require livelihoods maybe two or three times higher than it does today. A livelihood not only includes people, but also their abilities, incomes, foods, and other resources. For another hand, the multifunctional nature of forests promotes the creation of markets for forest products other than wood, which could generate enough capital to finance forest management linked to rural development. Policymakers, private forest ownership and the individual's capacity to identify the opportunities are essential factors in the making of growth possibilities for rural communities. Feedback from all experts suggest a need for training programs, aiming to present opportunities offered by the forestry sector for rural development. Most recent assessments of forest ecosystems prioritize the economic values including freshwater, carbon storage, production of foods and building materials, medicines, gas exchange, productivity from sunlight, soil conservation, shade, and biodiversity conservation. However, many ecosystem services assessments ignore the nonmaterial value of forests. For example, the spiritual and cultural value of forests is not only critical in scope but also imply to have a greatest potential for significant international conservation actions, given that several billion people value their forests predominantly because of their spiritual significance.



Goals and objectives of the session:

The goal is to contribute to a methodological debate on the role Nature-based Solutions (NbS) play in the sustainable development of rural communities. It is a complex issue, since socioeconomic, political and environmental aspects are involved. Policymakers, private owners, and the ability of individuals to identify opportunities are key factors. The need for training programs to ensure local populations know the opportunities offered by the forest sustainable development is essential.

Planned output / Deliverables:

Active audience participation is required for success and the proper development of the session. The idea is to facilitate interaction and contribute to the development of competences. It is planned to publish a special issue on the proposed topic in an indexed international journal.

II. SESSION PROGRAM

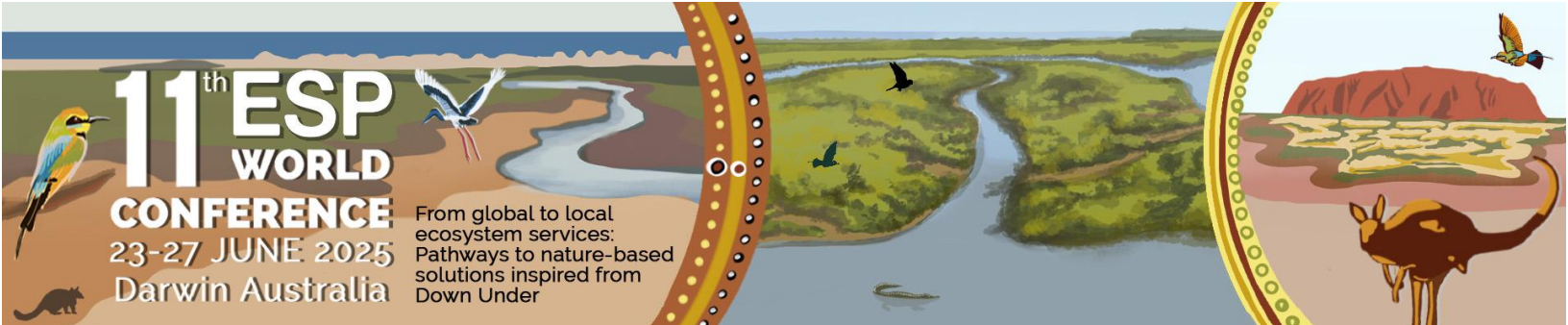
Room: Damibila 1

Date of session: June 24th

Time of session: From 10:30–12:30 (Room 5)

Timetable speakers:

Time	First name	Surname	Organization	Title of presentation
10:30–10:35	Anthony	O'Grady	Commonwealth Scientific and Industrial Research Organisation, Australia	Session Introduction
10:30–10:45	Cesar	Rojas	Universidad Distrital Francisco José de Caldas, Colombia	Nature-based Solutions in zones of high multifunctionality: a land-value capture approach
10:45–11:00	Kamal	Melvani	NeoSynthesis Research Centre, Sri Lanka	Bioremediation is a sustainable way to provide drinking water to rural communities: the case of the Kalpitiya Peninsula in Sri Lanka
11:00–11:15	Guangsi	Lin	South China University of Technology, China	Building a community circular economy: a solution to address the landscape simplification problem in traditional pond-dike areas



Time	First name	Surname	Organization	Title of presentation
11:15–11:30	Thomas Ava	Dick Jarett	Jagun Alliance Aboriginal Corporation	Integrating Bundjalung Cultural Knowledge and disaster recovery: A transformative model for sustainable timber systems
11:30–11:45	Anthony	O'Grady	Commonwealth Scientific and Industrial Research Organisation, Australia	Pathways to nature positive: a biodiversity assessment from BHP and CSIRO
11:45–12:00	Malgorzata	Blicharska	Uppsala University, Sweden	Multiple understandings of multifunctional landscapes in Sweden
12:00–12:30	Session host			Discussion & closing of session

III. LIST OF ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Nature-Based Solutions in Zones of High Multifunctionality: A Land-Value Capture Approach

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Keywords: multifunctionality, land use planning, policy instruments, watershed management

Rural areas in Andean watersheds have high ecological value and multiple ecosystem services (ES). Nature-based solutions (NbS) are a timely policy response that can contribute to land management in key conservation areas. Rural areas with high-value conservation supply multiple



ES and have mainly informal land tenure. However, the generation of conservation actions through the implementation of NbS does not adequately capture the land value. This study sought to identify opportunities for BNS development in areas of high environmental value and informal land tenure in the Coello River Basin, Tolima, Colombia. The methods used were the characterization and delimitation of units of potential value through the application of an ES multifunctionality index, the identification of land tenure forms, and the application of land value analysis methods in areas of high multifunctionality. Areas of high environmental value with high ES multifunctionality are predominantly located in the upper part of the basin, highlighting municipalities with the greatest diversity of land uses and more forest cover areas, as well as the least pressure on the supply of ES. Water supply is one of the main ES in the basin that promotes various local activities. Property land tenure in multifunctional zones is characterized by a lack of accessible information for evaluating informality in areas of interest for the conservation and development of NbS. Nbs in areas of high value and informal land-use trend conditions represent a mechanism for managing land value, but their implementation faces significant challenges, such as the need for stable funding, for instance, informal ES payments, coordination between entities, and adaptation to diverse local contexts. The adoption of Nbs requires an adequate strategic environmental assessment that includes elements of land-use multifunctionality and the social and economic aspects of land tenure, occupation, and ES demand.

2. Bioremediation is a sustainable way to provide drinking water to rural communities: the case of the Kalpitiya peninsula in Sri Lanka.

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Keywords: Bioremediation; nature-based solution; drinking water



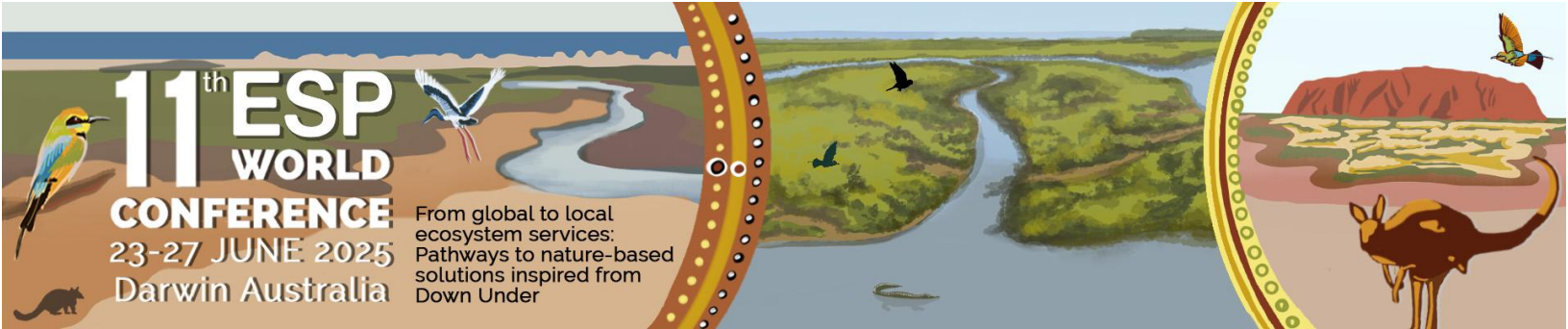
The unsustainable management of water resources worldwide leads to the lack of safe drinking water. This is evident in the low-lying, sandy Kalpitiya Peninsula in northwest Sri Lanka where the underlying Gyben–Herzberg groundwater lens is extensively pumped for irrigation and drinking water. Ground water quality throughout the Peninsula was acceptable until nitrate, nitrite, chloride, and potassium concentrations increased beyond WHO drinking water standards due to massive applications of chemical fertilizer and pesticides. The National Water Supply and Drainage Board declared that wells in the Peninsula were unsafe because of nitrate and nitrite contamination. In 2001, they contracted the Neo Synthesis Research Centre to bioremediate contaminated water in a well in Nawakkaduwa. Work involved restoring the micro watershed where trees and shrubs analogous to the closest natural forest were densely planted in concentric circles around the well, while annual and tree crops cultivated using organic regimes in the surrounding area. Newly planted forest vegetation matured by 2004 with canopies forming aboveground and a dense root mat belowground. Water from 8 piezometers installed in the micro watershed, model well and two control wells located along the hydraulic head were tested monthly for potability, from February 2004 to January 2009.

Data analysis revealed that tree roots effectively removed nitrates and reduced groundwater electrical conductivity. Further, hydraulic retention time for bioremediation or root uptake in the micro watershed decreased with vegetation growth and soil development. Although bioremediation was undertaken around 1000+ wells at that time, now 25 years later, the forest around the well has matured and drinking water will be freely distributed to 600 families in Nawakkaduwa who promise to conserve it. Bioremediation is an affordable nature-based solution that provides multiple ecosystem services, mainly clean drinking water. This technology needs to be practiced in other countries where energy intensive agriculture impacts groundwater quality.

3. Building a Community Circular Economy: A Solution to Address the Landscape Simplification Problem in Traditional Pond–Dike Areas

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Keywords: Agricultural system, Nature-based Solutions, Ecological restoration, Landscape simplification, Pond landscapes

In recent decades, the rapid commercialization of agriculture worldwide has led to the issue of landscape simplification. Landscape simplification refers to the loss of multifunctional cultural agro-ecosystems and the expansion of single-function, intensive farmland, posing a serious threat to the social and ecological values of agricultural ecosystems. In China's Pearl River Delta region, traditional pond landscapes are important agricultural heritage systems, known for their multifunctional characteristics, but they are currently undergoing structural transformations. Driven by market forces, farmers increasingly prioritize economic benefits, intensive fish farming has replaced the multifunctional farming system, leading to land-use simplification, a decline in biodiversity, and the loss of system multifunctionality. This study takes Ruxi Village in Xiqiao Town, Nanhai District, Foshan City, as an example to propose a nature-based solution for addressing the landscape simplification problem in traditional pond landscapes through the construction of a community circular economy. Ruxi Village retains the largest pond landscape in the Pearl River Delta but faces similar landscape simplification issues. The study found that the simplification of the pond landscape system is the result of human interventions in water, land, and biological elements, which have led to environmental problems such as wastewater discharge and pond silt accumulation. To address these challenges, and based on the already-formed intensive aquaculture system, we propose a solution that constructs a community circular economy. This approach involves implementing corresponding strategies across four stages: input, production, use, and post-use, to mitigate the negative impacts of landscape simplification. We divided Ruxi Village into three functional zones: an intensive aquaculture zone, a new agricultural zone, and an artificial wetland zone. By integrating the efforts of the entire community, we achieved internal waste utilization and enriched functional operations. This nature-based solution provides a sustainable development pathway to address the landscape simplification problem in traditional pond landscapes.



4. Integrating Bundjalung Cultural Knowledge and disaster recovery: A transformative model for sustainable timber systems

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Keywords: forestry, Caring for Country, circular economy, value chain

This research addresses critical gaps in post-disaster timber recovery by developing an innovative framework that integrates Bundjalung cultural heritage, ecological restoration, and commercial forestry practices. Building upon hundreds of hectares of Caring for Country (in this case, reforestation and revegetation work) conducted by our team and partners across Bundjalung Country, we leverage extensive baseline data to inform evidence-based approaches to timber system management. In Australia, valuable historical timber from disaster-affected structures is routinely lost to landfill due to the absence of established protocols for identification, grading, and repurposing. Simultaneously, conventional forestry models rarely incorporate Indigenous biocultural values, creating missed opportunities for sustainable and culturally appropriate approaches.

Our interdisciplinary methodology bridges diverse knowledge systems (including contemporary scientific research) to create circular economy models for timber resources. We are examining which native rainforest species will thrive under changing climate conditions while maintaining biocultural diversity, timber quality and cultural significance. The research is informing protocols for identifying culturally significant timber in disaster recovery operations and seeks to establish governance frameworks ensuring Aboriginal-led organisations maintain control of cultural knowledge while receiving appropriate benefits.

We propose that comprehensive baseline ecological data from extensive reforestation projects could enable precise monitoring of growth rates, species interactions, and climate resilience



factors, informing better decision-making across the timber value chain. There is potential for premium-priced, culturally-significant recovered timber products that transform industry value propositions from volume-based commodity timber to higher-value products with documented cultural provenance. Further work is required to interrogate cost-benefit ratios when comparing traditional disaster waste management with cultural salvage approaches, with additional social benefits through specialised employment pathways for Aboriginal communities. This research positions ecosystem services at the intersection of cultural heritage preservation, climate adaptation, and sustainable resource management, offering a transformative approach that enhances both the economic resilience and cultural integrity of timber systems while addressing pressing environmental challenges.

5. Pathways to Nature Positive: a biodiversity assessment from BHP and CSIRO

First author(s): Anthony O'Grady

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Keywords: Biodiversity, Nature positive, metrics, no net loss

The global goal nature calls out an urgent need to bend the curve of nature loss and to restore nature so that ultimately nature is recovering. The ambition of the goal has been integrated into the Kunming Montreal Global Biodiversity Framework with Target 15 GBF specially calling for greater disclosure of corporate and transnational companies biodiversity position and their impacts and dependencies on biodiversity. While an admirable goal, the measurement challenge in relation to biodiversity is substantial. Key challenges around definition of biodiversity, scale of measurement, spatial and temporal scales, are substantial. Against this backdrop, hundreds of metrics are being proposed to measure biodiversity and nature, creating confusion and stifling action in the corporate sector. In this talk we demonstrate an approach to large scale biodiversity assessment as applied to two Australian organisations, BHP and CSIRO. We argue that despite the apparent complexity in biodiversity as a concept, useful information can be generated at scale in a timely manner that provides a basis for future planning and action. Using habitat-based



biodiversity metrics we demonstrate the cumulative impacts that both BHP and CSIRO have had on biodiversity since 1987 and the contribution that these impacts have to species extinction risk in Australia. We also demonstrate how this information is being used by BHP to develop a roadmap to achieving its Healthy Environment goal of have 30% of the lands they steward under nature positive management.

6. Multiple understandings of multifunctional landscapes in Sweden

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Other author(s): Lusas Dawson, Michael Gilek, Marcus Hedblom, Mikael Karlsson, Neil Powell, Lara Tickle, Frida Öhman, Jayne Glass, Stefan Sandström, Tuija Hilding-Rydevik

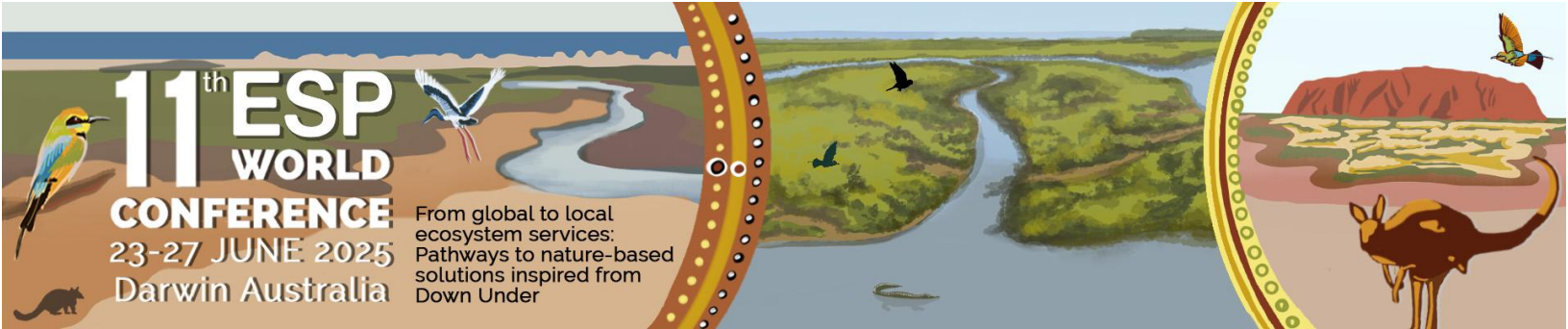
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Keywords: Governance, Multifunctional landscapes, Policy

Multifunctional landscapes provide a diverse array of ecosystem services that contribute to both biodiversity conservation and human well-being. However, different interpretations of multifunctionality in research and policy create challenges for achieving sustainable landscape management, making it difficult to balance different benefits across scales and stakeholders.

In this study, we examine the governance and implementation of multifunctionality in Sweden, where public agencies aim to integrate biodiversity objectives across sectors as a core element of sustainable landscape management to be balanced with delivery of other important functions. Through a review of scientific and policy literature, complemented by insights from policymakers and practitioners, we critically analyze how multifunctionality is interpreted and operationalized across five key landscape contexts: forest, agricultural, coastal and marine, urban, and mountain landscapes.



Our findings reveal that multifunctional landscape management in Sweden faces significant obstacles, including limited political support, fragmented governance, and the absence of effective mechanisms to capture and redistribute the full value of ecosystem services. While certain benefits, such as timber and agricultural products, are readily monetized, others—such as climate regulation, water quality, and cultural services—remain largely externalized, creating opportunity costs for local actors engaged in sustainable stewardship.