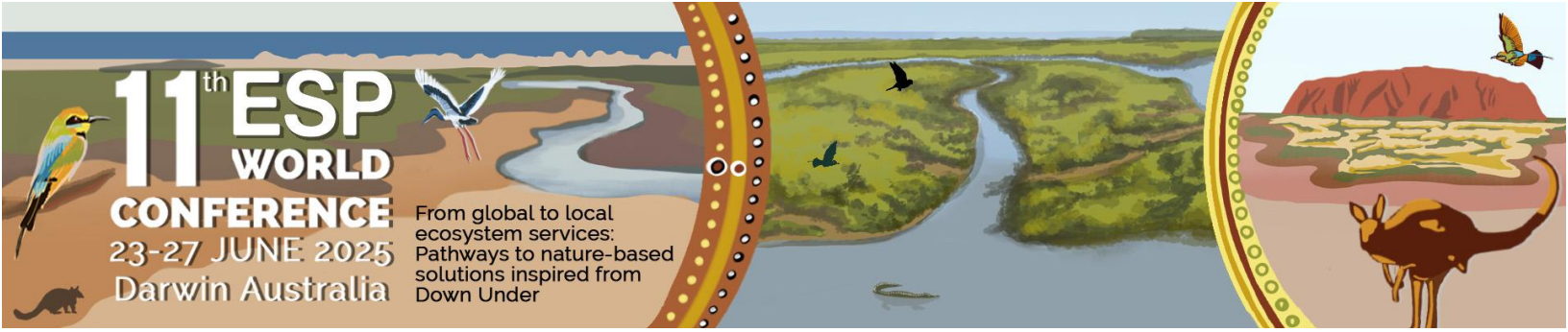


BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: B7

Harnessing local practices to tackle global challenges in high-latitude and high-altitude ecosystems

	Name	Organisation	E-mail
Host:	Benjamin Burkhard	Leibniz University Hannover	burkhardphygeo.uni-hannover.de

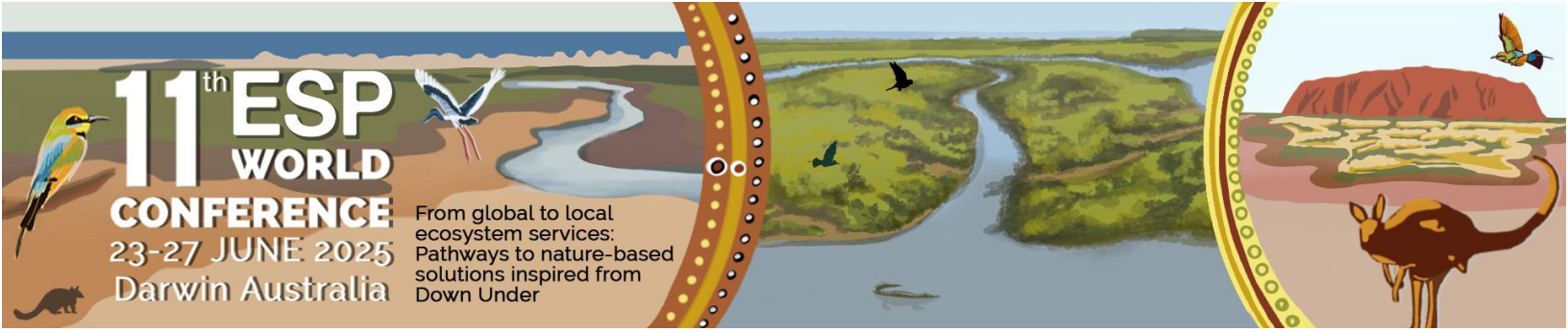
Abstract:

The recently created ESP Biome Working Group 7 on Tundras aspires to become a platform for knowledge sharing and co-production in relation to tundra, arctic, alpine, and snow-related ecosystem services, while advocating for socio-ecological perspectives on tundras through transdisciplinary integrative research.

In this session, we seek to address the major challenges currently faced by high-latitude and high-altitude ecosystems, such as Arctic tundras and Alpine regions. These areas are highly vulnerable to climate change and human activities' impacts, yet they hold significant ecological and socio-cultural importance. While Nature-based Solution (NbS) in these regions offer a promising strategy for climate change adaptation, their effective implementation faces several challenges such as the unique needs and complexities of specific ecosystems and their rapidly changing conditions.

The session aims at examining how lessons from tundra and alpine ecosystems—particularly the integration of Indigenous people knowledge, traditional management practices, and ecosystem services research—can contribute to pathways toward the design and implementation of Nature based Solutions (NbS) for nature restoration, conservation and sustainably use. We welcome topics dealing with strategies to address ecosystem fragmentation, loss of biodiversity, land use conflicts, climate resilience, and sustainable livelihoods, while emphasizing co-production of knowledge and transdisciplinary approaches.

Goals and objectives of the session:



1. Map the current state-of-the-art regarding NbS implementation in high-latitude and high-altitude ecosystems.

2. Present novel approaches to mapping, modeling, and assessing ecosystem condition and services in high-latitude and high-altitude ecosystems.

Planned output / Deliverables:

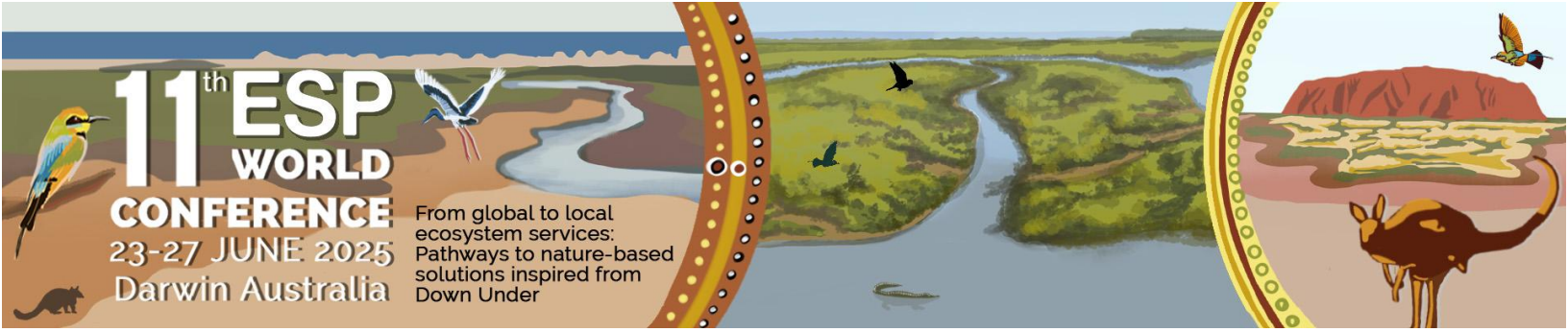
A joint open access journal publication or a journal special issue (depending upon the content of presentations).

II. SESSION PROGRAM

Room: Betbiyan 3
Date of session: 26.06.2024
Time of session: 14:00 -15:00

Timetable speakers:

Time	First name	Surname	Organization	Title of presentation
14:00	Benjamin	Burkhard	Leibniz University Hannover	Session Introduction
14:05	Shipra	Singh	IASA Laxenburg. Austria	Integrating Stakeholders' preferences with Ecological Sustainability in the Indian Himalayas: A Socio-Ecological Assessment of Forest Ecosystem Services
14:25	Benjamin	Burkhard	Leibniz University Hannover	Remote sensing and machine learning approaches to unveil palsa wetland ecosystem dynamics
14:45				Session wrap-up, next steps BWG7



III. LIST OF ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Integrating Stakeholders' preferences with Ecological Sustainability in the Indian Himalayas: A Socio-Ecological Assessment of Forest Ecosystem Services

First authors(s): Shipra Singh

Other author(s): Florian Hofhansl, Jaideep Joshi

First author affiliation: International Institute for Applied Systems Analysis, Austria

Contact: shiprasinghjnu@gmail.com

Keywords: Forest ecosystem services; socio-ecological factors; species availability, stakeholder preferences; sustainable resource management.

Understanding how socio-ecological variables shape stakeholders' preferences for Forest Ecosystem Services (FES) is critical for balancing human needs with ecological sustainability. This study evaluates FES preferences and utilization among residents, forest managers, and tourists in the Western Himalayan region of India.

We conducted structured surveys with 1,035 residents, 60 forest managers, and 133 tourists and developed a species usage index documenting local resource use of plant species observed in the nearby forest plots (360 quadrats of 0.1 ha each) across an elevation gradient spanning 300–3000 m asl. Forest managers prioritized regulating services (carbon sequestration), while tourists valued cultural (spiritual values) and regulating services (fresh air and water). On the other hand, villagers prioritized provisioning (fodder, fuelwood) and supporting (biodiversity) services essential to their livelihoods.

Most strikingly, we found a spatial pattern affecting those preferences since food, medicinal plants, and biodiversity tend to decline with altitude, whereas fodder, fuelwood, and carbon

sequestration generally increase with elevation. Notably, mid-elevations place the least emphasis on grazing, soil quality, and fresh air and water due to pine invasion. Education and employment emerged as strong determinants of FES perceptions. Principal Component Analysis revealed potential trade-offs between provisioning and regulating services, driven by differences in species distribution and usage. We found a negative correlation between species usage and species availability at higher elevations (above 2000 m), indicating resource management challenges at higher elevations.

Our study highlights the importance of considering local preferences and ecological data in forest management and conservation strategies. Given that forest managers are mandated to preserve forests and increase carbon stock, while residents rely on forests for daily needs, participatory governance is essential to mitigate conflicts and ensure sustainable resource use. Integrating these insights into national policies could enhance sustainable forest resource utilization and harmonize the differing priorities of local stakeholders.

2. Remote sensing and machine learning approaches to unveil palsa wetland ecosystem dynamics

First authors(s): Alexander Störmer

First author affiliation: Leibniz University Hannover, Institute of Earth System Sciences, Physical Geography and Landscape Ecology, Hannover, Germany

Other author(s): Mariana Verdonen, Timo Kumpula, Miguel Villoslada, Pasi Korpelainen, Henning Schumacher, Benjamin Burkhard

Presenting Author: Benjamin Burkhard

Presenting author affiliation: Leibniz University Hannover, Institute of Earth System Sciences, Physical Geography and Landscape Ecology, Hannover, Germany

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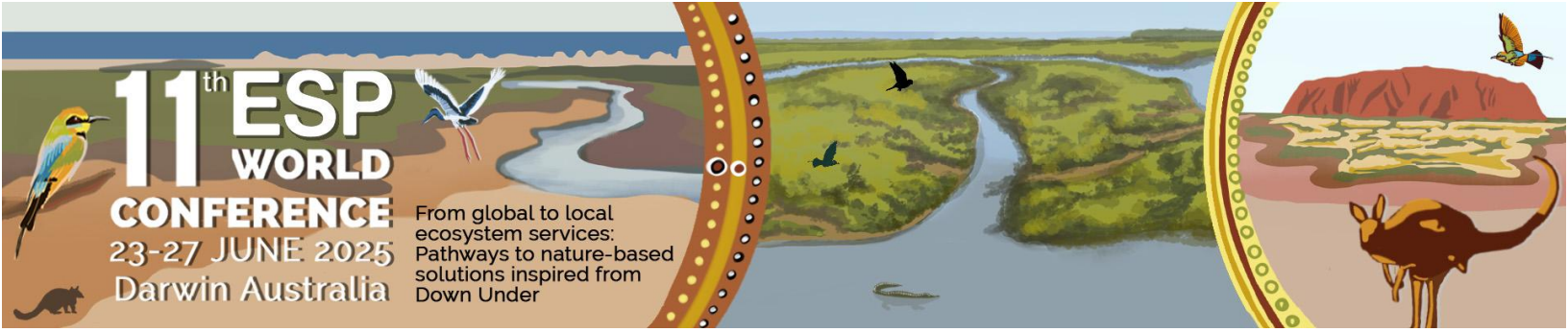

Keywords: palsa mires, permafrost, modelling, UAS LiDAR, climate change

Palsa wetlands are highly sensitive permafrost landforms, strongly influenced by climate-driven changes in snow distribution and thaw depth. Despite their small area, they provide various ecosystem services, including carbon storage for global climate regulation, local climate regulation (e.g., as early snow-free grazing and calving sites for semi-domesticated reindeer), water regulation, and climate archives. Understanding their spatial and temporal dynamics is crucial for predicting future landscape transformations in discontinuous permafrost regions. In this study, we present an integrated remote sensing approach to model fine-scale snow distribution and Active Layer Thickness (ALT) in palsa mires of northwestern Finland, combining high-resolution UAS LiDAR and multispectral data with machine learning techniques. The first study examines the role of snow distribution in permafrost degradation. Using Random Forest modeling with UAS LiDAR-derived input data and in-situ snow depth measurements, we identified key spatial patterns, including enhanced warming at palsa edges and inside cracks, which contribute to block erosion and structural collapse. The model demonstrated high accuracy, outperforming direct UAS LiDAR-derived snow depth estimates. The second study focuses on estimating and mapping thaw depth variability. By applying Random Forest regression to a combination of spectral and topographic indices derived from UAV data and Landsat 8 LST, we achieved highly accurate ALT predictions. Our findings highlight the significant influence of palsa topography on thaw depth, with dome-shaped palsas exhibiting deeper thaw than plateau-shaped palsas. Together, these studies demonstrate the potential of combining remote sensing and machine learning for fine-scale permafrost landform monitoring. Our approach provides new insights into interactions between snow cover, microtopography, and thaw dynamics—critical factors for assessing ecosystem stability and dynamics in Arctic wetland environments and their effects on local communities.