BOOK OF ABSTRACTS

I. SESSION DESCRIPTION

ID: B8

Ecosystem Services, Global Change and human health in Arctic and mountain regions: Challenges and solution

Hosts:

	Name	Organisation	E-mail
Host:	Uta Schirpke Miguel Villoslada	Eurac Research University of Eastern Finland	uta.schirpke@eurac.edu miguel.villoslada@uef.fi
Co-host(s):	Manuel Ebner Benjamin Burkhard Laura Poikolainen Timo Kumpula	University of Innsbruck Leibniz University Hannover Centre for Economic Development, Transport and the Environment University of Eastern Finland	Manuel.Ebner@uibk.ac.at burkhard@phygeo.uni-hannover.de lepoikolainen@gmail.com

Abstract:

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

In this first Tundras BWG session, we would like to address the major challenges currently faced by tundra ecosystems and the ensuing threats to the traditional livelihoods that depend upon these ecosystems. Biodiversity losses coupled with the fast-paced impacts of Climate Change could have far-reaching implications for ecosystem functions and services. Anthropogenic pressures have also become increasingly evident, with expanding infrastructure such as wind farms, petroleum industry, large mining projects, tourist resorts, and related network expansion

fragmenting the tundra environment, increasing the vulnerability of these valuable ecosystems. Moreover, healthy ecosystems contribute to the well-being and quality of life of local populations and surrounding areas, assuring safety, food and water security, and supporting physical, mental, and social health. To scope with the challenges emerging from global change pressures, there is an urgent need to improve the understanding of the relationships between the state of ecosystems and human health and to integrate such knowledge into decision-making.

The session includes presentations that address the ongoing challenges in tundra and mountain ecosystems from an ecosystem services perspective, comprising mapping and modelling approaches, transdisciplinary research, and socio-ecological perspectives. Simultaneously, we would like to map the current state-of-the-art regarding ecosystem services science, projects, and initiatives in tundra ecosystems. How well represented are tundra ecosystems in ecosystem services assessments? What are the methodological approaches currently in use? What is the role of transdisciplinarity and knowledge co-production in tundra research?

Moreover, we would like to discuss three key questions with regard to integrating human health in ecosystem services assessments. Which environmental aspects of ecosystem services are relevant for human health in tundra and mountain regions? Which physical or intellectual interactions with the environment contribute to an improvement of physical, mental, and social health? Which indicators used in ecosystem service assessments can be directly or indirectly linked to human health?

Goals and objectives of the session:

1. Deepen our understanding on ongoing challenges in tundra ecosystems from an ecosystem services perspective.
2. Map the current state-of-the-art regarding ecosystem services science, projects, and initiatives in tundra ecosystems.
3. Discuss key questions to support the integration of human health in ecosystem services assessments, bringing together scientists from different disciplines to identify related potentials and limitations.

Planned output / Deliverables:

A joint open access journal publication or a journal special issue (depending upon the content of presentations). The session will also be the basis for a common paper with interested participants on potentials and limitations of the concept of ecosystem services to integrate human health aspects in ecosystem service assessments. This will be further developed during and after the conference.

Session format:

Standard and short presentations and scientific debate.

II. SESSION PROGRAM

Room: Expert Street 9

Block 1

Date of session: 18th of November 2024

Time of session: 11:00 – 12:30

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
11:00 – 11:05				Introduction to the session
11:05 – 11:20	Mariana	García Criado	School of Geosciences, The University of Edinburgh	How will plant biodiversity change alter future ecosystem services in a warming Arctic?
11:20 – 11:30	Justine	Ramage	Stockholm University, Department of Physical Geography, Sweden	Mapping Arctic Permafrost Ecosystem Services
11:30 – 11:40	Stijn	Hofhuis	UIT, The Arctic University of Norway	Mesopredator management: Harvest data-based modelling workflow reveals drivers of tundra red fox population
11:40 – 11:50	Miguel	Villoslada	University of Eastern Finland	Leveraging synergies between UAV and satellite sensors to evaluate the impact of pale lichen biomass on land surface temperature in heath tundra ecosystems.
11:50 – 12:30				Focus Group Discussions

Block 2

Date of session: 18th of November 2024

Time of session: 14:00 – 15:30

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
14:00 – 14:10	Claudia	Caro	Universidad Nacional Agraria La Molina	Key ecosystem services in the high Andean ecosystems and their value to achieve Global Biodiversity Framework goals
14:10 – 14:15	Alberto	González-García	Université Grenoble Alpes	The deglaciation of the tropics, impacts on ecosystem services and emotionally-driven climate (in)action
14:15 – 14:20	Mattias	Gaglio	University of Ferrara	An Ecosystem Services Assessment towards the adoption of a Climate Change Adaptation Plan in the Province of Trento (Italy)
14:20 – 14:25	Ignacio	Diaz-Maroto	University of Santiago de Compostela	Cultural ecosystem services of communal temperate forests in the mountains of north-west Spain: livelihoods, human well-being and cultural-spiritual values
14:25 – 14:30	Agnieszka	Nowak-Olejnik	Jagiellonia University	Mountains for Mental, Physical, and Social Health: Unveiling the Role of a Multisensory Landscape
14:30 – 15:30				Focus Group Discussions

III.ABSTRACTS

The first author is the presenting author unless indicated otherwise.

1. Key ecosystem services in the high Andean ecosystems and their value to achieve Global Biodiversity Framework goals

First authors(s): Claudia Caro Vera
Other author(s): Vasco M. Mantas
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The high Andean mountains play a fundamental role in the provision of essential ecosystem services such as water security, carbon sequestration, habitat maintenance and tourism opportunities. However, their difficult access and the existence of altitudinal gradients pose significant challenges for the identification and valuation of all the ecosystem services they provide, especially in areas with limited field data. To address this challenge, a methodology for the identification of Ecosystem Services (ES) in the Junín National Reserve, Peru, was proposed. This methodology was based on the combination of geospatial tools with selective field data collection and a systematic survey of service-providing units. As a result, more than 100 ecosystem services were listed, using the CICES system as a classification framework. This study has established a foundational database that captures the vast potential of high Andean ecosystems to provide a wide range of services, which were grouped into management categories that were analyzed in light of their relevance to achieving the objectives of the global biodiversity framework and sustainable development goals.

Keywords: Global biodiversity framewok, High Andean Ecosystems, Bundle ecosystem services

2. Mesopredator management: Harvest data-based modelling workflow reveals drivers of tundra red fox population

First authors(s): Stijn Hofhuis

Other author(s): Chloé R. Nater, Matthew Grainger, Øystein Flagstad, Rolf A. Ims, Siw Killengreen, Dorothee Ehrich

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Expanding mesopredator populations that negatively impact biodiversity and are vectors of zoonotic diseases are an issue in many ecosystems. In the Arctic, expanding red foxes threaten endemic tundra species, and can thus be considered an ecosystem disservice. Intense red fox harvest is conducted as a management action, but its effect remains unclear. This is because we usually lack individual-based demographic data for estimating mesopredator population sizes and vital rates, hampering the assessment of management actions.

One potentially fruitful approach is to use harvest data within Integrated Population Models (IPM's). This allows for the integrated and unbiased analysis of multiple (incomplete) data sets obtained through harvest, expert knowledge or other published studies. Here we developed a versatile IPM workflow for studying population dynamics under different harvest regimes and environmental conditions. We applied this to an expanding red fox population in Arctic Norway. From 3678 harvested red foxes, we extracted data on age, reproduction, and genetic variation, and combined these data sources with data from opportunistic den surveys, informative priors on natural mortality, and environmental data. This allowed us to quantify red fox population dynamics over a period of 18 years, and to identify the drivers of changes in population growth rates using retrospective (LTRE) and prospective (PVA) analyses. We found that natural mortality and immigration were the main drivers of year-to-year changes in population growth rate. Among-year variation in vital rates could partly be attributed to variation in rodent abundance and constant harvest mortality likely contributed to limiting population growth.

These results provide valuable insights for the management of red foxes within vulnerable tundra ecosystems. Moreover, our accessible modelling framework can easily be transferred and adapted to other harvested species, facilitating the implementation of cost-effective population analyses that are of high relevance for informing management strategies and mitigating biodiversity loss.

Keywords: culling, demography, integrated population model, population dynamics, vulpes vulpe

3. The deglaciation of the tropics, impacts on ecosystem services and emotionally-driven climate (in)action

First authors(s): Ignacio Palomo
Presenting authors(s): Alberto González-García
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Tropical glaciers are facing a severe decline and the majority of them are expected to vanish before the end of the century. The ecosystem services they provide, clean drinking water, climate regulation, recreation, sense of place and spirituality, among others, are being highly impacted. Simultaneously, new ecosystems emerge, providing the opportunity for the co-production of new ecosystem services. For the preparation of United Nations International Year of Glacier preservation 2025, we modelled the extent of 30 selected tropical glaciers during the little ice-age (mid XIX century) and for the year 2050. Our results show the dramatic changes in glacier extent in less than two centuries. We couple these results with 30 interviews of a diverse group of actors that benefit from ecosystem services from these glaciers and that must cope with the unprecedented changes in the cryosphere. We analyse how ecosystem service dynamics change for this group of actors as well as the adaptation and transformation responses that emerge as a result of a radical landscape change. Interestingly, a series of human emotions seem to mediate the responses that actors develop in the face of tropical glaciers loss.

Keywords: tropical glaciers, climate change, ecosystem services, emotions, agency.

4. Mapping Arctic Permafrost Ecosystem Services

First authors(s): Justine Ramage
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Despite being critically important for communities living in the region, Arctic permafrost ecosystem services are not systematically classified and mapped, or aligned with the Sustainable Development Goals. This becomes increasingly urgent considering the unprecedented temperature rise and accelerated permafrost thaw in the Arctic. Permafrost thaw alters the livelihoods of permafrost communities by impacting infrastructure, exposing contaminants, and disturbing the supply of Arctic permafrost ecosystem services. While the impacts of permafrost thaw on infrastructure and contaminants are already under intense scrutiny, studies on Arctic permafrost ecosystem services are missing and are urgently needed. Recent research shows that permafrost communities are concerned about the consequences of permafrost thaw on their ecosystems, yet they have no tools to assess the impacts. The acute knowledge gaps in our understanding of the impact of permafrost thaw on local communities needs to be addressed. This paper presents a framework to identify, map, and value Arctic permafrost ecosystem services using community participatory approaches.

Keywords: permafrost, participatory mapping, ecosystem services, thawing

5. Leveraging synergies between UAV and satellite sensors to evaluate the impact of pale lichen biomass on land surface temperature in heath tundra ecosystems.

First authors(s): Miguel Villoslada
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Lichens cover around 8% of the Earth's land surface. While possessing the ability to colonize almost all terrestrial habitats, they play a key role in various ecosystem functions particularly at high altitudes and latitudes. More specifically, pale lichens are believed to play an important role in regulating energy and carbon balance in high-latitude ecosystems, since they control soil temperature regimes through the reflection of shortwave radiation. Due to this reflectance properties, changes in lichen cover and biomass may result in shifts in surface and soil

temperature regimes, potentially affecting the release of carbon from the soil to the atmosphere.

In this study, we aim at understanding the role of pale lichens as regulators of land surface temperature (LST) in a heath tundra landscape located in the border between Norway and Finland. We used a combination of remote sensing techniques, namely Unmanned Aerial Vehicles and Landsat data to unveil the effects of pale lichens on LST across various spatial scales, and to assess whether pale lichens have a higher cooling effect than vascular vegetation.

Our results confirm that pale lichens in heath tundra ecosystems present significantly lower LST values than typical tundra heath plant species such as evergreen shrubs or Betula nana, confirming their critical role in regulating tundra microclimate dynamics. Moreover, thicker lichen mats are associate to lower LST values. Finally, our analysis revealed the important role of the spatial scale of analysis, with markedly different results between landscape and local-scale assessments. By integrating field observations with multi-scale remote sensing analyses, we provided empirical evidence for the cooling effect of pale lichen cover, highlighting its importance in shaping thermal regimes at both local and regional scales.

Keywords: Pale lichens, remote sensing, tundra, Arctic, microclimate

6. How will plant biodiversity change alter future ecosystem services in a warming Arctic?

First authors(s): Mariana García Criado
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Plants are the foundation of terrestrial Arctic ecosystems. As the base of trophic chains, they determine ecosystem structure, function and the services they provide. Concurrent with rapid climate change, extensive vegetation change has been observed in the past few decades, including shifts in species abundance, composition and distribution. Specific mechanisms of change include northward advance of treelines, expansion of shrubs and graminoids, decreases in bryophytes and lichens, widespread species composition change and the creation of novel communities. However, considering the rapid pace of both climatic and biotic changes, and the observed high level of heterogeneous and individualistic responses to global change, documenting these impacts remains challenging, and more so understanding the consequences these might have for ecosystem services. Here, I present an overview of the current trends of

Arctic plant diversity change from a macroecological perspective, including functional traits, species distributions, diversity metrics, plant-herbivore interactions, and their relationship with climate change. Additionally, I discuss the effects these changes could have in the future of ecosystem services, including food provision, reindeer herding, climate regulation, carbon cycling, pollination, medicinal resources, and cultural and spiritual values. Overall, impacts on Arctic plants could be precursors of future changes in ecosystem function, wildlife habitats and livelihoods for Arctic people.

Keywords: plant biodiversity, Arctic tundra, ecosystem services, climate change

7. Cultural ecosystem services of communal temperate forests in the mountains of north-west Spain: livelihoods, human well-being and cultural-spiritual values

First authors(s): Ignacio J. Diaz-Maroto
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The main goal of our research is to study the cultural function of European temperate forests in the sustainable development of local communities and people living nearby. This is a complex and multidisciplinary topic given that it involves socioeconomic, political and environmental aspects. So adequate coordination between all stakeholders (administrations, forest owners, neighbours, forest users...) is necessary. The multifunctional nature of forests promotes the creation of markets, both for timber and non-timber forest products. Also, the regulation services that depend on them and the cultural services linked to the well-being of the population. A livelihood includes both people and their capabilities, income, food, another natural resources... Policymakers, forest owners, and individual capacity are essential factors in generating possibilities for growth and integrating that knowledge into decision-making. The assessment of forest ecosystem services has prioritized economic values, including fresh water, carbon storage, production of food and medicines, and soil conservation, among others. Nevertheless, on too many occasions the cultural-spiritual value of forests has been ignored because their intangible nature hinders their economic estimation. The significance of these services not only has a critical scope as it implies a greater potential for conservation actions. In fact, several billion people value their forests mainly for their cultural-spiritual meaning. Our work analyses the ancestral role temperate forests, a lot of them communal, play in the sustainable development of rural communities in Galicia, northwest Spain. These forests are a

special model of collective property between community members and have a unique legal status. Therefore, community forests could be a driving force for general well-being, citizen empowerment, equity, employment and local development.

Keywords: stakeholders, livelihoods, intangible nature, rural communities, Galicia

8. Mountains for Mental, Physical, and Social Health: Unveiling the Role of a Multisensory Landscape

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Mountain regions are popular destinations that offer visitors a range of benefits, including physical, mental, and social well-being. However, the influence of landscape factors and activities on the provision of these benefits remains unclear. Additionally, these regions face various threats that can undermine their ability to provide these benefits (climate and land use changes, pollution, and over-tourism).

Our study aimed to investigate which landscape elements enhance the provision of physical, mental, and social well-being benefits, which elements limit this flow, and how interactions with the environment facilitate their provision. To achieve this, we conducted 20 semi-structured interviews with visitors to two mountain areas in the Carpathians, Poland: Beskid Niski and Pieniny.

Visitors perceived all investigated benefits; however, they seemed to prioritize mental health, particularly relaxation and recovery opportunities, calmness, and refuge (escape from everyday life). Interestingly, in terms of landscape elements, visitors mentioned “greenery” as one of the most important factors for recovery, regardless of the specific type. The interviewees underlined also the multisensory dimension of the landscape, especially the soundscape (the silence of the night, the sound of water and wind as well as birdsong), in providing mental health benefits. Conversely, the noise associated with crowded destinations was highlighted as a significant disbenefit. Interviewees identified clean air as a key factor for overall health, while mineral water was highlighted for its benefits to physical health.

Interviewees mentioned various interactions with nature, but health seemed to be enhanced the most by physical ones (sports and recreation, observing nature). Physical effort was indicated as important for both physical and mental health. Conversely, relaxation was associated with the simpler act of sitting and observing nature.

Recognizing the importance of the mentioned landscape elements can guide land management efforts to create destinations that enhance well-being while preserving the unique character of mountain regions.

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Keywords: health benefits, cultural ecosystem services, disservices, social-ecological systems, subjective well-being