BOOK OF ABSTRACTS

This Book of Abstracts provides a comprehensive overview of the session content and is structured into three main sections:

I. Session Description – an introduction to each session, including its objectives and expected outputs
II. Session Program – a detailed schedule for each session, including speakers and timing
III. List of Abstracts – a complete compilation of all accepted abstracts

I. SESSION DESCRIPTION

ID: T17c

Advancing the natural capital accounting: connecting the dots between ecosystem extent, condition, and services

Hosts:

	Name	Organisation	E-mail
Host (s):	Megan Critchley	Basque Centre for Climate Change (BC3) - ARIES	megan.critchley@bc3research.org
Co-host(s):	Stefano Balbi	BC3 – ARIES	stefano.balbi@bc3research.org
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Abstract:

Natural Capital Accounting (NCA) is emerging as a foundational framework for guiding international policy and sustainability goals. It underpins major global initiatives such as the Kunming-Montreal Global Biodiversity Framework (GBF), the Sustainable Development Goals (SDGs), and the Global Goals on Adaptation (GGA). By integrating and structuring data on ecosystem extent, condition, and ecosystem services (ES), NCA offers a more holistic approach than the traditional ES biophysical supply assessment narrative.

Despite NCA's strengths, the links between ecosystem extent, condition, and service outcomes remain fragmented—particularly in how they are captured across monetary and non-monetary valuations, and across temporal, spatial, use and other stakeholder dimensions. This disconnect poses challenges for consistent monitoring and policy alignment.

The GBF is one example of a framework which could be enhanced through better integration of ecosystem condition monitoring. The A2 indicator "Extent of Natural Ecosystems" tracks the proportion of the Earth's surface covered by natural and semi-natural ecosystems, offering insights into biodiversity trends and land-use change. The indicator is linked to B1 "Services provided by ecosystems". However, in this process there is no assessment of ecosystem condition. This component is essential for understanding the functional capacity of ecosystems to deliver services such as climate regulation, water purification, and pollination.

Therefore the need for linked indicators that bridge Goal A (ecosystem integrity and biodiversity) with Goal B (sustainable use and ecosystem service delivery) of the GBF is urgent. NCA provides a unique opportunity

to harmonize these goals through ecosystem accounting frameworks like SEEA EA, which enable consistent tracking of ecosystem assets and services over time and space.

Knowledge of the relationship between ecosystem condition and ES outcomes remains limited, and studies are often restricted to small spatial scales. Scaling and strengthening these connections—through integrated modeling, machine learning, scenario analysis, and spatially disaggregated data—will be essential for achieving multiple biodiversity policy outcomes, including the European Nature Restoration Regulation aim of restoring at least 20% of land and sea areas by 2030, and the GBF's 2050 vision of living in harmony with nature.

This session aims to bring together researchers, policymakers and practitioners to explore challenges, methodological advances, opportunities and research needs to better establish and quantify, and integrate the components of natural capital accounting. We would like to explore key questions such as How can traditional ES supply modelling better integrate ecosystem condition into ES outcomes, and can this be done at scale? How can we better connect knowledge on ecosystem extent and condition to outcomes for ES and biodiversity, whilst maintaining the independence of the accounting components?

The session will use a mix of short talks (approx. 5 mins) and plenary discussions to identify operational, technical, political and scientific needs and opportunities to address key knowledge gaps and advance natural capital accounting. The session invites contributions from diverse disciplines and projects to foster dialogue across scales, systems and sectors.

1. Rendon, P., Erhard, M., Maes, J., & Burkhard, B. (2019). Analysis of trends in mapping and assessment of ecosystem condition in Europe. Ecosystems and People, 15(1), 156–172. https://doi.org/10.1080/26395916.2019.1609581

Goals and objectives of the session:

Showcase innovative approaches to assess ecosystem extent, condition, and service provision within an integrated framework across scales and systems. Short talks are invited, which:

- Conceptually frame and discuss the different terms and components of natural capital accounting, and how they apply to sustainable development across scales;
- Critically discuss challenges and opportunities in quantifying links between extent, condition and services;
- Identify methodological and conceptual challenges in capturing interactions between ecosystem condition and services;
- Introduce novel approaches (e.g. network-based approaches or machine learning) to model interlinked dynamics between ecosystems spatial extents, their condition and multiple ecosystem service outcomes.
- Bring together researchers and practitioners to co-identify research priorities for improving these links, fostering community building and networking.
- Strengthen the interface between scientific advances (such as integrated ecosystem assessments) and international policy frameworks, including the Kunming-Montreal Global Biodiversity Framework and European Restoration Regulation.

Planned output / Deliverables:

- A consolidated set of recommendations for future research directions on condition-service linkages.
- A synthesis report or session summary highlighting key insights, gaps, and opportunities to be shared with participants and made available to the ESP community.
- Enhanced collaboration among ongoing projects, initiatives, disciplines and geographic regions addressing ecosystem extent, condition, and services to build a collaborative network of researchers and practitioners working on conjunctive ecosystem modelling.

Session format:

We propose a session of short talks (up to 5 mins) to highlight key challenges, opportunities, showcase emerging research and technologies. These will form the basis of a guided plenary discussion to identify next steps. We estimate 1.5-2hrs for the session duration.

Related to ESP Working Group:

TWG 17 – ES Accounting & Greening the economy

II. SESSION PROGRAM

Room: C1
Date of session: Wednesday 20, May 2026
Time of session: 16:45 – 18:15

Timetable speakers:

Time	First name	Surname	Organization	Title of presentation
16:45	Megan	Critchley	Basque Centre for Climate Change	Introduction to the session
16:55	Alice	Bartolini	University College London, UCL	UK water ecosystem accounting for improved water management
17:05	Filipe	Bernardo	Universidade dos Açores	Tackling methodological challenges and development–conservation trade-offs in ecosystem service assessments of small and medium islands
17:15	Carlos Rio	Carvalho	Universidade Nova de Lisboa	An empirically calibrated, bird-based approach to habitat quality assessment in a fire-prone landscape of central Portugal
17:25	André	Tiemann	Dresden University of Technology	Towards natural capital accounting in the forest sector: Linking forest function mapping and the Common International Classification of Ecosystem Services (CICES)
17:35	Bita	Koushki	University of Naples Parthenope	From Disturbance to Decision: Assessing Carbon Sequestration Losses and Recovery Scenarios in a Managed Forest Landscape
17:45	Kiichiro	Hayashi	Nagoya University	Early decision-making support methodology to avoid conflicts between climate change and ecosystem services by using ARIES in combination with k.LAB Japan models
17:55-18:15	Megan	Critchley	Basque Centre for Climate Change	Questions for speakers, plenary discussion and wrap-up

III. ABSTRACTS

The first author is the presenting author unless indicated otherwise

1. UK water ecosystem accounting for improved water management

First author: Alice Bartolini
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The recent Independent Water Commission Final Report set out several recommendations for a reset of the UK water sector, including the establishment of long-term national priorities and improved transparency in water monitoring and reporting. This paper demonstrates how the System of Environmental Economic Accounting – Ecosystem Accounting (SEEA EA) can support these aims through the systematic compilation of water ecosystem accounts.

We provide methodological insights and empirical results illustrating how the SEEA EA can be applied to map the quantity (extent), quality (condition), and value of water resources in the UK, thereby improving the evidence base for effective water management and coordination across governance scales Despite uneven data availability across UK regions and persistent spatial and temporal gaps, we compile extent, condition, and ecosystem service accounts for 2009–2024 at national and regional levels.

Extent accounts draw on the UK Land Cover Maps and Water Framework Directive (WFD) datasets collected by the Environment Agency. We integrate these with estimates of river and lake volumes, derived from available datasets and hydrological models. For condition accounts, we develop three indicators: WFD ecological status, and nutrient and pathogen concentrations in rivers.

We also quantify the physical and monetary flows of a key ecosystem service: water provisioning. UK water abstraction statistics highlights significant sectoral dependencies on different water sources. We apply three valuation approaches: a resource rent approach, yielding unit prices of £0.38 - £0.66/m3; a replacement cost method, producing an estimate of £0.72/m3; and a value-transfer approach, resulting in a unit price of £0.38/m3. Applied to 2018 abstraction volumes, these unit prices generate monetary estimates ranging from approximately £6.24 billion to £11.80 billion (2025 £).

We claim that water ecosystem accounts can provide a robust, transparent evidence base to support long-term planning and enhance coordination across the UK water sector.

Keywords: Freshwater, ecosystem accounting, extent, condition, water sector

2. Tackling methodological challenges and development–conservation trade-offs in ecosystem service assessments of small and medium islands

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Small and medium islands (SMI) are biodiversity hotspots and socio-ecological systems highly dependent on key ecosystem services (ES) for human well-being. However, they remain insufficiently represented in ES assessments, not only due to their smaller spatial and demographic scale, but also because of persistent methodological constraints, including data scarcity, limited spatial and temporal resolution, difficulties in capturing fine-scale heterogeneity, and challenges in addressing uncertainty. As a result, ecosystem condition, ES supply and flow, and sustainability thresholds in island systems are often poorly characterized, limiting their usefulness for decision-making.
This contribution presents an assessment framework developed for the Azores archipelago, an EU outermost region, aimed at improving the understanding of ES sustainability in SMI while explicitly addressing methodological limitations of island-scale assessments. The approach combines spatial analysis of key drivers and pressures (land-use dynamics, agricultural intensification, urban development, infrastructure, and climate-related stressors) with exploratory scenario analysis to examine trade-offs

between socio-economic development and natural capital conservation. Temporal dynamics are explored using land-cover time series and remote sensing–derived indicators to assess how land-use and climate interactions affect ES provision over time.
A central focus is placed on identifying sources of uncertainty and scale mismatches that constrain ES assessments in island contexts, including limitations related to data availability, indicator selection, and satellite observation constraints. Based on these findings, the study proposes practical methodological adaptations to improve the relevance, reliability, and policy usefulness of ES assessments in SMI, including guidance on spatial resolution, data integration, and uncertainty communication.
By explicitly linking sustainability analysis with methodological refinement, this work contributes to advancing island-relevant ES assessments and supports evidence-based decision-making and sustainable development pathways in SMI environments.

Keywords: Island sustainability, Modelling and mapping of island ecosystem services, Conservation–development trade-offs

3. An empirically calibrated, bird-based approach to habitat quality assessment in a fire-prone landscape of central Portugal

First author: Carlos Rio Carvalho
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Biodiversity policy and natural capital accounting frameworks typically rely on a modular set of indicators to describe ecosystem extent, ecosystem risk or integrity, and ecosystem condition, supporting consistent reporting across scales. Translating these indicators into spatially explicit and temporally sensitive measures of ecosystem condition suitable for ecosystem service assessment remains methodologically challenging, particularly in landscapes subject to recurrent disturbance.
This study uses bird community observations to empirically inform habitat quality assessment within an ecosystem services evaluation in a fire-prone mountain landscape in central Portugal. The work was developed within the Transform Agenda (Project: Transform 4.2 – Ecosystem Services), included in the Portuguese Recovery and Resilience Plan (NextGenerationEU).
Bird community data collected over post-fire years were analysed using spatio-temporal Generalized Additive Models (GAMs), integrating land cover, vegetation productivity (NDVI), and fine-scale landscape structure. Modelled species richness and total abundance were combined into a composite Habitat Condition Index (HCI), providing a spatially explicit and temporally comparable indicator of ecosystem condition. The use of GAMs enabled reconstruction of pre-fire baseline conditions and post-disturbance trajectories.
The HCI was used to calibrate the InVEST Habitat Quality model, deriving habitat suitability and disturbance sensitivity parameters. Fire severity was incorporated as a continuous threat layer based on satellite-derived burn severity indices. Calibrated InVEST outputs were evaluated against independent HCI maps across multiple post-fire years, showing consistent spatial correspondence at landscape-relevant scales.
By grounding habitat quality assessment in observed bird community responses and integrating remote sensing and land-cover information, the approach has the potential to enable more sensitive evaluation of additionality, detection of service loss, and post-disturbance trajectories, using data that are readily available and scalable for policy and natural capital accounting applications.

Keywords: Habitat Quality; Ecosystem services; Natural capital accounting; Ecosystem disservices; Disturbance dynamics

4. Towards natural capital accounting in the forest sector: Linking forest function mapping and the Common International Classification of Ecosystem Services (CICES)

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In many European countries, forest function mapping (FFM) has become a commonly used tool for mapping social requirements on forests with special relevance for protection and recreation. The classification of forest functions shares similarities with the ecosystem services (ESS) concept, as they are somewhat comparable to the provisioning, regulation and maintenance, and cultural services from the Common International Classification of Ecosystem Services (CICES). However, there are also differences. For example, FFM is limited to the demand side, and this demand is not quantified.
The research focusses on the development of a conceptual and methodological framework that supports forest agencies to further develop their FFM under consideration of the ESS concept. Furthermore, opportunities are identified to contribute to natural capital accounting.
To do so, a synthesis of available German FFM guidelines at the state and national level was carried out. These findings were subsequently synthesised with CICES, resulting in a so-called customised CICES framework. On this basis, six ESS were examined to determine how the ESS potential, supply, demand, and flow can be quantified and mapped biophysically. Finally, using a case study in the Free State of Saxony, Germany, the ESS supply of forest-related environmental education and training was quantified and mapped to demonstrate how the demand-oriented FFM of the Saxony State Forestry Service can be complemented by a supply perspective.
The research shows that a multitude of forest functions can directly be translated into ESS. Adaptations to CICES were necessary, particularly regarding regulation and maintenance services. Furthermore, a large number of indicators were identified that may support the further development of FFM. Ways forward point to further developing the research to meet natural capital accounting principles. This applies in particular to the adaptation of ESS components and related indicators to populate the supply and use tables of the SEEA EA.
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Keywords: Natural capital accounting, Forest function mapping, Forest ecosystem services, Ecosystem services components

5. From Disturbance to Decision: Assessing Carbon Sequestration Losses and Recovery Scenarios in a Managed Forest Landscape

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Forests play a crucial role in climate change mitigation by storing large amounts of carbon in biomass and soils while continuously sequestering atmospheric CO_2. In forest landscapes increasingly exposed to climate-related disturbances, accurate spatial accounting of carbon stocks and sequestration services is

essential to support climate policy, ecosystem management, and nature-based solutions. This study presents a spatially explicit assessment of carbon storage and accounting of the carbon sequestration ecosystem service in the Tuchola Forest Biosphere Reserve, one of the largest forest complexes in northern Poland. In recent years, the reserve experienced a severe windstorm that caused extensive forest damage, raising concerns about its long-term capacity to sequester carbon and contribute to climate mitigation goals. The study focuses on quantifying carbon sequestration before and after the windstorm and on exploring how alternative biosphere management strategies may influence future carbon dynamics. The assessment is conducted using the InVEST Carbon Storage and Sequestration model, combined with spatial land-use and land-cover data and satellite-derived biomass information. Carbon sequestration loss is quantified through stock-difference accounting by comparing carbon stocks under pre-disturbance and post-disturbance land-cover conditions, allowing the spatial impacts of the windstorm on ecosystem service provision to be explicitly assessed across the reserve. Beyond disturbance assessment, the study develops and evaluates alternative biosphere management scenarios to restore and enhance carbon sequestration capacity. These scenarios represent different functional-group plantation strategies, including conifer-dominated stands, mixed forest compositions, and increased broadleaved species, reflecting plausible management pathways within a biosphere reserve context. By comparing carbon sequestration outcomes across scenarios, the study highlights how post-disturbance management choices can shape recovery trajectories and the long-term performance of this key ecosystem service. Overall, the approach demonstrates how ecosystem service accounting tools can support evidence-based decision-making and adaptive management in biosphere reserves and other managed forest landscapes facing increasing disturbance pressures.

Keywords: Carbon sequestration, Ecosystem service accounting, Forest ecosystems, Management scenarios

6. Early decision-making support methodology to avoid conflicts between climate change and ecosystem services by using ARIES in combination with k.LAB Japan models

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Understanding the impacts on nature is important to do a better decision-making. ARIES is one of the well-known initiatives to capture the impacts by using integrated models. The k.LAB Japan team is doing some projects related to developing ecosystem services and/or sustainability models by using ARIES platform, namely, k.LAB system. The ARIES integrated models with k.LAB Japan models were applied to a site selection decision-making as a case study. Renewable energy, such as, wind power site location was selected for this case study. Renewable energy, which is widely introduced in the world, is recognized as one of core countermeasure technologies against climate change. On the other hand, conflicts in the use of its land caused by renewable energy sitting happened with the other environment, social and disaster risk possibility, such as biodiversity/ ecosystem services and human existence. For the construction of renewable energy, land occupation by a facility and access road development were identified as a direct impact on the land. Also, indirect impact on land may happen. To avoid such conflicts, providing appropriate information is important for a better decision-making. So, in this study, the land impacts caused by renewable sitting was evaluated by using ARIES models with k.LAB Japan ecosystem service models, such as, carbon stock, crop, etc. This evaluation system was developed in the k.Modeler under the k.LAB system. The purpose of this presentation is to present the current development of this comprehensive evaluation tool for the use of appropriate early decision-making. Also, one of sustainability indicators was employed to this site selection for better decision-making in combination with the ecosystem service models.

Keywords: ecosystem service, renewable energy, sustainability, ARIES