# BOOK OF ABSTRACT



## I. SESSION DESCRIPTION

ID: T3

Science meeting reality: developing fit-for-purpose ecosystem services indicators



| | Title | Name | Organisation | E-mail |
|---|---|---|---|---|
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Abstract:

The development and use of ecosystem service indicators is a constant interplay between the indicator's scientific validity and the purpose for which they are generated and practically applied. Scientific assessments tend to emphasise scientific credibility and precision of an indicator, and are strongly driven by data availability. This is usually reflected in the ecosystem service indicators that are used to summarise and communicate findings of an ecosystem service assessment. At the same time, decision makers and practitioners are more likely to use information if it is relevant to the application and if the assessment process has been perceived as legitimate. Indicators are measures of something but usually also serve an

ultimate purpose, such as monitoring progress towards e.g., Sustainable Development Goals (food security, cultural identity, water security, poverty alleviation etc.), developing policy instruments (e.g. payments for ecosystem services, agri-environmental schemes), informing policy objectives and landscape design, and evaluating landscape restoration. However, ecosystem service indicators often provide information on the current or future state of the social-ecological system per se, instead of measuring progress towards reaching policy and societal goals. In this session of the Thematic Working Group 3 on Ecosystem Services Indicators we invite submissions that emphasise the practical purpose and application of ecosystem services indicators. This session will compile experience and insights from researchers' projects, and ideally practitioners' and decision makers' perspectives on linking ecosystem services indicators to specific purposes and applications. Submissions can be based on research concepts, actual field studies, ecosystem service mapping and modelling studies, national ecosystem assessments, sector-based projects etc. Submissions can also include best practice examples, as well as critical viewpoints on what characteristics are needed for ecosystem services indicators to be fit for purpose. One of our themes will be developing indicators that are suitable to design better-targeted agri-environmental measures, and payments for ecosystem services in general, by implementing result-based/ output-based payment schemes. The indicators should be central in your submission and presentation, rather than (general) information on the assessment. In addition, we expect the area of application of the indicators to be presented and the associated requirements to be clearly addressed. We plan to structure this session along the concrete areas of application of the indicators, e.g. indicators for result-based payment schemes, indicators for national ecosystem assessments, indicators for Sustainable Development Goals, etc..

## Goals and objectives of the session:

To stimulate transparent and constructive exchange on ecosystem service indicator development and use, put in context by the purpose for which they were developed. To identify main application areas for ecosystem services indicators, and discuss specific requirements in these areas of use. We would like to better link the wide expertise in ecosystem services indicators and quantification methods and practitioners to develop innovative policies and instruments. Finally, we want to advance and reflect on the work of ESP TWG 3 on ES Indicators.

## Planned output / Deliverables:

In the latter part of the session, we will discuss interest in and commitment to an open access Special Issue composed of the session contributions for an Open Access journal. We consider it crucial that practical experience and reflection should be published and shared

## Related to ESP Working Group/National Network:

Thematic working group: TWG 3 – ES Indicators

## II. SESSION PROGRAM

**Date of session:** Tuesday, 22 October 2019
**Time of session:** 10:30 – 15:00

### Timetable speakers

| Time | First name | Surname | Organization | Title of presentation |
|---|---|---|---|---|
| 10.30-10.35 | Welcome, introduction to the session by the organisers | | | |
| 10:35-10:47 | Can | Vatandaşlar | Artvin Coruh University, Turkey | Are the Indicators Used for Forest-related Ecosystem Services Appropriate? |
| 10:47-10:59 | Andre | Tiemann | TU Dresden, IHI Zittau, Germany | Towards ecosystem accounting in the forest sector: Assessing forest ecosystem services potential, flow and demand |
| 10:59-11:11 | Ildikó | Arany | MTA Centre for Ecological Research, Hungary | Interpretation challenges of indicators on the example of honey provision capacity |
| 11:11-11:23 | Alessandra | La Notte | European Commission Joint Research Centre | Sustainability scoreboards on crops: linking ecosystem contribution to actual production |
| 11:23-11:35 | Bettina | Matzdorf | Leibniz Centre for Agricultural Landscape Research (ZALF), Germany | Indicators for result-based agri-environmental schemes – What can we learn from biodiversity schemes for other kinds of ecosystem services? |
| 11:35-11:47 | Peter | Olsson | Centre for Environmental and Climate Research, Lund University, Sweden | The Naturvation assessment framework – an operational framework for assessing benefits of nature-based solutions towards urban challenges |
| 11.47-12.00 | Q&A, discussion with all presenters of the first block. Wrap-up of the first part. | | | |
| 12.00-13.30 | Lunch break | | | |
| 13:30-13:42 | Miriam | Von Thenen | Leibniz Institute for Baltic Sea Research Warnemünde, Germany | An indicator pool to support ecosystem service assessments for marine planning and management |
| 13:42-13:54 | Colin | Phifer | ORAU & Environmental | Development of Biophysical Metrics for Ecosystem Services |

| | | | | |
|---|---|---|---|---|
| | | | Protection Agency, U.S. | Assessment for Regional- and National-Scale Analysis |
| 13:54-14:06 | Takahiro | Ota | Nagasaki University, Japan | Indicators for threat level assessment of cultural ecosystem services in national/regional ecosystem assessment: an example of bequest value of cultural heritage sites in Japan |
| 14:06-14:18 | Clara | Villegas-Palacio | Universidad Nacional de Colombia | Adaptive capacity of social systems to loss or degradation of ecosystem services. A socio-ecological systems approach |
| 14:18-14:30 | Kremena | Gocheva | Institute of Biodiversity and Ecosystem Research, at the Bulgarian Academy of Sciences | Index-based, multipurpose, top-down ecosystem hierarchy of indicators and nomenclatures: Whole system approach to eliminating policy fragmentation |
| 14:30-14:42 | Andre | Mascarenhas | Humboldt Uni / Naturkundemuseum Berlin, Germany | Exploring linkages between biodiversity and ecosystem services policy indicators, sustainable development goals and essential biodiversity variables |
| 14.42-15.00 | Q&A, discussion with all presenters of the second block. Conclusion of session | | | |

## III. ABSTRACTS

*The abstracts appear in alphabetic order based on the last name of the first author. The first author is the presenting author unless indicated otherwise.*

1. *Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T3 Science meeting reality: developing fit-for-purpose ecosystem services indicators

# Interpretation challenges of indicators on the example of honey provision capacity

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Mapping and assessment of ecosystem services (ES) has grown in popularity, with a lot of new methods and indicators proposed every year. As there is a high degree of freedom when defining the concrete indicators, which can lead to hidden ambiguities and flawed interpretations, confusing decision-makers.

In this paper we explore the pitfalls of indicator ambiguities in the case of a concrete ES: the provision of honey from natural and agricultural ecosystems. Until recently honey provision used to be a relatively little studied ES, and most studies focused on its synergy with pollination. However, in the last few years honey provision received considerable attention on its own, with several new indicators having been proposed. Nevertheless, there are quite a few degrees of freedom in the way how honey provision capacities can be defined and measured, and consequently, there is a broad diversity between indicators developed in various parts of the world in what they actually show. The main purpose of this presentation is to unearth these hidden ambiguities, exploring the underlying implementation choices, and to give recommendations for a sane and robust methods selection and documentation process. Such ambiguities include, for example, defining the ES capacity level, handling the different 'components' of the ES, handling 'short term' fluctuations, and setting the unit and scale.

Although the examples shown are taken from the domain of honey provision, almost all of them are directly relevant for the assessment of the closely related ES of pollination, and several general lessons can be relevant for the development of any ES indicators.

*Keywords*: floral availability, nectar resources, honeybee foraging range, temporal variability, pollination

2. *Type of submission:* ***Abstract***

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## Index-based, multipurpose, top-down ecosystem hierarchy of indicators and nomenclatures: Whole system approach to eliminating policy fragmentation

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Ecosystem indicators and nomenclatures vary from simple parametric or statistical measurements such as the area of NATURA 2000 or water abstraction, to complex indices, e.g. status and trends for species of European interest, phenology or nutrient deposition (involving modelling over multiple data series). Indicator and parameter sets typically do not distinguish between fine and coarse spatial and temporal scales and often mix structural and functional categories.

Moreover, the parallel development of governance structures in policies impacting ecosystems but targeting different anthropogenic pressures have led to methodological inconsistencies between said policies. Reconciling them requires the creation of complicated cross-walks. For example, the 84 pressures in the MAES assessment framework form a part of its 238 condition indictors, whereas Art. 17 reporting under the Habitats Directive has a nomenclature of 220 pressures outside the indicator framework; both extensive sets still have gaps, e.g. lack of pressures on genetic diversity. Exploring such large ensembles of indictors and nomenclature

items (e.g. for linking ecosystem structure and functions described by 238 condition indicators with the 90 CICES ecosystem services categories) would require the study of an unfeasibly large number of permutations, by necessity neglect many synergies and require extensive modelling at the expense of precision. Such indicator fragmentation contradicts the parsimony principle defined in the indicator ensemble criteria requirements of the SEEA-EEA revision process.

We present the development of a single-index indicator hierarchy originally created for the ecosystem mapping and assessment in Bulgaria, being adapted for future habitat and species monitoring and reporting. Based on the "Whole system" approach and extensible by design, it will allow for wide data reuse across policies, with inputs from several monitoring and inventory schemes (water, marine, forestry, air, soils, etc.) and coherent analytical outputs towards ecosystem service accounts and multiple policies, such as climate change adaptation, or NEC Directive.

*Keywords*: Long-term ecosystem research, holistic approach, indicator hierarchy, extent, condition and capacity ecosystem accounts

3. *Type of submission:* ***Abstract***

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## Sustainability scoreboards on crops: linking ecosystem contribution to actual production

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Integrated accounting systems are meant to provide additional and consistent information to the core System of National Accounts (SNA). Satellite accounts are in fact developed by following accounting rules and mechanism that characterize economic accounts. In this exercise by combining ecosystem services accounts with agricultural statistics and food-related indicators, we attempt to propose a way to explore the three pillars of sustainability

with a systematic, replicable and coherent assessment. FAO looks after the in-depth development of Agriculture, Forestry and Fisheries (AFF) accounts within the United Nations System of integrated Environmental and Economic Accounts (SEEA). The JRC develops ecosystem services accounts within the KIP-INCA project (Knowledge and Innovation Project on an Integrated system for Natural Capital and ecosystem services Accounting). KIP-INCA follows the SEEA EEA (Experimental Ecosystem Accounting) guidelines and is thus consistent with standard National Accounts setting. The purpose of this exercise is to combine SEEA AFF accounts with INCA accounts to allow a combined analysis on ecological (ecosystem contribution), economic (market) and social (food availability) aspects of crop production. The market component involves many elements (i.e. raw crops, processed commodities, trading) that need to be further processed into a composite indicator. Once the three indicators are available, a scoreboard can be built per crop and per country. In this application, we consider 8 crops and 25 countries in year 2012. Results shows measurements that in some cases are in contrast with traditional agricultural reports and statistics, and this outcome is perfectly in line with the scope and development of the scoreboard, which is meant to be a tool for interpreting the three pillars of sustainability.

*Keywords*: Crop provision, crop statistics, ecosystem services accounting, food availability, crop trading

4. *Type of submission:* ***Abstract***

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## Exploring linkages between biodiversity and ecosystem services policy indicators, sustainable development goals and essential biodiversity variables

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Indicators play an important role in supporting policy processes to address monitoring and reporting requirements. This is reflected in the international sustainability, biodiversity and ecosystem services policy landscape. There, we find indicators that have been developed to

support the Sustainable Development Goals (SDGs), the Strategic Plan for Biodiversity 2011-2020 and the Aichi Targets in the context of the Convention on Biological Diversity, or the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Additionally, a set of Essential Biodiversity Variables (EBVs) has been proposed as an intermediate level between raw data and policy indicators. This multiplication of biodiversity and ecosystem services indicator systems poses challenges for a coordinated policy response to the sustainability and biodiversity issues currently faced by society. The aim of this research is to explore the linkages between indicators for SDG 15, the Strategic Plan for Biodiversity 2011-2020 and Aichi Targets, IPBES, as well as EBVs. This is done through a network analysis, which has been widely applied in social science to analyse linkages between actors in a network, but much less used to analyse linkages between indicators. The implications of our study for policy-driven biodiversity and ecosystem services assessments, as well as the applicability of network analysis to support scientific and technical work on policy-relevant indicators will be discussed. The research findings can be used for a more coordinated monitoring and reporting of biodiversity and ecosystem services.

*Keywords*: Indicators, Policy, Monitoring, Reporting, Network analysis

5. *Type of submission:* ***Abstract***

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## Indicators for result-based agri-environmental schemes – What can we learn from biodiversity schemes for other kinds of ecosystem services?

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Results-oriented remuneration has been discussed for many years as a promising approach to the design of agri-environmental measures. In contrast to measure-oriented remuneration, result-oriented approaches links payment directly to the achievement of a specific environmental objective. Thus, the criterion of conditionality is given in principle and farmers have more flexibility in managing their land.

In recent years, such result-based schemes have been increasingly implemented throughout Europe. However, so far mainly biodiversity schemes are implemented in practice e.g. by using plant species or birds as indictors. The main challenge is to develop appropriate indicators also for other ecosystem services e.g. in the area of water, climate and soil.

Based on own experiences in developing result-based payments schemes we will summarize in a first step the specific requirements for indicators appropriate for such kind of payment schemes.

In the second step, we will give examples for the implementation of result-oriented schemes and will focus on the particular challenges in practice. This is based on a review of implemented schemes.

In the third step, we will discuss the possible application of result-oriented remuneration approaches, especially beyond biodiversity. Which indicators are suitable here to map services in the areas of water, soil or climate? We will make suggestions what indicators and models could be used. This will end up an open discussion with indicator exerts about the usefulness of existing indicators to improve the agri-environmental schemes.

*Keywords*: payments for ecosystem services, innovative contracts, environmental effectiveness, output-based schemes

6. *Type of submission:* ***Abstract***

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## The Naturvation assessment framework – an operational framework for assessing benefits of nature-based solutions towards urban challenges

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Urban areas are facing a number of urban sustainability challenges such as densification, climate change as well as loss of biodiversity. Green and blue infrastructure, here defined as nature-based solutions (NBS), is now being considered or implemented in cities to meet the urban sustainability challenges. However, there is a lack of understanding in how to assess the magnitudes and multifunctionalities of NBS benefits. Here we create an easy, ready to-use operational assessment framework that can evaluate how NBS contribute to solve urban sustainability challenges through the usage of indicators that are credible, salient, legitimate and feasible. The development of our operational framework was guided by two questions; 1) How can we link and compare multiple NBS benefits to relevant urban challenges? and 2) How can we make certain that the framework is both scientifically credible as well as salient and legitimate to stakeholders and different user groups? Our results illustrates the need for scoring and normalization of NBS indicators in order to compare multiple NBS benefits towards challenges since each indicator is unique in terms of units and ranges. Further, we enhanced the credibility, salience and legitimacy of our framework through an iterative process where we develop and inform the framework with empirical and modeling indicator data combined with stakeholder interactions.

*Keywords*: Nature-based solution, co-benefits, sustainability, urban, operational framework

7. *Type of submission:* ***Abstract***

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# Indicators for threat level assessment of cultural ecosystem services in national/regional ecosystem assessment: an example of bequest value of cultural heritage sites in Japan

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Ecosystem or biodiversity assessment in national or regional scale is spreading rapidly as a common conservation tool. Cultural ecosystem services (CESs) and related ecosystem components have faced negative effects from various drivers in many areas. For example, second Japan Biodiversity Outlook (2016), national level ecosystem and ESs assessment, conclude that almost all assessed CESs have declined and will decline in the future. Although assessors can assess or estimate CES condition along time series, there is no suitable indicators or category to know threat level of target CES. Such threat level indicators or category can support policy makers to set priority for management with comparing between different regions or cases. This kind of threat level assessment framework is common for endangered species but uncommon for ESs (Maron et al. 2017). Our session in 2018 Asian ESP conference confirmed potential applicability of the indicator (i.e. supply/demand ratio) and threat level category suggested by Maron et al. Especially, when a CES becomes target, definition of supply and demand must clearly be made. This is because different kind of CESs and related value might be perceived differently by each stakeholder. In this study, we present some results of threat level assessment of nature related cultural heritage sites in Japan focusing on bequest value, by applying the indicators by Maron et al. We utilized the number of the listed cultural heritage and its listed timing for this CES supply. We also utilized regular social survey about satisfaction and request about cultural heritage policy for demand. From trial use of the indicator, we found that expression of demand in the indicator was quite difficult using existing time series data for some CESs. It is important to reach consensus about how to express specific value as quantitative figure among stakeholders for better indicator of threat level.

*Keywords*: threat level, cultural ecosystem services, cultural heritage, bequest value, national/regional ecosystem assessment

8. *Type of submission:* ***Abstract***

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## Development of Biophysical Metrics for Ecosystem Services Assessment for Regional- and National-Scale Analysis

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Interest in using ecosystem services (ES) concepts for decision making is high is increasing worldwide. The US Environmental Protection Agency (EPA) is a thought leader in better integration of ES into decision-making and policy formation. However, within the US, there is no clear set of national metrics in that can be used to facilitate the rigorous, discipline crossing boundary analysis needed to include ES in government policy at regional and national scales. To address this, EPA ecologists adopted the Final Ecosystem Goods and Services framework (FEGS) to define, classify and evaluate ecosystem goods and services with the goal of developing metrics for decision-making. The FEGS approach helped to operationalize ES analysis by: 1) focusing on components of nature directly enjoyed or used by people, and 2) focusing on the direct beneficiaries of ecosystem goods and service. Working within this framework, EPA scientists and collaborators developed beneficiary-specific example metrics of ES for seven ecosystems in the US, including rivers, lakes, estuaries, wetlands, coral reefs, forests and agroecosystems. These metrics were derived from interactive, interdisciplinary workshops hosted by EPA, in which social and natural scientists discussed, debated, and delineated FEGS boundaries and identified metrics that were valued and understood by scientists and non-scientists alike. Workshop participants considered a full-spectrum of ES and related metrics that may facilitate total economic valuation, including metrics for both direct-use and non-use values, by focusing on specific beneficiaries and their values. This is

the first phase of a long-term project to incorporate ecosystem services into decision-making and policy formation within the EPA. Future interdisciplinary research will test, evaluate, and refine these first-generation metrics of ecosystem services.

*Keywords*: *Final Ecosystem Goods and Services, FEGS, policy, United States*

9. *Type of submission:* ***Abstract***

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## Towards ecosystem accounting in the forest sector: Assessing forest ecosystem services potential, flow and demand

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In Germany and other European countries (e.g., Austria, Switzerland, Czech Republic), the forest function mapping (FFM) approach provides a tool for an integrative consideration of various forest functions (FF) in multifunctional forest planning and operation. This approach is well suited for spatial mapping of FF supply.

FFM can serve as a base to support the maintenance and restoration of forest ecosystems and their services, as it is addressed in target 2 of the EU 2020 Biodiversity Strategy. However, the integration of ecosystem services (ESS) into accounting and reporting systems at the EU and the national level requires an operationalisation of FF to assess the biophysical and economic values provided by forests. This task cannot be achieved by FFM itself, as FF are rarely quantified and spatial or temporal objectives are often not available.

Therefore, extending FFM through an ESS approach could be one option to assess the biophysical and economic values provided by forests. Previous work by the authors in the form of a customised CICES framework, based on existing data from FFM, has already shown the

potential of aligning FFM with the ESS concept in Germany. Especially the wide range of FF, which could be translated into an ESS terminology, supports this intention.

Building on our previous work, the methodology is developed further in order to assess forest ESS in a first step at a biophysical level and subsequently, towards an accounting framework in terms of SEEA Experimental Ecosystem Accounting. For this purpose, national (Germany) and international (e.g., Netherlands, United Kingdom, Australia) biophysical indicators are reviewed concerning their suitability for accounting purposes and their compatibility with the customised CICES Framework. Then appropriate ESS indicators are selected to implement them into digital FF maps via ArcGIS to draw inferences on the biophysical ESS potential, flow and demand.

*Keywords*: ecosystem services, ecosystem service indicators, forest function mapping, CICES, accounting

*10. Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T3 Science meeting reality: developing fit-for-purpose ecosystem services indicators

## Are the Indicators Used for Forest-related Ecosystem Services Appropriate?

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Ecological indicators are developed to provide information on ecosystem services (ES). Thus, decision-makers are informed to assess and manage the ES in a sustainable manner. Countries may apply different ES indicators in their assessments. Some of these indicators are useful while the impact of others is questionable. The present paper aims to (i) list the forest-related ES indicators used in Turkey and (ii) assess their appropriateness based on credibility, salience, legitimacy, and feasibility (CSLF) criteria. To this end, indicators actively used in Turkish forestry system were assessed using a checklist proposed by Oudenhoven et al. (2018). It was seen that forest area (ha), growing stock (m3 ha-1), biomass (ton), carbon stock (ton), increment (m3 ha-1 yr-1), non-wood forest products (kg yr-1), timber production (m3 yr-1), and the balance between increment and production (%) were the major indicators used for provisioning ES. Successfully regenerated area (ha), burned area (ha), protected forests (ha),

grazed forests (ha), encroachment (ha), firewood consumption (ster yr-1), fragmentation (patch qty.), silvicultural interventions (ha), and seed resources (ha) were the indicators for regulating ES. Regarding cultural ES, only five indicators were applied in Turkey. They were the value of timber harvested (TRY yr-1), the value of non-wood forest products (TRY yr-1), employment in the forestry sector (person yr-1), forest-related NGOs (n), and forest crime (n yr-1). The results showed that the indicators used for provisioning ES met the CSLF criteria better than those of regulating and cultural ES. In total, 72% of the checklist items were marked as positive in provisioning ES. It was 60% and 62% for regulating and cultural ES, respectively. Item-6 and item-9 referring to communicability, awareness raising, implementation plan, and adaptation were marked as negative almost in all ES groups. This showed that legitimacy criterion remained unmet in the development of most indicators. In conclusion, Turkey meets more than half of the CSLF criteria set for the forest-related ES indicators. However, special attention should be given to participatory processes for developing more appropriate ES indicators.

*Keywords*: Ecosystem services, sustainable forest management, criteria and indicators, national ecosystem assessment, forest ecosystems

*11. Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T3 Science meeting reality: developing fit-for-purpose ecosystem services indicators

## Adaptive capacity of social systems to loss or degradation of ecosystem services. A socio-ecological systems approach

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It is well known that ecosystems degradation has consequences on the wellbeing of social systems. The changes in social welfare derived from changes in ecosystem services (ES) supply depend on the social groups' vulnerability. The vulnerability has been defined as the degree to which the wellbeing of the social system is affected by changes in the ES supply. Adaptive capacity is a factor that affects the vulnerability of the social system and is defined as the system's capacity to respond to a threat such as deterioration in the supply and delivery of

ecosystem services (ES). Literature has evidenced a rising interest in understanding the AC of social systems when facing loss or degradation of ES. AC has been studied in the context of natural phenomena like flooding, earthquakes and to processes like climate change; however, its study when facing loss or deterioration of ES due to drivers as land use change has been less developed. The present study builds an AC index against the loss or deterioration of ES. For the estimation of the AC, 16 variables synthesized in six categories that were previously validated with a group of experts in the subject were evaluated. The variables were evaluated in ten types of beneficiary profiles identified concerning the ES water supply and erosion control in the Riogrande basin located in Colombian Andes. The index is constructed with weighting obtained in the consultation of experts and by analysis of main components (ACP) to analyze its robustness. Two indices are obtained by ACP and one by expert weighting. In all three indexes, the variables institutional efficiency, information distribution, technology and innovation, and local ecological knowledge were the main factors that determined the AC of the ES beneficiaries.

*Keywords*: Adaptive capacity, vulnerability, deterioration of ecosystem services supply, composed index, socio-ecological systems

*12. Type of submission:* ***Abstract***

T. Thematic Working Group sessions: T3 Science meeting reality: developing fit-for-purpose ecosystem services indicators

## An indicator pool to support ecosystem service assessments for marine planning and management

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There is growing evidence that the ecosystem service (ES) concept can provide valuable input to marine planning and management, especially when ecosystem services are placed within the ecosystem cascade. The cascade pictures ecosystem services as the link between the underlying ecosystem processes and functions and the benefits humans can receive from

ecosystems. However, indicators, which are needed for measuring ecosystem services, have often been applied inconsistently to the different steps of the cascade. This can lead to irregularities in ES assessments, when, e.g., changes in the supply are compared to changes in the use. Here, we apply a consistent approach to sorting indicators into the cascade. The approach includes the selection of marine ecosystem services, collection of indicators and structuring of the indicators. The indicators are presented in an indicator pool that allows filtering them based on the cascade steps, quality criteria and indicator themes. The study adapts the latest version of the Common International Classification of Ecosystem Services (CICES V5.1) to marine ecosystem services and associated indicators. The collected indicators reveal that there are still some gaps, which – to some extent – can be filled by adopting indicators from services that are generated by similar ecosystem components. While some indicators are very context-specific and require expert knowledge, the indicator pool does offer a suitable point of departure to select indicators for marine ES assessments. Using indicators at the different cascade steps allows the assessment of both the ecosystem components generating the services as well as the impacts on ecosystem services and their beneficiaries. The indicator pool thereby can be used to increase the transparency in the communication of results to stakeholders by showing which indicators are used and to create short narratives that describe the flow of marine ecosystem services.

*Keywords*: marine ecosystem services, indicators, CICES V5.1, ecosystem cascade, marine planning and management