BOOK OF ABSTRACTS

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I.   SESSION DESCRIPTION

ID: T3

Ecosystem services indicators in the era of big, coarse data

Hosts:

	Title	Name	Organisation	E-mail
Host:	Dr.	Alexander van Oudenhoven	Leiden University	a.p.e.van.oudenhoven@cml.leidenuniv.nl
Co-host:	Dr.	Evangelia Drakou	University of Twente	e.drakou@utwente.nl
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Abstract:

In the age of big data, especially in Europe, we have to ask ourselves: which of those data can be relevant for large-scale assessments and monitoring of ecosystem services, natural capital and nature-based solutions (e.g. MAES, IPBES, SEEA EEA, GEOBON). What are the key data sources, and what does it require for them to be useful for research, policy and management at multiple scales? Which indicators can be underpinned by these data sources? According to many, it is 'time to deliver', the era of bringing biodiversity, ecosystem services and their values to the fore. If we are to make our research speak to decision makers, it also means that we have to make numbers speak.

Taking databases and data sources as the starting point, and considering the question raised above, we will delve into (data for) the key indicators for large-scale assessments of ecosystem service assessments, assessments of nature-based solutions that work, in general, throughout Europe and beyond, and the operationalization of essential ecosystem service variables.

Feasibility and usability of data will have a prominent role in this session. Data availability is certainly important, but is having data sources available good enough? What kind of data are

appropriate for what purposes? What are the implications of up- and down-scaling data for indicator use and effectiveness? How "universal", and hence credible can indicators be across biomes (terrestrial, freshwater, marine) and social-ecological systems (including urban systems)? All of these are important questions to ask when preparing for the next generation of regional to large-scale assessments of biodiversity and ecosystem services.

In this session of the Thematic Working Group 3 on Ecosystem Services Indicators we invite submissions that emphasize the data behind the indicators used in large-scale ecosystem assessments, and the usefulness thereof in relation to the purpose of their assessment. This session will compile experience and insights from researchers' projects, and ideally practitioners' and decision makers' perspectives on linking large datasets to ecosystem services indicators in various practical assessment contexts. Data and the indicators should be central in your submission and presentation, rather than (general) information on the assessment.

Goals and objectives of the session:

To stimulate transparent and constructive exchange on ecosystem service indicator development. To identify key data sources, and ways to evaluate their usefulness. We would like to better link the wide expertise in ecosystem services indicators with experts on databases and their use. 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: Wednesday, 9 June 2021
Time of session: 11:00 – 15:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
11:00 11:10	Alexander	van Oudenhoven	Leiden University	Introduction
11:10 11:25	Kato	van Ruymbeke	KU Leuven	Assessing environmental performance of agricultural practices in Europe using ecosystem services: A rapid evidence assessment and environmental performance indicator approach
11:25 11:40	Sophie	Meier	Leibniz-Institute of Ecological Urban	Assessing potential wild bee habitats in Germany from nationwide datasets

Time	First name	Surname	Organization	Title of presentation
			and Regional Development	
11:40 11:55	George	Linney	UK Centre for Ecology and Hydrology & Lancaster University	The importance of accounting for natural capital attribute interlinkages when assessing ecosystem service provision
11:55 12:00				Discussion
13:30 13:45	Victor	Matasov	Peoples Friendship University of Russia	Changes of the recreation patterns in urban parks associated with COVID-19
13:45 14:00	Laurence	Jones	UK Centre for Ecology & Hydrology	Combining natural and cultural elements to model quality of landscapes (landscape character) at national scale
14:00 14:15	Madalina	Gugulica	Institute of Cartography	Mapping indicators of cultural ecosystem services in urban green spaces based on geosocial media data and unsupervised text classification
14:15 14:30	Ilan	Havinga	Wageningen University and Research	Modelling the aesthetic contributions of ecosystems using social media and computer vision
14:30 14:45	Markus	Venohr	Leibniz Institute of Freshwater Ecology and Inland Fisheries	Assessing water-based recreational activity dynamics from social media data
14:45 15:00				Discussion

III.   ABSTRACTS

Abstracts are ordered based on the session program. The first author is the presenting author unless indicated otherwise.

1. Type of submission: Abstract

T. Thematic Working Group sessions: T3 – Ecosystem services indicators in the era of big, coarse data

Assessing environmental performance of agricultural practices in Europe using ecosystem services: A rapid evidence assessment and environmental performance indicator approach

First author: Kato Van Ruymbeke
Other author(s): Liesbet Vranken, Erik Mathijs, Kewan Mertens
Affiliation: KU Leuven, Belgium
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Agroecosystems are one of the most important ecosystems for maintaining human wellbeing. Not only do we rely on them to provide food, they also provide secondary benefits such as recreation, erosion regulation and pollination. While conventional agricultural practices aim to maximizing production, agroecologically-friendly practices focus more on reconciling production with regulating ecological processes and sociocultural identity through the provisioning of ecosystem service (ES). Though many studies have evaluated the performance of (conventional and agroecological) agricultural practices against ES supply, this is mostly done by focussing on only a few practices simultaneously. We expand on this literature by incorporating 26 practices in an environmental performance assessment in order to draw more comprehensive conclusions on the impact of agricultural practice on ES. An evidence assessment of secondary literature evaluating the impact of 26 agricultural practices on 17 ES was carried out. Results were quantified by calculating sub-indicators reflecting impacts of practices on ES. Sub-indicators were aggregated per practice using weighted geometric aggregation into individual composite indicators (CI) reflecting overall environmental performance. Weights were adapted to three case study areas: Hageland-Haspengouw (Belgium), North Kent and High Weald (UK). Indicators were calculated at both farm and territorial level. Preliminary results indicate that agricultural practices were most commonly evaluated against regulating and maintaining services. Somewhat unexpectedly, only 29.4% of practices were evaluated against provisioning services. Across al three case study areas, extensive livestock systems was the highest performing practice at territorial level. The highest performing practices at farm level were agri-environmental measures (CI = 0.40) for Hageland-Haspengouw, and crop residue management for both North Kent and High Weald (CI = 0.45 and CI = 36 respectively). The lowest performing management practices at farm and territorial level were low agrochemical pesticide inputs at farm level and chemical fertiliser inputs at territorial level for all case studies.

2. Type of submission: Abstract

T. Thematic Working Group sessions: T3 – Ecosystem services indicators in the era of big, coarse data

Assessing environmental performance of agricultural practices in Europe using ecosystem services: A rapid evidence assessment and environmental performance indicator approach

First author: Kato van Ruymbeke
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Agroecosystems are one of the most important ecosystems for maintaining human wellbeing. Not only do we rely on them to provide food, they also provide secondary benefits such as recreation, erosion regulation and pollination. While conventional agricultural practices aim to maximizing production, agroecologically-friendly practices focus more on reconciling production with regulating ecological processes and sociocultural identity through the provisioning of ecosystem service (ES). Though many studies have evaluated the performance of (conventional and agroecological) agricultural practices against ES supply, this is mostly done by focussing on only a few practices simultaneously. We expand on this literature by incorporating 26 practices in an environmental performance assessment in order to draw more comprehensive conclusions on the impact of agricultural practice on ES. An evidence assessment of secondary literature evaluating the impact of 26 agricultural practices on 17 ES was carried out. Results were quantified by calculating sub-indicators reflecting impacts of practices on ES. Sub-indicators were aggregated per practice using weighted geometric aggregation into individual composite indicators (CI) reflecting overall environmental performance. Weights were adapted to three case study areas: Hageland-Haspengouw (Belgium), North Kent and High Weald (UK). Indicators were calculated at both farm and territorial level. Preliminary results indicate that agricultural practices were most commonly evaluated against regulating and maintaining services. Somewhat unexpectedly, only 29.4% of practices were evaluated against provisioning services. Across al

three case study areas, extensive livestock systems was the highest performing practice at territorial level. The highest performing practices at farm level were agri-environmental measures (CI = 0.40) for Hageland-Haspengouw, and crop residue management for both North Kent and High Weald (CI = 0.45 and CI = 36 respectively). The lowest performing management practices at farm and territorial level were low agrochemical pesticide inputs at farm level and chemical fertiliser inputs at territorial level for all case studies.

Keywords: ecosystem services, environmental indicators, environmental performance, agroecological farm management practices

3. Type of submission: Abstract

T. Thematic Working Group sessions: T3 – Ecosystem services indicators in the era of big, coarse data

Assessing potential wild bee habitats in Germany from nationwide datasets

First author: Sophie Meier
Other author(s): Ulrich, Walz, Ralf-Uwe, Syrbe, Karsten, Grunewald
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The ecosystem service of pollination is provided to a large extent by wild bees. However, their populations decline amongst others because well-connected nesting and foraging habitats have become rarer in Germany. To monitor the landscape structure providing these habitats, we created an indicator of the habitat potential for solitary wild bees with a short flight range of 200 m on average. The indicator is based on the approach of Zulian et al. (2013) who assessed the potential habitat of solitary bees using the CORINE land cover dataset (CLC) with a minimum mapping unit of 25 ha at the European scale. They rated each CLC-class regarding its potential nesting and foraging habitats, based on expert evaluation. Furthermore, potential edge habitats along water surfaces, forests and roads were modelled assuming that those habitats could also benefit wild bees. We adapted the European approach of Zulian et al. (2013) to the more detailed German land cover model (LBM-DE) which has a minimum mapping unit of 1 ha and includes the CLC-classification. To improve accuracy, linear elements like hedges, tree rows, rocks, streams, roads, railway lines and lanes from the German topographic-cartographic information system

(ATKIS) were added to the LBM-DE. The resulting data set is a national map of 5 x 5 m resolution for the time period of 2015, produced in a geographic information system. In Germany, the average habitat potential for wild bees is relatively low: 0.23 on a scale of 0 (low) to 1 (high). We will present details of our approach including its limitations regarding the definition of habitat types (CLC-classes) and the comparability of different time sections in the LBM-DE. Furthermore, the integration of additional datasets will be discussed.

Keywords: pollination, monitoring, indicator, LBM-DE, landscape structure

4. Type of submission: Abstract

T. Thematic Working Group sessions: T3 - Ecosystem services indicators in the era of big, coarse data

The importance of accounting for natural capital attribute interlinkages when assessing ecosystem service provision

First author: George Linney
Other author(s): Paula Harrison, Peter Henrys, Alan Blackburn, Lindsay Maskell
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To prevent further loss of our vital ecosystem services we must understand the linkages to their supporting natural capital. However, attributes of natural capital also interact with each other. For example, soil carbon content is influenced by soil moisture content. As a result, accounting for natural capital attribute to natural capital attribute (NC-NC) interlinkages can reveal further indirect natural capital attribute to ecosystem services (NC-ES) linkages. Despite their association, previous studies typically investigate NC-NC interlinkages and NC-ES linkages separately. Some studies considered trade-offs and synergies between ecosystems services using data for natural capital attributes as proxies to represent ecosystem services, thereby accounting for the NC-NC interlinkages rather than ecosystem service interlinkages. Other studies identify NC-ES linkages through literature synthesis, and thus do not recognise the indirect NC-ES linkages that arise from accounting for NC-NC interlinkages. In this study we use literature based evidence from the interactive visualisation platform LiNCAGES (Linking Natural Capital Attribute Groups to Ecosystem Services) to evidence NC-ES linkages, and a large yet fine grained monitoring dataset

(Countryside Survey 2007) to evidence NC–NC interlinkages, for 26 natural capital attributes and 13 ecosystem services. We found that accounting for NC–NC interlinkages identifies new positive and negative NC–ES linkages for many of the natural capital attributes. We investigated location and spatial scale context dependencies of NC–NC interlinkages with the natural capital attribute of soil carbon concentration. Through comparing commonalities between the NC–NC interlinkages identified at plot level to those aggregated over larger spatial scales we found spatial scale dependence in some NC–NC interlinkages, revealing potential limitations of aggregating such data. This study demonstrates the importance of considering both NC–NC interlinkages and NC–ES linkages simultaneously to understand trade-offs and synergies between ecosystem services more completely when making decisions for sustainable ecosystem service delivery.

Keywords: ecosystem service, natural capital, scale, trade-offs, land management

5. Type of submission: Abstract

T. Thematic Working Group sessions: T3 – Ecosystem services indicators in the era of big, coarse data

Changes of the recreation patterns in urban parks associated with COVID-19

First author: Victor Matasov
Other author(s): Anna Filyushkina, Dmitry Matasov, Yuri Dvornikov, Anastasia Konstantinova
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Cultural Ecosystem Services (CES) are nonmaterial benefits people obtain from ecosystems through cognitive, recreation, and aesthetic experiences. Provisioning of such CES is related to landscape structure of the park, and the demand could change affected by various factors, including weather conditions, social status of people, any kind of events or extreme disruptions. In our study we focused on the spatio-temporal changes in recreation influenced by pandemic situation. For three different parks in Moscow we collected data (2019 and 2020 years) from social network VKontake (the most popular website in Russia), which supports the sharing of georeferenced images through API. We used then Google OpenImages V6 dataset and modern YOLOv5x neural network to detect objects on images in our dataset and reclass them into ten

main categories of recreation. Spatial structure of the parks (land cover and infrastructure objects) was prepared based on OSM data along with satellite images. We also collected data on weather conditions, events, holidays, and government restrictions caused by pandemic period to complete the timeline of these factors. We used R for statistical analysis of the relation between park structure, factors timeline and changes in spatio-temporal recreation patterns. Our results showed an increase in total number of visitors in 2020 compared to 2019 in general, while during the first wave of pandemic (spring 2020) there was a huge drop in total numbers. Summer period without any restrictions was characterized by increase of visitors' total number without change in types of recreation – only sport events (like football match) reduced. But during the second wave (autumn 2020) we cannot see any reduction at all, instead we found a slight increase of photos' total number. Thus, we can conclude that in Moscow there were no significant changes in young generation's demand for CES, provided by parks during pandemic.

Keywords: VKontakte, social media data, image detection, neural network, cultural ecosystem services, spatial analysis, GIS

6. Type of submission: Abstract

T. Thematic Working Group sessions: T3 – Ecosystem services indicators in the era of big, coarse data

Combining natural and cultural elements to model quality of landscapes (landscape character) at national scale

First author: Laurence Jones
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Appreciated landscapes are an important service provided to society, but which only operates at large scale, and is dependent on multiple components of ecosystems, representing quality at a spatial scale greater than that of ecosystem. The aspects of landscape that people find attractive can be very personal, but there is an increasing body of evidence suggesting that certain types of features are generally seen either positively or negatively. Many studies which quantify landscape character focus primarily on these visual elements, but few incorporate cultural

elements or aspects of spatial pattern and non-visual cues in the landscape. Here we create a detailed composite index of 31 indicators based on publicly available data. These include positive (e.g. trees, water) and negative (e.g. built structures) visual elements, features of pattern and landforms in the landscape, as well as more experiential aspects such as tranquillity, openness and cultural and historical elements, and accessibility. These data are combined in a hierarchical structure to minimise issues of double-counting. Each indicator has a rule-base which allows spatial mapping of the benefit at relevant scales, and local variability in the way that they are applied. The underling mapping units are National Character Areas which fall into six different land use types (LUTs), defined according to geology, topography and broad patterns of land use. We created a new LUT to represent urban landscapes to complement the pre-existing five LUTs focused on rural landscapes. The rule bases are applied consistently for each LUT. By following this structured spatial and thematic approach, we demonstrate its utility to map landscape character at fine resolution, but applied at national scale across the whole of England. This method will be used to report on change in landscape character in a national Natural Capital monitoring programme for the 25 Year Environment Plan in England.

Keywords: natural capital, visual beauty, aesthetics, urban landscape

7. Type of submission: Abstract

T. Thematic Working Group sessions: T3 – Ecosystem services indicators in the era of big, coarse data

Mapping indicators of cultural ecosystem services in urban green spaces based on geosocial media data and unsupervised text classification

First author: Madalina Gugulica
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The integration of Cultural Ecosystem Services (CES) in urban planning and urban ecosystem management is imperative. Yet due to their intangible and subjective nature, CES are notoriously difficult to assess and challenges in their quantification still exist. Geosocial media data is spatially explicit and carries semantically rich information on how people perceive and interact

with their surroundings, which can be used to infer collective cultural use of urban green spaces. The potential of this data for social-cultural CES assessment has already been acknowledged by numerous studies that employ content analysis and rule-based or supervised text classification methods to derive indicators of CES. Nevertheless, these approaches are challenged in terms of consistency and cost-efficiency, as they either involve intensive labor or require large volumes of labeled training data. We introduce a novel approach that harnesses the descriptive captions of geotagged photographs, which is based on an unsupervised text classification algorithm to derive indicators of the socio-cultural use of urban ecosystems. The proposed method implements state-of-the-art NLP techniques and draws on semantic similarities between the most relevant words in a caption and a dictionary of keywords reflecting a CES indicator and its semantic dimension. We illustrate the applicability of our method by quantifying and mapping indicators of aesthetic appreciation and wildlife recreation in the green spaces of the city of Dresden, based on 1 million geotagged Instagram and Flickr photographs. The performance evaluation of the classifier revealed decent results for both indicators (0.68 $<=$ F1-score $< = 0.71$), while the spatiotemporal analysis of the derived indicators uncovered patterns of collective preferences and usage of urban green areas. The results of our work demonstrate the potential of the presented method for reliable, time-, and cost-efficient mapping of CES indicators and the strength of our approach lies in its simplicity, scalability, and spatial transferability.

Keywords: cultural ecosystem services indicators, urban green spaces, geosocial media, unsupervised text classification, spatiotemporal analysis

8. Type of submission: Abstract

T. Thematic Working Group sessions: T3 - Ecosystem services indicators in the era of big, coarse data

Modelling the aesthetic contributions of ecosystems using social media and computer vision

First author: Ilan Havinga

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Ecosystem services (ES) assessments including those conducted for ecosystem accounting purposes seek to capture the aesthetic contributions of ecosystems. However, modelling these contributions has been limited by traditional survey methods which are expensive to conduct at large scales. There has also been limited research into how these indicators of aesthetic landscape quality can be used to establish ES measures in line with the methodological requirements of national ES assessment frameworks such as the SEEA EA. Now, big data in the form of social media has emerged as a rich new source of information to understand human–nature interactions and establish cultural ecosystem service measures. The availability of geo–located social media data such as through Flickr, a photo–sharing platform, allows for the incorporation of individual beneficiaries as photos can be taken as individual expressions of value. At the same time, advances in computer vision have enabled large–scale analysis of this imagery. Using measures of aesthetic landscape quality based on Flickr imagery and computer vision, we explore possible ES methods and discuss their compatibility with ecosystem accounting principles. We consider previous conceptual work and the implications of user activity biases. The results show that Flickr and computer vision offer an important new approach for modelling the aesthetic contributions of ecosystems.

Keywords: big data, social media, computer vision, ecosystem accounting, indicators

9. Type of submission: Abstract

T. Thematic Working Group sessions: T3 – Ecosystem services indicators in the era of big, coarse data

Assessing water–based recreational activity dynamics from social media data

First author: Markus Venohr

Other author(s): Simone Podschun, Judith Mahnkopf, Kai–Ti Wu

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Recreation activities on and along water bodies are widely appreciated and practised. Where and when a water body is visited is subject to individual decisions and can lead to regionally different spatial and temporal hotspots of recreational activities. These temporal dynamics are insufficiently understood so far, but can potentially cause conflicts between users and disproportional impacts on freshwater systems. We explored a total of 3.3 million tweets from 2011 to 2015 in Germany and analysed the dynamics with regard to distance from surface waters, weather conditions, holidays as well as local and surrounding conditions (e.g., land use, population density, water, surface area, and surface water type). A relative approach was developed comparing the share of tweets posted under certain conditions to the total number of tweets in Germany to accommodate social-media-data's peculiarities. We established a generic indicator, the change factor (CF), that compares tweet shares at highest and lowest air temperatures and allows the assessment of use dynamics for individual areas. The results show a statistically significant, strong increase in tweet shares with air temperature in a distance of up to 50 m from water bodies. The strongest dynamics were found for tweets posted on non-working days, days without rain, from recreation areas, and at high surrounding population density. The results illustrate, for temperatures higher than 20 °C, an increasing preference for green areas near surface waters while avoiding urban areas. Our approach presented here, shows that the common bias of social-media-data being correlated to population density can be overcome by using a relative approach. Furthermore, adding temporal and distance parameters to the analysis helps to analyse and assess usage dynamics of freshwater ecosystems contributing to an enhanced understanding of site selection processes, usage conflicts, management effects and evaluating ecological impacts.

Keywords: freshwater ecosystems, big data, spatio-temporal dynamics, cultural ecosystem services, recreation ecology