BOOK OF ABSTRACT

I. SESSION DESCRIPTION

ID: T4b

Mapping cultural ecosystem services: use of social media to assess cultural ES

	Title	Name	Organisation	E-mail
Host:		Johannes Langemeyer	Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona (UAB)	johannes.langemeyer@uab.cat
Co-host(s):		Fulvia Calcagni	Institute of Environmental Science and Technology (ICTA), Universitat Autònoma de Barcelona (UAB)	fulvia.calcagni@gmail.com

Abstract:

The use of geolocated social media content from platforms, such as Flickr and Twitter, is gaining increasing popularity for assessing and mapping cultural ecosystem services and understanding people's multiple ways of engaging with and appreciating nature. While the research frontier in the field is moving quickly and innovative approaches continuously emerge, a generalization of methods, protocols and tools is currently widely lacking.
The session aims at providing a venue for studies that assess cultural ecosystem services through social media assessments inviting the presentation of novel applications. Furthermore, it aims at compiling different methods, protocols to trigger a critical discussion on plural understanding, context-(in)dependency and the possibility to generalize cultural ecosystem service assessments based on social media data, in order to allow for cross-study comparison and automatic assessments.

Goals and objectives of the session:

The main goal of our session is to showcase and mainstream the use of social media data for the assessment of cultural ecosystem services (CES). Our specific objectives are:
(a) To keep track of the research frontier and innovative social media-based studies;

(b) To explore common ground of methods and to start developing common approaches for the use of social media data in cultural ecosystem service mapping
This session will build on the sessions T8 "Making the intangible tangible: Using social media data to assess cultural ecosystem services" held in the last 2018 ESP EU Conference (San Sebastian, 2018).

Planned output / Deliverables:

This session is meant to further establish a community of researchers who are using social media data in ecosystem services research. It further aims at developing joint methods, protocols and tools for mapping cultural ecosystem services.

Related to ESP Working Group/National Network:

Thematic working group: TWG 4 – Mapping ES

II. SESSION PROGRAM

Date of session: Tuesday, 22 October 2019
Time of session: 10:30 – 18:00

Timetable speakers

Time	First name	Surname	Organization	Title of presentation
10:30–10:40	Fulvia	Calcagni	ICTA–UAB, Spain	Session Intro
10:40–10.55	Yaella	Depietri	Technion – Israel Institute of Technology, Israel	Participatory GIS and geolocated social media data to assess cultural ecosystem services in Haifa (Israel): a methodological comparison
10:55–11:10	Nina	Kaiser	University Duisburg–Essen, Germany	How do people perceive and interact with restored riverine areas?
11:10–11:25	Ilan	Havinga	Wageningen University, The Netherlands	Exploring the potential of Flickr photos to spatially quantify aesthetic services; a

Time	First name	Surname	Organization	Title of presentation
				case study of Texel island, the Netherlands
11:25-11:40	Nathan	Fox	University of Southampton, UK	Photosearcher package for R: reproducible software for cultural ecosystem service assessments
11:40-11:55	Oleksandr	Karasov	Estonian University of Life Sciences, Estonia	Mapping cultural ecosystem services in Estonia based on Flickr and VK.com social media data and topic modelling
11:55-12:00				Wrap up
13:30-13:40	Fulvia	Calcagni	ICTA-UAB, Spain	A tag is worth a thousand pictures: Social media metadata analysis to uncover distributional patterns of cultural ecosystem services values in a periurban park
13:40-13:55	Lukas	Egarter Vigl	University of Exeter, UK	Combining image recognition with text mining for next generation cultural ecosystem services assessment from social media
13:55-14:10	Simone	Podschun	Leibniz-Institute of Freshwater Ecology and Inland Fisheries (IGB), Germany	AQUATAG - Using social media data to assess the dynamics of water-based recreational activities
14:10-14:25	Hieronymus	Jäger	University of Innsbruck, Austria	Mapping cultural ecosystem services in mountain regions: insights from crowd-sourced tracking data of backcountry skiing-routes

Time	First name	Surname	Organization	Title of presentation
14:25-14:40	Gang Sun	Kim	Korea Environment Institute, Republic of Korea	Comparison of nature-based tourism estimated by big data sources
14:40-14:55	Michael	Sinclair	University of Haifa, Israel	A comparison of survey-based and crowdsourced travel cost valuations of recreation in Germany's National Parks
14:55-15:10	Derek	Van Berkel	University of Michigan, U.S.	Estimating the value of cultural ecosystem services for the United States
15:10-15:25	Ana	Ruiz-Frau	IMEDEA, Spain	The sum is greater than the parts: Integration of social media data to assess cultural ecosystem services in marine protected areas
17:00-17:15	Johannes	Langemeyer	Universitat Autónoma de Barcelona, Spain	Workshop intro: Towards a common approach for picture-based ecosystem service assessments
17:15-18:00	Closed workshop with speakers			

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: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

A tag is worth a thousand pictures: Social media metadata analysis to uncover distributional patterns of cultural ecosystem services values in a periurban park

First author: Fulvia Calcagni
Other author(s): Júlia Nogué Batallé, Francesc Baró, Johannes Langemeyer
Affiliation: ICTA-UAB, Spain
Contact: fulvia.calcagni@gmail.com

The need to better understand the nuanced interactions that connect humans to their surrounding natural environment is a key challenge of the ecosystem services (ES) science. In particular, many of these interactions are articulated through the provision of cultural ecosystem services (CES). However, the non-material and intangible nature of CES have challenged previous attempts to comprehensively assess and map the plural and subjective values that people attach to them. Furthermore, ES research still lacks a better understanding on how different social groups (based on gender, nationality, residence, age, etc.) access and experience CES benefits. Building on emerging methodological approaches inferring CES values through social media (SM) data, this study aims to address issues of CES distributional justice by including SM metadata analysis. Social media pictures' metadata generally includes geotag, tags and description, but it can also reveal photographers' attributes, such as gender and residence. We analysed and coded metadata of all the pictures (n = 1,885) retrieved from the photo-sharing platform Flickr that were geotagged during the years 2004-2017 within the periurban park of Collserola, a highly visited protected area located within the metropolitan area of Barcelona, Spain. In line with the main objectives of the study, we first assessed the methodological contribution of SM metadata analysis, and then performed spatial statistics in order to explain the distribution of pictures, paying specific attention to the social group of the respective photographers and considering different (independent) variables (e.g. distance from paths, from bus or train stations, etc.). Our results shows gender differences in the

distribution of CES, while origin did not prove to be a significant factor. This study shows the potential of SM metadata analysis in deepening and expanding our understanding of urban social-ecological systems and in revealing spatial patterns of CES distribution with potential justice implications.

Keywords: Cultural ecosystem services, Social media analysis, Landscape planning, Urban environmental justice, Spatial correlation and cluster analysis

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Combining image recognition with text mining for next generation cultural ecosystem services assessment from social media

First author: Lukas Egarter Vigl
Other author(s): Thomas Marsoner, Caroline Pecher, Erich Tasser, Daniel Depellegrin
Affiliation: Institute for Alpine Environment, Eurac Research, Bolzano (Italy), United Kingdom
Contact: dandepellegrin@gmail.com, lukas.egarter@eurac.edu

Cultural Ecosystem Services (CES), such as aesthetic and recreational enjoyment, as well as sense of place, local identity and heritage, play an essential role in supporting human well-being. Social media, like Flickr provide considerable potentialities to investigate CES, especially because they can overcome data in terms of spatial extent and data volumes to be harvested. In this research we present a novel methodology to predict CES supply from crowed sourced social media datasets using artificial intelligence (AI). The technique is tested for the UNESCO World Heritage site of the Dolomites (Italian Alpine Region) and investigates how users' perception of landscape is linked to CES based on the socio-ecological geographic conditions and the semantic content of the photo tags. Results show that CES hot spots are prominent in popular tourism attraction sites characterized by suitable environmental (e.g. managed farmland) and infrastructural (e.g. road network and accessibility) conditions. We conclude that the presented AI approach con provide a considerable advancement towards next generation CES assessment, and provide decision support in conservation and landscape planning in and around vulnerable natural environments.

Keywords: Cultural Ecosystem Services, Artificial Intelligence, UNESCO World Heritage Site, European Alps

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Participatory GIS and geolocated social media data to assess cultural ecosystem services in Haifa (Israel): a methodological comparison

First author: Yaella Depietri

Other author(s): Andrea Ghermandi, Daniel E. Orenstein

Affiliation: Faculty of Architecture and Town Planning, Technion – Israel Institute of Technology, Haifa, 3200003, Israel

Contact: yaella.d@technion.ac.il

Cultural ecosystem services are important components of human well-being and urban sustainability. Participatory GIS (PGIS) is widely used to assess and map these services. However, this is often a time-consuming and costly exercise. Assessments based on geolocated crowdsourced data from social networking services present new opportunities to assess these services through a large amount of accessible data, applicability at large scales, detailed spatial resolution, low costs, and for relatively long timespans. Some limitations of using social media to assess cultural services have nonetheless been identified. Amongst these is the issue of validation of the results. Personal interviews and surveys can be used at this purpose and to identify the potential for substitutability or complementarity of the two approaches. We take as a case study three green areas of the city of Haifa (Israel) and we compare the results obtained through a PGIS exercise and those obtained through the visual analysis of georeferenced pictures from three popular social media websites. The three areas were selected for the presence of different elements of cultural interest. Preliminary results indicate that the two methods provide similar results, but each also provides unique data, and thus are complementary to some degrees. For instance, the analysis of crowdsourced data is more adapted to gather information for areas specifically dedicated to touristic activities (e.g., the zoo and equipped viewpoints). In contrast, points of higher interest for the local populations, as well as those less accessible, are better captured through PGIS. The in-depth interviews provided detailed information about plant and animal species of interest, specific activities and more detailed information about historical sites. To conclude we suggest that

cultural services assessments through PGIS and through crowdsourced social media data overlap but also provide complementary information, especially depending on the type of persons interviewed in the PGIS exercise.

Keywords: Cultural ecosystem services, participatory GIS, crowdsourced geolocated data, social media, urban areas.

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Photosearcher package for R: reproducible software for cultural ecosystem service assessments

First author: Nathan Fox
Other author(s): Katherine E Parks, Laura J Graham, Tom August, Francesca Mancini, Felix Eigenbrod, James M Bullock
Affiliation: University of Southampton, United Kingdom
Contact: nf2g13@soton.ac.uk

The social media site Flickr hosts a large database of photographs alongside metadata, including spatial and temporal information. Photographs and their metadata can be easily accessed by making calls to the Flickr application programming interface (API). The accessibility of a large database of primary data has seen its use as a novel source of data for cultural ecosystem service (CES) studies increase. This includes studies assessing visitation rates in protected areas and understanding the drivers of recreational activities such as hiking. However, as there is no standard methodology for accessing the API this limits the reproducibility of studies. Some applications have been developed in an attempt to provide a more replicable manner of accessing the API, but both these and accessing the Flickr API directly have their limitations. First, when searching for photographs the Flickr API limits the number of returned images to 4,000 unique results per query. Second, the geographic range for searches is defined with a place ID or bounding box, but many users may have data for their study extent. Third, searches for photographs only return metadata, but not the image itself. Here, we developed an R package – photosearcher – which allows for reproducible studies, as well as addressing the outlined issues associated with accessing the Flickr API. We

demonstrate this package with an example of mapping CES distribution across Anglesey Geopark, Wales. Furthermore, we exemplify how the photosearcher package can utilize publicly available data on users, for additional analysis on socio-demographic factors.

Keywords: Flickr, cultural ecosystem services, R package, social media

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Exploring the potential of Flickr photos to spatially quantify aesthetic services; a case study of Texel island, the Netherlands

First author: Ilan Havinga
Other author(s): Patrick Bogaart, Lars Hein
Affiliation: Wageningen University, Netherlands
Contact: ilan.havinga@wur.nl

Ecosystems generate a huge amount of value for society through the cultural connections we hold with our natural environment. Despite this, cultural ecosystem services (CES) do not feature prominently in ecosystem service (ES) assessments. CES have proven to be some of the most challenging ES to measure, in part been due to the limits of traditional techniques such as surveys and questionnaires. Social media sources such as Flickr, a photo-sharing platform, offer a new opportunity to spatially quantify cultural ecosystem services in detail and at scale. We explore the potential of Flickr photos taken on Texel, an island in the north of the Netherlands, to quantify landscape presence as an aesthetic service. As a first step, we explored the representativeness of the data, analysing user activity and user origins. Second, we developed a new model to spatially quantify aesthetic services of the landscape. Our method builds upon the Photo-User-Day (PUD) method previously used to measure CES with Flickr data by calculating the visible area from one user's photos on one day. We describe this as the Photo-User-Day-Viewshed (PUDV). This PUDV is then distributed between the visible area using a distribution function. We found that the PUDV method was effective in capturing popular destinations on the island for their aesthetic quality. Beach and dune areas were well represented whilst agricultural areas in the centre of the island only contributed a small amount. Nevertheless, we found there to be significant issues in the representativeness of the

data although information available through user profiles has the potential of reducing these biases. More widely, there are also ethical concerns to take into consideration. Overall, however, landscape presence quantified using Flickr photos represents a significant step forward in the spatial quantification of aesthetic CES.

Keywords: Cultural ecosystem services, social media, spatial analysis, data science

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Mapping cultural ecosystem services in mountain regions: insights from crowd-sourced tracking data of backcountry skiing-routes

First author: Hieronymus Jäger
Other author(s): Uta Schirpke, Ulrike Tappeiner
Affiliation: University of Innsbruck, Austria
Contact: hieronymus.jaeger@uibk.ac.at

In the European Alps, cultural ecosystem services such as outdoor recreation are of great importance to local inhabitants as well as to visitors. Among the winter recreation opportunities provided by Alpine ecosystems, backcountry skiing is one of the most sought after, which is often perceived as a close-to-nature and sustainable alternative compared to resort skiing. Furthermore, surveys predict a rising demand for backcountry skiing in the future. However, increasing numbers of backcountry-skiers may evoke disturbance of wildlife. To map the actual use of backcountry-skiing routes and timings, several methods are available. Among these, air-borne photography, drone-tracking and social surveys are often cost-intensive and time-consuming. In our study, we propose a method to map "outdoor recreation" based on tracking data from the application Strava, which is a crowd-sourced outdoor sports network. Our results indicate strong distinctions in ecosystem service use between populated and remote areas. To reduce conflict areas between potential habitats and backcountry skiing routes, measures and strategies that guide and inform backcountry skiers need to be developed.

Keywords: ecosystem services, European Alps, wildlife, winter sport, spatial analysis

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

How do people perceive and interact with restored riverine areas?

First author: Nina Kaiser
Other author(s): Martin Palt, Andrea Ghermandi, Stefan Stoll
Affiliation: University Duisburg-Essen, Germany
Contact: nina.kaiser.aqua@uni-due.de

River restoration usually aims at improving the ecological conditions for biological life. However, what is currently missing in the field is how people interact with and perceive such areas. This aspect is important when it comes to acceptance of restoration projects. Cultural ecosystem services (CES) have a high potential to be impacted by restoration activities, because the public can gain access to areas, which were formerly limited. Our case studies are the Kishon river park in Haifa, Israel, in the heart of the most economically productive zone of Israel and the river Emscher in Germany. Both rivers share a past facing extreme pollution. By using image analysis of social media data, we detected different interaction types of people with the area. We completed our results with a survey among site visitors. The outcomes illustrate the opportunities and constraints of social media analysis for CES assessment. They give insights about the variation of use pattern of visitors and how people perceive restoration areas and activities. This is important for planning processes, especially for highly modified or in densely populated areas where competition for land is common, or where investments in restoration are cost intense and become subject of discussion.

Keywords: Social media data, river restoration, Kishon river, Emscher, cultural ecosystem services

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Mapping cultural ecosystem services in Estonia based on Flickr and VK.com social media data and topic modelling

First author: Oleksandr Karasov
Other author(s): Mart Külvik, Artem Domnich, Olha Kaminska
Affiliation: Estonian University of Life Sciences, Estonia
Contact: oleksandr.karasov@student.emu.ee

Location-based social media (LBSM) have become a popular source of data for cultural ecosystem services assessment, reflecting people's outdoor activities. Spatiotemporal clusters of geotagged photographs uploaded to LBSM, mark the interest in a place: such user-generated content is a double-filtered pictorial representation of the places (selected places are photographed, and selected photographs are uploaded to LBSM). However, extraction and classification of the meaningful information from the geotagged photographs remains a challenging task due to the complex character of their content. This, therefore, usually means the geotagged photographs are classified and interpreted manually. This process is rather time- and labour-consuming. We propose a novel methodology for semi-automated selection and classification of geotagged photographs that reflect various cultural ecosystem services provided within non-urban areas. We chose Flickr as a LBSM, commonly utilised with similar challenges and proven to be representative for cultural ecosystem services assessment, and VK.com as a LBSM popular amongst the Russian-speaking community in Estonia. We collected photographs with related metadata using API's of the mentioned services and applied the general model from Clarifai service to obtain the tags which predict the photographic content with an accuracy of 90% or higher. We assumed, that photographs, having the same pairs of tags, share the same topic (for example, seascape appreciation, fishing, drinking outdoors etc). Further, we processed Clarifai-generated tags with Python-based topic modelling algorithm called Latent Dirichlet Allocation and chose only the topics reflecting selected cultural ecosystem services. Currently, authors are working on linking the spatiotemporal patterns of the cultural ecosystem services provision to environmental and social factors that influence their distribution. Finally, revealed patterns could be used for more informed decision-making in landscape planning and management, as well as applied in the assessment of monetary landscape values.

Keywords: cultural ecosystem services, machine learning, topic modelling, user-generated content, automated image recognition

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Comparison of nature-based tourism estimated by big data sources

First author: Gang Sun Kim
Other author(s): Joungyoon Chun, Choongki Kim, Yoonjung Kim, Yong-Hyuk Kim
Affiliation: Korea Environment Institute (KEI), 370 Sicheong-daero, Sejong-si, 30147, Republic of Korea, Korea, Republic Of
Contact: gskim@kei.re.kr

Big data is a new source for estimating and evaluating nature-based tourism which is one of the most important cultural ecosystem services. As technology advances, it has become possible to acquire innovative big data that discerning people's preference on nature, but each big data source has unique characteristics to evaluate such preferences. Therefore, it is necessary to understand the characteristics of nature-based tourism estimated by each data source. In this regard, we evaluated nature-based tourism with Flickr, Twitter, and Mobile phone data, and compare its different characteristics in Jeju Island, which is known for its outstanding biological and cultural importance. The tourist attractions of Jeju Island were classified into cultural attraction, natural attraction, and other artificial facilities. A number of tourists estimated from each big data source were compared, and the patterns of each data according to tourist attraction classification were analyzed. As a result of comparison, mobile data showed high values in urban areas, and Flicker showed high accuracy in natural and ecological tourism sites. It is considered that researchers should choose effective data sources for each type of tourist attraction they are targeting. Also, to estimate a comprehensive cultural ecosystem service, it is thought that an ensemble technique that can compensate the shortcomings of data sources should be considered

Keywords: big data, tourism, tourist attractions, social network service

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Towards a common approach for picture-based ecosystem service assessments

First author: Johannes Langemeyer
Affiliation: Institute of Environmental Science and Technology (ICTA), Universitat Autónoma de Barcelona, Spain
Contact: johannes.langemeyer@uab.cat

Multiple studies have now used picture content from social media in order to assess cultural ecosystem services. Yet, the scientific use of social media data streams is still in its infancy, and methodologies for its examination lack critical testing of their robustness, including a comprehensive understanding (a) whether information posed online by social media users is representative for real world experiences by larger parts of the society (source bias), and (b) whether intangible benefits can be properly identified from social media data streams (interpretation bias). This study aims at collecting and comparing coding protocols from different research groups that have been applied to geolocated picture content from social media. While showcasing different approaches, the study will explore how to overcome the immanent biases the examination of pictures from social media embeds. At the same time this study is meant start a consolidation process and to develop a common approach for picture-based ecosystem service mapping. The ultimate goal of this study is thus to advance towards a common coding protocol that will allow for replicable and comparable results in future assessments of cultural ecosystem services and which will create the foundation for automatic assessments based on machine learning. The study will be based on contributions by the participants of the ESP session and beyond. The presentation during the session T4b ("Mapping cultural ES: use of social media to assess cultural ES") will kick-off the workshop on the same topic in the second half of the session.

Keywords: Cultural ecosystem services, social media, picture content, mapping, methods

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

AQUATAG – Using social media data to assess the dynamics of water-based recreational activities

First author: Markus Venohr
Other author(s): Simone Podschun, Robert Arlinghaus, Franz Hölker, Christian Wolter
Presenting author: Simone Podschun
Affiliation: Leibniz-Institute of Freshwater Ecology and Inland Fisheries, Germany
Contact: podschun@igb-berlin.de

Inland waters provide various ecosystem services and represent highly attractive landscapes. Recreational activities such as swimming, angling, boating, paddling, walking or cycling attract many users, yet quantitative information on the needs and interactions of different user groups as well as the ecological effects are largely lacking hampering integrated management concepts.

The project AQUATAG aims to (i) quantify the frequency, user preferences and ecological effects of various water-based recreational activities to (ii) derive socio-ecological carrying capacities and to (iii) develop management recommendations that contribute to achieving social and ecological management objectives.

Here we present a study that uses geotagged data of the social network Twitter to quantify dynamics of freshwater related recreation in Germany. As the ecosystem service flow occurs at popular locations on summer weekends, we assume short-term and locally extremely high use densities.

We analyzed about 3.3 million tweets posted during the years 2012-2015 and transformed these into an utilization model for Germany via boosted regression trees and Bayesian networks. Use dynamics of water-based recreation was found to be depending on weather, land use and distance to the water body. Moreover, spatial patterns indicated a strong shift in recreational use from urban areas to suburban recreational areas on hot summer days and during weekends.

The identification of extreme events of ecosystem service flow is of disproportionate importance for the functioning of aquatic ecosystems and biodiversity. On the one hand, direct recreational-induced consequences include the introduction of pollutants e.g. nutrients, detergents or pathogens and physical stress caused by boat waves, damage to vegetation, and other disturbances from visitors or engines. On the other hand, when extreme events coincide with sensitive periods of certain taxa (e.g., breeding birds in spring), important long-term consequences for freshwater biodiversity could occur, which is an open question to be addressed in the future.

Keywords: ES flow, twitter, spatial-temporal patterns, recreation, freshwater

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

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

The sum is greater than the parts: Integration of social media data to assess cultural ecosystem services in marine protected areas

First author: Ana Ruiz-Frau
Other author(s): Andrés Ospina-Alvarez, Silvia de Juan, Sebastian Villansante, Pablo Pita Orduna
Affiliation: IMEDEA, Spain
Contact: anaruiz@imedea.uib-csic.es

Marine protected areas (MPAs) provide fundamental ecosystem services for the maintenance of human wellbeing. If well designed and enforced they have the potential to increase the biomass of commercial and non-commercial species, protect habitats that offer coastal protection or climate regulation, among others. Yet, the provision of cultural ecosystem services (CES) is perhaps the benefit people can most directly relate to. However, defining human-nature interactions occurring within MPAs and the type of CES they provide, e.g., what ecosystems' attributes they value or what habitats or species attract most attention, and the activities people undertake is time consuming and often requires resources which are not generally available. In recent years, social media data has emerged as a potential source of information in environmental research, management and conservation. However, most studies have focused on the terrestrial environment while few have done so on marine and coastal areas. In addition, the majority of studies have restricted their scope to the use of data from

single social media platforms, therefore limiting their assessments to particular data formats, to particular sectors of the population or to particular user's needs and behaviours. Here we present an integrative analysis of Instagram and Twitter data for three iconic MPAS, namely Galapagos Islands, Great Barrier Reef and Easter Island. Text data from Instagram, a rarely used platform, and Twitter was analysed using graph theory methods, while Instagram photos were assessed through picture content analysis. We assessed the type of information that can be extracted from the different platforms and methodological approaches and how they complement each other in order to assess CES.

Keywords: marine CES, marine and coastal ecosystems, Instagram, Twitter, graph theory

13. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

A comparison of survey-based and crowdsourced travel cost valuations of recreation in Germany's National Parks

First author: Michael Sinclair
Other author(s): Marius Mayer, Manuel Woltering, Andrea Ghermandi
Affiliation: University of Haifa, Israel
Contact: msinclai@campus.haifa.ac.il

Passively crowdsourced data from social media platforms are increasingly used for the assessment and valuation of nature-based recreation. Given the availability at wide spatial scales and low cost, it holds much potential as a source of data for environmental researchers. To this date, however, limited research has focused on comparing the results to those of conventional, survey-based techniques. This study relies on geotagged Flickr photographs to analyse and value recreation in 15 German national parks and compare the results to those of independently conducted surveys. We use the metadata of public geotagged photographs to: (i) test the accuracy of various techniques that predict visitor's home regions at various spatial scales; (ii) designate home locations to all national park visitors; (ii) map spatial and temporal recreational patterns based on visitor designations; and (iv) estimate recreational values based on single-site travel cost models and compare value estimates to those generated by primary survey techniques. Results show Flickr visitation correlates well with observed visitation rates (Pearson's $r=0.97$, $p\text{-value}<0.01$). Techniques to designate home locations for Flickr visitors

result in group specific visitation rates which also correlate with onsite survey data for local (Pearson's r=0.84, p-value<0.01), other domestic (Pearson's r=0.94, p-value<0.01), and international visitors (Pearson's r=0.69, p-value<0.01). Results show that locals visit more often than other domestic (p-value<0.01) and international visitors (p-value<0.05) but take less photos per visit than international visitors (p-value<0.01). Temporal and spatial visitation patterns for local, domestic and international visitors are explored and, where possible, compared with other sources. Preliminary travel cost results for Harz National Park, return a travel cost coefficient significant and consistent with economic theory and a mean consumer surplus per visit of €23.44, which, compared to the €20.50 found using onsite surveys, highlights the potential for social media data to complement the techniques presently available to environmental researchers.

Keywords: national parks, crowdsourced travel cost model, social media, cultural ecosystem services, valuation.

14. Type of submission: ***Abstract***

T. Thematic Working Group sessions: T4b Mapping cultural ecosystem services: use of social media to assess cultural ES

Estimating the value of cultural ecosystem services for the United States

First author: Derek Van Berkel

Other author(s): Jeremy Baynes, Sean Woznicki, Anne Neale, Megan Mehaffey

Affiliation: University of Michigan, School for Environment and Sustainability, United States of America

Contact: dbvanber@umich.edu, derekvanberkel@gmail.com

The importance of cultural ecosystem services (CES) is increasingly being acknowledged in the nascent ecosystem services discipline, yet methods for estimating their value, supply and demand are scarce. The challenges of assigning monetary values to environmental goods considered irreplaceable and the lack of market surrogates for pricing CES have largely contributed to this absence. Hedonic, contingent valuation, and travel cost are approaches that have been used in the past. While effective, they are limited to small regions or a mere segment of society due to the difficulty of obtaining representative samples of the population. Alternatively, benefit transfer can be applied to larger regions, however being expert driven the method is not always representative of actual societal demand. Crowdsourced social media

data may offer a geographically representative measure for CES. In this paper, we present a methodology for estimating the monetary value of nature and quantify ing the supply and demand of CES for the continental US using social media. Over 1.2 million unique visitor trips to nature are inferred from public photographs (approx. 13 million). These scenic landscapes and outdoor activities are identified using TensorFlow, a machine learning algorithm that enables rapidly distinguishing image content. We estimate annual travel cost curves based on approximating home origin and destination of trips to nature areas for the entire US population. Our findings reveal substantial monetary expenditures for visits to natural settings. CES demand originates from highly urban counties, while supply areas include both urban and rural areas.

Keywords: Travel cost estimates, Mapping, Computer Vision, Artificial intelligence