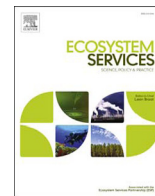




Contents lists available at ScienceDirect

Ecosystem Services

journal homepage: www.elsevier.com/locate/ecoser

Increasing the credibility of expert-based models with preference surveys – Mapping recreation in the riverine zone

Sven-Erik Rabe^{a,*}, Remo Gantenbein^b, Kai-Florian Richter^c, Adrienne Grêt-Regamey^a

^a Institute for Spatial and Landscape Planning, ETH Zurich, Switzerland

^b Department of Geography, University of Zurich, Switzerland

^c Department of Computing Science, Umeå University, Sweden

ARTICLE INFO

Article history:

Received 26 June 2017

Received in revised form 24 October 2017

Accepted 23 December 2017

Available online xxxx

Keywords:

Mapping

Ecosystem services

Recreation

Riverine zone

Survey

Expert-based

Switzerland

ABSTRACT

Recreation is a basic human need and therefore must be considered in spatial planning, which requires spatially explicit mapping of the recreation suitability of a landscape. The current methods for this type of mapping have limitations: On one hand, widely used expert-based models for large scale suitability assessments often suffer from discrepancies between the mapped values from expert assessment and actual user preferences. On the other hand, elicitation of personal preferences of potential users is complex and time-consuming, and their applicability to larger scales is limited.

In this paper, we demonstrate the development of a spatially explicit model for the recreation suitability of the riverine zone that integrates the preferences of the users with an expert-based modeling process. First, we conducted an analytic hierarchy process (AHP) with experts to generate four different model variants based on physical variables. These model variants differ in terms of the strength of the influence of the variables on the recreation suitability. Second, an online survey was used to gather data on user preferences for various river sections with regard to recreation. A comparison of the expert model results with the preferences of the potential users shows a clear correlation between one model variant and the users' preferences. This result suggests that it is possible to elaborate an expert model which corresponds to the preferences of users.

We made the model results available for the planning and development of the riverine zone in the canton of Zurich. To this end, they were integrated in a decision support platform together with other planning-relevant information.

© 2017 Elsevier B.V. All rights reserved.

1. Introduction

Recreation and physical regeneration are considered basic human needs that can be satisfied by outdoor activities such as walking and jogging (Zeidenitz, 2005; Mönnecke et al., 2006; Arnold et al., 2009). Nature-based recreation provides many benefits, such as physical exercise, experiences, intellectual stimulation, and inspiration (Kareiva et al., 2011; Daniel et al., 2012) and has been shown to positively affect an individuals' emotional well-being and health (Bowler et al., 2010; Korpela et al., 2014; White et al., 2015). It is also well documented that people benefit from access to water bodies (Volker and Kistemann, 2011, 2013; White et al., 2015; Nutsford et al., 2016), especially near-natural rivers (Junker and Buchecker, 2008; Arnold et al., 2009).

Ecosystem services have been increasingly used as a concept to describe the benefits people gain from ecosystems and landscapes. Ecosystem services are commonly divided into provisioning, regulation and maintenance, and cultural services (Haines-Young and Potschin, 2013). Recreation is allocated into the cultural ecosystem services (CES) category. CES are often underrepresented in assessments, which can result in biased planning decisions when conflicting interests have to be weighed against each other (Hernández-Morcillo et al., 2013; Plesant et al., 2014).

For example, the development of watercourses often faces challenges related to conflicting interests. The use of watercourses for recreational purposes opposes other interests, such as flood protection, nature conservation, as well as settlement or infrastructure development. To develop and prioritize the measures for water development and satisfy multiple interests, reliable and precise information regarding ecosystem services and different interests is indispensable to support decision making. To date, recreation

* Corresponding author at: Institute for Spatial and Landscape Planning, Stefano-Francini-Platz 5, 8093 Zurich, Switzerland.

E-mail address: rabes@ethz.ch (S.-E. Rabe).

and other CES have often been treated on an abstract level that has limited usefulness for spatial planning and decision making and does not meet the needs of local actors. Therefore, an adequate representation of CES in decision making is an urgent need (Chan et al., 2012; Bagstad et al., 2013; Ruckelshaus et al., 2013; Hauck et al., 2015; La Rosa et al., 2015; Scholte et al., 2015). This requires that the CES are integrated into maps to show their spatially explicit values. This mapping is necessary not only for decision support but also to raise awareness and set priorities (Hauck et al., 2013; Burkhard and Maes, 2017).

Hernández-Morcillo et al. (2013), La Rosa et al. (2015), Wolff et al. (2015), and Crossman et al. (2013) present in their reviews a variety of existing approaches on how the recreation potential of a landscape can be quantified and mapped. These authors also highlight the limited comparability of the different methods. The approaches can be split into two groups: A majority of the existing studies use physical landscape characteristics, such as accessibility or land cover to model recreation suitability in a spatially explicit manner (Kienast et al., 2012; Nahuelhual et al., 2013; Paracchini et al., 2014; Albert et al., 2015; Peña et al., 2015). These studies are based on the assumption that people's preferences can be assigned to an array of physical characteristics in a landscape. Such approaches are efficiently applicable from smaller to larger scales. The second group of approaches directly maps user preferences and shared values (Junker and Buchecker, 2008; Raymond et al., 2009; Kienast et al., 2012; Plieninger et al., 2013; van Berkel and Verburg, 2014). These methods use in-depth interviews, participatory mapping, or empirical surveys of a large number of people, for example, on the recreation behavior or preferences for the landscape. Directly mapping users' preferences requires a high number of respondents and highly differentiated surveys to adequately capture all aspects of a landscape that might be relevant to recreation. On the other hand, expert-based assessments relying on physical criteria are restricted by the uncertainty whether they actually represent subjective perceptions of user groups (Riechers et al., 2016).

Despite the existence of those different approaches, water-related recreational services or recreation suitability have not yet been mapped with high resolution across Switzerland, or not even at a regional scale. Spiess et al. (2008) examined the potential of water-related recreation areas for improvements in a pilot study in three Swiss municipalities. Their method aims at the required level of detail by developing a spatially explicit GIS-based logic-model; however, it does not include users' preferences, is only optimized for one specific agglomeration area, and is not usable in non-settlement areas. Within the scope of a systematic assessment of ecosystem services, an indicator based on accessibility of the waterfront areas has been previously suggested, but it has not been mapped (Kienast and Steiger, 2013; Gret-Regamey et al., 2014a). Furthermore, approaches that link user preferences with spatial data to identify recreation areas have been applied (Kienast et al., 2012; Buchecker et al., 2013), but they are often not sufficiently detailed in scale to be used in river development and thus support planning processes.

In this paper, we present an approach to map the recreation suitability of watercourses at a regional level in the canton of Zurich in Switzerland that combines the two approaches outlined above. We first apply an expert-based modeling approach to spatially assess recreation suitability in different sectors of the riverine zone using different model variants. We then select the most suitable variant by comparing the modeling results with the preferences of potential users from a user survey. We show that this procedure benefits from the advantages of both methods and can be applied with a reasonable effort in a region at a detailed scale. We further demonstrate that our approach allows for the selection of the best model variant with regard to consistency with user

perception, which then can be integrated into decision support platforms for supporting planning processes.

2. Methods

2.1. Process for mapping the recreation suitability in the riverine zone

The presented study follows several steps, which are shown in Fig. 1. The first six steps are part of the expert-based approach, while steps seven and eight belong to the user-based approach. Subsequently, the results of both approaches are compared (in step 9), and the best model variant is chosen for implementation into a decision support system (steps 10 and 11). The different steps are described in detail in the following sections.

2.2. Study area

Changes to the Swiss legislation on water protection (Waters Protection Act, Waters Protection Ordinance) in 2011 called for the designation of space for all watercourses as well as for revitalization and quality improvements to rivers (Göggel, 2012; AWEL, 2015b). Watercourse development measures must be implemented at a cantonal level (i.e., regional); thus, we focused our study on this level. Recently, the canton of Zurich initiated and implemented a decision support system (available at: gr-vis.ethz.ch) to be used for the future planning of watercourses, so we used this canton for testing our mapping approach. The size of the canton of Zurich is 1729 km², approximately one-fifth of the canton is settlement area (378 km²), and the length of the considered watercourses is approximately 3600 km (Fig. 2). We used watercourse segments as the spatial units for the recreation mapping. Therefore, we split the watercourses into 143,145 50-meter sections on both sides.

In the canton Zurich, recreation is a highly demanded service, since this region is densely populated and demand will continue to grow as a result of population growth (Meier et al., 2013). Leisure and recreational use is thus an important part of the spatial development and water-related planning in the canton of Zurich (Kanton Zurich, 2014). Accordingly, the recreation suitability has to be taken into account during the implementation of the revitalization planning (Göggel, 2012; AWEL, 2015b).

2.3. Expert-based approach

2.3.1. Step 1: Literature review

To define a first set of criteria, which may affect the recreation suitability of watercourses, we conducted a literature review (step 1). We searched Google Scholar and ScienceDirect for the keywords “recreation”, “mapping”, “cultural ecosystem services”, “river”, “water”, “stream”, and “revitalization”. We only considered literature that focused on the mapping of recreation if the described methods or criteria were related or were transferable to the riverine zone. This was the case if general aspects (e.g., recreation facilities, distances) were addressed and if the literature did not explicitly deal with specific forms of recreation which do not take place in the riverine zone (e.g., skiing).

The aspects found in the literature which might have an effect (positive or negative) on the recreation potential were first harmonized into a preliminary set of criteria to measure the recreation suitability of the riverine zone. For example, the aspects “noise load” or “acoustic level” from literature were only included as “noise” in the preliminary set of criteria in order to avoid content redundancies. In order to improve clarity and to facilitate the evaluation of the criteria in step 2, the criteria were grouped into thematic classes. For example, all criteria which influence the

Download English Version:

<https://daneshyari.com/en/article/6556258>

Download Persian Version:

<https://daneshyari.com/article/6556258>

[Daneshyari.com](https://daneshyari.com)