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# Mapping recreational visits and values of European National Parks by combining statistical modelling and unit value transfer

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ABSTRACT

Recreation is a major ecosystem service and an important co-benefit of nature conservation. The recreational value of National Parks (NPs) can be a strong argument in favour of allocating resources for preserving and creating NPs worldwide. Managing NPs to optimize recreational services can therefore indirectly contribute to nature conservation and biodiversity protection. Understanding the drivers of recreational use of national parks is crucial.

In this study we use a combination of primary data on annual visitor counts for 205 European NPs, GIS and statistical regression techniques to analyse how characteristics of NPs and their surroundings influence total annual recreational visitor numbers. The statistical model can be used for land-use planning by assessing the impact of alternative conservation scenarios on recreational use in NPs. The recreational use of new NPs can be estimated ex-ante, thereby aiding the optimisation of their location and design.

We apply the model to: (1) map recreational visits to potential new NPs across Europe in order to identify best NP location; (2) map recreational visits to a proposed new NP in the west of Germany in order estimate monetary values and to show how visits are distributed across the site; and (3) predict annual visits to all NPs of 26 European countries. Total annual visits amount to more than 2 billion annually. Assuming a mean value per visit derived from 244 primary value estimates indicates that these visits result in a consumer surplus of approximately € 14.5 billion annually.



## 1. Introduction

National Parks (NPs) are protected areas for the conservation of extraordinary landscape and wildlife for posterity and as a symbol of national pride. NPs contribute to stopping the loss of biodiversity, maintaining the naturalness and beauty of our landscape and the supply of ecosystem services. Thereby, NPs contribute to achieving the targets defined in EU biodiversity strategy 2020, such as "halting the loss of biodiversity and the degradation of ecosystem services" (EC, 2011), and the Aichi targets, such as "to improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity" (CBD, 2013).

However, financial resources and political support for nature conservation are limited and halting ecosystem degradation remains a great challenge. In the past, major policy goals on biodiversity protection have typically not been met, such as those set by the Convention on Biological Diversity, ratified after the global summit in Rio de Janeiro (1992) (Barbault, 2011; Leadley et al., 2010). And still, the future outlook reveals that biodiversity remains under threat and substantial action needs to be undertaken (SCBD, 2014).

One major co-benefit of nature conservation is the supply of recreational opportunities. NPs provide opportunities for visiting, experiencing, enjoying and learning about nature and biodiversity, and thus contribute to human well-being and environmental awareness. Nature recreation and tourism present a great economic value and an opportunity for rural economic development by generating income and employment through visitors' expenditures. The value of nature recreation and its economic opportunities can be used as a strong argument in favour of allocating financial resources towards nature conservation at different spatial scales (Balmford et al., 2015).

Nature conservation should not only focus on biodiversity and habitat protection, but should also take recreational co-benefits into account. Efficient land-use planning needs to consider all

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ecosystem services supplied. For allocating resources for nature conservation, it can be important to know how recreational co-benefits of nature conservation can be optimized. The most important indicator of the contribution of recreation to the local economy is the number of visitors (Jones, Bateman, & Wright, 2003; Bateman, Day, Georgiou, & Lake, 2006). Therefore, understanding the drivers that determine the number of visitors to protected areas is crucial for protected area management and for protected area designation.

The aim of this study is to analyse the effects of NP characteristics and their spatial context on total annual visits that are considered the main determinant of recreational economic value (Bateman et al., 2006). To this end, we develop regression models of visitor numbers using primary data for European NPs combined with additional spatial variables derived from GIS data. The estimated models give insights into the drivers of recreational use within European NPs and thus allow the prediction of visitor numbers for designated new NPs and alternative management scenarios. Similar to the study of Balmford et al. (2015), we combine our predicted visitor numbers with a mean value estimate per recreational visit, but derived from a much larger set of primary valuation studies. Thereby, the relative importance of recreational services is highlighted as compared to other ecosystem services and man-made goods.

Several studies have modelled visitor numbers of protected areas or nature areas based on spatial variables. One widely applied approach is to use choice models to predict recreational behaviour at the individual level. Typically, such studies use survey data containing information on the origin and destination of an individual recreational trip. However, such datasets are time-consuming to develop and are usually only available for relatively small areas (Pouta & Ovaskainen, 2006; Bateman et al., 2011; Hausman, Leonard, & McFadden, 1995; Jones, Wright, Bateman, & Schaafsma, 2010; Loomis, 1995; Feather et al., 1995; Parsons & Hauber, 1998; Sen et al., 2013; Shaw & Ozog, 1999; Termansen, Zandersen, & McClean, 2008). The purpose of the present study is to investigate the determinants of recreational use of NPs at a European scale and therefore we use data from visitor monitoring studies for NPs across Europe. Some existing studies have used similar approaches in order to investigate drivers of recreational park visits. For example, Neuvonen, Pouta, Puustinen, and Sievänen (2010) analyse effects of park characteristics on visitation rates for 35 Finnish NPs. Mills and Westover (1987) model the visitation rates for 121 Californian State Parks using four predictors representing park characteristics and the distance to the nearest population agglomeration. Hanink and White (1999) model recreational demand for 36 US National Parks using age and size as variables for describing the park, its distance and the population of the closest metropolitan area, as well as substitute availability as context characteristics. Hanink and Stutts (2002) model the demand for 19 recreational battlefields in the US. They use a substitute availability indicator weighted by individual substitute's characteristics. Loomis, Bonetti, and Echohawk (1999) find a significant effect of GDP per capita and of availability of wilderness on the number of recreational trips to wilderness areas per capita in the US. Ejstrud (2006) use a number of GIS indicators for modelling visitor frequency to 10 Danish open-air museums using six predictor variables, but do not report whether they show significant effects. The only study using international visitor data is from Balmford et al. (2015), which uses visitor data of protected areas worldwide. Their study uses only a limited number of relatively simple predictor variables and finds few significant effects. Their model may be appropriate to assess overall trends in protected area visitation rates, but may have few site specific implications. Loomis (2004) uses regression techniques to estimate the effect of elk and bison populations on visitation rates in Grand Teton National Park, US, using explanatory variables on how the park changes over time, but does not compare effects of alternative sites' characteristics.

All except one of the above mentioned studies use national data only for their statistical analysis. Thereby, the number of primary observations is in general relatively low. The purpose of the present study is to investigate drivers of recreational use for NPs Europe-wide and therefore, use visitor data from NPs in 21 European countries comprising 205 case study areas in total. Consequently, we can include more predictors in our initial model and try to estimate a more robust model. For example, national study areas are relatively small and therefore climatic conditions are often too similar to be considered as a predictor in a recreational demand model. Furthermore, we use more refined site and context characteristics as predictors in our model, which are computed and extracted from Europe-wide GIS data layers. As all our predictors are derived from large scale GIS data layers, the final model can easily be used to make predictions of visitors' frequency for any potential NP in Europe. Thus, recreational use can be mapped for any location in Europe without the need for an additional collection of information on the predictor values. Our spatial assessment can thereby be used for ecosystem service mapping as required by the EU Biodiversity Strategy 2020, improving resource allocation and calculating a green GDP (UN, 2014; Maes et al., 2012). Finally, we use a number of different statistical regression techniques to deal with spatial autocorrelation for a more in-depth identification of the spatial dimension of recreational use.

This paper is organized as follows: in section two we describe the data we use, first the primary data of visitor monitoring studies and second the predictors used in our models. In section three we explain the statistical regression techniques applied and present the estimated visitor models. The results are presented and discussed in section four and five, with conclusions provided in section six.

## 2. Data

### 2.1. Primary data

Our primary data are 205 total annual visitor estimates to European NPs and 245 estimates of monetary values per recreational visit for 147 separate nature areas in Europe. We collected the data through internet searches, review of relevant literature and by contacting researchers involved in this field, NP administrations and relevant governmental bodies in all EU countries. The data is described more in detail in (Schägner et al., submitted).

For the visitor data to be included, we required as a minimum quality criteria that the total annual visitor estimates are based on some form of on-site visitor monitoring, which is then scaled up to the entire area and the entire year. In order to check whether the quality criteria is met, we analysed the relevant publications on the visitor monitoring programs. In cases in which the information was not available or not accessible due to language barriers, we contacted the authors and relevant institutions. In total we could obtain annual visitor observations for 205 separate case study areas within Europe, which are either an entire NP or a subsection of a NP (see Fig. 1). All collected data were attached as attributes to a spatial layer in vector format, containing the boundaries of NPs or of their surveyed part. We obtained NP polygons from (World Data Base of Protected Areas) and the CDDA (Common Database on Designated Areas) (IUCN & UNEP, 2015; EEA, 2013) and from national agencies. If case study areas differed from the available polygons, we tried to obtain polygons from the authors of the studies, the park management or other stakeholders. In some cases we manually draw polygons with ArcGIS, based on information available in the case study publications or supplied by the authors. If multiple