Ecosystem Services xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

Ecosystem Services

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

Assessing and valuing the recreational ecosystem services of Germany's national parks using travel cost models

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ARTICLE INFO

Article history:
Received 30 June 2017
Received in revised form 14 November 2017
Accepted 15 December 2017
Available online xxxx

Keywords:
Cultural ecosystem services
Recreational ecosystem services
Recreational value
National parks
Travel cost method
Germany

ABSTRACT

This paper estimates the recreational ecosystem services (RES) of 15 German national parks (NLP) in one of the most comprehensive RES valuations of NLP systems performed to date. The RES were evaluated using zonal travel cost models (TCM) based on 24,548 representative interviews conducted with a uniform methodology between 2004 and 2015. Reaction functions were estimated for each park as double-log regression models. The lower-limit consumer surplus of recreation in German NLP totals EUR 385.3–621.8 million (including only visitors whose trip decisions were influenced by the parks' protected status), while an upper-limit value reached EUR 1.690–2.751 billion (including all visitors). Thus, NLP generate enormous non-monetary values for German society. The standardized approach applied could be used to harmonize assessments and valuations of RES in protected areas. Finally, the article advances the theory of RES assessment, valuation and mapping by highlighting the importance of on-site visitation data. RES do not exist *a priori*, but emerge as co-products of ecosystems and visitors' perceptions and valuations. For this reason, we discourage the use of context-specific RES results in benefit transfer approaches.

1. Introduction

National parks (NLP) provide numerous ecosystem services: regulating and supporting services as well as cultural services like recreation and spiritual values (TEEB DE, 2016). In recent years, an important trend has emerged towards mapping and assessing ecosystem services in general (Bunse et al., 2015), and in protected areas (PA), including NLP (Schägner et al., 2017; Fish et al., 2016). Such studies underscore the important services that PA provide to societies (Brown et al., 2015), thus presenting objective arguments in favor of conservation, especially for often-contested NLP (Martin-Lopez et al., 2011). Mapping and valuation offer the additional opportunity of analyzing trade-offs between different ecosystem services in a spatially-explicit form (e.g., wood production *vs*. recreation in a potential NLP) (Maes et al., 2012).

Parallel to this trend, cultural ecosystem services have attracted the interest of researchers (Daniel et al., 2012; Plieninger et al., 2013), so today, tourism and recreation are often used as the most straightforward cultural ecosystem services in quantification and valuation studies (Milcu et al., 2013), compared to more qualitative aspects like the spiritual, aesthetic and identity dimensions of ecosystems. Thus, it seems appropriate to explicitly assess recreational ecosystem services (RES) considering the widely-acknowledged role of nature and ecosystems as attraction factors for recreation and tourism (Deng et al., 2002). Consequently, we refer to RES as "the contributions of landscapes to non-specific and specific recreation opportunities" (Hermes et al., 2018, this issue).

Existing research on RES in German NLP often consists in economic impact studies that elucidate their role as major tourism attractions in rural areas (Job et al., 2016; Mayer and Job, 2014, Woltering, 2012; Mayer et al., 2010). However, such analyses focus on changes in sectoral and regional economic activities and so cannot reflect RES appropriately because they fail to consider effects on wellbeing (Benson et al., 2013).

NLP provide excellent cases for the assessment and valuation of RES because their protection status underlines their importance for conserving vulnerable ecosystems, while also functioning as major tourism attractions (Dudley, 2008; Balmford et al., 2015). This gives the advantage of reliable visitor frequentation in specific areas that is necessary for measuring recreational activities on-site. This issue has profound repercussions for our understanding of RES, since these services can only exist if the areas are frequented by recreationists. Without visitors, such areas have the

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https://doi.org/10.1016/j.ecoser.2017.12.009
2212-0416/

potential to provide RES, but do not *generate* them. One contrasting example of this is oxygen production by vegetation (see Section 2 for details).

This paper estimates – for the first time – the RES of 15 of Germany's 16 NLP, operationalized as recreational values, which were determined using travel cost models (TCM). Though both well-established and widely-criticized for several years (Ward and Beal, 2000), TCM are applied here to German NLP for perhaps the first time. Our results provide key, additional arguments that support NLP by showing that they generate considerable non-monetary values for German society as a whole. Beyond the benefits of valid RES assessments that offer relevant information to PA stakeholders, our article contributes to theoretical knowledge on RES assessment, valuation and mapping, while sketching a harmonizing approach to assessing RES in PA in general.

This paper is structured as follows: after theoretical considerations on RES in PA and their economic valuation (Section 2), Section 3 provides an overview of German NLP. Part 4 presents the TCM methodology and its data requirements. Results are reported in Section 5. Finally, Section 6 discusses these findings and draws conclusions.

2. Economic valuation of RES in protected areas

Economic valuation can be defined "as the attempt to assign quantitative values to goods and services... whether or not market prices are available" (Barbier et al., 1997, p. 10). The economic value of PA can be conceptualized using widely-accepted total economic value frameworks developed since the 1980s; approaches that generally differentiate between use and non-use values. Important elements of use values are the recreational values of PA (Mayer, 2013, 2014). Broadly-understood, recreational values refer to the willingness to pay (WTP) to spend leisure time in PA. The economic valuation of the recreational value of PA is not straightforward, however, because they are not conventional market goods with an obvious market price. Rather, the recreational values of PA constitute a congestible club or public good, depending on the access policy involved (Dixon and Sherman, 1990; Lindberg, 2007). For example, potential visitors cannot be excluded by raising entrance fees if a country has an open-access policy (e.g., Germany, New Zealand). Recreational values are congestible because, depending on visitors' subjective crowding tolerance level, the recreational experience can suffer if too many visitors arrive at once (Schamel and Job, 2013). These partly-fulfilled public good features explain why entrance fees and/or on-site expenditures by visitors are insufficient to measure the recreational value of PA, since they: (i) do omit the travel and time costs required to reach the destination; and (ii) may not encompass the maximum WTP for a park visit (Mayer, 2013, 2014).

One well-established approach to estimating recreational values at PA uses travel cost models (TCM) (Ward and Beal, 2000; Hanley and Barbier, 2009; Heberling and Templeton, 2009). TCM estimate the consumer surplus of park visitation using reaction functions of park visitation derived from regression models that depend on the relation between distances to, and visitation rates in, the survey area. Other important input variables are travel cost rates per person and mileage, differentiated by mode of transportation. Also, the opportunity costs of travel time and multiple-destination trip bias must be considered, as trip motivation is rarely oriented to one sole attraction (Freemann, 2003). Thus, TCM are a revealed-preferences approach to environmental economics (Pascual et al., 2010) because they are based on real trips to PA. Modelling approaches, in contrast, are based on simulating fictive visits (e.g., Schägner et al., 2016, 2017; Balmford et al., 2015). Therefore, our approach to estimating the RES of German NLP relies on actual (not potential) recreational use, considering: (i) physical factors (landscape amenities like the Wadden Sea, lakes as the Müritz, etc.); (ii) accessibility; (iii) the distribution of potential recreational demand (population density and settlement structure); (iv) destination image (NLP might be more well-known than comparable landscapes); and (v) the *uno-actu* principle in tourism. This final aspect sustains that an area cannot have recreational *value* if no visitors go there, but only a recreational *potential* influenced by the other features cited (Gee and Burkhard, 2010; Carius, 2013). Consequently, Costanza (2008) and Paracchini et al. (2014) classify recreation as "user movement-related". Fish et al. (2016, p. 211), do not regard cultural ecosystem services (including RES) as "*a priori* products of nature... but as relational processes and entities that people actively create and express through interactions with ecosystems". Despite this, areas without recent visitation may conserve the potential for future recreational activities. This corresponds to the concept of option values (Weisbrod, 1964; Hanley and Barbier, 2009; Pascual et al., 2010).

Regarding the state of research in this field, several case-study applications of TCM in NLP have been performed around the world (e.g., Bennett, 1996; Heberling and Templeton, 2009), but only a few compare results for RES among several national parks in one country. For the USA, Neher et al. (2013, p. 685) state that the: "[v]aluation of recreational visits to... park units has been largely unsystematic and fragmented"; an assertion that likely holds almost globally. One early, notable exception is Ward's (2003) estimation of the recreational value of 11 Australian NLP, which totaled AUT-$13.656 million (1997/98 values). The importance of this contribution notwithstanding, it includes only a few of that nation's 500+ NLP (Australian Government, 2017). The most complete assessment of recreational values of NLP was carried out by Neher et al. (2013) for 58 units of the US National Park System (NPS), including 16 NLP (out of 58). Using TCM, they extrapolated the overall recreational value of the entire NPS system (367 units) to an estimated US-$28.5 billion (2011 values) based on 279 million recreational visits in 2011. In Central Europe, however, no RES of NLP systems were evaluated comprehensively until we undertook our study (Mayer, 2013; Mayer and Job, 2014). In contrast to Neher et al. (2013), our analysis covers a much larger share of the NLP system, accounts for the multiple-destination trip bias systematically, includes the opportunity costs of travel time and all means of transportation used by visitors (instead of assuming car travel for each one) and is based on year-round visitor monitoring (instead of a "grab sample" over a 1–2-week period in the summer season).

3. National parks in Germany

The German conservation movement began in the 19th century as a reaction to the consequences of rampant industrialization on landscapes and the environment. In contrast to the North American idea of establishing NLP to protect vast unspoiled wilderness areas, the focus in Germany was on small-scale protected units. It was only a decade after World War II that large-scale PA (defined here as areas covering >10,000 ha with their own administration) were introduced there through the creation of the first Nature Park (*Naturpark*) in 1957. The first NLP was established in 1970 in the Bavarian Forest (Mayer and Woltering, 2017).

Compared to North America and other European countries (e.g., Sweden), the history of NLP in Germany is quite short; indeed, 12 of its 16 NLP have been designated since 1990 (Hunsrück-Hochwald, designated in 2015, is the latest). These 16 NLP cover a total terrestrial area of 214,558 ha, which is just 0.6% of the national territory (BfN, 2017). Their legal mandate is to protect endemic species and ecological integrity on extensive, mostly pristine, territories. As long as they do not compromise this

Please cite this article in press as: Mayer, M., Woltering, M. Assessing and valuing the recreational ecosystem services of Germany's national parks using travel cost models. Ecosystem Services (2018), https://doi.org/10.1016/j.ecoser.2017.12.009