



Analysis

Choice experiment assessment of public preferences for forest structural attributes

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ABSTRACT

Combining the approach used in landscape research with non-market valuation techniques, the aim of this study is to document human habitat selection for recreational purposes in a gradient of forest naturalness. The results indicate that respondents prefer older stands with vertical layering, irregularly spaced trees and a greater number of tree species. Our study thus indicates that forests that are managed (or left unmanaged) for biodiversity purposes are also likely to be attractive to humans. To conclude, while greater management intensity was associated with higher disutility regardless of the model employed, we do not perceive a risk of conflict between forest management designed to protect biodiversity and management targeting recreational value. Consequently, there is a need for spatially differentiated forest management that discriminates among different functions. The state ownership of all larger Polish forest massifs makes this zoning approach feasible.

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1. Introduction

The definition of forest management differs across the world's regions and changes over time in a given country or region. Lehtinen et al. (2004) termed this phenomenon the forest industrial regime. In Europe, sustained yield forestry emerged to satisfy the increased energy needs of metallurgic and other energy-demanding industries (Carlowitz, 1713/2000; Hartig, 1860). Since the emergence of the current discourse concerning sustainable development as a societal process seeking to ensure economic, ecological and social sustainability in the 1980s, a broad range of natural resource sectors such as sustained yield forestry have revised and broadened the suite of objectives that should be satisfied. Paramount among these is the challenge of valuing the environment with respect to both use and non-use values (Merlo and Croitoru, 2005).

Thus, after a long history of local multiple use (e.g., Elbakidze and Angelstam, 2007), the most important value associated with forests in Central and Northern Europe since the industrialization has been the use value derived from timber and pulpwood (Angelstam et al., 2011). However, in the recent decades both biodiversity, in terms of the conservation of species, habitat and natural processes, and the amenity values of forests, such as scenic beauty and recreational value, have become increasingly significant. The terms ecosystem services and green infrastructure capture the efforts to secure human well-being based on natural capital (European Commission, 2013). This rapid

transformation of the meaning of forest management poses challenges for policy implementation for several reasons. For example Blicharska et al. (2011) reported that managers' knowledge of new forest policy objectives was limited. Interviewing foresters in countries characterized by strong histories of power and institutional culture, Lawrence (2009) concluded that attitudes depended on both law and education, the authority foresters accumulated through experience, and the acting out of an emotional commitment to the forest. This transition from individual and tangible to multiple and complex forest management objectives stresses the need to estimate the value of both traditional material use values linked to wood production and immaterial values such as biodiversity and the social benefits of tourism and recreation.

As a result of this increased public demand for forest recreational services, a considerable body of literature has been published on public preferences concerning different types of forests and the attributes that characterize them. This substantial literature is primarily rooted in various landscape research disciplines and includes three main approaches. The first is the psychophysical approach. It seeks to relate individual physical attributes of the landscape with overall measures of scenic quality. The second is the psychological approach, in which individuals are asked to select from a checklist of adjectives that describe the landscape, and the relevance of these feelings is then assessed by relating them to overall scenic quality scores (Lee, 2001). The final approach is phenomenological. It is based on in-depth interviews or an analysis of literary sources, which yields rich qualitative data and is intended to evaluate the meanings that individuals attach to the landscape (Sheppard and Harshaw, 2001).

A common criticism of the existing studies on public forest preferences is the selection of the target population. Many such studies are

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exclusively limited to experts, and there are conflicting views on the extent to which expert judgments reflect those of the general public (Edwards et al., 2012). Many of these studies are also criticized for their scope and sample size. For example, Ribe (1989) states that the general validity of most empirical studies of forest perception is limited as they focus on a narrow range of forest types and are restricted to small groups of subjects. In addition, most existing studies have failed to link preferences to monetary costs and benefits, i.e., they rely on forest images that are scored (or ranked) by respondents but do not provide monetary estimates arising from marginal changes in forest attributes.

Non-market valuation techniques, including stated preference methods, have been applied to value forest externalities for several decades. However, most published studies have focused on estimating the recreational benefits provided by a given site (see, for example, Riera et al. (2012) for an overview), and few of them have sought to establish a link between forest or landscape attributes and recreational values (e.g., Mattsson and Li, 1994; Horne et al., 2005; Mill et al., 2007; Nielsen et al., 2007). Additionally, these studies often exclusively focus on a small number of forest structural attributes. For example, Nielsen et al. (2007) assessed public preferences for three attributes, i.e., variations in tree species composition, tree height structure and the presence of dead trees. Similarly, Horne et al. (2005) used attributes that were very broadly defined, i.e., the attractiveness of forest scenery. To incorporate forest attributes into forest planning, more comprehensive measurements are needed.

To better understand human habitat selection for recreational purposes, we combine the approach used in landscape research with non-market valuation techniques. The crucial aspect of this choice experiment (CE) study was the identification of the complete range of forest attribute types and their quantity on a management-intensity gradient from more to less natural forest (Peterken, 1996). As forests provide social values, we attempted to include forest attributes that are relevant to public preferences for forest recreation and are thus relevant to sustainable forest management policy.

The landscape and forestry literature identifies a long list of such attributes. Edwards et al. (2012) identified 12 key structural attributes of forests that affect the recreational attractiveness of forests. In our study, we attempted to operationalize forest characteristics as similarly to those in Edwards et al. (2012) as possible. However, in contrast to their study, which was a Delphi-type survey conducted using a panel of foresters and landscape experts, we employed CE and administered our survey to a representative sample of 1000 Polish citizens. As our survey was not administered to experts, we devoted a substantial effort to adequately explain the forest attributes considered. This was achieved by employing various visualization techniques and written descriptions.

To the best of our knowledge, our study is the first to quantify forest structural attributes with respect to both the social and relative contribution of each attribute to recreational value expressed in monetary terms. The WTP estimates can be useful in defining optimal forest management plans for Poland and other European countries. In addition, for each attribute we document the relationship between recreational value and attribute levels. In terms of policy implications, we show that there is a clear conflict between timber production and recreational use, i.e., the forest attribute levels associated with timber-oriented management result in substantial decrease in recreational values. On the other hand the obtained results indicate that forests that are managed (or left unmanaged) for biodiversity purposes are likely to be attractive to humans.

The remainder of the paper is structured as follows. In the next section, we give an overview of the forests in Poland. Section 3 describes forest characteristics which were used in the CE and Section 4 provides the details of the questionnaire structure and the survey work. Section 5 presents modeling approach and is followed by Section 6 which describes design and model specification. We next present modeling results, discuss policy implications and close with the conclusions section.

2. Forests in Poland

Currently, the total area of forests in Poland is 9.14 million hectares, which corresponds to 29.2% of the country's area. This figure places Poland in the group of countries with the largest forest areas in the European temperate forest region, after Germany and Ukraine. The majority of forests in Poland (i.e., 81.3%) are publicly owned, of which 77.4% are managed by the State Forests office. Throughout the post-war period, the forest ownership structure has remained largely unchanged. As Polish forests consist of both larger forest massifs that are suitable for recreation and numerous small patches that are not, the effective proportion of State Forests is even higher. Two additional factors that are important for the recreational use of forests are the structure of tree species and age classes.

Polish forests are primarily found on the poorest soils. This is reflected in the structure of tree species across regions. In the mountainous regions, Norway spruce (in the west) and Norway spruce and beech (in the east) are the main species. However, in most of the country, stands with Scots pine as the dominant species prevail. Thus, the predominant species in Polish forests are coniferous, accounting for 70.3% of the total forest area. In the period 1945–2011, the tree species structure in Poland's forests changed substantially, resulting in an increase in the share of stands with a prevalence of broadleaved species. In the State Forests, where these changes are monitored annually, the increase over this period was from 13% to 23.2%.

Stands aged 41–60 and 61–80 years prevail in the forest age structure and cover 26.7% and 18.5% of the forest area, respectively. Stands aged 41–60 years prevail in all ownership categories, while in private forests, they occupy nearly 40% of the area. Stands older than 100 years, including stands in the restocking class, stands in the class for restocking and stands in the selection harvest class account for 11.7% of the forest area managed by the State Forests, while in private forests, they only account for 2.3%.

3. Forest Characteristics

3.1. Identification of Relevant Forest Characteristics

Edwards et al. (2012) administered a Delphi survey.¹ The aim of their study was to assess public preferences for 12 key structural forest attributes in four European regions, i.e., the United Kingdom, the Nordic Region, Central Europe and Iberia. The attributes were selected based on an extensive literature review, which covered 330 studies, and after consultation with researchers in outdoor recreation (see Edwards et al. (2012) for details). For each of the four regions, a panel of experts with experience in forest preference research was invited to anonymously participate in a questionnaire survey. In total, 46 experts from the four listed regions participated in the survey. The attributes identified as having the greatest impact on the recreational attractiveness of forests are listed in Table 1. In Edwards et al. (2012), the experts were asked to:

- (i) Indicate the type of relationship between forests attributes in their region and recreational value as: positive, negative, bell-shaped, U-shaped, or even and
- (ii) Assign a weight, on a scale from 1 (low) to 10 (high), to indicate the relative contribution of each attribute to the overall recreational value of the forests in their region.

3.2. Attributes and Levels used in CE

In contrast to the study by Edwards et al. (2012), which was only administered to landscape and forest experts, our study was administered to a representative sample of 1000 Poles. As the subjects in our study

¹ A Delphi survey is a group facilitation technique, which is an iterative, multistage process, designed to transform opinion into group consensus.

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