



Assessment of landscape aesthetics—Validation of a landscape metrics-based assessment by visual estimation of the scenic beauty



Susanne Frank^{a,b,*}, Christine Fürst^b, Lars Koschke^a, Anke Witt^a, Franz Makeschin^a

^a Department of Soil Science and Site Ecology, Dresden University of Technology, Piennner Str. 19, 01737 Tharandt, Germany

^b Center for Development Research, Department of Ecology and Natural Resources Management, University of Bonn, Walter-Flex-Str. 3, 53113 Bonn, Germany

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ABSTRACT

The assessment of cultural ecosystem services, in our case landscape aesthetics, is the most commonly investigated but least formalized issue in the scope of the ecosystem services concept. In contrast to ecological or economic aspects, the assessment of aesthetics cannot easily be based on quantitative information. Therefore, two different methodological approaches that assess landscape aesthetics either from an objective or a subjective point of view have been established in the past.

This article presents in its first part an objective, landscape metrics-based assessment approach. We defined naturalness and landscape diversity as assessment criteria and selected Shannon's Diversity Index (SHDI), Shape Index (SHAPE) and Patch Density (PD) as indicators. We tested our approach for a set of nine different landscape types in a model region in Saxony, Germany.

For validating the developed methodology, we carried out a survey with 153 participants in order to investigate their subjective preferences for the different landscape types. These preferences had to be expressed by rating the landscape types on a scale from 1 (very ugly) to 5 (very beautiful). The study was based on three different data sets, namely photographs of the landscape types, satellite images, and land cover maps.

Statistical tests were applied (a) to investigate the impact of personal factors on the ratings, (b) to detect whether abstraction levels are suitable for preference studies, and (c) to compare the results of the objective approach (landscape metrics) and the subjective approach (visual assessment). Personal factors did not influence the visual assessment results significantly. We found the highest correlation of the landscape metrics-based assessment with the visual assessment results of the photographs. We conclude that the three landscape metrics might be applied to the monitoring of landscape aesthetics. An extended study with more participants might be useful to further investigate the reliability of our findings.

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1. Introduction

The value of landscape aesthetics for human well-being has gained considerable respect not only in the public perception, but also in socio-ecological research (e.g. Howley, 2011). Studies on landscape preference and landscape aesthetics have been carried out since the 1960s (Purcell et al., 2001). However, aspects such as the visual beauty of landscapes are not only of scientific, but also of public and political interest (Council of Europe, 2000; Wascher, 2000). Concerning politics, the conservation and development of diversity, unique character, and beauty as well as the recreational potential of the landscape are established by law as one of the

main targets of nature conservation (§1(3), German Federal Nature Conservation Act, 2010). The fact that landscape aesthetics as a cultural service is of permanent importance was also pointed out in the Millennium Ecosystem Assessment (MA, 2005). The authors found that “the demand for esthetically pleasing natural landscapes has increased in accordance with increased urbanization” (MA, 2005, p. 44). They observed that quantity and quality of areas which contribute to landscape aesthetics are declining. Another example in which landscape aesthetics plays a role for public life is regional planning which intends to simultaneously balance various interests, such as energy supply, economic development, biodiversity, and scenic beauty (Blaschke, 2006). However, standardized approaches for the assessment and monitoring of landscape aesthetics are still missing (Jessel, 2006; Kroll et al., 2012; von Haaren and Albert, 2011).

For landscape aesthetics assessment, two contrasting paradigms, the objectivist and the subjectivist paradigm evolved

* Corresponding author at: Department of Soil Science and Site Ecology, Dresden University of Technology, Piennner Str. 19, 01737 Tharandt, Germany.
Tel.: +49 035203 38 31377; fax: +49 035203 38 31388.

E-mail address: Susanne.Frank@tu-dresden.de (S. Frank).

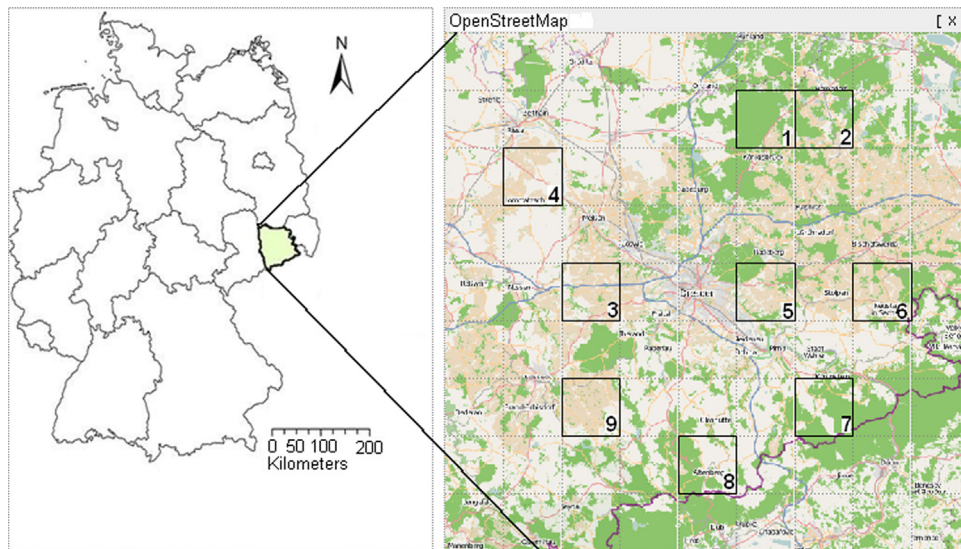


Fig. 1. Model region and focus areas (highlighted squares).

(Lothian, 1999). The paradigms assume that beauty lies either in the object (intrinsic attribute of the landscape) or in the eyes of the beholder (as a human construct), respectively. In the 20th century, the objectivist paradigm has dominated in environmental management practice, whereas perception-based approaches (subjectivist paradigm) dealing with the public's judgment have dominated in research (Daniel, 2001).

Within subjective perception studies, some personal factors, such as knowledge, experience, familiarity, demographic factors and cultural background, were considered to be important by several authors (Kaplan and Kaplan, 1989; Karjalainen, 1996; Kearney et al., 2008; Ribe, 2002; Virden and Walker, 1999; Zube et al., 1982). Gruehn and Roth (2010) highlighted that empirical surveys of landscape perception at various abstraction levels are needed to assess aesthetics of variable landscape types. An overview of studies on possible influencing factors was given by Kearney and Bradley (2011). Individual preferences cannot be reflected in objective studies, because these approaches strictly focus on the composition of a landscape as well as on the form and configuration of its elements. However, in order to make landscape aesthetics assessment applicable in planning practice, objective approaches might provide the necessary simplification (e.g. Bastian et al., 2006). de la Fuente de Val et al. (2006) suggested a synthesis of both paradigms in order to develop a comprehensive approach.

Some empirical studies (subjective approach) were conducted by Gruehn and Roth (2010) and Roth and Gruehn (2012). The authors found that neither demographic factors, nor professional qualification significantly affected the ratings. In another study, Augenstein (2002) developed a formalized method (objective approach) for a region in the Federal State of Saxony-Anhalt. Most of the important indicators that (Augenstein, 2002) found referred to perceived naturalness and to the human need to explore one's surrounding. The applied preference predictors were chosen following the theory of Kaplan and Kaplan (1989) and modeled on a Geographic Information System (GIS). Although this objective procedure is faster than empirical, subjective studies (such as Gruehn and Roth (2010)), twelve parameters need to be calculated in order to measure four predictors, which is still time-consuming in its application.

In this article we introduce an objective assessment approach, which was developed in the framework of a case study. We tested the reliability of its results by a subjective approach. We formulated the following research questions:

- (1) Is a landscape metrics-based assessment of the esthetic value of a landscape feasible and can it provide reliable results?
- (2) How can such results be validated by visual assessments? Is there an impact on the visual assessment results if different data sets (photographs, satellite data, land cover maps) are used that show the same landscape at different abstraction levels? Which of these data sets shows the highest correlation with the landscape metrics-based assessment results?
- (3) Do personal factors, such as age, gender, and professional qualification impact the visual assessment results? Which conclusions should we then draw on the reliability of the landscape metrics-based approach?

We present first a landscape metrics-based assessment method that was conceived in the context of developing the software platform GISGAME (Fürst et al., 2012). GISGAME enables the user to quickly assess the impact of land use and land cover changes on the provision of ecosystem services (Fürst et al., 2010a,b).

In order to validate this approach, we collected and analyzed individual preferences of 153 individuals considering a set of nine representative landscape types for a model region in Saxony, Germany. This study was based on photographs, satellite data, and land cover maps to test iteratively the impact of different abstraction levels on the visual assessment results. With this study, we intended to explore parallels or divergences between our landscape metrics-based assessment and the visual assessment.

2. Methods

2.1. Model region

Our model region (Fig. 1) is situated in the middle of Saxony, Germany. The area is dominated by three main landscape types: (i) the Saxon loess belt with highly productive loess soils and dominance of agricultural land use in the middle and north-western part of the model region, (ii) the Saxon-Lower-Lusatian heathland with sandy soils and dominance of forests in the north-eastern part of the model region, and (iii) the Saxon lower mountain range including the eastern part of the Ore Mountains with deeply weathered acid bedrocks and dominance of pasture and forests in the south of the model region (Mannsfield and Syrbe, 2008). Within these three landscape types, various smaller subtypes have emerged as a result of the settlement history (Lüdemann et al., 1964a,b, 1966, 1976).

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