How effective are planned buffer zones in reducing recreation impacts on an urban national park? – A combined visual discrete choice and agent-based modeling approach

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Introduction

New housing developments for ten thousands of new local residents in the 22nd district of Vienna will increase the recreation use pressure on the nearby UNESCO Untere Lobau Biosphere Reserve and the IUCN-category II Donau-Auen National Park (Figure 1). These areas are traditional, intensively used, recreational settings of high ecological value as documented by more than 600,000 visits annually (Arnberger, 2006). The increasing high recreation use pressure will negatively impact the park's natural resources and the quality of the recreational experience because of crowding and user conflicts (Arnberger, et al., 2010).

This study, that was co-financed by the Austrian Man & Biosphere Program (ÖAW-MAB), investigated planning and management options regarding their capability to reduce the increasing visitor pressure on these already heavily used protected areas. The research project aims in identifying the most effective design of planned buffer zones between settlement and protected areas.

Methods

This project relied on several methodological approaches. Stakeholders from several administration bodies and scientists from various disciplines participated in the project. Area visitors' preferences and behaviors were included in the modeling approach. In a first step, buffer zone scenarios were defined. In a second step, these scenarios were simulated regarding their effectiveness in reducing recreation impacts on the protected areas.

Definition of recreational scenarios

The main question was: How can the existing large-scale agrarian-dominated areas surrounding the protected area transformed into attractive recreational landscapes? Four basis scenarios were developed in stakeholder workshops. These scenarios included a bundle of landscape design, land use, traffic and recreational infrastructure measures. In addition, measures to restore the ecological integrity of the area were included in the scenario definition.

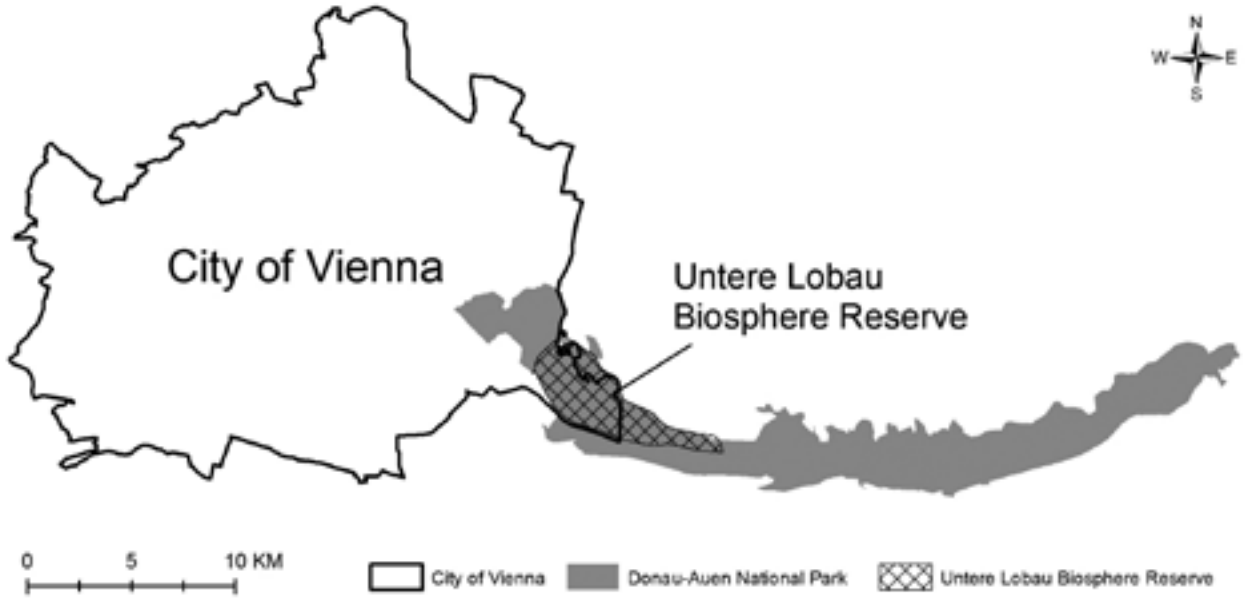

Figure 1. Study area in the 22nd Viennese district: Untere Lobau Biosphere Reserve and Donau-Auen National Park.

Trail preferences

Modeling visitors' behavior requires a sound knowledge about their landscape, recreational infrastructure and social use preferences. An image-based conjoint-choice survey asked the influence of various landscape types (ranging from natural to built environments), recreational infrastructure facilities and trail use conditions (trail user numbers, visitor activities) on protected area visitors' trail use intentions for specific leisure activities such as bicycling (N = 520).

Visitor evaluations were modeled as a function of the physical and social trail factors. Such approaches are rooted in the traditional microeconomic theory of consumer behavior and preference theory and have been applied to study preferences and choice behavior for a range of recreation and tourism related issues (Arnberger, et al., 2010; Louviere, Hensher and Swait, 2000; Reichhart and Arnberger, 2010).

Agent-based modeling

An agent-based model tested the scenarios regarding their capability to reduce visitor use pressure. The definition of agents and their decision making algorithms included several approaches. Besides trail preference data, behavioral and individual data, derived from visitor counts or on-site visitor surveys completed the definition of the agent types. Agents were defined as activity types such as bicyclists or dog walkers. GIS-data of the protected area itself as well as of the surrounding existing and planned buffer areas served as spatial input data and included vegetation structures, land uses, water bodies, access points and recreational infrastructures such as trail types. Agent-based simulations relied on the MASOOR simulation platform (Jochem, Marwik, Pouwels, and Pitt, 2008). Setting the input parameters was partly based on a previous agent-based model carried out in the study area (Taczanowska, Arnberger, and Muhar, 2008).

Results

The image-based survey found that visitors' trail use intentions were influenced by many physical and social trail factors. The role of these trail factors on visitor intentions depended on specific leisure activities: dog walking, for example, required different site factors than bicycling. Agent-based simulations indicated that the planned buffer zones can only absorb about 30% of the recreation use pressure. The use pressure on the protected areas will drastically increase. Therefore, additional green spaces in the urban-sprawl region are required to further reduce recreational use pressure on the protected areas.

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