

# Describing, Monitoring and Managing Visitor Flows in Parks and Protected Areas Using Computer-Based Simulation Modeling

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The popularity of outdoor recreation in parks and related protected areas has grown tremendously in the last several decades and recreational use of these areas has reached record levels in recent years. For example, the national park system received nearly 300 million visits in 2002, while the national forests received over 200 million visits. This represents both an opportunity and a challenge. The opportunity is to provide visitors with outstanding experiences that help build public support for national parks and related protected areas. The challenge is to protect the natural and cultural resources of these areas and the quality of visitors' experiences in the face of increasing recreational use. For example, high levels of visitor use can lead to trail erosion, loss of ground cover vegetation at and around campsites, extensive networks of social trails, and disturbance of wildlife (Hammit & Cole, 1998). In addition, increased recreational use of these areas can cause crowding and conflict, degrading the quality of visitors' experiences (Manning, 1999).

To effectively manage parks and related protected areas, information is needed about the visitor use of these areas. For example, information about the spatio-temporal distribution of visitor use can help managers identify potential recreation-related threats to the natural and cultural resources of an area and the quality of visitors' experiences. While in some cases it may be possible to monitor visitor flows through on-the-ground observation, this becomes increasingly difficult in larger recreation areas that receive more dispersed use. Consequently, monitoring and managing visitor use in national parks, wilderness and related forest recreation areas is both challenging and important.

Recent research suggests that computer-based simulation modeling is an effective tool for facilitating the planning and management of visitor flows in large, complex, and/or dispersed outdoor recreation areas, such as national parks, wilderness, and related forest recreation areas (Daniel & Gimblett, 2000; Gimblett, Richards, & Itami, 2000; Lawson & Manning, in press-a, in press-b; Lawson, Manning, Valliere, & Wang, 2003; Lawson, Mayo-Kiely, & Manning, 2003; Wang & Manning, 1999). This research has identified at least four ways in which simulation modeling of recreation use can facilitate more informed management. First, simulation modeling can be used to describe existing visitor use conditions. That is, given current management practices and existing levels of visitor use, where and when is visitor use occurring in a park or protected area. By providing managers with detailed information about how visitors are currently using the area, this baseline information can assist managers in identifying "hotspots". For example, does visitor use tend to concentrate in certain locations or at certain times within a recreation area, which may lead to crowding or conflicts among different types of visitors? Is visitor use occurring within zones that contain fragile ecological resources that are highly sensitive to recreation use?

Second, simulation modeling can be used to monitor the condition of "hard to measure" indicator variables (Lawson, Manning, Valliere, & Wang, 2003; Wang & Manning, 1999).

For example, how many encounters do backpacking visitors have with other groups per day while hiking? How does the number of people at a popular attraction site change throughout the course of a day or visitor use season and with increasing or decreasing levels of total visitor use?

Third, simulation modeling can be used to test the effectiveness of alternative management practices in a manner that is more comprehensive, less costly, and less politically risky than on-the-ground trial and error (Lawson & Manning, in press-a, in press-b). For example, what effect does a permit quota have on the number of encounters visitors have with other groups while hiking? How many new campsites would need to be built in order to ensure that visitors do not have to share campsites with other people not in their group? How do alternative transportation systems affect the density of visitor use along trails and at attraction sites? How does the addition of a new trail or road affect the flow of visitor use?

Fourth, simulation modeling data can be used to guide the design of more realistic research on public attitudes concerning the management of visitor use in parks and forest recreation areas (Lawson & Manning, in press-a, in press-b; Lawson, Mayo-Kiely, & Manning, 2003). For example, rather than asking the public to evaluate hypothetical management scenarios, questions can be designed to measure public attitudes about alternatives that simulation modeling suggests are feasible and realistic.

Using examples from several studies conducted in U.S. National Parks, Wilderness, and National Forests, this poster demonstrates the utility of computer-based simulation modeling to park and outdoor recreation management and planning. In addition, this poster identifies potential future applications of computer-based simulation modeling to visitor use management and planning in parks and related protected areas