

FROM MODEL T'S TO COMPUTER MODELS: INTEGRATING TRANSPORTATION AND VISITOR CAPACITY RESEARCH AND PLANNING AT YOSEMITE NATIONAL PARK

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Integrating Transportation and Recreation in Yosemite National Park

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YOSEMITE NATIONAL PARK IS ONE OF THE CROWN JEWELS of the national park system. Its remarkable convergence of natural features—the iconic Yosemite Valley, vast wilderness, ancient giant sequoias—along with its importance in environmental history—the precedent-setting establishment of the state reserve in 1864, the national park's close association with John Muir, the public battle over damming Hetch Hetchy—contribute to its well-deserved legendary reputation. However, its high profile as a recreation resource and its proximity to large urban centers combine to make the park an exemplar of the issues that challenge many national park managers. Primary among these are balancing public access and park protection, determining recreational “carrying capacities,” and managing visitor use in ways that protect the quality of park resources and visitor experiences. In this thematic issue of *The George Wright Forum* we describe a new approach to park planning and management that is designed to address these challenges. This approach recognizes and quantifies these relationships between transportation and recreation in parks.

The following four articles in this issue of *The George Wright Forum* outline the Integrated Transportation and Capacity Assessment (ITCA) model in detail, discuss its application to visitor-use management in Yosemite National Park, and consider the historic intersections

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of transportation and recreation. David White, Stacy Tschuor, and Bill Byrne present the vehicle-based road monitoring, modeling, and evaluation in which transportation is considered as recreation. This is followed by Nathan Reigner, Brett Kiser, Steve Lawson, and Robert Manning's presentation of the recreation-site pedestrian monitoring, modeling, and evaluation that addresses transportation's influence on recreation use. Doug Whittaker, Bo Shelby, Bret Meldrum, Henrietta DeGroot, and James Bacon extend discussion of the ITCA model to its application in park management, specifically the Merced River Plan. Christopher Johnson concludes the thematic set with reflections on the historical and ongoing relationships between transportation and recreation in America's parks and public lands.

Visitor use and management

With increasing visitation come corresponding visitor-use management challenges. In Yosemite these challenges are posed by both visitor use and the park's capacity and have the potential to impact the quality of visitors' experiences. In 1970, when annual visitation was two million, overcrowding in the campgrounds and meadows in Yosemite Valley sparked the Stoneman Meadow Riot. In 1997, when annual visitation reached four million, the park's capacity to accommodate visitors was compromised when Yosemite Valley infrastructure was severely damaged by flooding. Today, visitation hovers near four million individuals annually and the park confronts a litany of resource protection, visitor enjoyment, and operational challenges as a result (National Park Service 2012). For many parks and public lands, visitor-use management challenges are often related to transportation (Daigle 2008). High levels of visitor use induce congestion along Yosemite's roads and at major attractions nearly all days of the park's summer season. Park staff struggle to deal with the ever-increasing use and associated impacts through education, staff-intensive on-site enforcement of regulations, and design modifications.

Transportation and recreation in national parks

The prevalence of visitor-use management challenges associated with transportation in Yosemite is emblematic of the connections between transportation and recreation in in park and on public lands in general. Transportation and recreation are connected in two basic ways. A first connection is the implicit unity of transportation and recreation (White 2008). When visiting parks, transportation activities such as driving and walking are often the primary recreation activities of visitors (Cordell 2004). Indeed, scenic driving and day hiking are some of the most common recreational activities of visitors to Yosemite. As such, the quality of recreation experiences is analogous with the quality of transportation system performance. In this case, transportation *is* recreation.

A second connection between transportation and recreation is processual: transportation systems largely influence the distribution of visitors within parks (Lawson et al. 2009). To the extent that visitors primarily move about Yosemite along the park's road and trail networks, elements of the transportation system shape where visitors go and when they get there. The quality of recreation experiences, particularly with respect to crowding and congestion within recreation sites, is a function of the transportation system's delivery and distribution of visitors. If used to deliver the "right" number of visitors to the "right" places at

the “right” times (based on resource, experiential, and park facility considerations), transportation can be an important park and outdoor recreation management tool.

Planning for visitor-use management in Yosemite

Planning history. Managers at Yosemite National Park have long understood transportation to be a key element of visitor-use planning and management. Transportation infrastructure and systems are present in some of the earliest plans for the park (Olmsted 1865). With the 1980 General Management Plan (GMP), transportation and its connections to recreation quality and visitor experiences became a central focus of park planning and management (Yosemite 1980). This plan laid out an ambitious vision for promoting the quality of visitor experiences by removing day-use vehicular traffic from the eastern portion of Yosemite Valley. While this initiative was never implemented, the planning effort was effective at focusing attention on the connections between transportation and recreation quality.

Following the 1980 GMP, the park consolidated a number of localized management plans into comprehensive planning efforts in the form of the Yosemite Valley Plan and the Merced River Plan (National Park Service 2000a, 2000b). These plans outline a number of objectives, including preservation of high-quality natural and experiential resources and facilitation of public access and enjoyment. Transportation systems and their operation are positioned within the plans both as key components of recreation quality and important tools for managing visitor use. Subject to the public and legal process of the National Environmental Policy Act (NEPA), these plans have been challenged in court and remanded for refinement and further development.

Objectives for future planning and management. The discussions and deliberations about planning and managing visitor use in Yosemite have suggested several management objectives, including providing a diversity of recreation experiences, encompassing multiple spatial scales, being quantitatively rigorous, and being proactive and flexible. To accomplish these objectives to the satisfaction of legal requirements and public scrutiny, park managers must be able to document visitor-use levels and the quality of recreation experiences associated with these levels of use.

Integrated Transportation and Capacity Assessment

Leveraging the connections between transportation and recreation to structure the relationships between visitor use and experiential quality, Yosemite embarked on a program of research that culminated in 2010 with the ITCA project. Acknowledging transportation as recreation and transportation’s influence on recreation, the ITCA project integrates monitoring and evaluation of visitor use and experiential quality for both vehicle-based and pedestrian recreation in a quantitatively explicit and proactive way.

Basic conceptual model. The ITCA project has its roots in a basic conceptual model that links visitor-use levels with experiential quality (Figure 1). This model is informed by indicators and standards of quality and powered by computer-based simulation modeling and visual simulation. Indicators of quality are measurable, manageable variables that serve as proxies for management objectives—for Yosemite, preserving natural resource and experiential quality while facilitating public access and enjoyment. Standards of quality are the

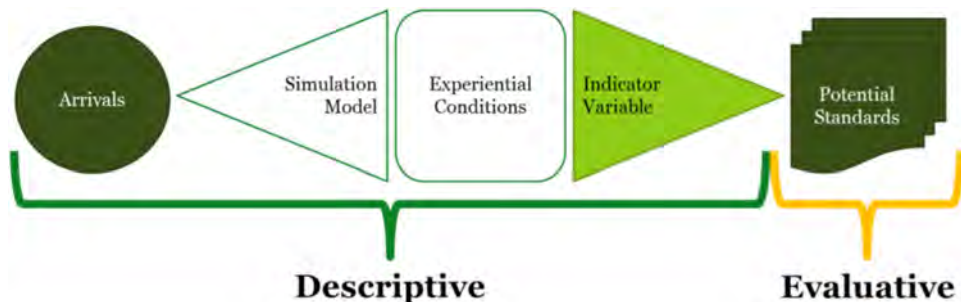
minimum acceptable conditions of indicator variables; they are quantitative benchmarks by which accomplishment of management objectives can be evaluated. Computer-based simulations enable scenarios of visitor use and experiential quality to be experimented with, extending the range of ITCA beyond current use levels and patterns to incorporate many alternative future conditions. Within the basic conceptual model, conditions of visitor use are first described and then evaluated.

The basic ITCA conceptual model begins with counting visitors as they arrive at the park itself, at specified road segments, or at recreation sites to describe and monitor the level of visitor use. This level of use is then distributed throughout the park's road and trail networks by simulation models in ways representative of the observed patterns of visitor behavior and movement. These simulation models estimate the experiential conditions of visitors. Translated into indicator variables, such as the time needed to travel park roads, the number of vehicles in view along road segments, the number of people at one time at attractions, or the number of other visitors encountered along trails, these experiential conditions can be evaluated against a range of standards of quality derived from surveys of park visitors. This progression of monitoring, modeling, and evaluation transforms counts of visitor use through predictions of experiential conditions to assessments of recreation quality with flexibility and the power to proactively consider alternative park use and management scenarios.

Applied conceptual model. While the basic conceptual model has served visitor-use planners and managers well, ITCA's unique contribution is its application of the basic model to the connections between transportation and recreation. The conceptual model illustrates how the basic progression of monitoring, modeling, and evaluation is applied (1) on roads for vehicular-based recreation and (2) at recreation sites for pedestrian-based recreation (Figure 2). These dual tracks of the ITCA applied model acknowledge the connections between transportation and recreation.

The road and vehicle track addresses the transportation-as-recreation connection. The numbers of vehicles entering the park and traveling along specific road segments are counted. Simulation models of vehicle use on park roads estimate the conditions of roadway congestion visitors may experience. These estimates are translated into indicators of quality for visitors' road-based experience—a key element of visitors' recreation experience as scenic and pleasure driving is a nearly ubiquitous and important recreation activity. Finally, road-

Figure 1. The basic conceptual model upon which the ITCA project is based.



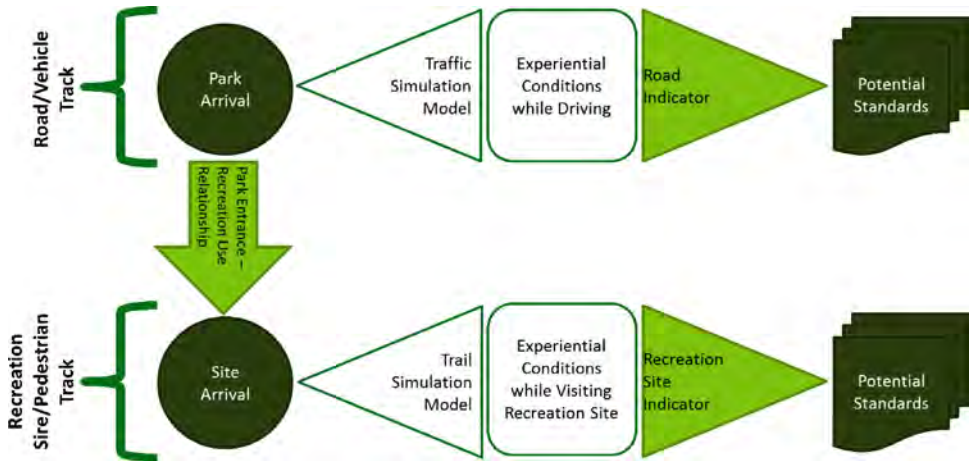


Figure 2. The dual tracks of the ITCA applied model: vehicular- and pedestrian-based recreation.

based recreation quality is evaluated against standards of quality elicited from park visitors.

The recreation site and pedestrian track addresses transportation's connection to visitor distribution. Based on statistical relationships between the number of vehicles entering the park and traveling specific road segments, the number of visitors expected to arrive at selected recreation sites and trailheads is estimated. The distribution and behavior of these arriving pedestrians is simulated and the experiential conditions, in terms of indicators of quality, are estimated and evaluated against a range of potential standards of quality elicited from park visitors.

Implications for visitor-use management

The ITCA conceptual models leverage the connections between transportation and recreation for the purpose of informing park planning and management. Understanding that transportation is indeed recreation for visitors in parks and that transportation systems influence recreation use enables park managers to employ transportation planning and operations as recreation management tools. Starting with counts of vehicle and visitor arrivals, the ITCA model supports these efforts with empirical data. Simulation lends flexibility and proactivity to the process by enabling alternative and hypothetical scenarios to be considered. Translation of visitor use and experiential conditions into indicators and standards of quality allows both monitoring and evaluation of recreation use and quality. By integrating transportation and recreation, roads and recreation sites, and monitoring and evaluation of visitor use, the ITCA model can provide Yosemite and other parks with a transparent, scientifically sound, and legally defensible process for examining and determining recreational carrying capacities at multiple scales and for diverse activities.

References

Cordell, K. 2004. *Outdoor Recreation for 21st Century America: A Report to the Nation:—The National Survey on Recreation and the Environment*. State College, PA: Venture.

- Daigle, J. 2008. Transportation research needs in national parks: A summary and exploration of future trends. *The George Wright Forum* 25(1): 57–64.
- Lawson, S., P. Newman, J. Choi, D. Pettebone, and B. Meldrum. 2009. Integrated transportation and use capacity research in Yosemite National Park. *Transportation Research Record* 2119, 83–91.
- National Park Service. 2000a. *Yosemite Valley plan: Supplemental Environmental Impact Statement*. Online at www.nps.gov/yose/parkmgmt/upload/yvp.pdf.
- National Park Service. 2000b. *Merced Wild and Scenic River Comprehensive Management Plan*. Online at www.nps.gov/yose/parkmgmt/upload/mrp2000.pdf.
- National Park Service. 2012. Annual park visitation, Yosemite National Park reports. NPS Stats, National Park Service Public Use Statistics Office. Online at www.nature.nps.gov/stats/park.cfm?parkid=557.
- Olmstead, F.L. 1865. Yosemite and the Mariposa Grove: A preliminary report. In *Yosemite and the Mariposa Grove: A Preliminary Report, 1865*. Yosemite National Park, CA: Yosemite Association.
- Yosemite National Park. 1980. *Yosemite General Management Plan: Visitor Use/Park Operations/Development*. Online at www.nps.gov/yose/parkmgmt/upload/YOSE_104_D13-16B_id338162.pdf.
- Yosemite National Park. 2012. Park statistics. Online at www.nps.gov/yose/parkmgmt/statistics.htm.
- Youngs, Y., D. White, and J. Woodrich. 2008. Transportation systems as cultural landscapes in national parks: The case of Yosemite. *Society and Natural Resources* 21: 797–811.
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