
Human Use Inventory, Monitoring and Simulation Projects

A list of published papers and reports (many available for download) on RBSim, and the projects listed here can be found at:

<http://www.srn.arizona.edu/~gimblett/RBSimBibliography.htm>

Huachuca Mountain Recreation and Associated Benefits of Leisure and Needs Assessment

USDA Forest Service
Coronado National Forest
Sierra Vista Ranger District
Date: 1996-1997

The purpose of this study was to assess the experience preferences and associated beneficial outcomes of the visitors to the Huachuca Mountains of Coronado National Forest. This study used a methodology comprised of on-site interviews, a mail back survey and observations to acquire data on visitors using the Carr, Brown and Miller Canyons as well as Ramsey Peak on the Sierra Vista Ranger District. The survey acquired information on visitor characteristics and demographics; recreational experience preferences for activities, facilities and services; preferences for physical settings and appropriate activity levels and perceived beneficial outcomes of recreational experiences and ability to acquire such outcomes.

Simulating Recreation Behavior In Complex Wilderness Landscapes Using Spatially-Explicit Autonomous Agents Broken Arrow Canyon: Arizona

USDA Forest Service - Coconino National Forest, Sedona, Arizona
Sedona Ranger District.
Sedona, Arizona
Date: 1996 -1997

Simulation techniques are used to explore the complex, spatial interactions among recreation visitors and their environment, as a means to improving wildland recreation management. The Recreation Behavior Simulator (RBSim) uses rule-driven autonomous agents as surrogates for human visitors coupled with geographic information systems to represent the environment for dynamically simulating recreation behavior. Behavioral rules are derived from visitor surveys conducted in Broken Arrow Canyon, Sedona, Arizona. Model runs allow both statistical and spatial analysis to quantify and explore recreational movement, actual and perceived encounters, as well as crowding and the influence of alternative trail alignments on encounters.

Intelligent Agent Model for Simulating and Evaluating River Trip Scenarios for the Grand Canyon National Park

Grand Canyon National Park
Grand Canyon, AZ. USA
Dates: 1998-2000

This project developed and tested a computer-implemented model for estimating the movement of and interactions among raft-trip parties on the Colorado River within Grand Canyon National Park. The model known as the Grand Canyon River Trip Simulator, is a special purpose simulator written specifically for the Grand Canyon. It was developed collaboratively between Northern Arizona University and the University of Arizona. Dr. Randy Gimblett was co-principle investigator for the project. This modeling system employs complementary statistical analyses and mathematical models based on existing raft trip itinerary data, as well as new data collected from trip reports from the summer seasons of 1998 thru 2000. The Grand Canyon River Trip Scheduling Model is a interactive computer simulation system providing dynamic visual displays of individual raft-trip progress, database reporting functionality, as well statistical analysis of the interactions among the multiple trips on river during specified (historic or future) time periods. The modeling system provides Park managers with an effective decision support tool for representing and evaluating alternative trip/launch scheduling and management scenarios.

Evaluating the Spatial and Temporal Distribution of Recreation Use in the John Muir and Ansel Adams Wilderness Areas: California

USDA Forest Service - Inyo National Forest. Bishop, California.
Inyo National Forest
USDA Forest Service
Date: 1999

This project develops field methods for capturing base line information on the spatial and temporal distribution of wilderness recreation use in the John Muir and Ansel Adams wilderness areas in California, USA. This study was conceived to address increased pressures and obvious conflicts between overnight backpackers and commercial packstock use in the Inyo and Sierra National Forest. Thirteen management zones were sampled in this study and a spatial and relational decision support tool was developed to examine use patterns.

California Sierra Nevada Wilderness Recreation Use Monitoring: Pacific Southwest Region 2000

USDA Forest Service - Inyo National Forest. Bishop, California. White Mountain & Mount Whitney Ranger Districts

Date: 2000

This project involves the development and implementation of a automated sampling strategy that assesses day use activities in ten of California's heaviest use Wildernesses. This study is based on increasing pressures from day recreation users and the Forest's inability to adequately identify use and trends. This project will also provide forest managers with information that can assist them in understanding the spatial distribution (where, when and why) of recreation use of the wilderness areas. This will be followed by the development of an effective decision support tool for representing and evaluating alternative management strategies.

Ironwood Forest National Monument Access, Travel Route Inventory and Visitor Use Study: Tucson, Arizona

Bureau of Land Management. Tucson, Arizona.

Date: 2001 - Present

This study utilizes a combination of automated counter pads and traffic counter in conjunction with visitor diary/surveys and observation to examine visitor flows and patterns of use in the monument. Automated technologies used for counting vehicles and visitors provide information on time of arrival at trailheads or key access points and overall numbers of local residents and visitors entering and exiting the Monument. A visitor survey was used to obtain more specific information on the nature of the visit. This information includes characterization of the visitor (i.e. number in party, mode of transportation, identification of destinations visited, duration and preferred travel route to destination). The visitor survey provided attitudinal data on preferences, experiences and satisfaction levels resulting from the visit. In addition, simulation modeling was used to construct a baseline of current visitor use conditions and is being used to develop and test new management scenarios.

Visitor Use Inventory, Monitoring and Recreation Impacts at Las Cienegas Conservation Area: Sonoita, Arizona

Bureau of Land Management. Tucson, Arizona.

Date: 2001 - Present

This study outlines a methodology that uses a combination of techniques to acquire a more thorough understanding of visitor use in Las Cienegas Conservation Area. This study inventories Recreation Sites, monitors visitor flows and patterns of use and employs travel simulation modeling for replicating spatial patterns of visitors in the conservation area and generating baseline or current visitor use conditions.

Modeling the Complexity of Recreation Visitation in Misty Fjords National Monument, Alaska

Tongass National Forest. U.S. Fish and Wildlife Service. Ketchikan, Alaska

Date: 2002

The purpose of this study was to study the complex interactions between commercial hunting/fishing trips, cruise ship, kayaks, floatplane and helicopter tours over the four month season of peak use in Misty Fjords National Monument. Many thousands of trips by commercial operators, kayaks and charter fishing boats converge in this extreme environment annually and ultimately impact the quality of those seeking a wilderness experience. The objective of this study was to acquire information on the spatial and temporal patterns of visitor use and use computer simulation to evaluate these interactions to speculate on the potential impacts of this increasing use on fish and wildlife populations in Southeast Alaska. Misty Fjords National Monument was created on December 1, 1978 by presidential proclamation. The Monument encompasses 2,294,343 acres within the Tongass National Forest. This complex problem employs a research methodology that uses a combination of visitor monitoring and computer simulation to address where and to what degree are visitors currently using Misty Fjords National Monument, peak visitation periods, seasonal time periods are sensitive in terms of human interactions on wildlife populations and to identify where and to what degree visitors are encroaching/impacting wildlife in Misty Fjords National Monument. GeoDimensions Pty Ltd extended the functionality of RBSim to handle the complexities of the project and developed new techniques for summarizing simulation outputs. A more detailed validation study is currently underway as focused effort in the Misty Core area to determine capacity and displacement issues to aid in the development of specific management objectives for the long-term protection of the Monument.

Recreational use Patterns in Relation to the Distribution of Rock Climbing Sites in Joshua Tree National Park

Joshua Tree National Park & ACCESS Fund

Dates: 2002-2003

The purpose of this project is to understand the current and future temporal and spatial visitor use patterns associated with wilderness rock climbing in order to: 1) evaluate the extent of the potential impacts to the wilderness, 2) identify the wilderness attributes that are most responsible for attracting heavy use, and 3) assess the merit of the proposed fixed anchor permitting process. Historically, conflict over fixed anchor use in wilderness areas throughout America has been overwhelmingly based on ideological arguments. Combining detailed visitor use data with a complete resource inventory illustrates the actual extent of the perceived resource problem. A comprehensive simulation that integrates visitor use profiles, wilderness resource data, and GIS landscape representation predicts the effectiveness of a fixed anchor permit process for controlling environmental impacts. More importantly, it also allows wilderness managers to experiment with other potential solutions and evaluate the results without field implementation.

The Benefits and Challenges of Computer Simulation for Backcountry Recreation Management

Aldo Leopold Wilderness Research Center, Missoula Montana

Dates: 2003-2005

This simulation project compares and contrasts two software packages RBSim and Extend using a database of patterns of visitor use data collected in 1999. This project develops statistical techniques for validation of simulation results and analyzes simulation outputs for determining simulation run-lengths, comparing and evaluating alternative management scenarios and standard methods for developing terminating and steady-state simulations for back country (wilderness) visitor use. The work is being published as a chapter in a US Forest Service General Technical Report on simulation in recreation management due out September 2005.

Spur Cross Conservation Area: Travel Simulation Modeling of Visitor Use: Phoenix, Arizona

URS Corporation

Date: 2003

This project examines the flow patterns of recreation visitation in Spur Cross Conservation Area. This study utilizes existing and proposed trail data and estimates of visitor numbers at various entrances to Spur Cross to simulate their interactions throughout the proposed season. RBSim was used to construct baseline conditions and to test out alternative management objectives.

High Lakes Inventory, Monitoring and Simulation: Salmon-Challis National Forest, Idaho, USA

USDA Forest Service, Salmon-Challis National Forest

Date: 2003-current

This project develops a long-term inventory and monitoring strategy that builds on previous efforts, while providing contemporary, statistically valid, and publicly defensible analysis of current conditions. With the recent development in the fields of Recreation and Wildlands Management, new tools are being provided to assist land managers in the development of management strategies to control resource impacts. This study uses computer simulation modeling that integrates inventory/monitoring data and GIS analysis with simulated human behavior. Through statistical analysis of field data, patterns of visitor use and impacts across the landscape are determined and geographically displayed. This type of analytical tool is well suited for use in the Bighorn Crags and Soldier/Langer Lakes areas. Utilizing this new technology in combination with our historical information results in providing scientifically sound analysis which enabling the display of current and historical use trends and impacts in these areas.

Visitor Monitoring and Simulation in Saguaro National Park

National Park Service

Saguaro National Park

Dates: 2003-2004

Understanding the spatiotemporal distribution of use is of fundamental importance to those who plan for and manage recreation. The kind and amount of visitor use has profound effects on the quality of the natural resources, visitor experiences and facilities in recreation areas. Therefore, it is critically important to be able to monitor the flow of visitation, in space and over time, and to be able to predict how distributions are likely to change in response to both management actions and factors that are not subject to managerial control. In some situations this is easily done. However, the ease of monitoring and predicting use declines as the size of the recreation area increases, the complexity of traffic flow increases, and the degree to which traffic flow is tightly controlled by management decreases. The purpose of this study is to provide a clear

understanding of the spatiotemporal distribution of visitor use in Saguaro National Park to address visitor use and resource management issues in the General Management Plan. Specifically, simulation model coupled with visitor flow data captured through inventory and monitoring is used to:

- Provide a better understanding of the baseline spatial and temporal patterns of visitor use.
- Aid in predicting how distributions of visitor use are likely to change in response to both management actions and factors not subject to managerial control.
- Allows for testing the feasibility and effectiveness of management plan alternatives.
- Allows for monitoring of hard-to-measure parameters (e.g. people at one time at a certain attraction or walking on particular trails) by using easily measured indicators (e.g. number of cars entering the park or parking at a trailhead).
- Support the planning and management of visitor use in situations where monitoring and predicting visitor flow is difficult.
- Improve communication of implications of management prescriptions to the public

The Sonoran Desert National Monument Resource Management Plan and Associated Environmental Impact Statement

URS Corporation/BLM

Dates: 2004-present

URS Corporation in conjunction with The Arizona Bureau of Land Management (BLM) are involved in developing a Resource Management Plan (RMP) for the Sonoran Desert National Monument and a Resource Management Plan for the Phoenix South area along with an associated Environmental Impact Statement (EIS). The planning area will include the Sonoran Desert National Monument and other lands in the Ajo area, Gila Bend Mountains, and smaller parcels east to Globe-Miami, known collectively as the Phoenix South, Arizona. This component of the project develops an assessment approach to analyze recreation opportunities, threats to recreation resources including the degree to which these resources are vulnerable or threatened by natural causes or other planned actions, or conflicts within the Sonoran Desert Monument. In addition the EIS evaluates visitor safety needs, capacity for permitted commercial and other organized activities and opportunities for enhanced management or protection of recreation resources

Pattern of Human Use Simulation in Canada's Mountain Parks (Banff, Yoho, Kootney & Jasper National Parks)

Parks Canada

Dates: September 2004 – May 2005

Parks Canada has the responsibility to improve the visitor experience and ecological integrity of Canada's Mountain National Parks. This project addresses the need to improve the understanding of the complex patterns of visitor use with simulation modeling. Parks Canada has already invested considerable resources in data collection of park Infrastructure, biodiversity and surveys of visitor use. This proposal is a logical step in the overall effort to develop a comprehensive understanding of the relationship between the spatial-temporal patterns of visitor use and goals for ecosystem management. The aim of simulation in this context is to develop a dynamic spatial-temporal model of visitor use in the form of a visitor simulation model where outputs are in the form of GIS maps that can then be over-laid with maps of ecological resources of the parks. This will provide a direct method of developing an integrated understanding of the implications of visitor use on the management of biological systems. The purpose of the study was to build a baseline or "existing conditions" simulation of travel patterns in Banff, Yoho, Kootenay and Jasper Park National Parks. This simulation forms the basis of a series of subsequent simulations that can be used to explore a wide range of management issues such as What is the existing pattern of use (over some time period, seasonal, weekly, daily) and how does this use pattern impact other resource management issues?; When are the peak visitation periods?; How are visitors distributed in the landscape, where do visitors concentrate in the landscape?; What are the spatial/temporal relationships between patterns of visitor use and season use of wildlife habitat and other resource management issues.

Validating the Recreation Visitation Model for Misty Fjords National Monument: Balancing Increased Visitor Use and Wilderness Character

Tongass National Forest. Ketchikan, Alaska

Dates: 2004-2005

The scope of this project is to monitor the impacts of increased recreation use in Misty Fjords National Monument. This study builds on the pilot project undertaken in 2002 study that utilized existing data from commercial hunting/fishing permits, cruise ship schedules, known and predicted wildlife locations, and other sources to simulate recreation use in the Monument. The University of Arizona worked with USFWS and Tongass National Forest to explore the use of this secondary data source in conjunction with computer simulation to mimic the patterns of visitor use, and speculate on the impacts of this increasing use on fish and wildlife populations in Southeast Alaska. The 2002 study was undertaken to address the questions or where and to what degree visitors were currently using Misty Fjords National Monument, to identify the peak visitation periods, and to estimate the seasonal time periods that are sensitive in terms of human interactions on wildlife populations. The results of this study illustrated that using indirect data collection method (existing travel logs, trip itineraries etc.) coupled with computer simulation could indicate patterns of use, associated 'hotspots' of recreation interactions, and encounter levels in Misty Fjords. The simulation provided an

opportunity to examine visitor use patterns and associated encounters over time. While encounters are not the only measure that can be used, they are important when considering social and ecological impacts of visitation on wilderness character and experience. When visitor use is aggregated by mode of travel, recreation activity, and encounter levels, attention can be focused on detailed studies examining the visual and auditory impacts of floatplane activity, boat traffic, and vessel interaction on wilderness character.

Spring Black Bear Harvest Simulation Model in Prince William Sound, Alaska

Glacier Ranger District
Chugach National Forest

Dates: 2004-2005

Black bear harvest levels have increased rapidly during the past 10 years in Prince William Sound (PWS). Harvest in this area is managed by the Alaska Department of Fish and Game (ADF&G) as a single hunt unit. Unit 6d includes approximately four million acres of coastal, temperate rainforest. An ADF&G status report for 6d found a 100% increase in bear harvest between 1995 and 2001. In 2002, this area reached a record of 467 bears taken which was approximately 25% more than any other black bear harvest unit in Alaska. This harvest level represents an unknown number of individual hunting parties using the shoreline of PWS. The USFS has received several reports of user conflicts in the western Sound between bear hunting groups and other non-harvesting users using the shoreline during late May and early June. Conflicts are apparently exacerbated by the practice of bear baiting. The goal of this project was to model the spatial and temporal overlap of harvest and non-harvest recreational use in the Sound during the spring bear hunt. These models will allow us to understand the potential for overlap between different user groups under current management strategies.

Monitoring and Estimating Visitor Use Levels at Madrona Ranger Station, Arizona

Rincon Institute

Dates: 2004-2005

Visitation to Saguaro National Park has increased more than 50 percent since the 1988 GMP from 2,118,500 visits in 1990 to 3,424,000 in 1999. Park use is expected to continue to increase at about the same rate in the near future as Tucson attracts more visitors and residents. Last year, Saguaro National Park (SNP) was named by Tucsonans as the best place to take out-of-town guests to see the desert, and this trend is likely to continue. Within SNP there are many historic and cultural features that speak to past use and are worthy of preservation. The Madrona Ranger Station for example, has been an important part of the park history and operations for decades. Its role in the future will be

expanded dramatically to include interpretation and resource protection as the population of the Rincon Valley grows and access to this part of the park is improved. The Chimenea Creek riparian corridor is likely to be a very popular destination for local residents and traditional visitors. The intensity of use the Madrona area will experience will dramatically increase. If the park is not able to maintain a residential and administrative site here, resources will be severely degraded and significant operational inefficiency will result. In addition, the corridor leading to the Madrona Ranger Station is shared between humans and wildlife. As the Arizona Trail and proposed adjoining trail systems continue to be developed, the threat to the natural resources surrounding Madrona and in particular to the wildlife is extreme. While preserving and expanding valuable wildlife habitat is one method to protect species diversity, controlling and monitoring visitor use is equally important. With neither of these methods in place, the threat to wildlife at the moment is very real.

The purpose of this report is to estimate the amount of visitor use that is currently occurring at the Madrona Ranger Station and in particular the Madrona pools. The following questions guide this study:

1. Where and to what degree are visitors currently using the Madrona Ranger Station and surrounding area?
2. What are the actual and projected peak visitation periods?
3. What seasonal time periods are sensitive in terms of human interactions on wildlife populations in Madrona Ranger Station and surrounding area?
4. What are the mitigation, protection and habitat restoration actions that can be used to reduce impact on wildlife and their associate habitat while allowing visitor access to the area?