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The science of visitor management in parks and protected areas: from verbal reports to simulation models

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Abstract

Visitor management in parks, wilderness and other protected areas requires information about visitor-environment interactions and, particularly, the distribution and flow of visitors in space and time. Such information is usually sketchy and based largely on the verbal reports of visitors. A review of recent psychological and neurological research and theory suggests that traditional verbal survey methods cannot in principle provide an adequate basis for models of human landscape navigation. We argue for more use of direct observation of visitor movements and the utility of travel simulation models. Simulation modelling of visitor flow can be helpful in making monitoring programs more efficient, in fine-tuning existing management programs, and in assessing the likely consequences of alternative future scenarios We review early efforts to simulate the flow of recreation use, describe several current modelling efforts and conclude with suggestions for a research and development effort.

Key words: Environmental perception, outdoor recreation, psychology, travel behaviour, visitor flow.

Introduction

Many of the world's natural parks, wilderness areas and other protected areas are established for the dual purposes of ecological preservation and recreational use. Managers of such places must balance visitor use and environmental protection. Regardless of the balance selected, policy development and implementation requires fundamental information about visitors, their needs and wants, the impacts of their visits, and their distribution and flow in space and time (Eagles 2002; Hendee & Dawson 2002). Following the lead of the physical and biological dimensions of park management, these visitor management information needs should be met through the application of rigorous science and the development of tools that facilitate management (Watson et al. 2000).

An understanding of the distribution and flow of visitors, and the factors that influence flow, is particularly important to effective planning and management – in making monitoring programs more efficient, in developing transportation, facilities and management systems, in fine-tuning existing management programs, and in assessing the likely consequences of alternative future scenarios. Unfortunately, information on visitor flow is usually sketchy at best. The techniques available to research and plan for visitor distribution and flow are neither diverse nor well-developed. This is a severe constraint to effective visitor management. However, new and promising tools are emerging. This paper begins with a discussion of the most common technique for gathering information about visitors – the verbal report or visitor survey. We briefly review recent research that argues for moving beyond traditional verbal surveys to more spatially and temporally precise monitoring and modelling of visitor behavior. We review historic visitor flow simulation modelling efforts and describe current efforts.

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Verbal surveys and visitor flow

Most of what is known about visitors and their interactions with each other and with the park environment has come from verbal surveys, the ubiquitous and long essential tool for visitor research. On the way in, along the way, on the way out or some time after returning home visitors are questioned about who they are (from simple demographics to their deepest motivations), where they are going (e.g., which park or region of a park), when they were there (days or parts of days) and what they were doing while there (often by responding to a check list of visitor activities). Quality of experience may be assessed by questions about global sastisfaction and/or about specific components of the visit (fishing, scenery, wildlife viewing), features of the park (visitor center, parking, interpretation, toilets) or social factors (encounters, crowding, helpfulness of rangers).

Verbal surveys are and will continue to be an essential tool for park visitor research. Many important questions can most efficiently and effectively be addressed by posing questions to visitors and obtaining their answers in words. Some important questions can only be addressed this way. Moreover, in some venues (especially politics and public relations), what people say can be more important than what they do. But visitor impacts on sensitive environments and on each other result more from what people do than what they say. Managing visitor impacts and experiences requires information about who is where, when, and doing what, information that may not be adequately captured in traditional verbal surveys.

The empirical data base indicating that people do not always do what they say or say what they do, is large and venerable. The dissociation between verbally expressed attitudes and overt behavior is legendary in the social and behavioral sciences (Nisbitt & Wilson 1977) and park visitor research is not immune. The mismatch between words and deeds can at times be due to genuine failures of perception or memory (visitors don't always accurately know where they are or remember later what they did there), and at times it may derive from intentional deceit ("we did not go into the restricted area"). When environments and visitor reactions are only represented by words, there may be more fundamental reasons for worrying about the validity of verbal survey results. Recent psychophysiological and neurological research provides evidence that word-action dissociations may be a result of the fundamental "modular" architecture of the human mind.

Words versus environments

It is not uncommon for assessments of public responses to different environments to be based on verbal descriptions of (or just labels for) those environments. Is there any evidence that reliance on such verbal representations produces valid assessments? Are answers to such questions consistent with responses based on direct experience of the environments that the verbal descriptions intend to represent?

Representational validity has been a central concern in environmental preference research, but very few studies have directly compared environmental preferences based on verbal descriptions with preferences based on direct experience. Daniel & Ittelson (1981) showed high correlations between responses to verbal labels/descriptions and photographs of the same places. But the point of this study was to show that environmental representations are largely irrelevant when the environments being compared are grossly and qualitatively different (e.g., the Grand Canyon versus a grocery store aisle). For the most part, the environmental perception/preference literature has bypassed the question of whether words can sufficiently represent environments on the way to asking whether photographs are a sufficient representation (Daniel & Boster 1976; Shuttleworth 1980; Stamps 1990; Zube et al. 1987).

For many environmental preference questions, the weight of the evidence is that obtaining valid answers requires highly realistic visual representations (e.g., photographs) of the environments/conditions at issue. Even then, important limitations have been noted. Environments with significant dynamic elements (flowing rivers) may require dynamic (animated/motion) representations (Brown & Daniel 1991). If sensory modalities other than vision are important in the environment, additional features (the sound of flowing water) may need to be added to the representation (Hetherington et al. 1994). More recent environmental representation studies have focused on the sufficiency of emerging computer-graphic/computer-simulation techniques. Environmental preferences (and other perceptual judgments) have been studied for computer representations ranging from abstract wire-frames to still video images/montages (Bergen et al. 1995; Bishop & Leahy 1989; Daniel & Meitner 2001; Vining & Orland 1989). This work indicates that high levels of color and texture fidelity (viz the environments represented) are needed to achieve valid responses.

There is widespread belief that exposure to natural environments, in either active or passive pursuits, is psychologically and physically beneficial, especially for highly stressed, urbanised humans (Parsons 1991; Ulrich 1983). Consistent with this belief, it has been shown that viewing natural environments (directly, in photographs or in video) can produce rapid and substantial physiological recovery from stress (Hartig et al. 1991; Parsons et al. 1998). But there do not appear

to be any studies that have directly investigated whether verbal descriptions (read or heard) of these environments have similar effects. In a recent review, concern about environmental representation in this context has focused on whether even high quality visual representations (photographs, video tapes and high-realism computer simulations) are sufficient to support the restoration effects of direct environmental experience (Parsons & Hartig 2001).

Verbal representations of environments have been studied directly in the context of wayfinding, especially studies comparing the effectiveness of verbally presented directions (route descriptions) versus maps as aides to learning and navigating spaces. Studies have compared verbal and map-directed route navigation in real and simulated environments, with the general finding that both can lead to successful performance (Evans & Pezdek 1980; Franklin & Tversky 1990; Thorndike & Hayes-Roth 1982). Map representations are generally superior in supporting configural knowledge, as indicated by performance when the navigator is required to go off the primary route to avoid a roadblock, to get back on track after a navigational error, to find a successful shortcut, or to reverse a route. However, neither verbal descriptions nor maps produce the same outcomes as learning by direct exploration of the environment. This difference, between secondary (from maps and words) and primary (direct experience) spatial learning (Presson & Hazelrigg 1984), affects knowledge of the space and performance on a number of navigation-related tasks. Learning from both verbal and map representations, for example, tends to distort actual spaces toward a more Cartesian reference system and to shift perception/memory of oblique intersections and curved paths toward right angles and straight paths (Evans & Pezdek 1980).

Studies of the neurological substrates of spatial learning and navigation in three-dimensional environments also indicate that only high-realism environmental representations are sufficient to produce neurological activation patterns similar to those expected to occur in actual environmental encounters. For example, brain scans of subjects learning relatively abstract virtual mazes or towns differ from those of subjects learning from richer, more realistically depicted environments, and it is the latter representations that produce patterns of neural activity most consistent with those expected for direct spatial learning (Parsons & Hartig 2001).

A number of investigators have noted the potential advantages of using virtual environments to study wayfinding (Bishop 2001; Rohrmann & Bishop, in press). Computer simulation/VR research, like the preference research discussed above, has by-passed the question of whether verbal descriptions would suffice to represent the virtual environments with which their subjects interact. As in the preference literature, texture and color fidelity/realism in environmental representations have been found (or assumed) to be important. In addition, studies using "walk-through" ("drive-through" or "fly-over") simulations have been especially concerned about motion parameters, both the depiction of movement of the navigator through the environment and the motion of dynamic elements in the environments represented. Indications are that, in addition to rather high levels of form and color realism, realistic movement/motion is also necessary for valid environmental responses. In particular, interactive capabilities must be sufficient to allow the subject to explore visually, and in depth, the environment represented (Bishop 2001; Bishop et al. 2001). Moreover, efforts are increasing to develop more natural navigational response options for VR systems. Based more on intuitions than on actual empirical study, verbal responses, and even mouse or joy stick systems, have apparently been judged inadequate to support valid conclusions about human navigation in three-dimensional environments.

Words versus actions

In some circumstances asking people to report verbally where they have been and what they did may be sufficient. But there are many circumstances where this is not appropriate. For an obvious example, while lost persons do exhibit consistent and predictable navigational patterns (Malinkowski & Gillespie 2001), it would seem inappropriate to ask them where they have been. Young children are quite capable of navigating though complex environments, but they are unlikely to have the verbal skills to describe sufficiently where they have gone/would go or how they would get there. In fact, there is some evidence that young children may only be able to indicate the extent of their spatial understanding through responses that are basically similar to actual navigation. In one study (Lehnung et al. 2001) preschool children performed significantly below older elementary school children on a spatial learning task when configural knowledge was assessed by moving a compass-like pointer to indicate the direction of a learned landmark (not in sight). However, when the same children were allowed to indicate the direction by orienting their body and pointing with an extended arm, the young children preformed as well as the older children. This result is consistent with findings that implied spatial learning and navigational ability for adult subjects depend considerably on the tasks/responses used to assess that ability (Kitchin 1996).

People routinely overestimate the steepness of an incline, whether facing an actual hill to climb or a photograph. Few hikers would find this suprising. But such exaggerations, consistently found in verbal reports, do not occur when people indicate estimated steepness by their actions. For example, when people estimate the steepness of a hill by adjusting an unseen platform with their hand, the exaggeration goes away and slope estimates are much more accurate (Bhalla & Proffitt 1999; Creem & Proffitt 1998; Proffitt et al. 1995). A related experiment (Wraga et al. 2000) used an environmental-scale representation of the Muller-Lyer illusion, in which a line segment extending between two circles is consistently judged to be shorter than it is. When this illusion was arranged so that the line (between the circles) extended in front of the observer as a "path," verbal estimates of the length of the path showed the expected underestimation. However, when subjects were blindfolded and asked to walk to the end of the path, the bias in length estimation did not occur.

These findings, coupled with a large body of basic neuropsychological studies of normal and brain damaged individuals, form the basis for the view that mental representations of environmental objects that support explicit memory or verbal reports are anatomically and functionally separate from the implicit representations that guide actions toward those objects (Milner & Goodale 1995). Psychologists and neuroscientists make important distinctions between the perceptual and cognitive processes used to represent objects for the purposes of remembering them and/or reporting about them versus the processes that direct actions toward those same objects. Verbalising about objects and acting toward them appear to be associated with distinct and substantially independent underlying neurological systems in the brain.

Implications for visitor flow

The research outlined above indicates that it is very unlikely that verbal descriptions can provide valid environmental representations for the study of visitor behavior and flow. For assessing visitors' aesthetic and other environmental preferences, only high fidelity, realistic environmental representations will suffice. For questions regarding visitors' navigation through the environment, representational standards are likely to be even higher, including high fidelity visualisations of movement parameters (for both the visitor and dynamic environmental features) and high levels of interactivity to support active exploration of the environments represented.

Whether environments are represented by photographs or directly experienced, verbal expressions of behavior or behavioral intentions often are not consistent with actual responses toward those environments. The pervasive dissociations between words and actions that have generally plagued verbal surveys of attitudes, beliefs and behavioral intentions are increasingly believed to be a reflection of the fundamental architecture of the human mind/brain. Thus verbal surveys are not likely to adequately answer the *who*, *where*, *when* doing *what* questions that are essential to understanding visitor flow in parks and protected areas.

Simulation models of visitor use

Since verbal reports alone are unlikely to ever provide a valid basis for ascertaining visitor's preferences for and/or reactions to environmental conditions in parks and protected areas, more direct monitoring of visitor movements through and actions in park environments is needed (Watson et al. 2000). This monitoring can provide the raw data for simulation models of visitor use and behavior, which have great potential for supplementing insights obtained through verbal reports. Although simulation models have substantial potential to contribute to basic understanding of visitor behavior in park environments, the emphasis of this paper is on the practical management applications of simulation models. Travel simulation models have the potential to be useful tools that facilitate planning and management of visitor use in situations where monitoring and prediction of visitor flow is difficult. Such a tool would be particularly beneficial in national parks, wilderness areas and other large areas with complex traffic systems, and management objectives with concern about problems associated with crowding and the biophysical effects of concentrated use (Hendee & Dawson 2002).

There are at least three ways in which simulation modelling of recreation use can contribute to improved management. First, simulation modelling can improve the quality and cost-effectiveness of monitoring programs. Simulation makes it possible to use easily measured indicators (the number of cars entering through an entrance station or parked at a trailhead) to monitor hard-to-measure parameters (number of groups visiting certain attractions or walking on particular trails). In particular, many areas have developed management plans that include standards for a maximum acceptable number of encounters per day on interior trails and campsites. Many parks and wilderness areas expend resources attempting to directly monitor encounters but have found this indicator to be extremely difficult to monitor effectively (Watson et al. 1998). Simulation models could predict encounter levels in the interior based on relatively inexpensive counts of groups or visitors entering at different trailheads. Virtually every

national park and wilderness area could make use of simulation modelling as a monitoring tool.

Second, simulation modelling can help fine-tune existing management programs. Where amount of recreation use is limited, simulation models can help managers develop use limitation programs that optimise the tradeoff between amount of use and crowding, while minimising loss of freedom and spontaneity. In contrast to use limitation programs that utilise fixed itineraries (in which visitors are either told where and when they can go or they must state where and when they will go), programs that utilise entrance or trailhead quotas minimise loss of freedom and spontaneity (van Wagtendonk & Coho 1986). Recreationists are free to travel wherever and whenever they want once they gain access to the area. With entrance or trailhead quotas, the challenge to the manager is to set quotas that maximise total use without causing unacceptable levels of congestion at specific locations within the area. This is difficult to do given the complexity of travel patterns and minimal information available about travel patterns. Simulation models would allow the manager to "experiment" with different entrance or trailhead quota schemes to identify a program of quotas that optimises the tradeoff between amount of use and congestion.

Simulation models can also help fine-tune management programs in which camping is only allowed at a limited number of designated campsites. This is a particular issue with backcountry camping. The challenge with designated sites is to control use levels and distribution such that (1) the total number of designated sites needed to accommodate a given amount of use is minimised and (2) unoccupied sites are available to all groups, so that few groups need to either camp with another group on a designated site or make a new campsite. Most backcountry areas with designated sites require recreationists to adhere to a fixed itinerary of designated campsites. This approach accomplishes the objectives just described, but it severely constrains freedom and spontaneity and many recreationists deviate from their itinerary (Stewart 1989). Simulation modelling can help managers achieve these same objectives without having to resort to fixed itineraries. Simulations can predict the number of groups per night within different interior camping locations as a function of number of groups entering different trailheads. This understanding can be used to alter the number of designated campsites in interior locations or adjust trailhead quotas on the basis of the current number and distribution of designated campsites.

A third use of simulation modelling is to evaluate alternative future scenarios. Simulation could estimate how travel patterns and number of encounters between groups might change with increased use in the future. It could assess the effects of an action taken to reduce use through a rationing program. It could help evaluate actions that might influence the spatial and temporal distribution of use, such as changing quotas, building or closing trails, building new facilities, requiring mass transportation and scheduling the timing of trips. Trial and error could also be used to evaluate these actions but simulation avoids many of the problems inherent to trial and error.

Early visitor use modelling efforts

The potential of simulation modelling as a park and wilderness management tool has been recognised for decades. In a paper published in 1975, Cesario (1975) describes a simulation modelling approach that utilised GPSS (General Purpose Systems Simulator), a simulation language designed to deal with scheduling problems. At about the same time, International Business Machines (IBM), Resources for the Future, and the Forest Service collaborated on a wilderness travel simulation model, also using GPSS language. The model was dynamic, stochastic and discrete, meaning that it represented a system that evolves over time, incorporates random components, and changes in state at discrete points in time (Law & Kelton 2000). Two generations of the model were developed. The first generation (Smith & Krutilla 1976) developed the basic model structure and was applied to a limited data set collected in the Spanish Peaks Primitive Area, Montana. The second-generation model involved adaptations to accommodate a wider range of situations and provide additional outputs (Schechter & Lucas 1978). The need for these changes became clear when the model was applied to a more extensive data set for the Desolation Wilderness, California, an area that is much more heavily used than the Spanish Peaks.

The model included a replica of an area's travel network, its entry points, trails, cross-country routes and campsites. It distinguished between the travel patterns of different kinds of users (different group sizes and modes of travel) and of groups arriving at various times (different weeks, different days of the week and different times of the day). Each simulation involved generating groups of different kinds and different travel patterns arriving at various entry points, where they are assigned a specific travel route (set of trail segments and campsites). They move along this route, overtaking and passing slow groups, encountering groups moving in the opposite direction or camping along the trail and they camp at campsites, where they may encounter other groups.

The data needed to make the model operational include detailed information on the travel network, visi-

tors, and the travel patterns of different types of visitors. This data was generated from surveys of visitors that included information on their characteristics and travel patterns. Often a trip diary was used. Typically a number of simulation runs were conducted for different management scenarios. Summary statistics provide information on use patterns and number of encounters by type of encounter, type of group, and by individual trail segment and campsite. A variety of validity tests, based on data from the Desolation Wilderness, contributed a substantial degree of confidence to the model (Schechter & Lucas 1980).

One unique aspect of the effort to develop the wilderness travel simulation model was the effort expended on working with wilderness managers in model development and testing, in encouraging others to utilise it and in developing user manuals and conducting training. Model developers clearly hoped the model would be widely used by managers capable of building and running the model themselves. Indeed, the model was adapted and applied to river recreation (McCool et al. 1977) and a long-distance trail (Potter & Manning 1984). On the Colorado River in Grand Canyon National Park, Arizona, Underhill et al. (1986) used the model to evaluate the effect of upstream dam operations on downriver whitewater boating patterns. In Yosemite National Park, California, the model was modified to simplify data collection requirements and used to generate trailhead quotas for some of the more popular wilderness areas in the United States (van Wagtendonk & Coho 1986).

Despite this promising beginning, the wilderness travel simulation model never lived up to its original promise and fell into disuse. Much of this can be blamed on the cost and difficulties of running computer simulations in the 1970s and early 1980s. Simulations often had to be run on remote mainframe computers, with individual simulations costing $1000. With the advent of the personal computer, all this has changed. By the mid-1980s, Rowell (1986) reported that he had modified the wilderness travel simulation model so that it could be run on a personal computer. He also built in the capability to graphically represent output data in map form, making it spatially explicit. However, there was little effort to encourage use of this model and land managers apparently have never used it.

Recent innovations in visitor use modelling

Renewed interest in recreation travel simulation modelling developed in the 1990s. Manning and his associates at the University of Vermont have used a commercially-developed general-purpose simulation package, Extend (1996) and built simulation models for use in their "carrying capacity" research in several national parks. Their models have much in common with the wilderness travel simulation models developed in the 1970s, but can be run inexpensively on personal computers. In particular, simulated groups are assigned entire travel routes. For example, data collected on carriage roads in Acadia National Park identified 381 unique travel routes, which were randomly assigned to simulated groups on the basis of frequencies reported by survey respondents (Wang & Manning 1999). The assignment of routes also takes into account variation in travel routes between different travel modes (walking or biking) and different group sizes.

Validity tests suggest the model provides a reasonably accurate representation of the system. Moreover, model output can be related to management planning standards that set maximum levels of congestion on the carriage roads, suggesting the levels of use likely to violate standards. The model has also been used (1) to assess how the scheduling of bus transportation in Yosemite Valley will influence levels of congestion at popular destinations (Budruk et al. 2001), (2) to relate the number of vehicles entering Arches National Park, Utah, to the persons-at-one-time at Delicate Arch (Lawson et al. 2002), and (3) to adjust entry quotas at arrival points at Isle Royale National Park, Michigan, to minimise the problem of multiple groups having to use individual designated campsites on the same night.

Gimblett, Itami and their associates have taken a different simulation approach in applied research for land management agencies in Australia and the United States. Employing an object-oriented, individual-based simulation approach, they have developed the Recreation Behavior Simulator (RBSim). Instead of assigning groups entire travel routes, autonomous agents make decisions, on the basis of behavioral "rules" derived from visitor surveys, along the way, responding to what is encountered (Gimblett et al. 2000, 2001). Their approach couples the use of multi-agent systems with geographic information systems (GIS) to produce simulation models which are more flexible and complex than previous models. Interestingly, they have developed models for the Sierra Nevada and the Colorado River (Daniel & Gimblett 2000) two of the places where the original wilderness travel simulation model was developed.

Data input requirements for RBSim include the same types of data needed to operationalise other simulation models. However, to realise the advantages of more complex decision-making that RBSim allows for, additional information is needed to develop the "rules" that drive the artificial intelligence techniques employed. Typically, rules are initially derived from expert opinion, but are subsequently modified on the basis of observation of patterns of inputs and outputs

of the model, under a variety of operating conditions (Gimblett et al. 2000). To the extent that "rules" vary substantially between areas, additional model development and programming will be needed to apply RBSim in a new place.

RBSim can produce the same types of information about travel patterns, encounters, and other measures of congestion that other simulation models can. It also provides spatially explicit visualisation capabilities that can be helpful in gaining insight into the behavior of recreationists, as well as the spatial pattern of use. Perhaps of most importance, RBSim should be more capable of predicting the effect of management scenarios far removed from the present situation. For example, RBSim is capable of assessing the effect of building new trails, something other approaches cannot do. Roberts et al. (2002), originally working on the Colorado River with the RBSim group, have developed their own unique simulation engine, mixing mathematical modelling, statistics, artificial intelligence, fuzzy logic and other mathematical techniques to enhance the ability of the simulated rafting trips to react dynamically with their surroundings as they move down the river.

Conclusion

Clearly, park and protected area managers could profit from ready access to models capable of simulating travel patterns and recreation behavior. Managers of backcountry areas could utilise the ability to monitor interior conditions by simply measuring visitor use at trailheads. Those with significant concerns about managing recreation use would profit from the ability to explore the conditions likely to result from different choices between management scenarios. Those managers that have implemented rationing systems or that require the use of designated campsites could use simulation to fine-tune their systems. The recent innovations in simulation technology described above suggest the potential to provide managers with ready-access to this tool. When the wilderness travel simulator was developed in the 1970s, considerable effort was expended on developing a generic tool, supported by training manuals and training sessions, to make the tool readily available for use by managers. A similar technology development and transfer effort, based on recent improvements in technology, seems vitally important at this time. Although it will never completely replace the need for ongoing innovation and research-driven improvements to simulation technology, there is substantial need for a simulation tool that managers can use without having to contract the work to researchers.

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RBSim 2: simulating the complex interactions between human movement and the outdoor recreation environment

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Abstract

This paper describes advancements in recreation management using new technology that couples Geographic Information Systems (GIS) with Intelligent Agents to simulate recreation behaviour in real world settings. RBSim 2 (Recreation Behaviour Simulator) is a computer simulation program that enables recreation managers to explore the consequences of change to any one or more variables so that the goal of accommodating increasing visitor use is achieved while maintaining the quality of visitor experience. RBSim provides both a qualitative understanding of management scenarios by the use of map graphics from a GIS as well as a quantitative understanding of management consequences by generating statistics during the simulation. Managers are able to identify points of over crowding, bottlenecks in circulation systems, and conflicts between different user groups.

RBSim 2 is a tool designed specifically for the purposes of simulating human recreation behaviour in outdoor environments. The software is designed to allow recreation researchers and managers to simulate any recreation environment where visitors are restricted to movement on a network (roads, trails, rivers, etc.). The software architecture is comprised of the following components:

- GIS module to enter travel network, facilities, and elevation data
- Agent module to specify tourist personality types, travel modes, and agent rules
- Typical Trip planner to specify trips as an aggregation of entry/exit nodes, arrival curves, destinations and agents.
- Scenario designer to specify combinations of travel networks, and typical trip plans.
- Statistical module to specify outputs and summarise simulation results

This paper describes the RBSim software architecture with specific reference to the trip planning algorithms used by the recreation agents. An application of the simulator at Port Campbell National Park, Victoria Australia is described.

Key words: Recreation simulation, intelligent agents, recreation management, individual based models, Geographic Information Systems, Recreation Behaviour Simulator.

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