Ondrej MITAS, Helena MITASOVA

A MODEL FOR CARTOGRAPHY'S ROLE IN MANAGING THE PARK VISITOR EXPERIENCE

Ondrej MITAS, B.A., Parks, Recreation, and Tourism Management, North Carolina State University, Box 8004, Raleigh, NC 27695 USA.

Helena MITASOVA, Ph.D., Marine, Earth, and Atmospheric Sciences, North Carolina State University, Box 8208, Raleigh, NC 27695 USA.

Abstract: Outdoor recreation management research has made great strides in measuring why people participate in outdoor recreation and which benefits they enjoy from recreational experiences. The use of spatial analyses as both preliminary information and management products can orient the findings of outdoor recreation management studies towards improvement of visitor experiences. Under our proposed model, the spatial perspective would be added to well-established quantitative and qualitative procedures to offer outdoor recreation managers an integrated base of information for management decisions. Finally, cartographic products of geospatial analyses may be used as parts of persuasive education-based management solutions. An example of the proposed procedure for recreation management research is the lead author's recent thesis work at Jockey's Ridge State Park, North Carolina, USA.
Keywords: GIS, Benefits Based Management, outdoor recreation, sand dunes

Introduction

In this paper, we describe a conceptual model for the use of contemporary cartographic techniques, especially geospatial analysis, in the study of visitor experiences in outdoor recreation. Outdoor recreation in parks and protected areas covers a wide range of settings and activities and has been a primary focus of the leisure studies field for over 25 years. Theories of geography, landscape architecture, and leisure studies have all sought to inform spatial issues that arise in park management. The resulting body of knowledge has addressed threats to the quality of recreation experiences, such as environmental impacts and crowding. However, applied research of the visitor experience to inform park management usually treats spatial issues on a somewhat superficial level. Maps are used to illustrate and sometimes quantify user behavior and areas of concern. However, the methods of social science used are typically far more sophisticated than the cartography. According to Mohamedahmed (2000) "leisure researchers have shown only moderate interest in embracing a spatial perspective in their explorations of a variety of leisure phenomena, despite the critical role it plays in the understanding of many forms of recreation behavior" (p. 40). Therefore we offer the following research question:

> How could contemporary cartographic techniques enhance studies of the visitor experience in outdoor recreation settings?

We will examine the research precedent for this question from the leisure studies as well as cartographic fields. We will then propose a model for integrating cartographic techniques and products into the experience-oriented procedures for park management research. A description of the model is followed by an example study of Jockey's Ridge State Park in North Carolina, USA (Mitas, 2006). The role of cartography in managing the Jockey's Ridge experience is discussed. Finally, the implications of our model for future research in leisure studies as well as cartography are explored.

Research Precedent

The most widely accepted research paradigm concerning questions of park management is Benefits-Based Management (BBM). Manning (1999) defined Benefits-Based Management (BBM) as study of "the ultimate or higher-order benefits of recreation that flow to individuals and society at large" in

ways that can be measured empirically. Pierskalla, Lee, Stein, and Anderson (2004) examined nine pilot studies of BBM using meta-analysis. The studies included several State Parks in Minnesota as well as State Parks and private natural areas in Colorado and Arizona, USA.

Research intended to inform the BBM approach has contributed towards understanding of benefits sought by recreation participants. However, BBM has been criticized as being narrow in method and domain (Hemingway and Parr, 1999; More, 2002). Recent studies (Frauman and Cunningham, 2001; Stein, Anderson, and Thompson, 1999) have explored possibilities of variables besides benefits that may be important to measure for management, and stakeholders besides participants whose perceptions may be pertinent to management. Studies to inform BBM have not widely utilized spatial visualization or analysis, suggesting a need for a conceptual model of spatial and social research of the outdoor recreation experience. According to Mohamedahmed (2000), "The preoccupation with social profiles rather than visitor distribution and behavior has led to unjustified reliance on surveys in recreation site studies, though much can be achieved through simple observations and mapping" (p. 39).

Mohamedahmed (2000) offers a thorough literature review of the use of GIS technology in research that informs outdoor recreation management. While cartography and GIS has been extensively used to inventory parks' natural resources and to provide information to park visitors (see for example the *Interactive map center* provided by the US National Parks Service at http://www.nps.gov/gis/), use of geospatial tools in social studies of park visitor behavior is less common, often due to insufficient data and complexities associated with GIS tools. Growth of Web-based GIS over the past 5 years along with the US government policies that provide free and easy access to geospatial data opened new opportunities to use geospatial information well beyond its traditional disciplines.

Geographic Information Systems have been used to study the more specific management issue of environmental impacts. Examples include (Carr, 2006). GIS is typically used to record, visualize, and quantify areas of environmental degradation caused by recreation activity such as camping and depreciative behavior such as vandalism. When compared against visitor perceptions of environmental impacts, such research serves as a precedent for the present study. A 1995 study by Confer, Graefe, and Tire cited by Mohamedahmed (2000) examined issues of carrying capacity that may affect boaters' recreational experience, demonstrating "the feasibility of [spatial analysis] for manipulating and displaying social and spatial data in GIS" (p. 44). Such use of GIS technology is even more relevant to our inquiry than assessments of environmental impacts.

The most recent developments that provide tools for combining user data with Internet resources to create customized maps on-line without the need to download any data or software further extend the interest in geospatial information in general and "map-making" in particular (see for example Mapping Hacks by Schuyler et al., 2005; Google Map Hacks by Gibson and Schuyler, 2006). At the same time, GIS is stimulating the development of sophisticated simulations of visitor behavior using intelligent agent modeling. Itami and Gimblet (2001) present RBSim 2 that combines concepts from recreation research and artificial intelligence to explore complex interactions between humans and the environment aimed at reducing bottlenecks and overcrowding during the holidays. This precedent of emerging technologies demonstrates the potential of contemporary GIS and cartography to model and analyze management problems in outdoor recreation.

The Conceptual Model

Many issues addressed by park management have spatial components. We have discussed research in outdoor recreation management that has developed a framework of managing park spaces and facilities towards a maximum of beneficial outcomes to current and future visitors. This research forms a precedent for the use of cartographic elements to both study and enhance the visitor experience (Figure 1).

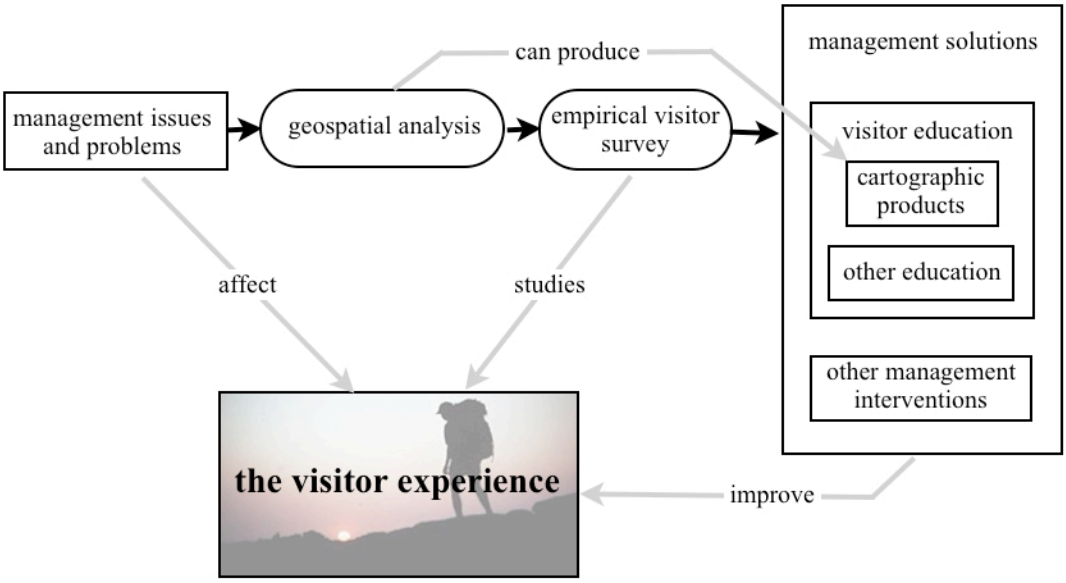

Fig. 1. Conceptual model for the use of advanced GIS and cartography in management of the outdoor recreation visitor experience.

Management issues with spatial components such as crowding and environmental impacts have been shown to reduce satisfaction from outdoor recreation experiences (Manning, 1999). These problems interfere with the space of the park in question, changing it in ways that visitors may be able to perceive. Visitor surveys as well as quantitative assessments of the situation are used to measure the extent of problem. Visitor surveys are regarded with particular importance because, when done correctly, they can assess the relationship between the issue at hand and the quality of the visitor experience.

We propose that a cartographic analysis of the spatial dimensions of issues such as are discussed by Manning (1999) including crowding, conflict, environmental impacts and depreciative behavior, as well as natural change, can inform the design of a visitors survey study. Cartographic visualization of spatial phenomena in parks can be used to determine ideal sites for sampling of visitors. Survey questions can also be written with direct reference to locations or phenomena of interest. The visual and conceptual representation offered by modern cartographic techniques allows researchers to form a tangible understanding of the physical aspects of the management issue before relating it to the visitor experience.

For example, research of environmental impacts has shown that the visitor experience is largely unaffected by less noticeable impacts such as soil compaction (Manning, 1999; Roggenbuck, 1992). A cartographic representation of compacted areas created before a survey is administered to visitors can serve as a baseline reference for the extent and location of soil compaction that the survey respondents may have seen. When combined with the survey results, the researchers and managers will understand *which areas* of soil compaction may have affected the visitor experience, and *where* these areas are.

Geographic Information System (GIS) analyses are especially suited to inform research of the visitor experience because of their capability for exploring spatial and temporal relationships between landscape features that influence the visitor's behavior. Moreover, they are easily connected to databases that can contain geospatial as well as visitor behavior data, as long as it is referenced to particular spatial points or areas. The GIS can then be used not only for capturing the visitors behavior at a certain point in time but also study its evolution over time.

A survey of visitors can then proceed with a substantial precedent of site-based information. Typically, such a survey measures benefits and outcomes that visitors may receive from the park, as well as their visitation and activity participation behavior. This information is then related spatially, temporally, and generally to the management issue of concern. The goal of the visitor survey is to inform an intervention in the management of the park to maximize benefits that visitors gain from the experience. Analyses of visitor data are usually displayed in the form of tables in technical reports, but can be linked to existing geospatial data and visualized spatially (Figure 2). Mohamedahmed confirmed that, as of 2000, very little such linking had been done in outdoor recreation management research.

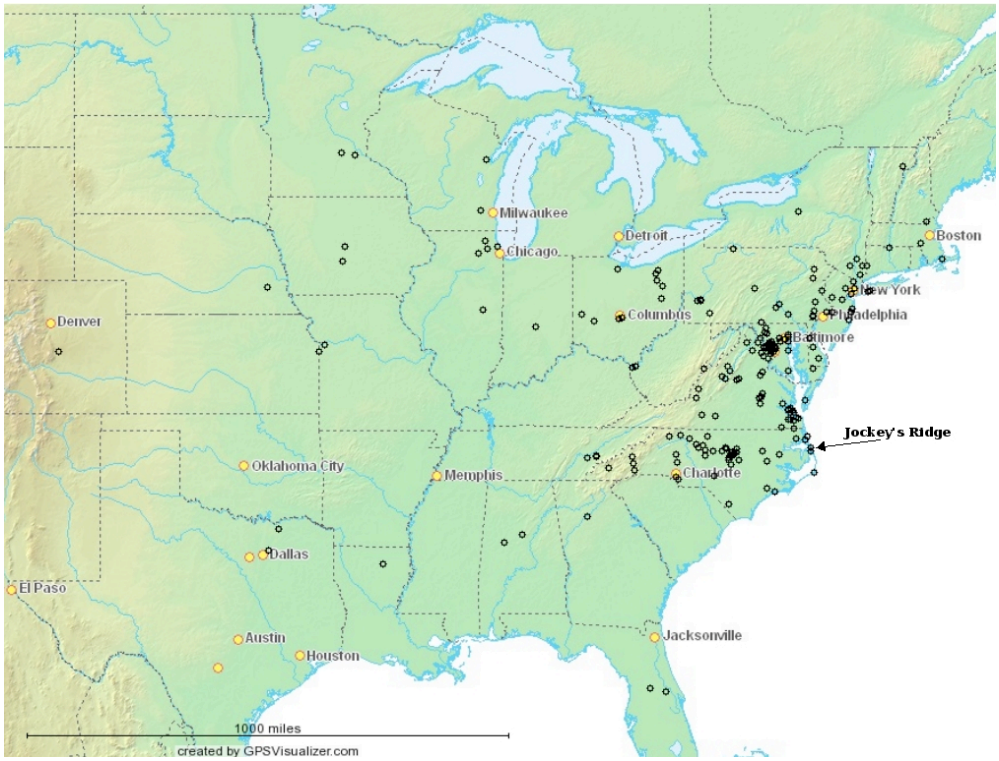

Fig. 2. Geospatial data related to visitors can be mapped using on-line mapping tools – in this case the location of Jockey's Ridge state park visitors home zip codes were mapped using the tools provided at http://GPSvisualizer.com/. Web tools were also used to compute the median distance from visitors' homes as 380km.

Manning (1999) discusses several categories of intervention actions that can be used to address management issues. The category of educational actions - explaining the issues and attempting to change visitor behavior through persuasion - is often advantageous, due to its typically low cost and low impact on the visitor experience Manning (1999). Specifically, "persuasive communication is generally believed to be a lighthanded or subtle visitor management strategy that protects visitors' freedom and the essence of leisure engagements" (Roggenbuck, 1992, p. 194). It is effective in preventing uninformed, unintentional, unskilled, or careless acts of depreciative behavior (Roggenbuck, 1992). Studies such as (Bullock and Lawson, 2006) also show that educational actions are widely supported by park visitors. We suggest that geospatial products that result from initial, pre-survey geospatial analyses can be a valuable component of educational materials such as brochures and informative signs. In addition to reinforcing verbal information, including an illustrative map of the natural and human elements at issue may hold potential to increase effectiveness of the educational message by addressing visitors that tend to learn visually, with pictures rather than words. The fact-based origin of geospatial analyses could also add persuasive power to educational displays, as visitors are sensitive to the credibility of the source in their reactions to persuasive messages (Roggenbuck, 1992).

Example: Jockey's Ridge State Park, North Carolina, U.S.

Jockey's Ridge State Park, located on North Carolina's Outer Banks barrier islands in the southeastern U.S. (Figure 2), contains the largest active sand dune on the U.S. Atlantic coast. Park managers have faced complex issues of natural change at the park. Movement of sand has required interventions such as planting and removal to prevent the dune from threatening surrounding houses and roads. Also, the dune has decreased from a height of 42.1 meters (138 feet) to 25.3 meters (83 feet) over the past 50 years (Figure 3), causing concern to some local residents and visitors that the smaller size of the dune made the park less exciting and less valuable to visit. A 1996 research summit at the park found that taking management action based on scientific research was critical to avoid political conflict and degradation of the visitor experience (Ellis, 1996). This stated need for research set the precedent for empirical studies of the geomorphology, natural history, and visitor experience at the park.

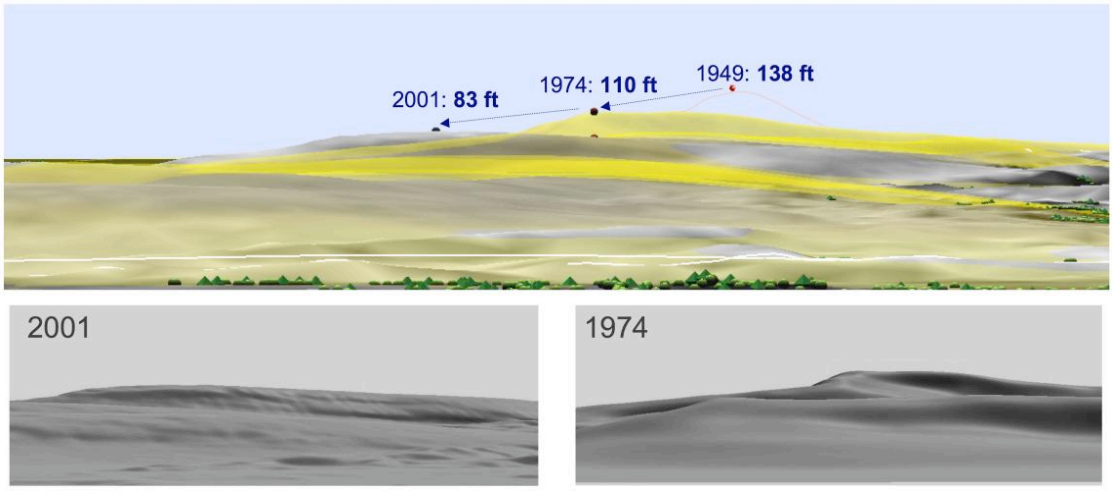

Figure 3. Eastern view of the dune from the ocean based on DEMs computed from digitized contours (1974) and LIDAR data (2001) and visualized using GRASS GIS.

A stratigraphical study of the Jockey's Ridge dune by Havholm et al. (2004) used ground-penetrating radar and core samples to show that the dune had historically cycled between high-growing maritime forest (such as Nags Head Woods, just north of Jockey's Ridge) and the current unvegetated active dune. GIS modeling and historical research by Mitasova, Overton, and Harmon (2005) quantified the processes that shaped Jockey's Ridge by measuring the dune's deflation and migration rates. This research included 3-dimensional spatial visualization using land use raster files draped over digital elevation models as well as quantitative analysis of sand volume and elevation changes (see also Mitasova and Hofierka, 2003). Finally, overlay analyses by Mitas, Mitasova, Overton, and Harmon (2005) analyzed potential for spread of vegetation and effects of dune movement on elevation of the Sand in the Tracks trail in the park. Cartography and GIS played an important part in these studies. For example, the historical research was facilitated by availability of on-line scans of historical maps that indicated the presence of sand dunes and that revealed that the high elevation was relatively temporary phenomenon (Figures 4, 5).

This research was necessary to understand the geomorphological processes that had caused concern to park managers and required management actions. By quantifying the dune's movements and relating them to the natural history of the area, it was possible to predict the locations and extent of future management problems. It became clear that sand from the park will continue to cross the south and west borders of the park until stabilized, and that the dune had diminished in size partly because of vegetation growth at the base of the dunes, as is typical of a dune-forest cycle seen across the Outer Banks before development for tourism (Cobb, 1906). Measurement and visualization of these concerns was important to discussing the theoretical basis for a visitor survey with professional colleagues. The maps and 3-dimensional views of the dune area were also important in justifying the study to resident stakeholders and designing the study with an accurate perception of issues in mind. Informal interviews with stakeholders and park management were used to generate survey questions.

Figure 4. Sections of historical nautical charts (NOAA, 2006; Library of Congress, 2006) indicate presence of sand dunes on the barrier island but no dune elevation data or specific Jockey's Ridge feature. The maps cover the following period: a) 1795, b) 1823, c) 1862, d) 1862, e) 1879.

Figure 5. More recent maps and photos: a) 1917, b) 1950 provide more detailed information including elevation, indicating that the relatively high dune with distinct peak (138ft, 42m) was a recent, short-term phenomenon.

Visitor survey data were collected by a paper questionnaire given to a systematic sample of visitors entering the park at various times of day during the peak summer season and also during the early fall of 2005. The questionnaire contained 24 interval-level scale items as well as several open-ended questions that asked visitors for their thoughts on Jockey's Ridge as a unique attraction in the Northern Outer Banks tourism context and their feelings on the dynamic nature of the park's natural features. A factor analysis of scale items revealed five factors: Personal Benefits, Observing Nature, Sensational Benefits, Structured Activities, and Solitude. The scores for these five factors were then entered as independent variables for a series of linear and logistic regressions. Several significant relationships were found between the factors and behavioral and perceptual variables (Mitas, 2006).

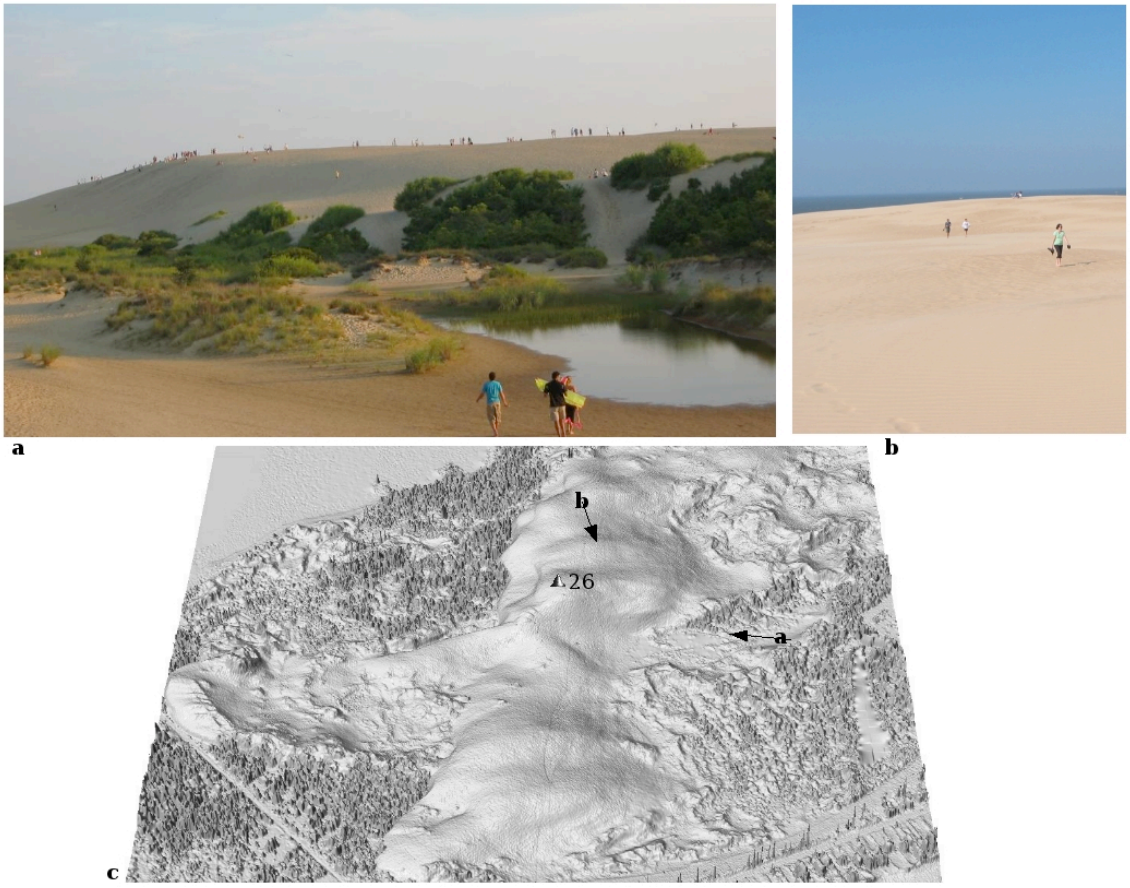

Fig. 6 Jockey's Ridge with visitors a) peak summer season with shallow water pools in low areas forming after rain; b) on the top of the dune in October with view of the Atlantic ocean; c) model of the dune based on lidar data showing the viewing locations on the photos.

Responses to the open-ended questions were content analyzed for themes and coded to determine theme occurrences and relationships, revealing a variety of important themes in the experience of the dynamic landscape of Jockey's Ridge in the context of Outer Banks tourism. The importance of nature as communicated in the qualitative responses suggested that for many visitors nature is at the center of the Jockey's Ridge experience. The nature-oriented management of Jockey's Ridge as a State Park and the natural character of its landscape offer visitors a relief or contrast from the highly developed touristic environs of the Northern Outer Banks. The experience of nature with the dune feature as its chief attraction provided opportunities for family time and bonding, peace and quiet, and visual enjoyment of a spectacular natural scene (Figure 6). Experience of Jockey's Ridge as a natural setting led to the predominant perception that the ever-changing size and shape of the dune are caused by natural processes. Many visitors experienced changes as enjoyable or simply inevitable (Mitas, 2006).

A small number of visitors, however, found the processes of dune movement and deflation upsetting, often because they perceived commercial development rather than natural processes to be the

cause of the changes. This finding suggests that additional education could be a management solution that will improve the Jockey's Ridge experience for some visitors. Specifically, visitors who would otherwise believe that development was causing the dune to shift and decrease in height may appreciate these changes if they understand the natural processes that actually cause them (Mitas, 2006).

At this writing, the results of the visitor survey have not yet been discussed with park management. However, visualizations and geospatial data from the initial GIS and stratigraphical analyses have already been made available to park management. The initial cartographic research of the management issues, then, will be part of the solution. Color prints of visualizations as well as multimedia presentations can be used by the managers and staff at Jockey's Ridge State Park for interpretive displays and presentations.

Implications

We have presented a conceptual model for the use of contemporary geospatial visualization and analysis in research of the visitor experience. We have shown theoretically and by way of example how developing cartographic technology can be applied towards park management issues, eventually increasing the quality of outdoor recreation experiences. This model has implications for research in the leisure science as well as cartographic fields, and holds potential as a protocol to integrate the two fields of study. In general, future research could test the connections between cartographic procedures and visitor experiences presented in our model empirically to refine its effectiveness as a procedure for managing outdoor recreation experiences.

A spatial perspective of management problems in outdoor recreation such as crowding, conflict, environmental impacts, and natural change offers an understanding of these situations that merely quantitative or qualitative analyses cannot. Our model suggests that spatial analyses can provide useful background information towards the design of a visitor survey. Future research could explore the possibilities of basing empirical research of visitors on geospatial knowledge to develop instrument design and sampling procedures that address specific management issues. Additional research on the use of cartographic products in visitor education is also needed. Effectiveness of different types of maps and visual elements in educational interventions could be tested to further specify recommendations to park management. Existing literature on effectiveness of persuasive education (Roggenbuck, 1992) is thorough but not sufficiently specific to determine the importance of visual information specifically.

GIS and digital cartography technology could, in turn, be developed to produce more effective educational products to visitors. Web-based GIS systems have made geospatial analysis accessible to a general population. A product of this type targeted at park and landscape management would be effective in informing managers of the extent and location of management issues.

The advances in leisure science research of outdoor recreation over the past 25 years have built a solid theoretical foundation for management of visitor experiences on empirical survey research. Adding not only spatial tools, but a spatial perspective to management issues and visitor behavior as well as education could broaden the information available to park management, ultimately resulting in more efficient and effective management practices. Furthermore, spatial analysis suggests an expansion of the spatial perspective in theoretical understanding of outdoor recreation visitor experiences. Such understanding would be welcome at a time when outdoor recreation resources are seen as important to society yet subject to frequent political conflict.

References

BULLOCK, S. & LAWSON, S. (2006, February). Searching for 'mutually agreed upon coercion' to protect the 'commons' on Cadillac Mountain: A stated choice analysis. Paper presented at the Southeast Recreation Research Conference, Wilmington, NC.

CARR, C. (2006, February). A model of environmental impact at rock climb areas, Red River Gorge Geological Area, Daniel Boone National Forest, Kentucky. Paper presented at the Southeast Recreation Research Conference, Wilmington, NC.

COBB, C. (1906). Where the wind does the work. *National Geographic* 8 (9), 80-85.

ITAMI, R.M., & GIMBLETT, H.R. (2001) Intelligent recreation agents in a virtual GIS world. *Complexity International 8*.

ELLIS, M. (1996). Jockey's Ridge State Park resource management. North Carolina Department of Parks and Recreation, Raleigh.

ERLE, S., GIBSON R., & WALSH, J. (2005). *Mapping Hacks : Tips & Tools for Electronic Cartography*, Sebastopol, CA, (O'Reilly).

FRAUMAN, E. & CUNNINGHAM, P. H. (2001). Using a means-end approach to understand the factors that influence greenway use. *Journal of Park and Recreation Administration* 19 (3).

HAVHOLM, K.G., AMES, D.V., WHITTECAR, G.R., WENELL, B.A., RIGGS, S.R., JOL, H.M., BERGER, G.W., HOLMES, M.A. (2004). Stratigraphy of back-barrier coastal dunes, northern North Carolina and southern Virginia. *Journal of Coastal Research* 20(4), 980-999.

HEMINGWAY, J. L., & PARR, M. G. W. (1999). Leisure Research and Leisure Practice: Three Perspectives on Constructing the Research – Practice Relation. *Leisure Sciences* 22,139 –162.

The LIBRARY of CONGRESS (2006) Civil War Maps:
http://memory.loc.gov/ammem/collections/civil_war_maps/

MANNING, R. E. (1999). *Studies in outdoor recreation: Search and research for satisfaction* (2nd ed.). Corvallis, OR, (Oregon State University Press).

MITAS, O. (2006). *The visitor experience at Jockey's Ridge: Humans and nature in a dynamic coastal landscape.* Unpublished master's thesis, (North Carolina State University, Raleigh, NC).

MITASOVA, H. and HOFIERKA, J., (2003) Impact of new mapping technologies on communication of geospatial information. *Kartograficke listy* 11, 53-61.

MITASOVA, H., OVERTON, M., HARMON, R.S., 2005, Geospatial analysis of a coastal sand dune field evolution: Jockey's Ridge, North Carolina, *Geomorphology* 72, 204-221.

MOHAMEDAHMED, S. A. (2000). *Human environmental interrelationships in recreation settings: A spatial approach.* Unpublished doctoral dissertation, Tucson, AZ, (University of Arizona).

MITCHELL, T. (2005) *Web Mapping Illustrated : Using Open Source GIS Toolkits*, Sebastopol, CA (O'Reilly).

MORE, T. A. (2002). "The parks are being loved to death" and other frauds and deceits in recreation management. *Journal of Leisure Research* 34 (1).

NOAA OFFICE of COAST SURVEY (2006) Historical Map and Chart Collection:
http://nauticalcharts.noaa.gov/csdl/ctp/abstract.htm

ROGGENBUCK, J.W. (1992). Use of Persuasion to Reduce Resource Impacts and Visitor Conflicts. In Manfredo, M. J. (ed.), *Influencing human behavior: Theory and applications in recreation, tourism, and natural resources management*. Champaign, IL: Sagamore.

STEIN, T. V., ANDERSON, D.H., & THOMPSON, D. (1999). Identifying and managing for community benefits in Minnesota state parks. *Journal of Park and Recreation Administration* 17 (4).

Resume

Model ulohy kartografie pri riadeni pobytu navstevnikov parkov

Vyskum manazmentu rekreacie v prirode sa snazi vysvetlit preco sa ludia takejto rekreacii venuju, aky prospech im (a spolocnosti) prinasa a pouzit tieto poznatky v riadeni rozvoja prirodnych parkovych aglomeracii a rekreacnych zariadeni. Pouzitie priestorovej analyzy moze poskytnut dolezite informacie pri priprave prieskumu navstevnikov a jej vysledky mozu byt zahrnute do opatreni na skvalitnenie pobytu navstevnikov pri sucasnom zachovani kvality priprodneho prostredia. V nasom prispevku navrhujeme koncepciu zaclenenia priestorovej analyzy do integrovanej informacnej bazy pre riadenie parkov ako noveho komponentu popri standardnych kvantitativnych a kvalitativnych pristupoch. Kartograficke produkty vytvorene na baze vysledkov priestorovej analyzy sa mozu stat sucastou vzdelavacich podkladov pre riadenie. Priklad takehoto modelu vyskumu riadenia v Statnom parku na pobrezi statu North Carolina je obsahom autormi predlozeneho clanku.

Fig. 1 Konceptualny model pouzitia GIS a cartografie pri riadeni pobytu navstevnikov prirodnych parkov.
Fig. 2 Priestorove data o navstevnikoch parku je mozne kartograficky zobrazit pouzitim internetovych mapovacich systemov, napriklad zip kody (adresy) navstevnikov Jockey's Ridge parku boli zobrazene pouzitom GPSvisualizer.com. Internetovsky program bol tiez pouzity pri vypocte medianu vzdialenosti medzi parkom a bydliskom navstevnikov ako 380km.
Fig. 3 Pohlad na dunu z vychodu od oceanu simulovany na zaklade digitalnych modelov terenu vypocitanych z digitalizovanych vrstevnic pre rok 1974 a lidarovych dat pre rok 2001. Data boli spracovane systemom GRASS GIS (http://grass.itc.it).
Fig. 4 Vyrezy historickych namornych map (NOAA, 2006; Library of Congress, 2006) naznacuju pritomnost dun v oblasti barierovych ostrovov, ale chybaju informacie o vyske a nie je specificky zobrazeny Jockey's Ridge. Mapy su z nasledovnych rokov: a) 1795, b) 1823, c) 1862, d) 1862, e) 1879.
Fig. 5 Mapy a fotografie z rokov a) 1917, b) 1950 obsahuju detailnejsie informacie vcitane vysok a naznacuju ze duna charakterizovana relativne vysokym vyraznym vrcholom pretrvala relativne kratko, vyska na zaciatku storocia bola mensia ako v sucasnosti.
Fig. 6 Sucasny Jockey's Ridge s navstevnikmi: a) spickova letna sezona; b) na vrchole duny v oktobri v pozadi s Atlantickym oceanom; c) model duny vypocitany z lidarovych dat s vyznacenymi pohladmi na fotografiach a, b.