FEDERAL AGENCIES
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A HERITAGE TOURISM TOOL: NATIONAL REGISTER OF HISTORIC PLACES

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"Historic and Architectural Resources of the Upper Delaware Valley, New York and Pennsylvania," a multiple property project nominating nearly 200 sites to the National Register of Historic Places, provides research data important to the promotion of local heritage tourism efforts.

I am, or have been, a professional journalist, a professional historian and a professional sociologist. I'm also a devoted amateur tourist. Whenever I get the chance to travel, whether in Europe, Canada, Florida, California or New England, I look for historic sites, picturesque communities and interesting architecture, the same things visitors look for when they come to my home territory, the Upper Delaware Scenic and Recreational River. The popular term for this kind of visitation is heritage tourism. In this paper, I will describe research which can be an important component in promoting that kind of tourism.

Specifically, the research I am involved with is titled, "Historic and Architectural Resources of the Upper Delaware Valley, New York and Pennsylvania." It incorporates a survey of approximately 400 historic properties and preparation of materials for a multiple property nomination to the National Register of Historic Places.

The research developed for these nominations has given tourism officials a perspective on local heritage, and the information to promote it. In the process of gathering data, researchers heightened the historic and architectural consciousness of the property owners, and uncovered the kind of stories that are appealing to tourists. As a result of this work, advertisements and brochures can tell would-be visitors that Volney Skinner's Milanville House was "a 19th Century Inn for Lumber Jack Rafters," that Roebling Delaware Inn was a Delaware and Hudson Canal Office, and that Mary Pickford signed the register at Rohman's (Shohola Glen Hotel). The research provides information for guides to use on walking tours. It helps communities draw visitors to "heritage days." It finds the stories for storytelling performances. It makes site interpretation and historic markers more interesting and accurate.

By way of background, let me tell you something about the National Register of Historic Places. The Register is basically a federal planning document. It provides a list of historically and architecturally significant properties which should be protected from federal action. That means the Army isn't supposed to use an architectural masterpiece for target practice, and federal dollars are not supposed to be used to build a dam flooding a Civil War battlefield.

Companion legislation in most states sets up a parallel structure for protecting sites from state funded or permitted action.

State and federal listings only protect a property from action funded or permitted by state and federal governments. Local historic designations may go further, restricting what owners do to private property with private funds. Communities like Savannah, Georgia, may go so far as to require that owners paint their houses with historically appropriate colors. Local designation in New York City recently resulted in litigation when a historic church wanted to build a skyscraper on the back of it, an action the city Landmark Commission decided would damage the architectural significance of the building. These kind of regulations are most often found in areas that place an especially high value on historic architecture as a focus for tourism.

Whether the designation is listing on the National Register of Historic Places or recognition by a local landmarks commission, a considerable amount of research is required. Construction dates, builders' and architects' names, historic significance, architectural styling, the names and stories of important people associated with the site, description of the property, and more must be ferreted out and documented.

With that background in mind, let me tell you about the Upper Delaware National Register project. Started officially in 1983, it built upon data that had been developed by local historians during the Bicentennial Celebration years. A task directive for the project resulted from conversations between the New York State Historic Preservation Office and the National Park Service. Covering about 56,000 acres of land, almost all of it in private ownership, on two sides of the river, in two states, this was an ambitious and unusual, perhaps unique, project.

Initially, the State of Pennsylvania was unwilling to take on such a large, experimental project. So it began with just New York State and the National Park Service developing research, and a local organization, the Upper Delaware Heritage Alliance, assuming official sponsorship. In 1990, Pennsylvania came on board. By June 1991, 400 properties had been inventoried, all of them at least 50 years old and worthy of consideration. The states had gone through their review processes on a staff level, and determined that almost 200 of those properties were eligible for the National Register of Historic Places.

The research was conducted in two stages. During the survey stage an effort was made to identify every building or structure in the river corridor which was at least 50 years old and might have historic or architectural significance. Each of these buildings was located on USGS maps, photographed, exterior and interior described, and historic information noted. Once the states reviewed that material, and made preliminary determinations of eligibility, more detailed documentation was prepared on those properties. The Multiple Property Documentation Form provided an introductory document for all of these nominations. Its two most detailed sections address historic context (a history of the river valley within the framework of important associated contexts), and property types (e.g., historic districts, residences, religious properties, commercial buildings). In addition, a nomination form is prepared for each historic district or individual property to be nominated. These forms include photographs, maps, property owner information, physical description, and detailed justification of historic or architectural significance.

Working with such a large geographic area and involving two states, has been a rewarding and useful experience, but complicated one. The states are not accustomed to working together on National Register projects. This is normally a function that is taken care of on the state level before it gets to the federal government. The federal Keeper of the Register checks over nominations, but in most cases (particularly in states like New York and Pennsylvania, where there are very active state historic preservation offices) the states do the extensive review, and decide whether or not a nomination should be accepted.

The final nomination review stage has now been reached in both states. Beginning in June 1992, it will take more than a year of presenting preliminary material, and nomination forms for state review. Sometime in 1993 we expect to have all of these properties on the National Register.

In practical terms, federal or state designation doesn't mean a lot to the average property owner. As a result, the most important part of the program may not be the designation, but rather the research process itself. There is relatively little threat from federal or state funded projects to these sites. The greatest problems are deterioration, owner neglect, and perhaps most threatening of all, remodeling. The research process, with owner contact, and the attendant educational opportunities, can convince a neglectful property owner that he has something worth preserving. It can even open the eyes of the dedicated remodeler to the value of restoration.

It also has the potential to impact the area's economy. I'm a native of the Upper Delaware Valley, which gives me a special feeling for the economic needs of its residents. The area where I work is a non-traditional National Park Service area. We own very little of the property, and according to our River Management Plan, the National Park Service will never own more that 125 acres; the rest will be primarily in private ownership. Therefore, it is the private owner, and often his economic concerns, that are paramount.

To the private owner, the whole idea of heritage tourism sounds like a money maker. It calls forth images of a "clean," family oriented industry, a tourism opportunity devoid of the immoral, criminal, disruptive elements that may plague other kinds of entertainment attractions.

But successful heritage tourism involves more than the decision to promote history. Here is what an editorial in Preservation News (the publication of the National Trust for Historic Preservation) had to say about it: " To some the words heritage tourism may carry only stereotyped images of horse drawn carriage tours, or docents in period costumes, but the essence of heritage tourism lies in recognizing an area's unique qualities and making the best cultural, economic use of them." This is where the National Register comes in. It helps us in many ways, but most importantly it identifies those unique qualities which characterize an area.

You've probably heard some of the horror stories of places where they got the idea of heritage tourism . . . but not quite. One of my colleagues from Gettysburg tells about a group of people that had gone to Williamsburg, and visited the colonial buildings there, then came back and wanted to tear down all the Victorian houses in Gettysburg and rebuild them, Williamsburg style. The historic research associated with the National Register, and the interest it generates within local communities, can forestall this kind of destructive thinking. It can help a community to understand what is uniquely theirs and develop the kind of tourism that builds on their heritage.

In the Upper Delaware Valley, this has led to important interaction with local property owners, development of promotional materials, and encouragement of a strengthened historic preservation ethic. One of the things we're especially enthusiastic about is the increasing number of bed-and-breakfasts, and other commercial ventures based in restored historic buildings. This not only boosts the economy, it saves a portion of the area's heritage and improves the general quality of life.

In addition to private property owners, business associations, historical societies and cultural groups are very much a part of the heritage tourism picture. Drawing upon National Register research, I do walking tours and assist others in developing interpretive programs for historic sites. I work with people who put on heritage days and street fairs focusing on historic themes. I do armchair trips around the river valley via slide presentations.

One of the most successful promotions utilizing our National Register research has been the Cultural Historic Attractions Tour (CHAT) map and guide. A glossy, professional quality effort produced by the Sullivan County Office of Public Information, it was funded, and supervised, by the Upper Delaware Council (UDC), a coalition of river corridor townships. Through the UDC, local historians were brought into the project and information from the National Register research was used to check accuracy, and provide historical background.

The opportunities for using this research have only just begun to surface. Publicity surrounding National Register nominations increases local interest in old and historic properties. A UDC conference on tourism and economic development drew enthusiastic response, and highlighted heritage tourism. The Callicoon Business Association is in the process of developing historic markers for each of its Main Street stores. The Big Eddy Storytellers are planning a performance event featuring local folklore and historic tales. This fall, the Upper Delaware Heritage Alliance will kick off a program to provide recognition plaques for valley buildings over 75 years old.

As more and more people recognize the potential for heritage tourism, the demand for local historic information escalates. Research generated by the National Register nomination process has taken on a life of its own, so that the importance of the information by-product may far exceed the importance of the government designation. Although the program is designed to protect historic and architecturally significant properties from damage by government action, that may turn out to be the least of its usefulness.

One of the special advantages of the multiple property approach to the National Register is its open-ended quality. Once the Multiple Property Documentation Form has been submitted with the first nominations, the supporting documentation is a matter of public record, reviewed, and on file with the states and the Keeper of the Register. The detailed statement of historic contexts, registration requirements, geographic data, summary of identification and evaluation methods, and major bibliographic references are completed, and do not need to be repeated. New nominations can be added with relative ease.

With the Upper Delaware project, we are already aware of at least a dozen properties which may be National Register eligible, despite being omitted from the initial nomination list of nearly 200 sites.

Virtually all of these properties are not now included due to "lack of sufficient information." That means more research is needed. It also means the project may not be completed in my life time. If that sounds like a pessimistic statement, I don't mean it to be. I see it as a continuing opportunity.

As long as human beings are interested in their past and its stories, there will be heritage tourism (by that or some other name). As long as there is heritage tourism, there will be the demand for more information and stories, related to local history. And that means research and more uses for the kind of information a National Register project produces.

THE ENVIRONMENTAL SIGNIFICANCE OF HISTORICAL PARKS: A STUDY OF EVOLVING PARK VALUES

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Introduction

It has been traditional to think about national parks and equivalent reserves in terms of basic "types" or "categories" of parks. Classically, we tend to label parks as "natural," "historical" or "cultural," and "recreational." These labels are based on what are viewed as the park's most significant resources or values. But is this the way visitors view parks? Do park values evolve in the minds of visitors? Can parks serve multiple values? We explored these questions in a study of visitors to Roosevelt Campobello International Park.

The Study

Roosevelt Campobello International Park is located on Campobello Island, New Brunswick, Canada. The park was created to commemorate United States President Franklin D. Roosevelt. The original and traditional focus of the park is the historic Roosevelt family cottage. Created in 1964 by international treaty, the park was initially comprised of the Roosevelt Cottage and the surrounding ten acres of grounds. However, over the years the park has acquired nearly 3,000 acres of surrounding lands which include a variety of fine inland and coastal ecosystems.

Under terms of the treaty creating the park, the Roosevelt Campobello International Park Commission requested technical assistance in park planning and management from the U.S. National Park Service. Accordingly, a survey of park visitors was conducted under the auspices of the North Atlantic Region in the summer and fall of 1989. Park visitors were sampled on ten randomly selected days. Sampling consisted of contacting 1,000 randomly selected visitors and soliciting their cooperation in participating in the study. Names and addresses of visitors were collected and participants were mailed a mail-back questionnaire upon their return home. Using two follow-up mailings a response rate of 90.2% was attained, yielding 902 completed questionnaires. Questions collected information concerning visitor characteristics, and visitor opinions and attitudes about selected park management issues.

Findings

Several study findings relate to the ways in which visitors value the park. First, respondents were asked directly whether they preferred that park management emphasis be placed 1) primarily on historical resources with natural resources of secondary importance, 2) primarily on natural resources with historical resources of secondary importance, or 3) equally on historical and natural resources. The vast majority of visitors (76.7%) preferred the third alternative, indicated that in the minds of most visitors the park has clearly evolved from initial establishment as an historical site to a park with at least equal importance as a natural area.

Second, the activities in which visitors participate and rate as important indicate that park values may be changing. The activities in which visitors now participate tend to be somewhat passive and oriented toward the historical values of the park. The four most popular activities were touring the historic cottages, driving scenic roads, photography, and touring the flower gardens. However, respondents were also asked to indicate which activities they considered most important for the park; that is, which activities should the park be sure to plan for. Considered in this context, more active and environmentally-oriented activities tend to increase in importance. While touring the historic cottages remained the most important activity, driving scenic roads and photography declined in relative importance. Alternatively, walking or hiking trails, picnicking, and nature study increased in relative importance.

Third, the age distribution of park visitors, and its apparent influence on park values, indicates that the public significance of the park may be evolving. The current visitor population is heavily skewed toward the older age categories. Over 60% of visitors are 50 years of age and older, and nearly 40% are 60 years of age and older. Most of the visitors in these older age categories have direct knowledge and memories of Franklin D. Roosevelt and his importance in national and international affairs. Consequently, their attention tends to be focused on the Roosevelt theme of the park, particularly the purely historical elements of this theme. However, younger visitors evidence a stronger orientation toward the natural and environmental resources of the park. They are also more interested in more active recreational pursuits which are focused on the environment. For example, younger visitors hiked and beachcombed more often and toured flower gardens and viewed the orientation film less often than older visitors. Younger visitors also rated hiking, beachcombing, and bicycling as more important park activities than did older visitors and rated touring the historic cottages and flower gardens as less important. Younger visitors also visited the natural areas of the park more often and tended to favor more park management emphasis on natural resources. They were also more strongly in favor of preserving the park's natural resources and were less favorable about the management practice of vista clearing. Greater interest in the natural aspects of the park on the part of younger visitors may also translate into somewhat less interest on their part in the traditional historic resources of the park. Younger visitors felt they learned less than older visitors about Franklin D. Roosevelt and his life on Campobello Island.

Conclusion

Roosevelt Campobello International Park originated as a traditional "historical" area. However, it appears to be evolving to take on significant environmental and related recreational values as well. This is due to changes in the park itself as it has expanded to take in surrounding natural areas. However, it is also due to changes in the visitor population. The great majority of visitors recognize the significant natural resource base now contained within the park. Perhaps even more importantly, a new generation of younger visitors is clearly more oriented toward this natural resource base than the traditional historical values of the park.

Evolving park values at Roosevelt Campobello International Park do not mean that the traditional historical resources of the park should be somehow diminished in importance. The issue facing the park might best be described as how to maintain public interest in the Roosevelt theme as fewer park visitors in the future may have highly focused and direct interest in Franklin D. Roosevelt. A potential solution to this issue is to tie the historical Roosevelt theme more closely to the natural resources of the park. For example, more emphasis might be placed on how the Roosevelt family used the surrounding natural landscape for recreation, relaxation, and inspiration. Perhaps activities of the Roosevelt family could be recreated providing opportunities for more active recreation pursuits tied more directly to the natural environment. This would be more in keeping with the majority viewpoint of visitors that park management should be balanced between historical and natural resources.

CAMPSITE IMPACT MANAGEMENT:

A SURVEY OF NATIONAL PARK SERVICE

BACKCOUNTRY MANAGERS

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Though a central purpose for the creation and management of parks, visitation inevitably affects the natural resources of parks. This is particularly true at campsites, where visitation and its effects are concentrated. This paper presents partial results from a survey of National Park Service managers regarding general strategies and specific actions implemented by park managers to address campsite impact problems.

Introduction

The National Park Service (NPS) encourages backcountry recreational uses that promote visitor enjoyment through a direct association with park resources. Backcountry, the primitive, undeveloped portions of parks, is generally open to a variety of dispersed recreational uses. It is recognized that any recreational use will result in some level of impact to park resources. Examples of recreational impacts include trampling and loss of vegetative cover, tree damage, compaction and erosion of organic litter and soil, introduction of exotic vegetation, harassment and/or displacement of wildlife, and pollution of water resources (Hammitt and Cole 1987, Marion and Merriam 1985, Ream 1980). Survey research also indicates that some of these impacts are perceived as significant by visitors and may degrade the quality of their recreational experiences (Lucas 1979, Roggenbuck et al. In Press).

NPS managers have responded to recreational impact problems with a considerable variety of visitor and resource management practices. These management approaches may be classified, for example, on the basis of their strategic purpose (Manning 1979). Strategies are broad, general approaches for addressing the basic causes of problems. Reducing recreational use or enhancing resource durability are examples of management strategies.

A second system of classifying backcountry recreation management practices focuses on tactics or actions. Tactics are specific actions implemented by managers to accomplish a management strategy (Cole et al. 1987). Restrictions on length of stay, differential fees, and permit quotas are examples of tactics designed to accomplish the strategy of reducing recreation use. Tactics can be classified according to the directness with which they act on visitor behavior (Peterson and Lime 1979, Lime 1979). Direct management practices regulate and restrict visitor behavior, leaving little or no freedom of choice. Indirect management practices attempt to influence the decision factors that lead to visitor behavior. For example, the objective of reducing backcountry campfire impacts might be achieved through a ban on campfires, a direct management approach, or through an educational program informing visitors of the undesirable ecological and aesthetic impacts of campfires and encouraging the use of portable stoves, an indirect approach.

This paper reports results from a survey of NPS managers conducted to determine the type and severity of recreational impact problems in backcountry areas of the Nation's parks. The survey also documented general strategies and specific management actions applied by managers to resolve these problems. While the survey covered a wide range of backcountry recreation management problems relating to resource impacts and visitor experiences, this paper focuses on campsite impact problems and their management. Campsites, because they serve as a focal point for visitor activity, receive concentrated use and are usually the most heavily impacted areas in backcountry regions.

Methods

The survey included all NPS units with substantial backcountry resources. Backcountry was defined as those areas managed primarily for natural conditions and processes that are generally not accessed by visitors with standard passenger vehicles. The survey instrument was a mail-back questionnaire that solicited information on backcountry recreation management problems, implemented actions and their perceived effectiveness, carrying capacity, and resource and visitor monitoring.

The survey was sent to 103 park superintendents requesting that they be directed to appropriate backcountry managers or rangers for response. Ninety-three completed surveys were returned for a 90 percent response rate. Completed surveys were input into dBASE III+ databases for distribution to participating park units, and transferred to the SPSS-PC+ statistical package for analysis.

Results

Backcountry managers rated the perceived severity of eight types of campsite impacts using a Problem Severity Scale ranging from 0 (Not a problem) to 3 (A problem in most areas) (Table 1). For seven of the eight types of campsite impacts the most common rating was 1: "A problem in a few a areas". Average ratings ranged from 1.3 for herbaceous vegetation and soil impacts to 0.6 for user-constructed facilities. For these impact types, managers perceived more pervasive problems with herbaceous vegetation and soil impacts; approximately one-third of the managers rated these items as being a problem in many or most backcountry areas. Such findings would imply that campsite impacts are generally confined to popular attraction areas rather than prevalent throughout backcountry areas. This finding would be expected given the results of visitor distribution studies that reveal markedly uneven use patterns in wilderness and backcountry areas (Lucas et al. 1971, van Wagtendonk 1981).

The remainder of this paper focuses on specific tactics or actions which backcountry managers have implemented to address campsite impact problems. For presentation, these actions are divided into four groups according to their general strategy: (1) actions to reduce backcountry use, (2) actions to redistribute or contain use, (3) actions to improve minimum impact behavior, and (4) actions to enhance resource durability.

A thorough review of the literature on backcountry and wilderness recreation management practices was conducted during survey development. This review resulted in a compilation of over 100 specific actions which park managers might employ to address backcountry recreation management problems. Managers were asked to review and add to this listing and check all actions that were currently in effect for all or some portion of their backcountry. An effort was made to distinguish between indirect actions (typically indicated by the terms "encourage" and "discourage") and more direct regulatory actions (typically indicated by the terms "require" and "prohibit").

Table 1. Severity of several types of campsite impact as perceived by National Park Service backcountry managers.

Type of Campsite Impact	Severity Scale [a] 0	1	2	3	Avg
	(No. of Parks)				
Herbaceous vegetation loss/ compositional change	14	49	17	10	1.3
Soil exposure/erosion	12	46	24	8	1.3
Tree and shrub damage/loss	22	50	13	5	1.0
Multiple fire sites	32	36	18	3	0.9
Campsite proliferation	37	38	10	3	0.8
Exotic vegetation introduction	37	38	12	2	0.8
Excessive site size	42	30	14	2	0.7
User-constructed facilities	40	42	6	1	0.6

a/ 0 = Not a problem
1 = A problem in a few areas
2 = A problem in many areas
3 = A problem in most areas

Strategy 1: Actions to Reduce Backcountry Use

The objective of this strategy is to reduce campsite impacts by reducing backcountry use, although other problems or concerns may be addressed by such actions. Of 63 parks that require visitors to obtain backcountry permits, 33 restrict permits by campsite availability (Table 2). Four parks prohibit overnight use. Less restrictive regulations include trip length of stay limits (47 parks) and campsite length of stay limits (58 parks). Indirect use reduction actions include limiting access by closing roads (29 parks) and trails (12 parks), and by reducing road maintenance (11 parks) and trail maintenance (17 parks).

Recreational ecology research indicates that use reduction may be an ineffective strategy for minimizing many types of campsite impacts (Cole 1982, Cole and Marion 1988, Marion and Merriam 1985). Campsite impact studies have consistently shown that the most dramatic changes occur with initial or low levels of site use. Thereafter, the relationship between amount of use and many types of resource impacts diminishes substantially. Consequently, site use reductions, unless substantial, will not significantly improve site conditions.

Table 2. Number of parks employing actions to reduce backcountry use.

33	Permits are restricted/rationed by campsite availability
47	Require trip length of stay limits
	Backcountry access is made more difficult by:
29	closing roads
11	reducing road maintenance
12	closing trails
17	reducing trail maintenance
58	limiting campsite length of stay
1	discouraging overnight use
4	prohibiting overnight use

Strategy 2: Actions to Redistribute or Contain Use

The objective of this strategy is to reduce campsite impacts through use redistribution or use containment. The most common action under this strategy was to discourage or prohibit camping in environmentally sensitive areas (50 and 43 parks, respectively) (Table 3). Prohibitions on camping in fragile ecosystem or vegetation types (24 parks) or near popular park features (14 parks) are also fairly common actions. However, such actions may be largely ineffective unless use can be successfully shifted to impact-resistant areas (Cole 1981). Relocation of campsites from fragile to more durable soils and/or vegetation types is practiced by 32 parks. Twenty-six parks encouraged and eight parks required camping in impact-resistant ecosystem types.

Actions that encourage or require dispersed camping are another form of use redistribution. In its purest form, visitors are directed to camp on sites with no evidence of previous use. Only 12 parks encourage this form of dispersed camping. Such a practice is difficult to implement or enforce and few parks are likely to have a sufficient number of potential camping locations. A more common approach is to discourage or prohibit camping within a certain distance or sight of trails (11 and 28 parks, respectively) or within a certain distance or sight of other campsites (18 and 17 parks, respectively). The effectiveness of dispersed camping is dependent upon maintaining very light use on dispersed sites and encouraging the use of minimum impact camping practices (Cole and Benedict 1983).

Visitor concentration or containment is a more effective approach in areas where use is heavy or camping locations are limited. Most commonly, visitors are required to camp on designated campsites either parkwide (23 parks) or in certain areas (29 parks). Twenty-three parks restrict backcountry camping to designated geographic areas. An alternate, non-regulatory campsite selection approach to visitor containment encourages visitors to use moderately impacted sites and to avoid lightly and severely impacted sites (Cole and Benedict 1983). The objective of this approach is to encourage complete recovery on lightly impacted sites and a reduction of impacts on highly impacted sites. Few parks appear to have adopted this approach. Use of moderately impacted sites is encouraged or required by 9 and 2 parks, respectively. Use of lightly impacted sites is discouraged or prohibited by 11 and 4 parks, respectively, and use of heavily impacted sites is discouraged or prohibited by 17 and 9 parks, respectively.

Strategy 3: Actions to Improve Minimum Impact Behavior

The objective of this strategy is to reduce campsite impacts through educational or regulatory actions that encourage the adoption of minimum impact camping practices. Seventy-two of the surveyed parks indicated that minimum impact backcountry use practices are taught. A wide variety of communication mediums were used: low impact literature (46 parks), backcountry access bulletin board displays (48 parks), personal contact with backcountry rangers (64 parks), and video or slide programs (9 parks) (Table 4). It is difficult to assess the percentage of visitors reached by these efforts, however, 37 parks indicated that low impact literature is provided or shown to most or all backcountry visitors.

Educational approaches are also widely applied to address a number of specific visitor impacts. Nearly all (85) parks emphasize a "pack-it-in, pack-it-out" policy to reduce litter in the backcountry, 22 parks provide free litter bags. Most parks address human waste disposal by instructing visitors to bury fecal material (61 parks), although 13 parks instruct visitors to carry out human wastes (typically river parks). Impacts from campfires and wood gathering are addressed by discouraging the use of axes and saws (14 parks), campfire building (9 parks), and by encouraging the use of stoves (42 parks).

Table 3. Number of parks employing actions to redistribute or contain use.

	Discouraged	Prohibited
Camping in environmentally sensitive areas is	5	43
Camping in fragile ecosystem or vegetation types	26	24
Camping within a certain distance or sight of popular features	10	14
Camping in certain designated geographic areas	6	33
Camping within a certain distance or sight of roads/facilities	6	43
Camping within a certain distance or sight of trails	11	28
Camping within a certain distance or sight of other campsites	18	17
Camping within a certain distance of water	4	41
Camping on lightly impacted sites is	11	4
Camping on heavily impacted sites is	17	9
	Encouraged	**Required**
Camping in impact-resistant ecosystem/vegetation types	26	8
Camping on designated campsites parkwide	16	23
Camping on designated campsites in certain areas	11	29
Camping in certain designated geographic areas	11	23
Camping on sites with no evidence of use is	12	0
Camping on moderately impacted sites is	9	2

32 Relocate campsites from fragile to more durable soils and/or vegetation types
37 Locate campsites/facilities on durable sites

Regulatory actions designed to compel minimum impact behavior provide more direct options for implementing this strategy. For example, campfires are prohibited by 40 parks and backpacking stoves are required in 34 parks.

Strategy 4: Actions to Enhance Resource Durability

The objective of this strategy is to reduce campsite impacts through campsite maintenance and rehabilitation and the provision of facilities. Forty-six parks indicated that they perform general campsite maintenance and 25 parks seed and transplant vegetation on campsites (Table 5). Impacts are also reduced by concentrating or channeling use through the location of firepits or other facilities (40 parks). Resource protection facilities that reduce impacts by containing use include shelters (9 parks), tent platforms (12 parks), firegrates (28 parks), and tables (19 parks).

Discussion and Conclusion

The diversity of backcountry recreation management problems and potential management strategies and tactics results in considerable complexity for backcountry managers. A principal objective of this study was to gather, analyze, and share information about backcountry management problems and alternative solutions. The communication of this information will be facilitated by distributing survey results in both printed and electronic formats. Databases in dBASE III+ will allow parks to identify potential management alternatives and contacts at other parks who have had experience with various management strategies and actions. Encouraging technology transfer between parks can be an effective means for sharing the expertise of backcountry managers regarding both successful and unsuccessful approaches for addressing backcountry recreation problems.

Actions implemented by backcountry managers to address campsite impacts range from indirect lighthanded options to direct, authoritarian options. A common wilderness management principle is to apply the minimum action required to accomplish established objectives. Due to their "costs" to visitors, managers should evaluate and implement the most effective indirect controls to delay or minimize the imposition of direct controls (Hendee et al. 1990). While no effort was made to distinguish between backcountry versus wilderness management in this survey, the NPS draws few distinctions between its management of these two land classifications.

Table 4. Number of parks employing actions to improve minimum impact behavior.

72 Teach minimum impact backcountry use practices
42 Teach minimum impact camping techniques
46 Low impact literature is available on request
45 Low impact literature is displayed at visitor centers and ranger stations
48 Low impact literature is displayed on bulletin boards at backcountry access points
37 Low impact literature is provided or shown to most or all backcountry visitors
64 Park rangers are instructed to convey low impact messages during backcountry visitor contacts
9 Low impact videos or slide programs are routinely shown at visitor centers
85 Emphasize "pack-it-in, pack-it-out" policy
22 Provide free litter bags
61 Visitors are instructed to bury human wastes
13 Visitors are instructed to carry out human wastes
53 Visitors are instructed to defecate away from all water sources
42 Backpacking stoves are encouraged
34 Backpacking stoves are required

	Discouraged	Prohibited
Ground fires, parkwide, are	9	40
Ground fires, in certain park areas, are	9	44
Cutting standing dead wood is	7	77
Axes/saws are	14	17

Table 5. Number of parks employing actions to improve resource durability.

40 Concentrate or channel use on sites through location of firepits or other facilities
46 General campsite maintenance
25 Seed/transplant vegetation on campsites
9 Provide shelters for visitor overnight use
12 Provide tent platforms
28 Provide firegrates
19 Provide tables

between its management of these two land classifications. Previous surveys of wilderness management practices have generally shown more reliance on regulations than nonregulatory alternatives (Washburne and Cole 1983, Fish and Bury 1981). This was particularly true for the NPS, as compared to the other wilderness management agencies. A review of Tables 2-4 supports the finding that direct actions are also used more frequently than indirect actions with respect to the mitigation of campsite impact problems in NPS backcountry areas.

NPS Management Policies (USDI 1988) direct managers to avoid unacceptable impacts on backcountry resources or adverse effects on visitor enjoyment of appropriate recreational experiences. In effect, managers must weigh recreational use against its associated resource impacts, implementing visitor management actions as necessary to maintain an acceptable balance. Direct regulations are both necessary and appropriate under certain circumstances, for example when recreational use threatens irreversible resource damage (camping in environmentally sensitive areas) or the safety of visitors and park wildlife (feeding bears). Additionally, McAvoy and Dustin (1983) cite self perception theory in arguing that direct regulations, in conjunction with indirect measures, can assist visitors in forming and internalizing attitudes and beliefs that support subsequent low impact behaviors.

Little formal data exists regarding the effectiveness of alternative management actions, although indirect actions are generally regarded as less effective than direct actions (Hendee et al. 1991, McAvoy and Dustin 1983). Perhaps the most significant shortcoming of NPS backcountry recreation management is that managers lack the means to evaluate the success or continuing need for implemented actions. For example, the accuracy and longevity of most campsite impact monitoring programs are insufficient to provide the data necessary for such analyses. Recent guidance provided by Cole (1989) and Marion (1991) may aid in the development of such programs. Monitoring can provide an objective record of resource conditions over time that permit early detection of problems, suggest effective mitigating actions, and enable evaluations of management action effectiveness.

Another fundamental shortcoming of NPS backcountry recreation management is that most parks lack a formal management framework to guide decision making necessary to balance recreational use and resource impacts. Several new frameworks evolved from and are currently replacing management approaches based on carrying capacities. Our survey revealed that an increasing number of parks are adopting these frameworks, which include the Limits of Acceptable Change (14 parks), Visitor Impact Management (2 parks), and the Carrying Capacity Assessment Process (1 park). The revised NPS Management Policies (USDI 1988) offers guidance to parks that, over time, should address these deficiencies: "The National Park Service will identify acceptable limits of impacts, monitor backcountry use levels and resource conditions, and take prompt corrective action when unacceptable impacts occur."

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TRAIL INVENTORY AND ASSESSMENT APPROACHES APPLIED TO TRAIL SYSTEM PLANNING AT DELAWARE WATER GAP NATIONAL RECREATION AREA

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Trail system planning and management require accurate assessments of existing trail resources and their condition. A standardized and efficient process for surveying, inventorying, and assessing trail systems was developed and applied in the Delaware Water Gap National Recreation Area. Two approaches employed were (1) a Trail System Inventory, and (2) Prescriptive Work Logs. These complementary approaches provide resource managers with valuable information regarding the location and length of individual trails, their current condition and needed maintenance work, and material and labor estimates necessary to conduct such work.

Introduction

This paper describes two trail inventory and assessment approaches developed and applied at Delaware Water Gap National Recreation Area (DWGNRA) in support of a comprehensive trail planning effort. The trail surveys and final report were developed by the Appalachian Mountain Club (AMC) Trails Program under cooperative agreement with the National Park Service (NPS)[1]. Here, we review the criteria used to select the specific trail survey approaches, discuss our application of these approaches, and critique the capabilities and limitations of the approaches. We believe the standardized, yet flexible, techniques applied in DWGNRA offer significant advancement over earlier, less structured approaches.

Trail System Planning in DWGNRA

The objective of natural resource management planning is to translate legislation, regulations, and policies into objectives, programs, and specific actions (Hendee and von Koch 1990). The trail system planning strategy for DWGNRA mirrored this process by translating DWGNRA General Management Plan (GMP) goals into specific trail resource recreation alternatives for visitors. To meet the needs of resource visitors and resource managers, the strategy for DWGNRA included: (1) identification of recreation interests, (2) identification of management objectives, (3) documentation of trail resources, and (4) prescriptions for correcting resource problems in light of recreation interest and management concerns. To be effective, this plan had to be flexible by design in order to address both current and future trail resource needs.

Approaches to trail system planning are selected according to management objectives, often derived with cooperative involvement of interested and involved individuals and organizations. The process adopted here is marked by the cooperation of an external organization in analyzing the suitability of trails to address recreation demands and concerns. The results of this effort are intended to feed a public review process.

Project Background

DWGNRA is managed by the NPS and is located in the states of Pennsylvania and New Jersey. Established along a 35 mile stretch of the Delaware River by an Act of Congress in 1965 as part of the Tocks Island hydroelectric project, DWGNRA today embraces some 54,000 acres of the nearly 70,000 acres originally circumscribed. Congress, as part of the Tocks Island Dam legislation, directed the Army Corp of Engineers to assemble a detailed set of maps for the area within the congressionally mandated boundaries. These cartographic documents provided a rich resource for this project.
The 1987 DWGNRA GMP called for the enhancement of day and overnight hiking opportunities, to be accomplished with the provision of an expanded trails network. The GMP specifically obligated DWGNRA to work with trail clubs and organizations in planning for expanding and maintaining the trail system. The AMC, though headquartered in Boston, met the NPS needs as a conservation and recreation organization with an organizational chapter located in the DWGNRA region. In 1975, the AMC had performed a study under cooperative agreement with DWGNRA (Appalachian Mountain Club). More significantly, in 1988 the AMC had completed a park-wide trail study for Acadia National Park in Maine[2]. In 1989 DWGNRA invited the AMC to complete a similar study of their trails.

Primary Goals of the Project

DWGNRA faced a situation common to many parks and forests: how to upgrade an existing, partially informal trail system in an organized manner when both the current conditions and viable options for improving the system are incompletely documented. DWGNRA intended to offer a trail system with a diversity of dispersed recreation opportunities, but required information to direct the necessary efforts in a cost-effective manner.

The primary goals of this project, then, were to:

1. Emphasize the protection of the existing and proposed trail system resources by identifying deficiencies, alternative engineering solutions, and visitor management actions.

2. Produce a report for DWGNRA containing documentation of the trail system's current status, options for future alignment, and estimated costs required to realize potential alignments. This report was intended to provide a preliminary set of recommendations for the comprehensive trail planning process.

3. Incorporate the objectives of the DWGNRA GMP wherever possible, especially those to: (a) provide a quality trail system that emphasizes a minimal disruption of natural processes while servicing a broad range of visitors, and (b) employ existing dirt roads, trails, and woods roads to the greatest advantage.

1/ Williams, Peter B.; Marion, J.L.; Rajala, R.R. 1992. A comprehensive trail inventory and preliminary recommendations for development and maintenance of a trail system in Delaware Water Gap National Recreation Area. Gorham, NH: Appalachian Mountain Club, Trails Program. 93 p. [unpublished].

2/ Williams, Peter B.; Rajala, R.R.; Martin, B.H. 1988. Acadia National Park trail system assessment. Gorham, NH: Appalachian Mountain Club, Trails Program. 69 p. [unpublished].

Selection of Inventory and Assessment Approaches

The cooperative agreement between DWGNRA and the AMC addressed the need to document existing conditions through a comprehensive trail resource inventory and assessment. The purpose for the report was to fuel a public review period, to provide a starting point for comments by managers and interested members of the public. To achieve these ends, two state-of-the-knowledge techniques for trail inventory and assessment were applied: (1) a *Trail System Inventory* and (2) *Prescriptive Trail Work Log* assessments.

Four techniques were considered (Table 1). Each approach has its own unique capabilities. Of the techniques applied in DWGNRA, a *Trail System Inventory* approach provides a broad description of the system as a whole, including the location, classification, and general features of individual trails. The *Prescriptive Work Log* approach, in contrast, catalogs specific features of a trail. Groups of trails may then be reviewed according to their features or deficiencies (e.g.: drainage needed in a local area, district, park, or forest). Originally, prescriptive work logs served trail maintenance purposes. The location of existing trail engineering features were catalogued along with any work needed to maintain those features. A modern prescriptive work log, however, fulfills management, as well as maintenance, objectives. Contents of prescriptive work logs completed in DWGNRA consist of observations oriented toward maintenance and management of the trail resource, oftentimes coupled with references to selected visitor management and recreation features (e.g.: viewsheds, camping potential, general parking availability). Such techniques can be modified according to a manager's need to obtain information for a variety of purposes, including maintenance, visitor interpretation, natural resource protection, or any combination. The information gathered by each of the two techniques selected for application in DWGNRA, then, was intended to complement the information gathered by the other.

Table 1. Four trail inventory and assessment techniques.

Technique	Purpose
Trail (System) Inventory	Identify and catalog the trail system's physical resources including surface type, location, or access opportunities. Often incorporates non-physical classifications such as ownership, type of use, or maintenance level.
Prescriptive Trail Work Logs	Identify trail tread deficiencies and prescribe tread engineering solutions. Adaptable to resource and visitor management purposes. Provides basis for cost and staff estimates and recommendations.
Research Level Measurements	Studies designed to understand processes such as relationships between visitation and resource degradation.
Monitoring Level Measurements	Monitoring resource conditions over time. Oriented toward measuring parameters documenting resource impacts rather than resource maintenance and management.

Monitoring and Work Log Approaches Compared

Of the four approaches outlined in Table 1, heaviest debate focused on whether to apply monitoring or prescriptive work log techniques to support the anticipated report's recommendations. Monitoring is done to measure physical changes to the environment resulting from an influential factor, typically recreational use. For example, soil loss occurring over a period of time may be measured. While monitoring might provide objective assessments of trail resource conditions, such measurements do not provide the information necessary to estimate the cost for repairing the effects or mitigating the cause of resource degradation. Yet, estimating these costs was an important management objective for the project. Further, monitoring is not intended to prescribe recommendations for addressing concerns about the resource or visitors, a primary goal of the cooperative agreement.

For this project, a monitoring effort would have yielded a description of the changes occurring as a result of recreation. A prescriptive work log approach, however, would yield a description of the recommended solutions to such physical changes. One final factor was considered: trail maintenance recommendations will vary according to the type and amount of existing or anticipated recreational use. In many ways, trail work is discretionary by its very nature; those who work on trails must make judgments concerning how best to remedy a perceived problem. The need for flexibility in describing trail maintenance recommendations became the crucial criteria for selecting an approach. Because prescriptive work logs originally were devised to document recommendations based on direct field observations, they are most easily adapted to provide information necessary for estimating costs.

Trail System Inventory: Methodology

Three objectives of equal priority guided the trail system inventory. First, the twenty-five year old Army Corps of Engineers maps required ground verification of all trails and roads features. Second, an inventory of the basic features of the trail system was to be completed. And, third, the cartographic data would be prepared for transfer to DWGNRA's Geographic Information System (GIS). Using the Corps' maps (1:400 scale) as a baseline, two surveyors were directed to hike all roads and trails appearing on the maps, confirm the existence and location of these features, and accurately locate any roads or trails not appearing on the maps. While hiking the system, the inventoried roads and trails were categorized according to NPS management classifications, access, ownership, surface, average width, and maintenance level. Scenic features, water courses, major maintenance needs, and vehicle barriers also were noted on the maps.

Trail System Inventory: Applications

The trail system inventory painted a broad overview of the entire system of roads and trails found in DWGNRA. From this baseline information, a preliminary trail system was selected during a consultation period involving NPS and AMC staff. This period of *intermediate evaluation* was built into the field schedule of the project. The prescriptive work log technique for assessing trails was applied to the trails comprising this preliminary system.

The GIS applications of the inventory data are perhaps the most beneficial. Access to high quality maps during the trail planning review process will encourage constructive criticism of the preliminary trail system's layout. Not all roads and trails inventoried in DWGNRA were selected for the proposed system. Only those that appealed to the perceived visitation demands and the indicated management objectives were selected. However, access to an accurate set of trail resource maps will better communicate the AMC's rationale for recommending the particular system found in their report. Also, computer generated maps will likely facilitate interpretive efforts, maintenance efforts, resource protection efforts, and resource management efforts, as well as search and rescue, and fire fighting operations.

A well formulated trail system inventory should remain applicable for many years. However, a new inventory of specific trails or areas, possibly with new parameters, may be necessary following the onset of natural disasters (extensive flooding or heavy snow-melt), introduction of a new form of recreation (mountain bike or horse use), or inauguration of new management directives (management zoning).

Prescriptive Work Logs: Methodology

Various forms of prescriptive work logs have been applied by agencies and organizations in diffuse regions of the country. Hooper (1988) describes a trail log format employed by the NPS, though this particular approach is considered to be a physical inventory separate from what Hooper refers to as a condition/ corrective survey. Prescriptive work logs have traditionally blended a detailed physical inventory with a series of corrective prescriptions intended to remedy any trail tread and alignment deficiencies observed along a trail. The AMC Trails Program has applied such assessments extensively for some fifteen to twenty years. Proudman and Rajala (1981) describe several methods for conducting prescriptive work logs. Recent incorporation of the capabilities of personal computer technology to store, analyze, and present information has made the prescriptive work log format even more useful than in the past.

For a prescriptive work log to be a reasonable estimate of a trail's condition, the individual conducting the survey must be accomplished in trail construction and design. Prescriptive work logs completed in the DWGNRA were compiled by an individual proficient with a wide range of trail work techniques and the many options for mitigating trail resource damage. In general, prescriptions for trail work actions should be the minimal necessary to stabilize the trail tread, should emphasize protection of natural resources, and should exhibit a clear understanding of the trail's role within the locally available recreational opportunities. Further, those who are compiling the surveys should be given clear understanding and directions regarding the intentions for the trail.

In DWGNRA, a format for prescriptive work logs was selected that relied upon pocket dictation device to record comments. These comments were organized by verbal reference to distances indicated by a five foot circumference trail-measuring wheel pushed along each trail. The wheel's counter displayed the distance from a starting point within six (6) inches by tallying five foot intervals to the nearest tenth of an interval. The location of permanent reference features such as stream crossings or conspicuous rocks was noted to facilitate accurate future location of sites requiring work.

The dictation notes were later transcribed and formatted on a computer word-processor. A standard format has evolved at the AMC (Example 1.). The work logs can then be printed and placed in a ring-binder for simple access. A well-documented prescriptive work log done in the Northeast will remain a good gauge of a trail's condition for roughly five to ten years, depending on the amount of recreation use, the form of that recreation, and any severe weather.

Example 1. Format of an AMC Prescriptive Work Log.

Project Title (if appropriate)

Trail: ADAM'S CREEK TRAIL
file name: "ADAMCRK.LOG"
pages: 12
Area: West of Rt. 209, north of Dingman's.
Date: Aug. 26, 1989
Synopsis: Containing a summary of the work log's highlights. Appropriate comments include trailhead information (sings, parking, access, etc.), safety concerns, natural features, basic geology (helpful for work crews), and major issues or problems associated with the trail.

1=5 ft	Comments	Work
006	[EX: information that a work crew would use to orient themselves or to find a work site, suggestions for installing the work, or dimensions of existing trail work.]	6' Water Bar, Right; install 20" ditch parallel to tread [in gully adjacent to road].
012	**ref.** trail traverses section of old road w/ stone wall, **Left;** terrain drops off down to creek, **Right;** no work needed.	
173	**ref.** remains of old jeep road joins from Left; 2 large red pines on ground	Install **5 Rock Steps** to harden 3-foot-deep gully.

The dictation method of recording prescriptive work logs has advantages and disadvantages. Occasional errors in handling the tape recordings do occur, and clear enunciation of concise comments is imperative. Furthermore, the dictation tapes must be transcribed, introducing another potential source of error. However, compared to the alternative of recording comments on paper forms, dictation devices have several advantages. The devices are more efficient in the field since they require only one hand to operate, as compared to taking notes on a clipboard. Further, notes on paper are more time-consuming to write and there is a tendency to be too brief. If a prescriptive work log is to be used as a document in a trail work labor contract, or is to be used by a field crew who is unfamiliar with an area, detailed descriptions of work locations are very important. Finally, dictation devices work well in plastic bags under wet conditions, allowing assessment of trail drainage problems at times when those problems are most obvious.

Prescriptive Work Logs: Applications

By following standardized procedures for recording comments, managers and their staff can assemble information in a format that facilitates field efforts and trail work planning. Managers concerned with allocating budgets and staff, and staff concerned with completing field projects, benefit from the information in prescriptive work logs, originally developed for specifically these purposes. In DWGNRA prescriptive work logs facilitated planning efforts by providing information about the proposed trail system's strengths and limitations. Prescriptive work log trail maintenance assessment figures for each trail were entered into a computer database and printed in a catalog format (Example 2). A database also permits managers to calculate labor and materials

necessary to complete the estimated work needed on a trail. Data from the prescriptive work logs completed in DWGNRA can effectively summarize the trail maintenance work required for a single trail or any selected grouping of trails. Additionally, prescriptive work logs are commonly used as a field guide for trail work contractors and cooperators.

Example 2. Format of an AMC Catalog Entry of Prescriptive Work Log Summary.

Project Title (if appropriate)

Trail Name:	**Adam's Creek**
Length:	**0.93 mi.**
Date of Log:	**Aug. 26, 1989**
Logged By:	**Name**

General Characteristics

Difficulty:	**moderate**
Existing use:	**Hiking**
Level of use:	**moderate**
Recommended use:	**Hiking**
Expected level of Maintenance:	**moderate**
Sensitive areas?:	**Yes**
Potential safety concerns?:	**Yes**

Maintenance Figures

Item	Total Feet	Units
Rock Steps	n/a	43
Log Steps	n/a	0
Step Stones	n/a	32
Ditching	6	1
Wood Water Bar	16	2
Rock Water Bar	0	0
Cribbing	75	1
Stream Bridge	0	0
Bog Bridge	0	0
Sidehilling	0	n/a

Comment:
Adam's Creek has several stream crossings. The streams are shallow, except in flood. Step-stones are needed to traverse somewhat deeper sections. Beyond the upper falls is a mill. A number of options are present for connecting the current trail with the mill area if this is desired. Additional route-finding work will be necessary to determine the preferred route. The south bank is recommended for accessing the mill. The north bank is steep and has more obstacles. Management decisions concerning use, type of use, local loop hikes, etc. should be made prior to the installation of this route.

Discussion

Trail inventories and prescriptive trail work logs offer managers a standardized, yet flexible, method for inventorying and assessing individual trails or entire trail systems. A consistent methodology for compiling information about trails enhances the capacity of an agency or other organization to manage those trail resources. This paper illustrates the application of two separate but complementary trail surveys which provided information vital to the DWGNRA comprehensive trail system planning process. The trail survey information formed the basis for AMC recommendations regarding the proposed DWGNRA trails system, including the type, extent, and cost estimates of the trail work required to fully establish the proposed system.

Trail surveys provide objective information about trail resource conditions and the capabilities of the trail resource to sustain various forms of recreation. Such information should be integrated with expressed public needs and views when formulating a final trail system plan. It is recommended that the results provided by trail surveys be presented to the public as background information supporting public involvement and review. Such input is viewed as critical to the design and implementation of a broadly accepted network of trails appealing to recreationists of all interests, whether hikers, walkers, horse-riders, or bicyclers.

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FEDERAL AGENCIES
U.S. Forest Service

CUSTOMER EVALUATION OF CAMPGROUND MANAGEMENT: HURON-MANISTEE NATIONAL FORESTS

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Customers gave high satisfaction ratings for seven campground management attributes. Friendly staff received the highest average rating. Correlations among attribute ratings, and written comments suggest that a friendly staff is associated with high ratings for a number of other important attributes. Preferences for increased development were mixed.

Introduction

High customer satisfaction ratings for each of the seven campground management attributes included on a customer satisfaction survey stand out in the responses of 120 visitors who were surveyed at Huron-Manistee National Forest campgrounds during summer, 1989. "Excellent" was by far the most common rating for each of the attributes, and there were very few responses in the "below average" or "poor" categories. "Friendly staff" and "safe and secure" received the highest average ratings, followed by "first impression" and "clean and in good condition." Other attributes were not far behind:

Table 1. Mean customer ratings of campground management attributes.

Attribute	Mean rating*
Friendly staff**	1.2
Safe and secure	1.2
First impression	1.3
Clean and good condition	1.3
Information	1.4
Fees were fair	1.6
Opportunities for family	1.8

* Based on excellent = 1, better than average = 2, average = 3, below average = 4, and poor = 5.

** For actual wordings of the questions a copy of the questionnaire can be obtained from the author.

Individuals were given the opportunity to provide additional comments on each of the attributes as well as general comments, and most did so. The full text of all comments is available from the author, and it provides good insight into the preferences of campers. The following summaries of each attribute were developed from those comments to help convey how individuals interpreted each question:

Friendly staff: Most comments referred to campground hosts and a few to concessionaires.

Safe and secure: Many comments referred to an absence of anti-social behavior such as thefts, loud noise, motorcycles, etc. Many mentioned that a person on site in a position of authority is a key to a safe and secure campground.

First impression: Most comments on first impressions related to the presence of hosts, the beautiful natural settings, and nice facilities.

Clean and good condition: Many comments referred to toilet facilities, pumps, and the condition of sites.

Information: Most comments related to maps and rules and regulations. Several suggested the desirability of maps of the area and nearby attractions.

Fees were fair: Those who thought that fees were high made comparisons with current fees for rustic campgrounds in State Parks.

Opportunities for family: Comments focused on facilities for children and sports activities.

There was a high correlation between "friendly staff" and "information," meaning that people who rated one of these attributes high tended to also rate the other high (and similarly for low ratings). Both of these attributes also had quite high correlations with "first impressions." These suggest that friendly employees provide information and promote a good first impression, something that a number of respondents noted in their written comments.

Selected comments about "first impressions" that point out the importance of "friendly employees:"

"our hosts have made us very welcome and we love it here"

"the host was a great help"

Selected comments about "information" that illustrate the importance of "friendly employees:"

"Mr. Gleason is tops"

"all handed right to us very clear"

Other comments about first impressions suggest that the setting and facilities also contributed to first impressions. Selected quotes from first impressions include:

"beautiful setting"

"love natural setting"

"like the large lots"

There was also a high correlation between "safe and secure" and "information." This is not surprising since the question about safety and security focused on the prompt and fair enforcement of rules and regulations; while the information question focused, in part, on the availability and understandability of rules and regulations. It would seem reasonable to expect a tie between clear information about rules and regulations and their subsequent enforcement. Perhaps friendly people working in a campground could also be expected to make users feel more safe and secure. This is apparent in comments such as the following:

"the man in charge gave us a feeling of feeling safe here - very pleasant"

"Chuck and Norma do a wonderful job of running this campground. The rules are enforced and it is a very peaceful place"

Comments on the questionnaires stress the importance of having a person on site to enforce rules and regulations and prevent anti-social behavior such as loud noise, driving through at night in vehicles, and using fireworks:

"Yes (feel safe and secure); but not without our hosts enforcing it"

"A park like this needs a host, or motorcycles would be running up and down the park road all the time"

Campground hosts received considerable praise for their work in providing a safe and pleasing environment, as did concessionaires. Some users mentioned a desire for more of a uniformed presence such as a "ranger." Many comments noted that a breakdown in control at a campground leads to major problems for users. Discussions with Forest staff indicate that one of the sites, which provided nearly half of the interviews, had previously been heavily used as a "party spot" until a concessionaire set up operations at the entrance and maintained tight control over the traffic flow and inappropriate behavior. The concessionaire maintained close personal contact with the campers. The fairly high correlation between cleanliness and safety also suggests that a clean and well-maintained campground suggests a safe and secure environment where rules are enforced. The high ratings for "safe and secure" and the written responses suggest that the campers generally feel very safe and secure in the campgrounds where they were surveyed. For example:

"felt secure in leaving camp unattended while running to store, etc."

Satisfaction with fees was not highly correlated with satisfaction with other campground attributes; but in all instances the correlations were positive, suggesting that individuals were more likely to be satisfied with fees if they were satisfied with other aspects of the campground. Fees had their highest correlation with "opportunities for family," suggesting the importance of these opportunities to respondents. Individual comments on the questionnaire indicated that many respondents associated "opportunities for family" with additional developments in the campground or adjacent areas. Since the question focused on whether the campground and surroundings provided "recreation opportunities for the entire family," many respondents suggested playground equipment and related facilities for children -- particularly at Round Lake. Others suggested higher levels of development to include showers, dump stations, electricity, etc. The correlation between fees and "opportunities for family" may also be attributable to a tendency to set campground fees according to level of development i.e., higher charges for sites with electricity, dump stations, etc. For example, the following comments that were provided on the fees question:

"State Parks get $4.00 for rustic campsites"

"For $6.00 a night we should at least have electric"

Variations by Site

Data were available for seven sites; but only the five that had 9 or more observations were included in the analysis of variation among sites. The number of observations per site at these five facilities ranged from 9 to 56. Due to the small number of responses, subsequent discussion is limited to the individuals interviewed and should not be extrapolated widely.

Round Lake (57 observations) ranked higher than the other five sites in "clean and good condition,", "fees were fair," "friendly staff," "information," and "safe and secure." It rated a close second in the other two categories of "first impression" and "opportunities for family." Old Grade (11 observations) fared the worst of the campgrounds, ranking last in all attributes but "safe and secure." It was not possible to explain the differences in ratings between the two sites on the basis of the comments given by respondents, other than to note strong support for the new concessionaire/host at Round Lake.

Levels of Development

Individuals interviewed at Round Lake were asked an additional question concerning the appropriate level of development for that campground. They were asked to respond "yes" or "no" to the following question: "Do you feel this campground would be better served with additional facilities such as electricity, showers, etc.?" Responses were divided almost evenly between the two choices (28 "yes" and 27 "no."). Illustrative responses include the following:

"we would love to see electricity at least"

"dump station and a small playground for kids"

"keep it like it is"

"putting in those would take away from what people want to get away from"

Those who opposed the additional facilities often mentioned a desire to keep the rustic nature of the campground, and one who supported the developments qualified their support with the comment "providing the current rustic atmosphere was kept." Opponents of upgraded facilities also mentioned that there were other campgrounds available that provided such developments. Some who said "no" to the developments cited the small size of the campground. Ten respondents who were in favor of additional facilities also mentioned a need for a dump or pumping station for RVs. Some also mentioned the need for an upgraded water system and playgrounds.

Summary and Conclusions

Subsequent discussion focuses on implications for management and research:

Management

Customers reported high levels of satisfaction with the management of campgrounds. They were most satisfied with friendly staff, safe and secure environment, and their first impressions; but the ratings for clean and good condition, information, fees, and opportunities for the entire family were quite good. For example, although "opportunities for family" received the lowest average rating, half of the respondents rated those opportunities as "excellent."

Friendly staff not only received the highest average rating; but correlations with other attributes and written comments suggest that a friendly staff is associated with good information, a safe and secure campground, and good first impressions. This underscores the association between a friendly staff and a high-quality camping experience.

While limited data restricted comparisons among sites, there is some indication that Round Lake provides higher quality experiences than the other sites, particularly Old Grade. The reasons for this appear to be attributable to a particularly good concessionaire and host.

Respondents at Round Lake were almost evenly divided in their support for "additional facilities such as electricity, showers, etc." The issue appears divided along the dimension of a primitive environment vs. high levels of facilities. It points out the need to provide for a range of camping experiences in the National Forests.

Research

The written responses provided useful insight into the ratings and sound recommendations for management. It appears useful to include them on subsequent evaluations of customer satisfaction.

The small number of responses limited comparisons among sites and it was surprising that written comments did not help to explain differences in average ratings between sites. Subsequent efforts might involve additional respondents and might inquire directly about the difference between the site

where the individual is located and other sites that they have used or know about. For example, "What do you like most (or least) about this site in comparisons with others that you use or know about?" or perhaps "What would have to be offered at another site in order to induce you to use it instead of this one?"

The camping experience is also influenced by the setting in which the campground is located, including the local landscape and nearby opportunities for recreation. Questions about these attributes might provide useful guidance for locating subsequent campgrounds or managing areas around them.

A number of comments about facilities for the entire family and the desirability of additional facilities such as electricity and showers mentioned the "image" of a National Forest campground. Perhaps subsequent studies could explore the "expectations" or "image" held by the public for National Forest campgrounds.

Individuals express their evaluations of campgrounds and campsites in their choices of places to camp. Much could possibly be learned by evaluating the use patterns of sites and campgrounds or presenting individuals with hypothetical choices of campgrounds and campsites and evaluating their responses. The use of hypothetical choices enables the evaluation of settings that do not currently exist and also makes it possible to evaluate the preferences of those who do not currently use National Forest campgrounds.

URBANITES' AWARENESS AND USE OF SIX LAKE STATES NATIONAL FORESTS: A SPATIAL ANALYSIS

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Awareness and use of six Lake States National Forests decreases with distance from a Forest, number of Forests that are closer to home, and crossing a state line. When these distance-related variables are accounted for, awareness and use of the Superior National Forest is higher than the other Forests.

Introduction

Recreation managers of National Forests and other public lands are increasingly interested in developing marketing strategies that will help them serve the public most effectively. The USDA Forest Service's National Recreation Strategy identifies a range of marketing information needs that outdoor recreation research can help meet (Dwyer, 1990). An important first step is identifying the existing and potential customer base so that marketing programs can be targeted. For example, National Forests in the Lake States and other regions in the U.S. often exist in relatively close proximity to one another, in some cases side-by-side divided only by a state line. What factors influence people's awareness and use of different forests? Basic information like this is needed before an effective marketing program can be implemented.

This paper examines awareness and use of National Forests in the Lake States by those who live in selected urban centers within the region. Urbanites constitute a major customer base for forest recreation, and the concentration of existing and potential customers in urban areas is an important consideration in any marketing effort. But while on-site recreation surveys consistently reveal a strong base of satisfied urban customers, very few studies have looked at general samples of urban users and nonusers. Thus little is known about how the general urban public perceives forest recreation opportunities.

Methods

A random sample of residents in four major urban centers (Duluth, Minneapolis/St. Paul, Green Bay, and Milwaukee) were surveyed by mail. In one section of the survey, individuals were asked if they were aware of or had ever used any of six Lake states National Forests; the Superior, Chippewa, Chequamegon, Nicolet, Hiawatha, and Ottawa. Respondents were considered to be "aware" of a Forest if they had ever visited or "knew of but never visited" the Forest. There were approximately 200 respondents in each of the four urban centers.

This discussion focuses on awareness and use of the six National Forests by respondents in the four urban centers, a total of twenty-four origin-destination pairs. The percent of respondents from each origin who reported that they had heard of or visited individual Forests is presented in Table 1. Travel distance between each origin-destination pair was calculated from road maps and represents the actual road distance from city centers to the nearest point on the Forest (Table 2). Data were also gathered on whether a state line must be crossed during the trip as well as the number of Forests that were closer to the origin than the destination Forest. While the limited number of observations (24 origin-destination pairs) restricts the analysis, some insight into awareness and use of Forests by urbanites can be gained from analysis of the data.

Results

A state line separating a city from a Forest reduces awareness and use of a Forest more than travel distance or the number of other Forests that are closer to the city. The significance of state boundaries appears to reflect barriers to information and the increased cost of out-of-state hunting and fishing licenses.

Individuals may be less aware of Forests in other states since most tourism promotion is done by the state, and National Forests may not be featured in efforts to draw individuals from out-of-state. Information dissemination programs of individual Forests may contribute to this pattern as well.

The need to cross a state line was a significant explanatory variable for individuals who reported that someone in their household had hunted or fished in the past three years, as well as for individuals who reported no hunting and fishing activity. However, a state line was a significantly greater barrier to use for individuals from households where someone had hunted or fished. This suggests that the need for hunting and fishing licenses explains part, but not all, of the role of state lines in travel behavior.

The effect of a state line on levels of awareness and use is illustrated by the Chippewa and Chequamegon National Forests. These two forests are about the same distance from Minneapolis/St. Paul; but the awareness level of the Chippewa for this urban center is 37 percent higher than the Chequamegon, and the percent reporting that they visited it is 19 percent higher. Our analysis suggests no significant differences in the reputation and attractiveness of the two Forests, so much of the difference might be attributed to crossing the state line between Minnesota and Wisconsin. Similarly, the Ottawa is only slightly farther from Milwaukee than the Chequamegon; but its levels of awareness among Milwaukee respondents is 33 percent lower than the Chequamegon and the proportion who have ever used it is 32 percent lower. Much of this difference might be attributed to the need to cross the state line from Wisconsin into Michigan in order to reach the Ottawa.

Once distance, state lines, and closer forests are accounted for, there are still differences in levels of awareness and use of the six National Forests. The awareness of the Superior among respondents is 25 to 41 percent higher than the five other Forests, and the percent of respondents who had ever used it is 18 to 27 percent higher. Also, there is an unusually high level of awareness of the Superior National Forest among people who live 400 or more miles from the Forest, even though few of them actually visit it. The popularity of the Boundary Waters Canoe Area Wilderness as a destination, along with the controversy surrounding its establishment, management, and use may have brought significant publicity to the Superior. The Superior is also two to three times larger than the other Forests, which most likely adds significantly to its awareness and use. There did not appear to be significant differences in reputation and attractiveness among the five other Forests.

The high levels of awareness and use of the Superior National Forest are illustrated by respondents from Minneapolis/St. Paul. The Superior is farther from Minneapolis/St. Paul than the Chippewa; but the awareness level for the Superior is 19 percent higher and 27 percent more of the respondents reported that they had ever used it. Much of this difference can be attributed to increased reputation and attractiveness of the Superior. Similarly, the Superior is also farther from Milwaukee than the Chippewa; but 30 percent more of the Milwaukee respondents were aware of the Superior and 23 percent more had used it.

Table 1. Percent of respondents who were aware of or have visited a National Forest, by urban center.

NATIONAL FOREST	Duluth		Minneapolis/ St. Paul		Green Bay		Milwaukee	
	% Aware	% Used	% Aware	% Used	% Aware	% Used	% Aware	% Used
Superior	99	83	98	66	78	25	77	26
Chippewa	83	45	79	39	46	6	47	3
Chequamegon	67	27	42	20	88	44	73	44
Nicolet	25	3	27	8	96	77	87	62
Hiawatha	27	5	19	8	49	19	40	12
Ottawa	24	5	19	4	45	17	40	12

Table 2. Distance to National Forest from urban centers, in miles.

NATIONAL FOREST	Duluth	Minneapolis/ St. Paul	Green Bay	Milwaukee
Superior	61	198	403	497
Chippewa	102	176	454	463
Chequamegon	50	181	163	275
Nicolet	196	294	52	181
Hiawatha	521	455	130	259
Ottawa	233	316	155	284

Before discussing implications of the study, two possible problems with the data must be explained:

1) The average levels of awareness and use presented in Table 1 appear to be unusually high. Part of the reason may be that individuals who were aware of or had used the National Forests were more likely to respond to the questionnaire -- 70 percent chose not to respond. The questionnaire cover boldly referred to "YOUR NATIONAL FORESTS" with a drawing of a densely forested setting as well as symbols for a wide range of outdoor recreation activities. This report focuses on differences in average levels of awareness and use across cities and Forests. These differences are not influenced by the "response bias" unless there is a tendency for a different segment of the population to respond in each of the urban centers or about each of the Forests. We do not think that this is the case.

2) Information was not available on distance to other comparable opportunities on areas administered by other agencies (i.e., state and county parks or other Federal facilities). The lack of this information will influence the results to the extent that these other opportunities are substitutes for experiences on National Forests, and their availability is correlated with other variables in the analysis. For example, if with increasing distance from an urban area there are increasing numbers of state and local parks that can substitute for National Forests. We suspect that the problems from not considering these areas are not great; but perhaps individuals working on specific Forests have some insights here.

Implications for Management and Use

Within the Lakes States region, urbanites' awareness and use of National Forests appears to be strongly influenced by state lines, travel distance, and the number of National Forests closer to their homes. The close relationship between these three distance-related variables made it difficult to attribute variations in people's knowledge and use of the Forests to any single cause. However, it is clear that state lines act as barriers to knowledge and use of Forests for people who live outside the state. When distance-related variables are accounted for, residents of the four urban centers do not differ in their awareness and use of the Forests; but among the Forests the Superior has a significantly higher level of awareness and use. This may be due to the large size of the Superior (two to three times the size of the other Forests) or its reputation, including that of the Boundary Waters Canoe Area Wilderness.

The analysis calls for careful consideration of (1) the reasons for the particularly high levels of awareness and use of the Superior (beyond size and the BWCA), and (2) the nature of the apparent barrier to awareness and use associated with state boundaries. The reasons for the generally higher levels of awareness and use of the Superior National Forest may provide a useful guide for efforts to increase the awareness and use of other Forests.

The significance of state boundaries may have important implications for marketing strategies that target urban centers with information programs about a Forest. If it is a matter of information flows, then perhaps efforts to increase awareness and use of Forests across state lines could take a regional approach to information dissemination. However, if fishing and hunting licenses or other barriers are important, regional information programs would probably be ineffective. Very different strategies, such as reciprocal licenses, would be needed to expand the market area of individual Forests beyond the state in which they are located.

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MEASUREMENT and MODELING

THE ANATOMY OF COMPLEX DATA: THE UNDERLYING STRUCTURE OF QUESTIONNAIRES AND FORMS

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Information about people's behaviour has a structure underlying it which is lost when the information is captured in traditional surveys and analyzed using traditional computerized statistical packages. Important conceptual errors arise in the analysis as a result. By using an entity-relationship approach to data, these errors can be avoided.

The Problem with Questionnaire Data

When conducting a visitor survey in a Canadian national park, you typically intercept parties exiting a park or facility, and apply questionnaires to members of the party. You may ask them about activities participated in , and how satisfied they were with their experiences of these activities. At the end of the day, you have collected a number of records which have data on a variety of things such as the time and location of the interview, the number in the party, trip purpose, sex of respondent, activities participated in and satisfaction scores for each of them. (Although not obvious at first, you end up with the same kind of record set when you gather information on a form to register a party into a campground. Everything said here about a questionnaire applies equally well to an administrative form.

In both cases, the collection of data seems quite straightforward. Yet there are a number of problems that lurk beneath the placid surface of this example.

Typically, you capture this data for analysis in a computer by putting it into a table with each record (each questionnaire or form) being a row of the table, and each variable being a column or field. This table will have to have columns or fields provided for each of the activities you can potentially ask about. Figure 1 illustrates such a record layout and gives an example of a record. Here the row is arranged vertically because of space limitations, but typically it is horizontal. If there are twenty activities in the park, your record is going to have to contain twenty fields to hold the satisfaction scores for the activities and twenty additional fields for any of the other variables you might want to collect about the activity. No one, of course, is expected to do all twenty activities, so there are going to be a lot empty spaces your data set. Similarly, your questionnaire is going to have to have to list the same number of activities if you are going to record this data.

Now, what happens when a respondent comes along who has participated in activity number 21? You have to leave it out, or anticipate an "other" category. what if there are 200 possible activities? Your questionnaire and your record layout start getting rather long. You could, of course, just record "first activity," "second activity," and so forth, but you still have to anticipate the total number of activities respondents are going to answer, or you are going to let them answer, and set aside that space in your record layout. And you are going to have some complicated data manipulation to do if you wanted to sort the data according to a specific activity.

You have stopped a party, and you ask one individual about his or her activities, What if you want to ask the second, and third individual in the party about their activities, which could be quite different" You have to anticipate more record space and a longer questionnaire. Alternatively, you could capture your enquiry on a second and third questionnaire, and lose the information about the partly, or have to repeat it, adding risk of error by duplicating the information incorrectly.

VARIABLE NAME (field name)	TYPICAL RECORD
QUESTIONNAIRE ID	321
TYPE	ip
LOCATION	main gate
STINT	11 am
PARTY SIZE	3
LAST EXIT	yes
TRIP PURPOSE	4
SEX OF RESPONDENT	m
OVERALL SATISFACTION	4
ACTIVITY 1 PARTICIPATED	no
NUMBER OF TIMES	.
SATISFACTION	.
ACTIVITY 2 PARTICIPATED	no
NUMBER OF TIMES	.
SATISFACTION	.
ACTIVITY 3 PARTICIPATED	no
NUMBER OF TIMES	.
SATISFACTION	.
ACTIVITY 4 PARTICIPATED	no
NUMBER OF TIMES	.
SATISFACTION	.
ACTIVITY 5 PARTICIPATED	yes
NUMBER OF TIMES	1
SATISFACTION	5
ACTIVITY 6 PARTICIPATED	no
NUMBER OF TIMES	.
SATISFACTION	.
etc.	
etc.	

Figure 1. Typical record layout.

That is one good reason why we rarely interview every member of a party individually, and why we develop simple activity lists. The use of traditional questionnaires and record layouts has a lot of influence on the kinds of information we gather and analyses we undertake.

Our problems do not stop there, however, We recorded information about the interview, the party, the respondent, and his or her satisfaction with activity five all in the same record. Now, there is nothing to stop an analyst from creating a query which relates data about the party to the satisfaction with activity five. But the party did not do activity five, the respondent did. Even if other members of the party did activity five, we do not know if they shared the respondent's level of satisfaction with it.

It gets worse. Our analyst now takes the information about the party's satisfaction with activity 5, combines it with other information about parties, and uses it to project the amount of use activity 5 will get over the next decade; then he recommends a multi-million dollar investment in facilities to support activity five, because of high use levels...a costly mistake.

Of course, such an elementary mistake as using individual data and applying it in a party context is not likely to be made by an experienced researcher. However, it is often the case, at least in a large organization like the CPS, that an analyst (who may not be experienced) comes upon the data a year later, without a lot of context knowledge about how the data were gathered. There is

nothing inherent in the data structure to prevent him or her from making the mistake just described. On the contrary, the data being all on one line encourages him to think that any of the variables can be related to any others.

Underlying Structure

Figure 2 presents an alternative way to view the structure of the data in our example. Here each datum collected hangs on the branches of a tree like leaves. The first branch on the left captures the idea that there is an interview, which has certain characteristics such as time, location, and methodology (say to identify which of several standard ones is being used) and, of course, some sort of unique identifier such as a serial number. These "characteristics" we call attributes or the interview.

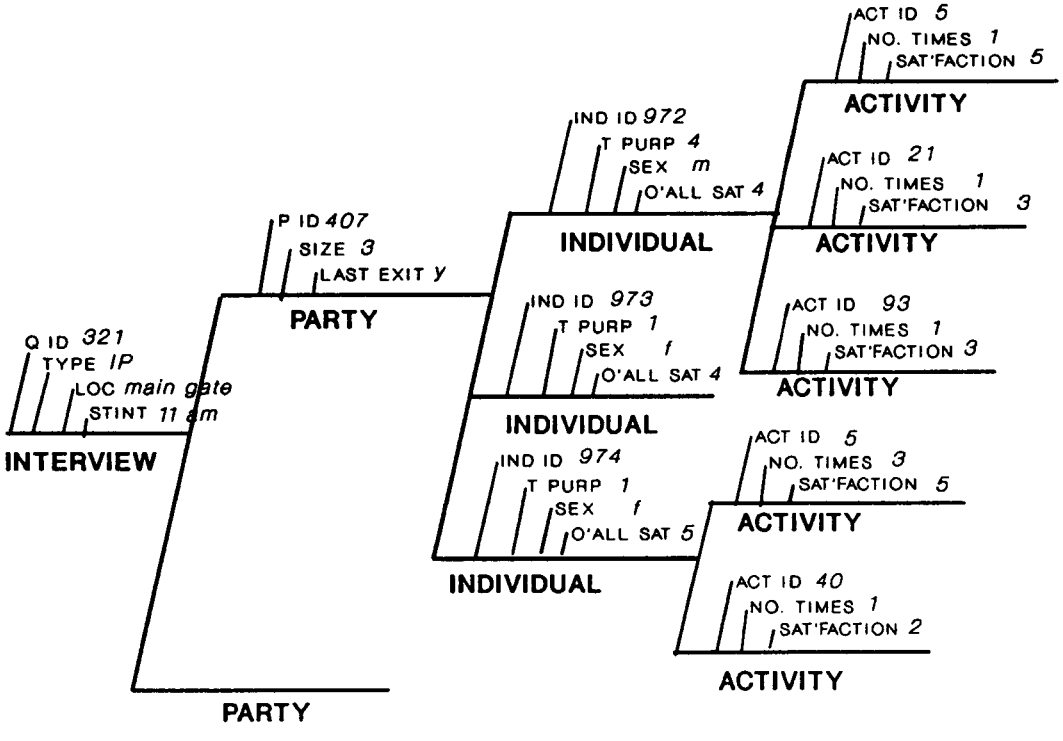

Figure 2. The underlying structure of the data.

In order to conduct the interview, the interviewer has to stop a group of people. There is the possibility that the group stopped, which is normally a party, is in fact several parties (e.g., traveling together by chance in a mini-van). The branching allows us to reflect this, by showing that we can display attributes of as many parties as we find. However, we typically find only one party, so other branches are not elaborated in this example.

We see the same logic at the next branch, where we reflect that there are several individuals in the party we have stopped. Branches can be added vertically to illustrate as many individuals as it takes to describe our party. And each branch displays the attributes of the individual that we had chosen to collect: trip purpose, sex, overall satisfaction, and an identifying number.

If you examine this structure overall, you can see that it illustrates the answers to a single questionnaire, or, in terms we were using in Figure 1, a record. Traditionally, the record would have been stored as a series of fields in a single line. The number of individuals in the party, the number of activities an individual practiced, even the number of parties in an interview, would all have to have been anticipated and built in. With this branching structure, another individual or activity can just be tacked on the bottom of its branch. This structure, unlike the table in Figure 1, does not get longer. However, when necessary, the branches get deeper.

The second thing to notice about this structure is that it handles answers in two different ways. For questions that can have only one answer (sex of respondent, party size), the answer is displayed on the branch as an attribute. For questions that can have more than one answer at the same time (what activities did you participate in, who are the individuals in our party), the structure sprouts another branch. This is crucial. Every multiple answer question must create another branch or you are back into the problem of elongating your record length. Note however, that you can ask the multiple answer questions in as single answer way, and avoid branching (e.g., "How many activities did you participate in?") "How many people were in your party?" are both questions that have a unique answer.) They net you a lot less information than if they were asked as multi-answer questions, but that information might well not be useful for your purposes, so you have lost nothing.

The third thing to note is that some attributes are more appropriate on some branches than on others. You can ask sex

of an individual, but it makes no sense to ask it of a party. By the same token, you can ask trip purpose of an individual. It might appear that a party can have a trip purpose, but the fact that the structure recognizes the party as different from the individual helps reveal that the party which has a common trip purpose is only a special case where all the individuals in the party happen to have the same trip purpose. There is no necessity that this should happen.

More subtle is the case with satisfaction. Parties do not express satisfaction, individuals do; but when they do, the satisfaction expression that they give is either attached to their own branch (it is a satisfaction with the overall visit) or they express several satisfactions. If the express several satisfactions, all of them cannot be displayed on the individual's branch, they must be displayed on the activity branches.

Capturing the Structure in an Automated Data Base

But so what? We can draw a diagram on paper and pretend to model the data, but when we go back to the computer, the statistical package still seems to demand that we put it all in a table. And if we want these questions to occur on a questionnaire, or in a form, we have to give the respondent enough boxes to put down all his possible choices; we still have the problem of listing the 20 activities only to have a visitor arrive having done activity 21.

There is, however, another way to organize the data, using an entity relationship model (Beaman 1985). An entity relationship model breaks the data into a series of tables, instead of as a single, large table. Each smaller table refers to a single "subject" or entity. Long records in a traditional data set contain many "subjects" (e.g., description of interview, party characteristics, individual characteristics) linked by the fact that they are in the same record. Entity relationship tables link their subjects explicitly by keys, or identifiers in each record which tell the user which data in one table goes with which data in another table. This approach gives us the flexibility we need to capture the tree structure of Figure 2.

Figure 3 shows that each of the branches becomes an entity, or separate table. The attributes of each branch become the fields of the table. In this way, if we add an individual, or an activity, we are just adding another row to a table, not changing the structure of the records themselves. The points at which the branching takes place are stored as keys. For example, if individual 972 (his key) participated in activities 5, 21, and 93, the lines on which those activities were stored in the activities table would also contain the individual's key, 972. This is, of course, a very superficial explanation of entity-relationship modeling, but it is beyond the scope of this paper to go further. The feasibility and power of storing data in ways like this can already be seen in some applications that constitutes variants on the idea presented here (see for example Jaro, 1989, Lewkowicz 1989).

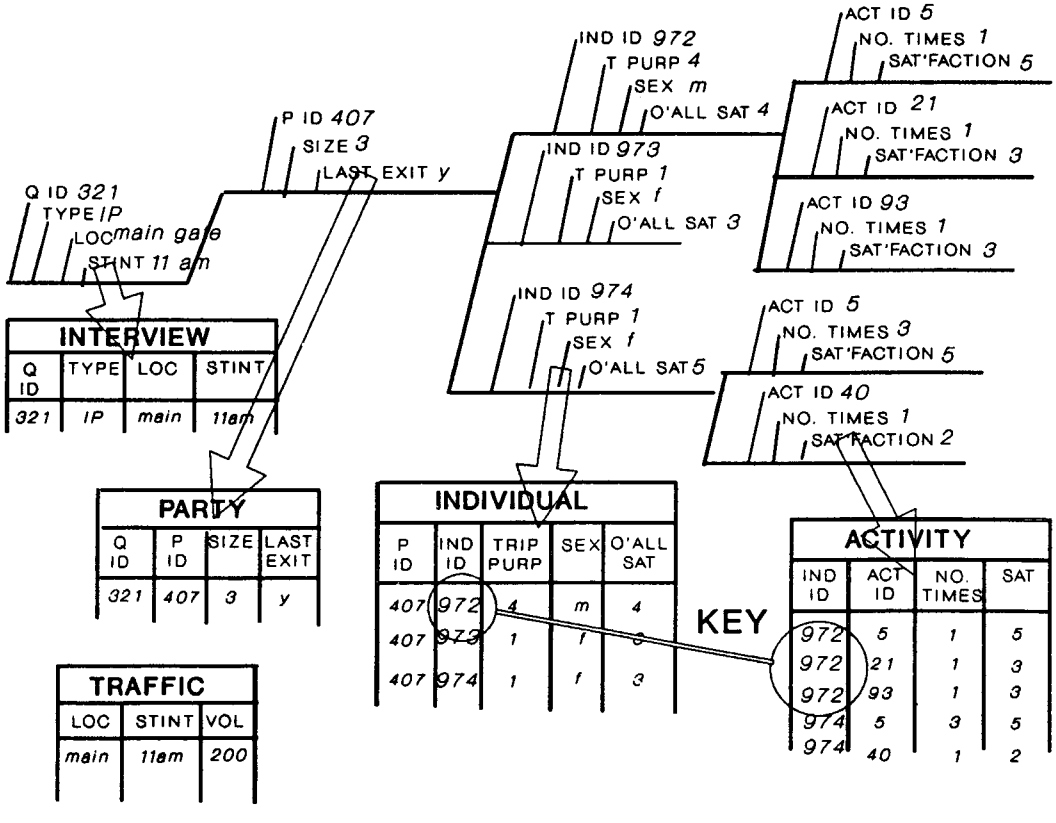

Figure 3. Transforming the tree into an entity-relationship data base.

With a set of such tables, properly keyed, I can reconstruct any record just as I could with the tree. Figure 3 shows how I can identify individual number 972 and his three activities, which party he belonged to, when he was interviewed, and so on.

I can reconstruct a record, add an unanticipated activity, or handle more than the foreseen maximum number of individuals to the record without destroying any record structure. I can support open-ended lists of activities. Of course, the open-ended character of the data base is best exploited by computer aided questionnaires. If I add an activity, it would be nice if it came up on my prompt list the next time I asked the question. If I used a pre-existing list of activities, it would be nice if I didn't have to recreate it on the questionnaire, but merely have the computer go and get it for the prompt list.

I can even get my prompt list of activities from some other, official list, or from a standard list used for some other purpose, if I am interested in corporate data consistency (which CPS ought to be). This is an extremely important feature. Inconsistency in coding from one data collection to the next makes it very difficult to combine data from different sources. As a result, organizations collect enormous amounts of duplicate information. Using official lists as coding lists ensures that financial, administrative, socio-economic and other forms of data are all collected on a consistent basis and can all be easily combined (Beaman and Grimm, 1989).

I can incorporate independent data sources into my data base. Take the example of a sampling weight. To calculate a weight for my record in the traditional table, I have to find some data on the size of the total universe which passed by the intercept point and calculate the sampling fraction. The I have to enter this ratio into each traditional record as a new variable, probably called WEIGHT. The raw data is lost.

In an entity relationship mode, if I have recorded stint as an attribute of the interview in the interview entity, and if I have data by stint from a traffic counter, I merely have to take the attribute stint as a key (since it occurs in both entities) and I have all the information I need to calculate the weight built into the data base. I still have to calculate the weight for each record when I come to do the analysis, but I do it each time from the raw data in the original source. There are two advantages of this. First, I know where the data to calculate the weight came from, so I know how the weight was calculated, even if I return several years after the survey. In a traditional structure, I have as a weight a single number and it is no longer clear where it came from. Second, if the universe count is corrected later, my data do not become obsolete. The weights are calculated from original data each time I do analysis, so my weights are automatically corrected for the new universe data.

This essentially means that whole tree structures (see Fig. 2) can intersect. I can combine the information from two questionnaires or a questionnaire and a number of forms. In fact, the tree structures are not unique. The data managed according to an entity-relationship model can be combined in any number of ways, depending on your analysis needs. trees are not unique. However, the combinations are not infinite, but limited by the relationships between them (the keys); that is, the combinations are constrained by the logic of the model. Users are protected from error.

I can incorporate data from different sources just by finding the right key; I can also reuse entities. This has important consequences for building up a corporate data base, and for making the development of questionnaires easier. Once I have entities defined, I can use them as building blocks for future surveys. This ensures that from survey to survey I am building up a corporate data set. I may not want to do exactly the survey that my colleague did in another park. However, I probably want to explore many of the same concepts. So I can use many of the same entities. In fact, I have an advantage even in using the same questions. The corporate data base gets augmented without my having to produce exactly the same survey, since the new information I gather can increase the tables that already exist, and any new questions that I ask create some new entities. These are all available to the next analyst that comes along without him having to know how the survey was done.

If entities can be reused, so can attributes. Just as we related certain attributes to one entity and not to another, because it was not logically valid to do so, we can define a set of logically appropriate attributes for each entity, so that any future user of that entity can have a choice of logically valid attributes. He does not have to use them all, but he is helped in his use because he is offered choice of only what is sensible to use. This is the concept of a context set; that is, the set of all attributes which are logically consistent with the entity and so are available to use. It is called a context set because it provides the complete set of measures which any specific implementation of the entity is made up of.

Reusing entities also implies that data for entities can come from sources other than a questionnaire, such as an administrative form. Cotter (1992) has described the use of automation to register campers, thus creating a base of information about camper characteristics, length of stay, preference for types of campsite, and equipment type. These things are captured as part of regular administrative processes, and so add no cost or burden to research. However, they are in fact information that would normally require a survey to collect. Even better, they are often census data, and this fact can be exploited to leverage sample data, such as using it for weighting or recognition of bias. By using entity relationship data base models, it is possible to exploit this source of data to supplement research efforts, and in certain circumstances to eliminate it all together. This solves the problem of open-ended lists and record layouts, but does it solve the analysis problem?

The Analysis Problem Solved

Most of the problems of analysis arise because we confuse what variables can logically go together. For example, we relate satisfaction to parties or participation in activities to parties, because the party, individual and activity information is all in the same record. It is easy to ask for data on satisfaction by party characteristics, and nothing will indicate how wrong that is. If the data is stored in an entity relationship structure, this query is much harder to do. In our example, satisfaction scores are stored in a table called activities, which does not contain any information on parties. It does, however, contain information which points to the individuals who did the activities (the key). Therefore, it is relatively easy to relate satisfaction scores to the characteristics of individuals, and quite difficult to formulate a query which relates those scores directly to parties without going through individuals. The structure of the data contains the logic of he phenomenon being studied.

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SYSTEM DYNAMICS MODELING OF RECREATION SYSTEMS

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Interactive system dynamics computer models are useful to recreation researches for a wide variety of problems ranging from forecasting to impact assessment. This paper describes how problems of recreation and resource use can be understood from a dynamic point of view. Stress was primarily placed upon explanation of causal structure, using the System Dynamics approach to simulation and implementation of models for decision making and education.

Introduction

We live in a world of rapid change. This particularly significant for recreation systems analysis because of the strong interactions between recreation and the rest of society. The purpose of this paper is to describe the construction, refinement and application of interactive system dynamics computer simulation to model recreation system to assist in research and decision making efforts. It also demonstrates how these models can be used as graphic educational tools to facilitate the understanding of complex relationships in recreation systems.

The Concept of System Dynamics

System Dynamics was developed at the Massachusetts Institute of Technology in 1956 by a small group of modelers led by Professor Jay Forrester, who set up the first System Dynamics program at M.I.T.'s Sloan School of Management. The method is aimed at providing a distinctive set of easily usable tools which might be used by system owners, rather than just analysts; centered on a very generic set of building blocks which are universally applicable.

The purpose in applying System Dynamics is to facilitate understanding of the relationship between the behavior of a system over time and its underlying structure and strategies, policies and decision rules.

In summary, the System Dynamics method:

1. searches for the conscious or unconscious goals of the system and for the related feedback processes associated with specific problem behavior.
2. specifies the complex dynamics associated with situations where goals cannot be reached or are in conflict.
3. follows the flow of information and the processes involved in decision making and policy setting.
4. frequently deals with feedforward processes, in which people attempt to forecast the future in order to act in the present.
5. is sensitive to the impacts of lags and delays in decision making for the system as a whole.
6. represents non-linear as well as linear relationships among the variables in the system to make the model as realistic as possible.
7. uses computer simulation techniques to model system problems.

The Model

The major use of a System Dynamics diagram is to identify information feedback loops which have been created by linking resource and information flows. It is the analysis of such loops which facilitates understanding of how the process, organizational boundaries, delays, information and strategies of systems interact to create system behavior. The contribution of feedback loops to system behavior depends primarily on whether they are positive or negative.

Influence diagrams facilitate identification of whether a feedback loop is positive or negative. The rule for this that if the net effect of all individual influence links in a feedback loop is negative, then the whole loop is negative. Conversely, if the net effect is positive than the loop is positive. The net effect can be obtained by multiplying together the signs of the individual influence links.

A simplified feedback loop diagram of the model is present in Figure 1. To clarify the discussion of the model, the diagram is divided into five subsystems: (1) infrastructure subsystem, (2) superstructure subsystem, (3) recreation resources subsystem, (4) management subsystem, and (5) visitor subsystem. These subsystems are briefly discussed in the following sections.

Infrastructure Subsystem

Infrastructure capacity will increase due to investment and will decrease due to depreciation. The investment of infrastructure depends on accessibility, load index and development plans. The first mechanism is the existence of a negative feedback loop outlined in Figure 1.

Superstructure Subsystem

Increasing visitors would increase user rate(i.e. visitors/ superstructure capacity). Thus, increasing user rate would promote the construction of superstructure capacity. Also, the construction of superstructure capacity is not only increasing superstructure capacity but also increasing level of service. The basic structure of the subsystem is shown in Figure 1.

Recreation Resources Subsystem

The magnitude of recreation resources would increase due to development. The larger magnitude of recreation resources, the more attraction for visitors. Meanwhile, the magnitude of recreation resources would influence the carrying capacity. The load index would depend on carrying capacity and visitors. The behavior circuit is outlined in Figure 1.

Management Subsystem

Two functions of management subsystem: one is resources maintenance, another is resources development. The magnitude of recreation resource could expand the maintenance capability. If there is a gap between potential maintenance capability and real maintenance ability, then recreation resource will contribute to the decline. The basic progression is depicted in Figure 1.

Visitor Subsystem

In this paper, we assume that the foundation for sustained visitor growth is dependent on the magnitude of load index and the recreation resources. If the infrastructure is available, the visitors will make use of the resources. The feedback loop (Fig. 1) model indicates growth due to changes in the infrastructure capacity and the magnitude of recreation resources.

The STELLA Software

STELLA is a software program that has been designed to bring system dynamics to broad-based audiences and designed to let you quickly build, simulate, and analyze a system. The STELLA software exerts a discipline on the modeler by only allowing information links on the computer screen to made between certain variables. In Figure 2. shows our structural diagram of the recreation system.

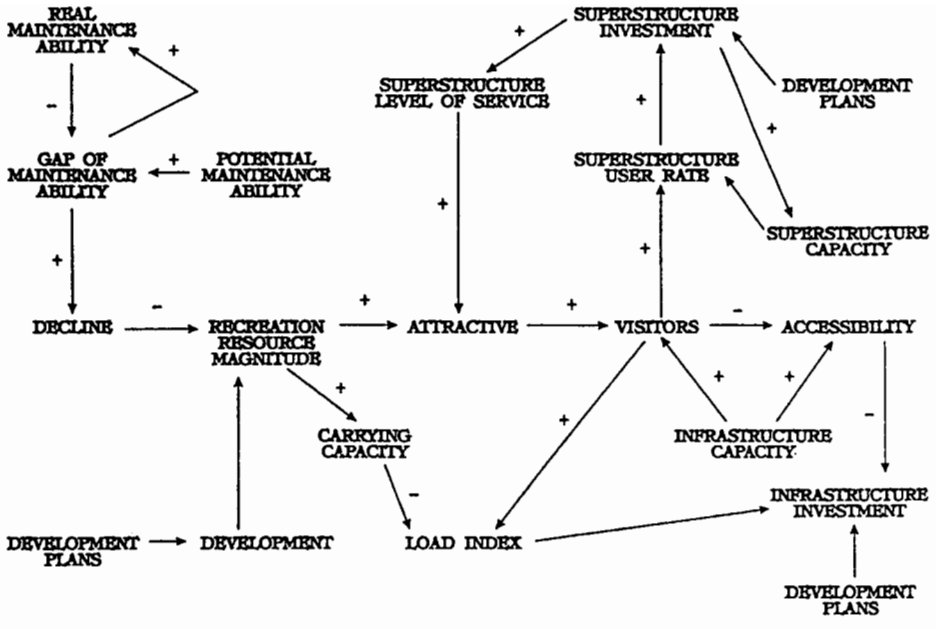

Figure 1. The feedback loops of recreation systems.

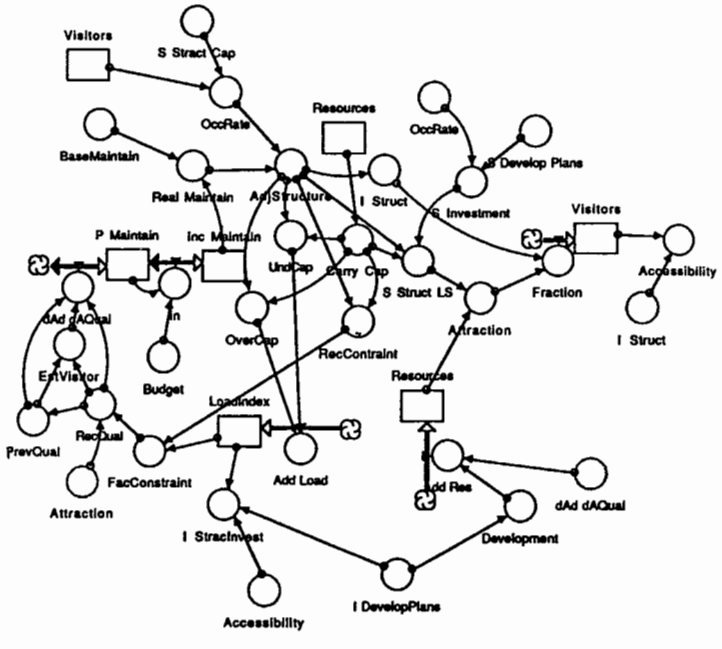

Figure 2. The structural diagram of recreation systems.

Results of Simulation

The model has been simulated for 15 years of period using STELLA II for Macintosh computer. The year 1991 is selected as an initial year for the simulation. The simulation period is set for 15 years. Figure 3. describes an example of the total visitors trend. The vertical axis is the simulation time and the horizontal axis is the number of people.

Conclusion

The foregoing study represents an investigation into a 'hard' type of system where, despite the lack of a reference mode of behavior, it was not difficult to conceptualize an appropriate model and to build user confidence in its ability to adequately represent the real world situation. The model created was clearly not totally endogenous, but aimed at designing control to enable the system to improve its ability to deal with a set of fluctuating exogenous inputs.

In summary, the model has the following advantages:

1. The model is logical and simple. It is easy to understand the system analysis for the recreation system.
2. The model is flexible and general. Components can be easily added and deleted. The model can be applied to any other activities and any county, region, or state level.

Limitation of the model is mainly concerned with the lack of the data that are suited for parameter estimation or model validation.

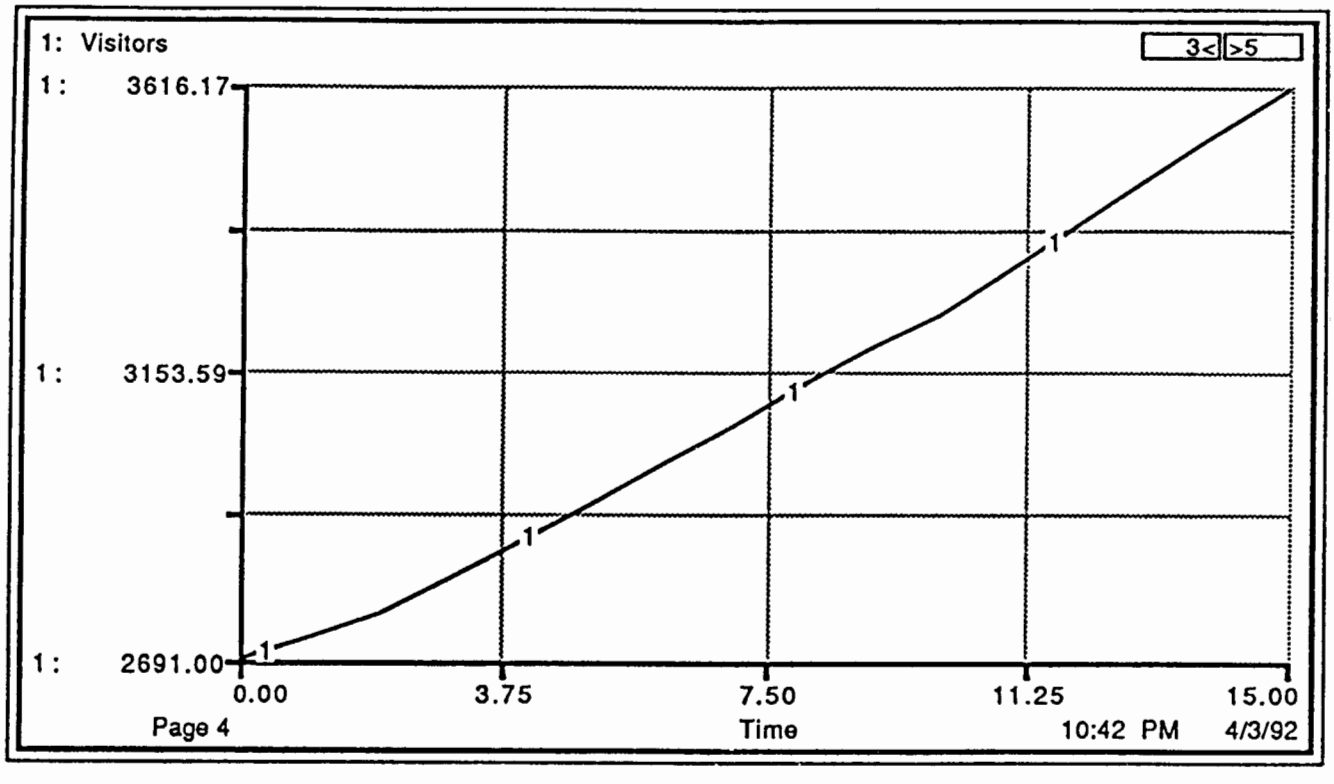

Figure 3. Result of simulation.

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A GEOGRAPHIC INFORMATION SYSTEMS APPROACH TO ANALYSIS OF THE SPATIAL RELATIONSHIPS BETWEEN RECREATIONAL BOATING USES AND PERCEIVED IMPACTS.

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This paper describes a method of analyzing spatially distributed boater activity patterns and site specific attitudes using a geographic information system to manipulate and display the data. The results demonstrate the feasibility of this methodology. Recreation researchers and managers would be well served by incorporating GIS technology for the analysis and display of spatially and temporally distributed information.

Background

Maps are spatial representations of information. When that information can be characterized by its geographical location on a map it becomes a spatial pattern. Spatial patterns, like other forms of information, can be analyzed statistically. Many phenomena can be represented by points on a diagram and these graphic representations are called point pattern maps (Boots and Getis 1988). Point pattern maps can be studied to determine information about the processes that generated the pattern.

Point patterns can be described in a number of ways. These include measures of the compactness or dispersion of the points, their arrangement and their geographic location. For example do they have a tendency to clump or cluster in certain areas, more often than would be expected by random occurrences. Arrangement measurements describe the relative location and the association of the points to one another, while dispersion measurements focus on the density of the point groupings. Even when we do not know much about the processes that generated the pattern, we can gain information from analysis of point pattern maps. This may enable us to acquire some initial insights into the occurrences and possibly formulate hypotheses for testing.

Many types of information used in visitor carrying capacity and impact assessment systems, such as the Limits of Acceptable Change system (Stankey, Cole, Lucas, Peterson, and Frissell 1985) or the Visitor Impact Management planning framework (Graefe, Kuss and Vaske 1990), are positional in nature. Examples of the type of data which may be involved are soil type, slope, aspect, ground cover, overstory vegetation type and percent crown closure for environmental parameters (Hammitt and Cole 1987; Kuss, Graefe and Vaske 1990). Factors influencing the social component may involve size and location of viewsheds, amount of screening between sites, proximity to other sites or facilities, location of the site or facility (i.e.. near a road, on an island, etc.), degree of crowding experienced and a variety of others (Shelby and Heberlein 1986; Manning 1986).

Maps have traditionally been used as the means of displaying, analyzing, storing, and managing these types of geographic or positional information. They are rapidly being replaced by geographic information systems in an automated or computerized framework, as a means of spatial data storage and management. A geographic information system, or GIS, is a computer-oriented information system for the capture, editing, storage, retrieval, management, update, analysis, output and display of digital spatial (and non-spatial) data for use in a decision-making, management, or planning process framework. This concept is an adaptation and combination of the more general theories of management information systems (MIS) developed by the business community in the 1960's and the computer aided design and drafting from engineering applications (Burrough 1987).

The GIS has proven to be a valuable tool for the assessment, management and analysis of natural resources through its ability to handle both positional and descriptive attribute information. Locational analyses, resource planning and management, and change detection all involve interrelating several types of spatially distributed resource information (Heit and Shortreid 1991).
While useful, making maps with a GIS is seldom an end in itself. The greatest benefits from these systems are obtained through modeling and problem solving aimed at managing natural and man-made resources. Any information that can be represented on a map can be stored, managed and analyzed with a GIS (Antenucci, Brown, Croswell, Kevany and Archer 1991).

Related Literature

The study of "recreation geography", the investigation of the spatial properties and distributions of recreation, is a science still in its infancy. Mitchell's (1969) earlier observation that this area lacks generalizations and basic theories is still for the most part true today. There have been few studies of the spatial aspects of recreation activities.

Stankey (1973) in his paper on visitors' perceptions of carrying capacity included a very interesting spatial analysis of crowding. He created an index of crowding (IC) as a ratio between total number of complaints of reported crowding (TC) to the total number of visitors sampled who visited the area (TV), IC = TC/TV. To display this information he plotted the index of crowding on a map of the area and constructed isolines. These lines had values representing the percentage of users reporting crowding. By this method he determined the areal extent of crowding at various points.

In a study of spatial behavior in recreational boating, Lentnek, Van Doren and Trail (1969) found that boaters that participated in the same activities traveled similar distances and tended to cluster at the same lakes. There was a natural logarithmic distribution of frequencies exhibited by the distance decay function by activity specialization. From these observations they concluded that trip purpose and trip length are related, and that there is a spatial structure to boating activity specialization. If this structure exists between lakes, there is no reason to believe that it doesn't exist between different areas of a single body of water.

In a more recent spatial analysis of recreational boating behavior, Jaakson (1989) examined the potential for user conflict on a heavily used lake in Ottawa, Canada. In this study the positions of boats were recorded onto a form designed as an 867 cell data matrix at fixed time intervals. From this data the density per cell was calculated as well as the diversity of boat types and their rated incompatibility. This data was analyzed to determine the potential for conflict due to crowding or incompatible uses.

Purpose

The purposes of this paper were to map and examine the spatial distribution of sites reported as most and least enjoyable by recreational boaters on Berlin Lake located in Mahoning, Portage and Stark Counties, Ohio and on Delaware's Inland Bays

located in southern Delaware. Additionally, in the Inland Bays study, the reported locations of areas avoided and places where they participated in selected on-water recreational activities were examined and analyzed for a clumping or clustering pattern indicative of increased densities. Areas of potential inter-activity conflict sites were also identified by overlaying point pattern maps of the various activities. Finally, the reported boating routes were analyzed to determine areas of potential crowding and overlaid on activity maps to identify potential user conflict.

The sites were analyzed through measures of dispersion and arrangement to determine if the location of the reported points exhibited positive autocorrelation indicated by a clumped spatial distribution. These clusters were then analyzed to determine if they were significantly different from a pattern of complete spatial randomness and a dispersed or negatively autocorrelated spatial pattern. A dispersed pattern would be indicated by the points appearing spread out and somewhat regular with a maximum distance between all points. A pattern of this type would indicate that the activities represented by the points have a tendency to repel each other.

The overall aim was to explore the possibility of identifying controlling factors of the individual clusters and possible environmental and locational parameters that might influence the development of these patterns. This was accomplished through cross tabulation of the point pattern maps and the base maps to identify if there were significant numbers of co-occurrences between the two maps. Ultimately, it is hoped that it will be possible to predict which sites are likely to be considered by users as enjoyable. This ability to predict users' opinions will enable managers to make more informed decisions and to maximize user satisfaction.

Study Sites

Berlin Lake

The first study site examined was Berlin Lake, a U.S. Army Corps of Engineers managed lake built in the 1940's. The location of the study site is Eastern Ohio, near Youngstown, on the Mahoning River about 35 miles upstream from Warren, Ohio. The reservoir has a surface area of approximately 3,590 acres and a perimeter of approximately 70 miles of shoreline. The lake is 18.6 miles long with a maximum depth of 76 feet (U.S. Army Corps of Engineers n.d.). The main stated purposes of the dam are flood control, low flow augmentation, pollution abatement, recreation, conservation and enhancement of fish and wildlife habitat. The public recreation facilities include picnic areas, campgrounds, swimming areas, launch ramps and other recreation areas. Additionally, there are commercial recreation facilities operated through concession agreements which include a marina, bait shop and store (U.S. Army Corps of Engineers n.d.). There are many private and boat club docks located around the lake. These are permitted by the Corps to adjacent land owners and area boat clubs. Use levels on the reservoir are high throughout the summer boating season, especially on weekends. On busy weekends it is not unusual for parking lots to be over-flowing and long lines to be found at the boat ramps (Graefe, Drogin, Cottrell and Titre 1990).

Delaware Inland Bays

The second study area is located in the Inland Bays area of southeastern Delaware, and includes all of Rehoboth, Indian River, Little Assawoman Bays and their tributaries. The Inland Bays are relatively shallow, five to eight feet, and have an average surface area of approximately 15 square miles. The bays are encased by a barrier island complex to the east and fringing marshes on the north, south and west. The area is approximately 50 miles southeast of Dover, Delaware and 20 miles north of Ocean City, Maryland. To the east, located along the Atlantic Ocean are the beach front communities of Rehoboth Beach, Dewey Beach and Bethany Beach, as well as a number of smaller resort communities. The area is a major visitor destination for both consumptive and non-consumptive recreational users (Delaware Department of Natural Resources and Environmental Control 1988).

Boating access to the Inland Bays is provided by an extensive network of facilities surrounding the bays. These facilities include about 75 marinas which provide nearly 6,100 boat slips, 63 boat ramps(8 public and the remaining privately operated ramps), and approximately 325 private docks (Delaware Department of Natural Resources and Environmental Control 1989). Recreational uses of the Inland Bays system examined in this study included small craft sailing and power boating, wind surfing or sailboarding, water skiing, swimming, sunbathing, sightseeing, fishing, crabbing, clamming and jet skiing. On a weekend day during the summer, boats are present over a large percentage of bay waters. Public opinion appears to be that the bays are too crowded and that more marinas will generate more boat traffic, degrade water quality and negatively impact natural resources (Battelle Memorial Institute 1989). This analysis was part of a larger project to develop resource and visitor impact management plans for the Inland Bays (Falk, Graefe, Drogin, Confer and Chandler 1992).

Methodology

Data were collected through exit interviews with boaters at major access points in the two study areas. As part of the interview boaters were asked to mark on a map of the area places they enjoyed most and least, those they avoided and where they participated in a variety of boating related activities. The site data from the questionnaire maps was manually digitized, analyzed and displayed using IDRISI, a grid-based geographical analysis software package (Eastman 1992a; Eastman 1992b). Each map was positioned and attached to the digitizing table. A unique identifier (questionnaire ID number), a site code and desirability or activity code were entered from the keyboard, and then the (X,Y) coordinates were digitized using Tosca digitizing module (Jones 1992).

The first study was an exploratory spatial analysis of data collected previously by Graefe, Drogin, Cottrell and Titre (1990) for a boating capacity evaluation of Berlin Lake. Boaters in that study were asked to mark on maps of the lake the locations that they enjoyed most and least during their boat trips. A sample of 105 questionnaire maps were randomly selected, yielding 229 most/least enjoyable point sites, approximately two points per map. Also, the lake area, roads, streams, public use and access areas were digitized from the base map to compare with most/least enjoyed site clusters.

For the Delaware Inland Bays study area, 422 on-site interviews were completed, with 318 completing the map section properly. In this case, boaters again identified places they enjoyed most and least, as well as areas they avoided. They were then asked why they liked, disliked or avoided these locations. The inclusion of areas that were avoided was an attempt to identify and document boater displacement. Additionally, they were asked to indicate where they engaged in various boating activities and the boating route they followed. Also, the responses to other survey questions were stored as non-spatial attribute entities, and linked to the spatial data by means of the unique identifier through dBase IV and an IDRISI linking program, which acted as a relational database management system. Finally, as part of this study, on-water boat and activity counts were completed to estimate relative density levels. These counts, on the various sections of the bays were used to validate the boater self-reports.

From these maps, point pattern maps of the reported satisfaction, displacement and activity sites were created, along with line maps of the reported boating routes. A total of 785 points were digitized, an average of slightly more than two points per map. The line route maps were coded by day, and overlaid with the activity maps to create potential user conflict maps. The bay water area (Rehoboth, Indian River and Little Assawoman Bays), coastline, DE-MD state line, major roads, streams, public use and access areas were also digitized from the base map to crosstabulate with the clusters and to provide a geographic reference. Additionally, combined spatial and aspatial queries were used to identify reasons for desirability and displacement responses. For example, in a given area what

were the most often mentioned reasons for not enjoying or avoiding the area.

Limitations

There were many limitations to the Berlin Lake study, due to its exploratory nature. Additionally, the data were not collected with a GIS approach to spatial analysis in mind so many assumptions had to be made. For example, it was assumed that the specific site location reported was located at the centroid of the mark made on the map. The scale of the map also influenced the accuracy and precision of the point locations.

In both studies the number of sites identified by questionnaire respondents varied from none to eight. This range of site reports allowed some of the respondents to bias or weight the results. Therefore, for example in the Berlin Lake study, even though the sample size was 105, it may not be representative of the population. For the purposes of this study this was not critical, but should be considered in future studies of this kind. In the Inland Bays study an effort was made to control the number of responses per boater, but some variation in the number of responses per map still exists.

In the Delaware Inland Bays study, many of the problems were overcome by standardizing the mapping survey procedures. However, a problem was encountered when using photocopied maps for the survey. In the photocopying process the maps became slightly distorted differentially. This distortion led to a mismatch between maps of up to one-eighth inch. Due to this problem it is suggested that the maps be professionally printed if greater accuracy is desired. Additionally, as in the Berlin Lake study, the size and scale of the maps probably affected the accuracy of the data. Finally, all of the respondents did not mark locations for each of the possible desirability variables and activity locations. Some respondents indicated they enjoyed the entire bay and did not avoid any of it. Others participated in activities that were not limited to a fixed point or small area, for example jet skiing or water skiing. In future studies these types of mobile activities should be treated and stored as lines and polygons or areas, rather than points.

Results and Discussion

Berlin Lake

The results of the exploratory study on Berlin Lake were promising in spite of the many limitations. The reported most/least enjoyable point sites did exhibit significant clustering. These clusters, however, did not appear to be correlated to any access points, roads or streams. The location of the centers of the clusters were mostly in the center of the lake. The geographical location of the plotted data for Berlin Lake did not exhibit any predictable arrangement other than the random clusters. The clusters were not highly correlated to any of the mapped data, such as access, roads or railroads. These clusters were significantly different from a pattern of complete spatial randomness and positively autocorrelated or clumped.

It is notable that overall, the least enjoyable sites appear more tightly clustered than the most enjoyable sites (Figure 1). This is contrary to what might be expected given that there are almost twice as many most enjoyable sites reported. There were 145 most enjoyable sites identified, while there were only 84 least enjoyable sites identified in the randomly selected sample of surveys.

Figure 1. Site desirability point pattern map of Berlin Lake.

From these results it can be inferred that spatial clustering of points reported as most and least enjoyable by boaters occurred in the survey data. The causes of this clustering are probably related to measurable factors. However, there may be many factors, including both physical and social parameters, and these effects may act to cancel each other out. This would further complicate the process of identifying these factors.

Delaware Inland Bays

The results from the Inland Bays study exhibited more predictable and interpretable patterns. There were a total of 382 points mapped in the desirability section of the survey. These included points reported as most enjoyed, least enjoyed and sites avoided. In addition there were a total of 403 activity sites located on the maps. The activities include sailing, powerboating, sailboarding, clamming, sunbathing/sightseeing, fishing, crabbing, swimming and other, which includes jetskiing. The most common activity reported was fishing followed by crabbing, power boating and clamming. The rest of the activities collectively accounted for less than fifteen percent of all the reported activity sites.

All of the reported points were distributed throughout Indian River and Rehoboth Bays with slightly higher point densities in the area of the Indian River Inlet to the ocean. This may suggest that users are dispersing themselves throughout the bays and thereby avoiding conflict and reducing densities. It also indicates that nearly all of the bay system is used by someone. The point pattern of activity sites also showed an overall high diversity of use occurring throughout the bay system. An enlargement of the Indian River Inlet area revealed more clearly the general trend of increased point density in this area. This increased density was most apparent in and around the inlet. This interpretation is consistent with that observed during the on-water survey of boating use, which was part of the overall study.

A map of a random sample of reported routes was also generated to identify trends in boating use (Figure 2). A sample was used to represent the entire data set of reported routes due to the cluttered appearance and uninterpretable maps produced when all the routes were displayed. From this map the areas of highest use were where the two bays connect and the inlet to the ocean. It is also evident that narrow or constricted areas of the bays and the dredged channels appear most crowded.

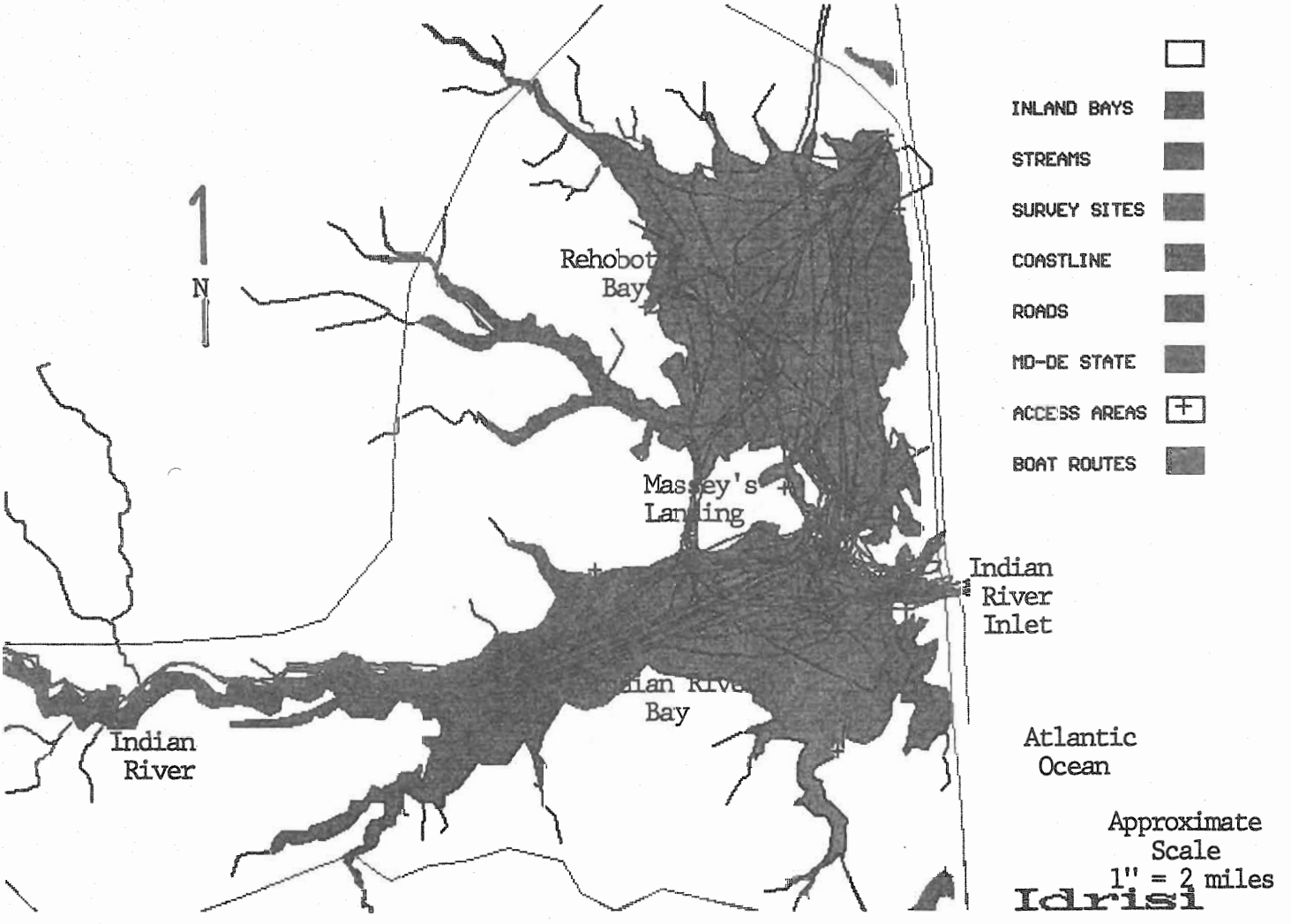

Figure 2. Reported boating routes trend map of Delaware Inland Bays.

The geographical location of the plotted data did exhibit a somewhat predictable arrangement. It is notable that overall and like the Berlin Lake data, the least enjoyed sites and the avoided sites appear more tightly clustered than the most enjoyed zones. Clustered points or those that display a clumping pattern indicate there is some agreement among users on the desirability of an area. The most enjoyed areas displayed on the site desirability point pattern map (Figure 3) display a much lower rate of clustering with a more dispersed point distribution. Again this was contrary to what might be expected given that there were more than 1.5 times as many reported enjoyable sites.

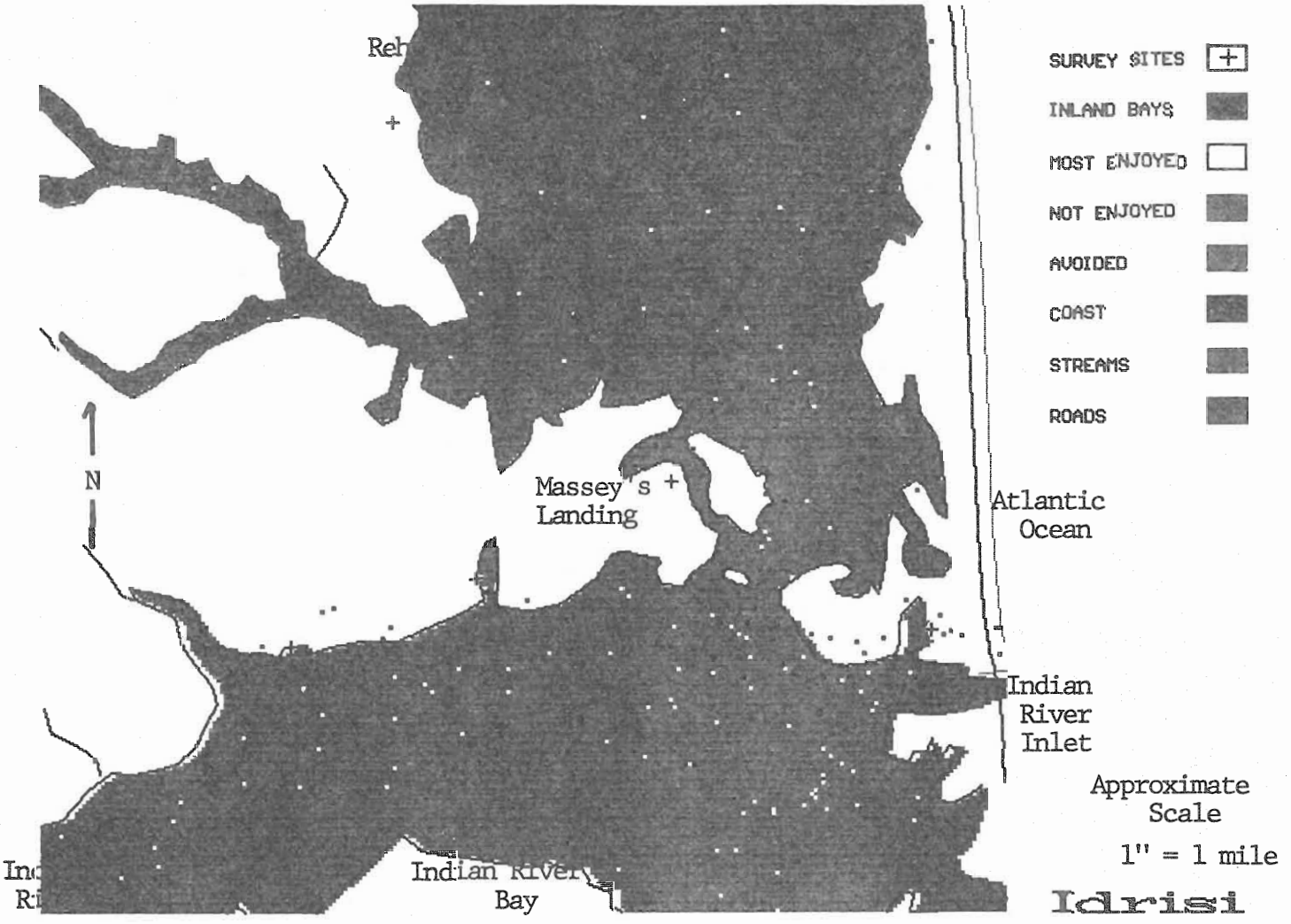

Figure 3. Site desirability point pattern map of Delaware Inland Bays.

This may suggest that factors people find as most enjoyable are varied and therefore somewhat disperse. Also, most of the bays were reported as most enjoyable by someone, suggesting that overall, people find all sections of the bays enjoyable. The minor clustering that was evident at locations throughout the bays was due to people participating in the same activities and finding the areas enjoyable for similar reasons. This may be a function of water depth or some other positional environmental factors that could be identified and included in the spatial database for future research projects.

The areas most commonly reported as least enjoyed or avoided shown in the desirability point pattern map (Figure 3) included the area surrounding the inlet and the water area connecting the two bays. These areas did exhibit significant clustering which suggests many people find the same areas least enjoyable and that many people also avoided these same areas. This was somewhat predictable given the potentially conflicting and heavy usage this area receives. In Rehoboth Bay there was a weak cluster located just north of Massey's Landing, the connection to Indian River Bay. Again, based on the reasons given by the respondents, this was due to increased traffic passing through the confined area of the dredged channel there. The balance of Rehoboth Bay exhibits no significant clusters, and in fact the points are significantly dispersed.

In this study the most often reported reason for enjoying locations was the high quality of the fishing experience. This was followed by a perceived lack of crowding or low use densities at these sites. Other frequently mentioned reasons for enjoying the areas included good crabbing and clamming, as well as favorable water or weather conditions. Crowding or too many boats/people were the most often reported reasons for the low desirability of areas, followed by unpleasant water or weather conditions. Other reasons included perceived conflicts with jet skiers, lack of fish, crabs or clams and reckless or unsafe boating practices. Reported reasons for avoiding an area included shallow water or sandbars, as well as crowded conditions. Also mentioned were water conditions other than depth (e.g.. waves, poor water quality or dirty water), unsafe, reckless or inconsiderate boaters and jet skiers. It is important to note that these points, unlike all of the others examined, do not represent locations used by recreational boaters. They are in fact, locations from which these users were absent by choice. These areas represent a displacement of users to another place, activity or time.

The distribution of selected on-water activities and areas of potential inter-activity user conflict also revealed some significant positive autocorrelation. From the number of points on the map of the areas where users reported fishing it is evident that fishing is the most commonly reported activity in the inland bays. This finding is in agreement with the results of the questionnaire analysis and the on-water counts. Besides being the most common activity, fishing also appears to be the most strongly clustered. The primary area of fishing is Indian

River Bay east to the Inlet and out to the ocean. These results were not surprising and are further validated by the on-water counts. This area is shown enlarged with reported boating routes included in Figure 4.

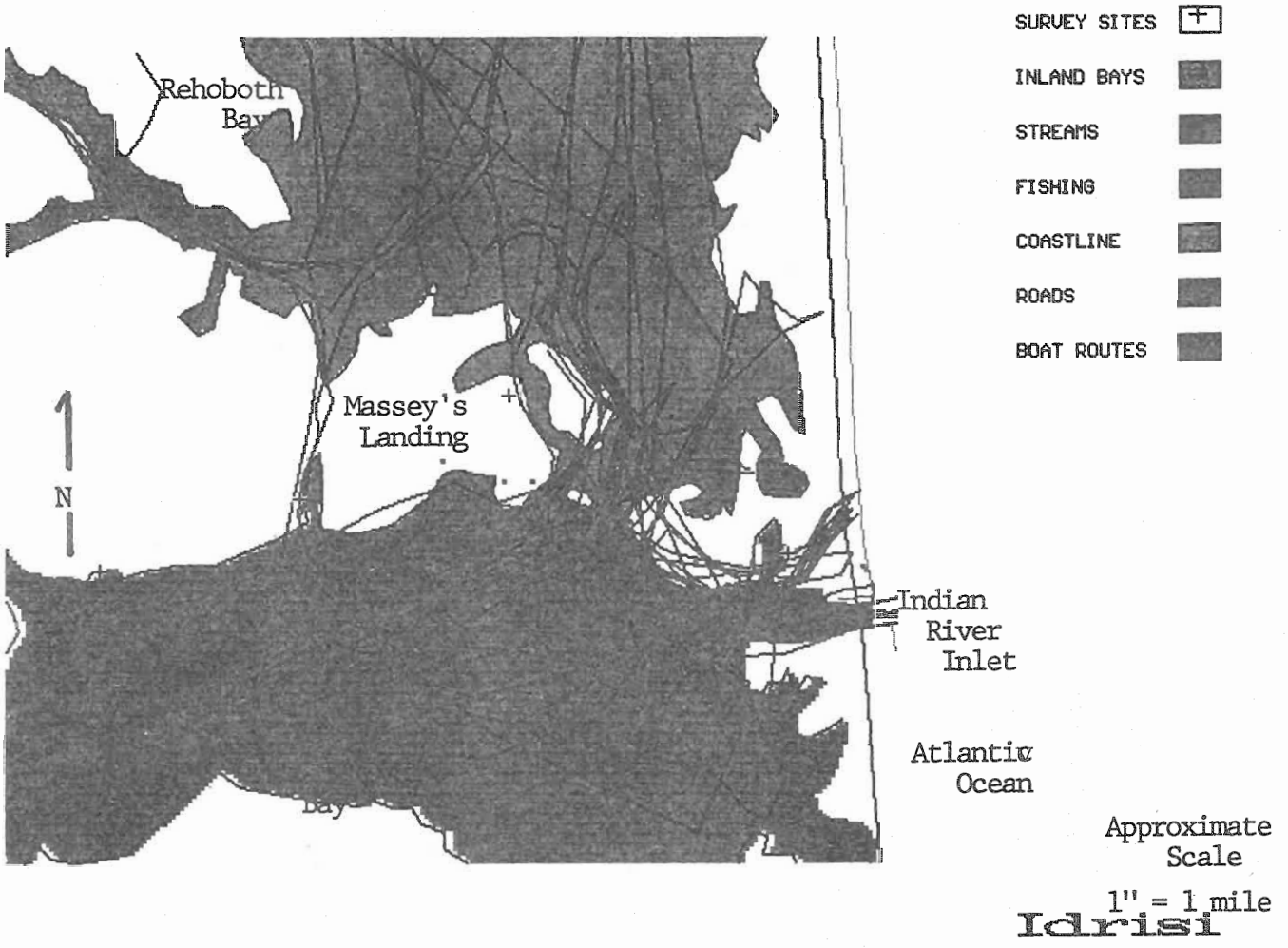

Figure 4. Map of reported fishing sites with boating routes.

When the routes were overlaid on the fishing activity map, areas of potential user conflict between fishermen and power boaters could be identified. These two activities seem to have the highest potential for inter-user conflict. Their primary areas of usage overlap almost completely. Additionally, the type of usage differs with fishermen reporting primarily anchored or drift fishing, while powerboating by definition is mobile. The main area of potential conflict appears to be the area from Indian River Inlet to Massey's Landing. Additionally, it appears that most of the major boating channels also tend to be the best fishing spots. It seems that areas not utilized by boaters are also not used by fishermen to any great extent.

The second most popular activity participated in by boaters on the inland bays identified through the mapping, the questionnaires and the on-water counts is crabbing. The commonly reported areas where crabbing occurred were the points where Indian River, and other tributaries flow into Indian River Bay (Figure 5). There was a second concentration of crabbing in the northwest corner of Rehoboth Bay at the areas where its tributaries enter the bay. This is not surprising, due to the occurrence of water conditions favorable (i.e. water chemistry, salinity, bottom conditions, etc.) for crabs at these areas.

With the routes overlaid an identification of areas of potential user conflict between crabbers and powerboaters was performed. By examining this map it appears that overall there is insufficient evidence of any important inter-activity user conflict zones (Figure 5). This may be due to the fact that most crabbing is done in shallow water and the tributaries, whereas, power boating is limited to the deeper sections and channels. The sites on Indian River Bay where Indian River enters do exhibit the possibility for conflict due to the narrow, confined nature of the bay at those points. However, this may be distorted somewhat in that the displayed boating routes may have been the crabbers themselves.

Clamming was the third most popular activity identified. The primary areas of clamming usage include the east shore of Rehoboth Bay, with the highest concentration just east of the connection at Massey's Landing. Additionally, a few areas in Indian River Bay along the north shore and just south of the inlet on the east shore were identified (Figure 5). These areas are fairly shallow and are therefore accessible to clammers.

By examining the map of clamming sites with the boating routes overlaid it was apparent that the primary areas of clamming activity are not the primary boating routes. There is one notable exception in the area to the east and south of Massey's Landing (Figure 5). However, from this data, there is

not enough evidence to indicate that clamming and power boating are a major source of user conflicts. However, due to the type of potential conflict and safety issues, (i.e. unprotected clammers with just heads and shoulders above water in an area with power boaters) these two activities should be monitored.

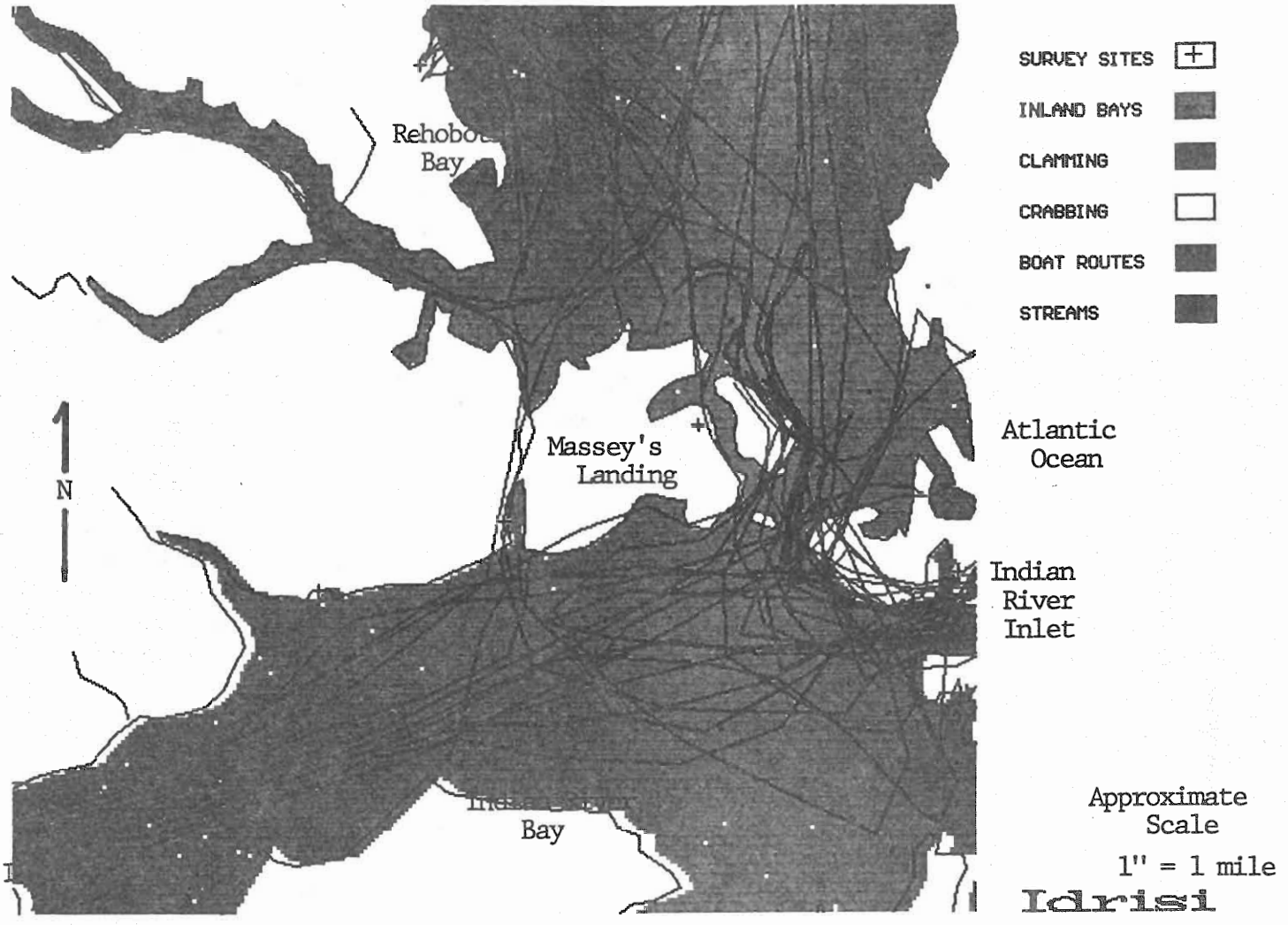

Figure 5. Map of reported crabbing and clamming sites with boating routes.

The dispersed distribution and low density of participants in other activities such as sailing, sailboarding, sightseeing/sunbathing, water skiing, swimming and jet skiing, should not be interpreted as having no conflict potential. On the contrary, these activities by their nature do exhibit a potential for inter-activity conflict and increased safety concerns. For example, swimmers, sailboarders and water skiers all spend some time, unprotected in the water where they could come in conflict with power boaters. Therefore, these activities should be monitored for changes in use levels and activity site locations.

Summary

In summary, based on the results of these spatial analyses of boating distributions and patterns, it is feasible to include a geographic component in recreation research. Point pattern analysis and spatial cross tabulation statistical techniques for the analysis of survey responses appears practical based on the results of these two studies. This observation can be justified through examination of the point pattern maps created from the survey data.

These types of analyses can be accomplished cost effectively through the integration of geographic information systems technology. Additionally, the ability to display this data in a map format adds a dimension that allows researchers and managers to gain further insights into users' behavior.

Future studies could be designed with this type of analysis in mind, allowing for a more thorough and complete testing of the analytical and statistical procedures. From these studies, hypotheses could be formulated and tested to further refine these procedures. The possible applications of GIS and spatial analysis techniques to a wide variety of resource and visitor management and research are as varied as they are exciting.

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AN ARRIVAL RATE DEPENDENT MODEL FOR ESTIMATING PARK ATTENDANCE

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Vehicle occupancy levels and arrival rates for state parks were used to model the estimated attendance within individual recreation areas. Previous studies show that occupancy levels may not hold constant as attendance levels increase. An exponential model was developed that reflected the rise in occupancy levels as the vehicle arrival rate increased. The model was tested for consistency between two parks and among the various sites in each park.

Introduction

The measurement of visitation is central to the management of parks. Estimates of visitation are needed when planning facilities, administrating the various units of a park system and researching the characteristics of the users. Visitation serves as a measure of the service that parks produce.

Background

Traffic counters are often employed to estimate the number of people entering a recreation area. The occupancy rate used to expand vehicle counts into visitor counts is a crucial component of this process. The Pennsylvania Bureau of State Parks has used occupancy rates ranging from 2.5 to 4.0 persons per vehicle, based upon various in-house studies. It is not unreasonable to expect these rates to vary with changes in fuel prices, automobile sizes and recreation trends. Therefore, it is important to check these figures periodically. A study of occupancy was conducted by Penn State for the Bureau at Presque Isle State Park in 1987 (Strauss and Lord, 1987). At this time it was observed that the occupancy was averaging 2.18 people per car. At the same time it was noticed that the hourly average ranged from a low of 1.52 people per car to a high of 2.56 people per car. Upon further examination, it was noticed that the higher occupancy rates occurred during the busiest periods. Lower occupancy rates occurred during the less crowded periods, such as early mornings or weekdays. An exponential model was developed to reflect this tendency.

The Presque Isle study dealt with an exceptionally large park that is somewhat atypical of the other units in Pennsylvania's park system. Furthermore, this park's single entrance meant that its entire usage could be measured with one traffic counter. Most state parks contain several entrances and often have several distinct activity areas.

Objectives

In a continuation of the above study, the Bureau collected data at two parks in York County Pennsylvania during 1990 to further evaluate the effects of crowding and occupancy upon visitation. The parks differed in their size and the types of activities offered. Unlike Presque Isle each has several entrances. The data from these parks was used to test the occupancy model for consistency between the parks, as well as between the different areas in each park.

Gifford Pinchot State Park was developed in the late 1950's and contains 2,338 acres, including a 340 acre lake. The park offers camping and beach swimming, but does not have a marina. Only electric motors are allowed on the lake. There are seven parking areas available to the public. There are no large towns in the immediate vicinity of this park.

Codorus State Park is slightly more modern and somewhat more developed than Pinchot. The park was constructed during the late 1960's as part of the park system's second major expansion, "Project 70". The 3,302 acre park is oriented around a 1,275 acre impoundment. It has a marina, a campground and a swimming pool. The lake has a 10 horse-power limit. There are 17 different parking areas in this park. It is also located near Hanover PA, a town of 15,000 people.

Park interns were hired to collect data on vehicle occupancies at each park. Over 1400 hours of observations were collected at the different sites in each park during the course of 19 sample days. Samples were collected on six weekdays, 10 weekend days and two holidays. At Codorus, several entrances were aggregated, resulting in estimates for seven sites at that park. One of the Pinchot entrances was dropped from the study due to lack of significant use.

Vehicle occupancies were observed for one hour periods during random times of the day. The intern would station himself at an observation point that allowed a view of each vehicles occupants as they passed over the traffic counter. Additional visitor information not pertaining directly to this paper was collected through exit interviews.

Modeling Visitation as a Function of Arrival Rates

Scatter plots of the hourly observations revealed a connection between the average number of people per vehicle (occupancy) and the number of vehicles per hour (arrival rate). Site six at Gifford Pinchot serves as an example of a low use site (Figure 1, next page). Codorus's site four contrasts as a high use site (Figure 2, next page). Notice that when the arrival rate was high, the occupancy level was in the range of two to three people per car. During the periods of low use, the average occupancy rate usually dropped to less than two.

Linear correlations of the relationship between the number of people per vehicle and the number of vehicles per hour demonstrated the strength of this relationship at the different sites (Table 1, next page). The sole negative correlation at site four of Gifford Pinchot was reflected in the coefficients estimated for that site.

If the occupancy rate is assumed to vary with the arrival rate, then the following general model suggest itself:

$$\text{People/Vehicle} = a\,(\text{Vehicles/Hour})^{b-1}. \quad (1)$$

Since the objective of this study was to estimate visitation, the following form of the model was deemed more appropriate to the task:

$$\text{People/Hour} = a\,(\text{Vehicles/Hour})^{b}. \quad (2)$$

The exponential coefficient, b, determines the degree to which occupancy changes with the arrival rate. The scalar coefficient, a, alone does not reveal the occupancy rate. The occupancy rate must be calculated for a specific arrival rate using equation 1.

In order to test the significance of the coefficients at the different sites in each park, a log-log transformation of the model was developed (3).

$$\ln(\text{People/Hour}) = \ln(a) + b\,\ln(\text{Vehicles/Hour}). \quad (3)$$

This linearization allowed the addition of indicator variables for each site.

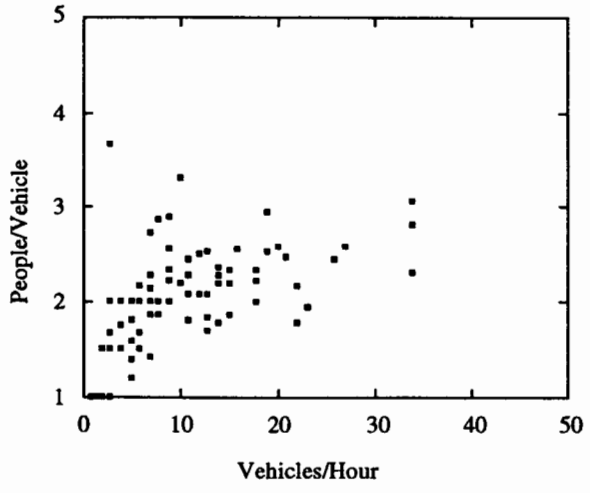

Figure 1. Plot of occupancy versus arrival rate at site six, Gifford Pinchot State Park.

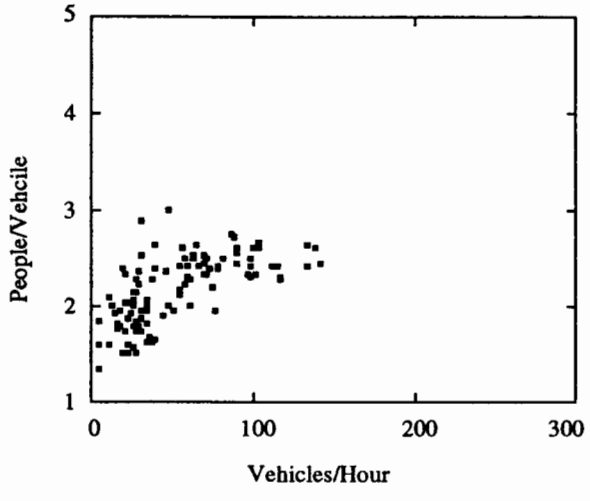

Figure 2. Plot of occupancy versus arrival rate at site four, Codorus State Park.

Table 1. Linear Correlation between people/vehicle and vehicles/hour at each site.

Gifford Pinchot	Correlation	Codorus	Correlation
Site 1	.518	Site 1	.378
2	.472	2	.064
3	.263	3	.296
4	-.021	4	.647
5	.419	5	.130
6	.557	6	.339
		7	.088

Results

The models for each park were significantly different and therefore estimated separately.

In Codorus State Park, the exponential term showed no significant variation between sites. Site was significant enough to require different multiplicative terms. The seven models estimated for Codorus are shown in Table 2. An R-square of 0.948 was obtained from the regression on the transformed variables. While the exponential term does not vary, the scale term ranged from 1.339 to 1.647. The average number of vehicles per hour observed at the sites is listed on the table along with the occupancy rate predicted at this arrival rate. The predicted occupancy rate for double the average arrival rate and for half the average arrival rate is given. Since the exponential portion of the models was consistent over all sites, the degree of non linearity for each site was the same. That is to say a proportional increase in any site's arrival rate has the identical effect on its occupancy rate.

A general trend can be observed where the sites with the highest average arrival rates had the highest occupancy levels. Overall the average occupancy levels varied from 1.64 people per vehicle to 2.72 people per vehicle.

The sites proved to be significant for both the scale and the exponential terms of the model at Gifford Pinchot. Table 3, shows the model terms for this park. An R-square of 0.973 was obtained from the regression on the transformed variables. The exponent varies from a high of 1.249 to a low of 0.985, with the latter value providing essentially a linear model. The scalar term ranged from 1.165 to 2.408. The average occupancy levels ranged from 1.87 to 2.43, and again showed a tendency to vary with the average arrival rate. Notice that the largest exponents do not necessarily correspond with the highest occupancy levels. What they do correspond with is the sensitivity of the occupancy rate to changes in the arrival rate. For example, at site four, the occupancy rate for this fairly busy site only varied from 2.26 to 2.31, over a range of arrivals of half the average to twice the average. At site 2, the occupancy varied from 2.18 to 2.54, under similar arrival rates.

Discussion

There are several good reasons to be concerned with the occupancy rate being used to estimate attendance at recreational areas. Accurate visitation figures are useful to both managers and researchers. Some of these needs could be served adequately by good total visitation information, such as an average occupancy rate would supply. Indeed, the R-square of a simple linear model of visitation would not fall far below the ones found here. With the limited capacity of most passenger vehicles and considering that a driver is always present, the variation in occupancy will be held to a minimum. Given this bound, it should not be surprising that the number of vehicles arriving is a good predictor of visitation. However, a model using occupancy as a function of the arrival rate raises some interesting possibilities.

The design of park facilities, must reflect accurate estimates of use in order to provide efficient service. For example sewage treatment facilities are designed with specific rates of flow in mind. A large over- or under-estimate of use could result in not only inefficiency but the failure of the system. These design decisions affect existing as well as planned parks. Since the recreational patterns of visitors change over time, as a park rehabilitates its facilities, accurate estimates of current visitation patterns are needed.

The administration of any public system involves a competition for resources with other public agencies and projects. Attendance is at least a partial measure of the recreational service being produced. Reliable estimates supported by sound empirical evidence, will provide the most accurate picture of the park system's output.

In the ever increasing event that a fee system is to be established in a park system, the accuracy of the visitation estimates may be crucial. This would be especially true if the revenues from the fees would be retained by the park system and their annual appropriation reduced by the anticipated revenues.

Researchers also make use of visitation estimates. Many user surveys determine average characteristics from a sample of visitors. When these figures are expanded into totals, their reliability is only as good as the total population figures. Marketing studies and economic impact studies are good examples of this application.

A model of visitation, as developed here, does more than just address these needs. For the most part, good average occupancy rates would do just fine. This model, however, gets at the concepts of crowding and capacity. Both occupancy and arrival rates are closely tied to crowding. Further development of the model may provide insights into this behavioral phenomenon.

Table 2. Model coefficients and predicted occupancy rates for Codorus State Park.

Site	Scalar Term	Exponential Term	Average Arrival Rate (Car/Hour)	Occupancy at Average Arrival Rate (Peo/Car)	Occupancy at Twice Average Arrival Rate (Peo/Car)	Occupancy at Half Average Arrival Rate (Peo/Car)
1	1.395	1.124	11.0	1.88	2.05	1.72
2	1.499	1.124	11.5	2.03	2.21	1.86
3	1.361	1.124	35.2	2.12	2.31	1.94
4	1.339	1.124	5.1	1.64	1.79	1.50
5	1.567	1.124	53.9	2.57	2.80	2.36
6	1.647	1.124	57.3	2.72	2.97	2.50
7	1.505	1.124	18.3	2.16	2.35	1.98

Table 3. Model coefficients and predicted occupancy rates for Gifford Pinchot State Park.

Site	Scalar Term	Exponential Term	Average Arrival Rate (Car/Hour)	Occupancy at Average Arrival Rate (Peo/Car)	Occupancy at Twice Average Arrival Rate (Peo/Car)	Occupancy at Half Average Arrival Rate (Peo/Car)
1	1.262	1.175	19.1	2.11	2.39	1.87
2	1.605	1.112	30.6	2.35	2.54	2.18
3	1.496	1.113	7.1	1.87	2.02	1.73
4	2.408	0.985	35.6	2.28	2.26	2.31
5	1.551	1.110	58.5	2.43	2.62	2.25
6	1.165	1.249	10.0	2.07	2.46	1.74

The visitation models were re-arranged into the form of Equation 1, thereby permitting them to be overlaid on the scatter plots of occupancy versus arrival rates. The two sites (Figs 1 & 2) are reproduced in Figs 3 & 4 with the estimated model superimposed.

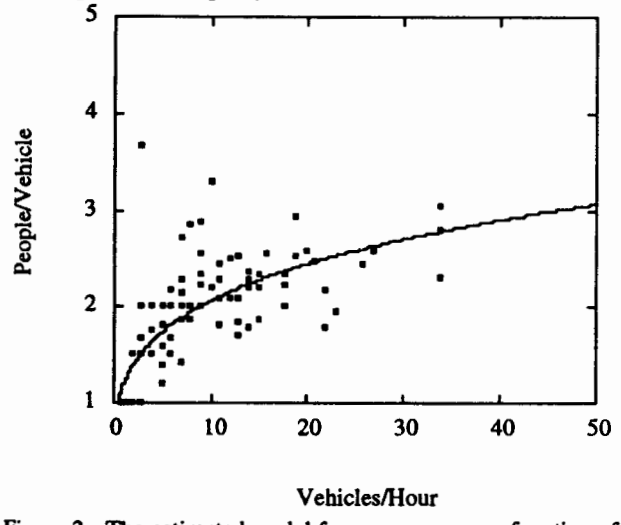

Figure 3. The estimated model for occupancy as a function of arrival rate overlaid on the scatter of the data from site six, Gifford Pinchot State Park.

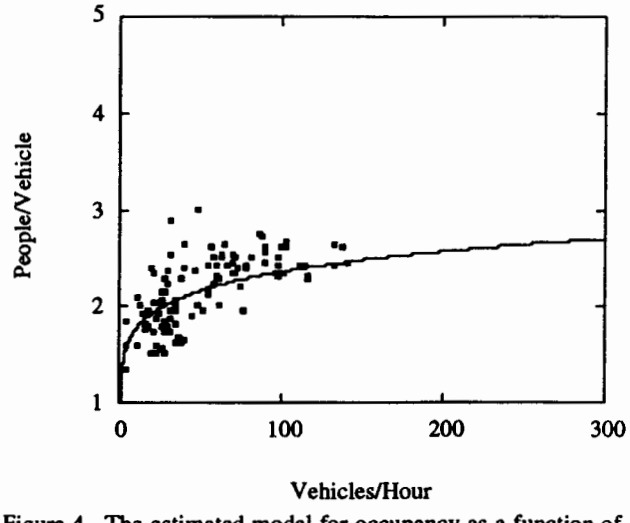

Figure 4. The estimated model for occupancy as a function of arrival rate overlaid on the scatter of the data from site four, Codorus State Park.

A Continuing Study

In an effort to learn more about this phenomenon, the Bureau of State Parks and the School of Forest Resources have initiated an expanded study of visitation measurement. Twenty-two recreation areas in nine parks of various sizes throughout the state are being studied. These areas represent a cross section of activity opportunities, ranging from single purpose areas to large multi activity complexes. Exit interviews will be incorporated into the study to determine the activity profile of the visitors.

A measure of capacity will be incorporated into the model. Measures of the surrounding population will also be tested. The types of activities offered will be tested for their effect on the models coefficients. The intent of these embellishments is to develop a general model for estimating visitation.

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SEASONAL SCENIC VALUE AND FOREST STRUCTURE IN NORTHEASTERN HARDWOOD STANDS [1]

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This paper reviews the findings of past research relating scenic value to structural characteristics of forests. Data from 23 northeastern forest sites are used to describe the relationship of seasonal scenic value to six structural attributes: time since harvest, crown closure, understory layer, herbaceous ground cover, large trees, and slash or downed wood. The relationships are inconclusive, but indicate that there are seasonal differences, and some relationships are not linear,. Sample sizes for future studies are suggested.

Introduction

Private owners control approximately 85 percent of the forest land in the New England and New York. Of this percent, a major portion are non-industrial woodlot owners (Harper 1990). They are often less concerned with the income from timber harvest than they are with the potential loss of amenity values. With this in mind, it has become even more important that foresters be able to make decisions within traditional forest management strategies that maximize retention of scenic resources after harvest. The Northeast Forest Experiment Station of the U.S. Forest Service has recognized this situation and begun developing a computerized aid to help these landowners determine appropriate management systems and silvicultural treatments for their land (Marquis 1991).

Since the early 1970's a great deal of attention has been paid to the way people perceive landscape scenery, particularly forest resources (Arthur & Boster 1976; Ribe 1989). In spite of this, notably little attention has been paid to the relationship between scenic value and forest management in the Northeast. Although scenic quality has traditionally been thought of as the desirable secondary result of forest management, it is only recently that foresters have recognized scenic value as a primary goal of forest management (Marquis 1991).

Literature Review

The management of forest visual quality would be greatly facilitated if the structural characteristics now used by foresters to manage forests also were predictors of scenic value. These characteristics include forest age, spatial distribution, vertical forest structure, canopy openings, species composition, large tree dominance, herbaceous ground cover, and downed wood or residual slash. Table 1 summarizes which structural variables were investigated by 24 previously published reports.

Age Structure

Palmer (1990) found that the scenic value of northern hardwoods was low immediately after a harvest, increased in value as the site 'greened up', and began to decrease in value as regeneration began to obstruct the view. The scenic value of the site began to increase again as the regeneration foliage began to thin at eye level. In the West, Brown and Daniel (1984) found that mature even-aged ponderosa pine stands were preferred to uneven-aged stands which were preferred to young even-aged stands. In addition, Hull and Buyhoff (1986) showed that the scenic value of even-aged loblolly pine stands increased with age.

Other researchers have also found that younger forests are perceived to be less attractive than older forests because they have high stem density (Brush 1978, 1979; Daniel & Boster 1976; Hull & Buyhoff 1986). Low stem density can also decrease scenic value, an idea important in relation to clearcuts. Buyhoff et al. (1986) determined that 1150 1 to 5 inch stems per acre is the "scenically optimal number" with more or fewer stems decreasing scenic value. This determination is probably influenced by the relationship of basal area or stem size. In contrast to Buyhoff, Arthur (1977) reports that increasing stem density was positively related to scenic value, but Ribe (1989) speculates that this may be because her photographs included clearcuts. People did not necessarily prefer stands of high density, but clearcuts, with densities of zero, were perceived as unattractive.

Table 1. Studies of the effect of structural characteristics on forest scenic value.

Study citation	Forest type	Age structure	Spatial distribution	Vertical structure	Canopy openings	Species composition	Large tree dominance	Herbaceous ground cover	Downed wood
Arthur 1977	Ponderosa	•	•		•		•	•	
Benson 1974									•
Benson & Ulrich 1981	Lodge pole								•
Brown & Daniel 1984	Ponderosa	•	•	•	•		•	•	
Brown & Daniel 1986	Ponderosa		•				•	•	
Brush 1978	Eastern	•	•	•			•	•	
Brush & Palmer 1979	Eastern	•	•	•		•	•	•	
Buyhoff et al. 1986	Loblolly	•							
Cook 1972	Mixed					•			
Daniel & Boster 1976	Western	•					•	•	•
Daniel & Schroeder 1979	Ponderosa					•	•	•	
Echelberger 1979	Eastern		•					•	
Herzog 1984	General					•			
Hull & Buyhoff 1986	Loblolly	•					•		
Kellomaki & Sav. 1984	Coniferous					•			
Klukas & Duncan 1967	Min.mixed					•	•		
Palmer 1990	N. hardwd	•							
Patey & Evans 1979	General							•	
Radar 1971	General							•	
Ribe 1989	General	•	•	•	•	•	•	•	•
Schroeder & Daniel 1981	Western					•	•	•	•
Schweitzer et al. 1976	Fir & larch						•		•
Vodak et al. 1985	General						•		•
Yeiser & Shilling 1978									•

1/ We thank Jeffry E. Penneston and Robert M. Sanford for their assistance in conducting this research project. This research was sponsored in part by grants from the McIntire–Stennis Cooperative Forestry Research Program and the North Central Forest Experiment Station, USDA Forest Service.

Spatial Distribution
The way trees are arranged within a forest stand--their spatial distribution--may also contribute to the way people perceive forest landscapes. Sporadic dense clumps of trees within generally open ponderosa pine stands was found to be more preferred by Arthur (1977), but less preferred in studies by Brown and Daniel (1984, 1986). Ribe (1989) speculates that the relationship of clumping to scenic attractiveness may be weak because of other factors intruding on the forest scene that influence perception. For example, clumping distributions that help define meadow openings may improve scenic value (Brush 1978, 1979). In effect, these clumping distributions create a point of visual convergence which contributes to a condition of vista enframement (Forest Service, 1973). Echelberger (1979) states that regardless of situation, forest openings and the distance to which one's view can penetrate the forest are positively correlated with scenic value.

Vertical Structure
Brown & Daniel (1984) found no specific relationship between scenic value and vertical forest structure--the number of canopy layers from lowest to highest. However, when researchers focused on the presence of a seedling or shrub understory, they did find relationship--albeit mixed--to scenic value. Brown and Daniel (1984) further report that the combination of grasses, forbs, and shrubs had the highest impact on scenic value within test sites. Brush (1978) reports that since the presence of an understory reduces the potential for visual penetration into northeastern forests, it decreases scenic value. In a later publication, Brush (1979) reports that a varied understory in a red pine stand increases aesthetic perception.

Canopy Openings
According to Ribe (1989), "the presence of canopy openings in eastern US forests has been found to have a weak but positive influence upon scenic preference." Brown and Daniel (1984) attribute increases in vegetative ground cover in western United States forests to such canopy openings. In addition, Arthur (1977) reports that breaks in the canopy layer contribute to increasing crown prominence in ponderosa pine. However, Ribe (1989) speculates that canopy openings, in addition to allowing desirable vegetative ground cover to become established, may encourage the growth of saplings, thereby reducing potential visual penetration and subsequent scenic value. Research articles often do not consider the relationship between canopy openings and scenic value reduction because the relationship between scenic value and tree density or basal area is more easily measured. There has been no effort to separate the scenic value influences of canopy openings and tree density.

Species Composition
Although a variety of empirical studies on the relationship of species composition to scenic value have been conducted, the results may be influenced by the particular landscape and cultural context in which they occurred. Cook (1972) reports that a mix of species can increase scenic value in a given setting. Aspens, oaks, junipers, and firs have a beneficial aesthetic effect when included within a ponderosa pine stand, although aspens are most highly preferred (Schroeder & Daniel 1981). Kellomaki and Savolainen (1984) observed that white barked birches mixed into coniferous stands have the same kind of effect on perception of forest scenery. Similarly, mixing at least 10 percent of other species into a ponderosa pine forest as reported by Daniel and Schroeder (1979) tends to increase scenic value.

Ribe (1989: 62) critically evaluates these results by suggesting that they are "influenced by cultural, regional, contextual, and subjective expectations." For example, Brush (1979) reports that Massachusetts woodlot owners demonstrated a preference for hemlock, birch or mature open pine stands, rather than for mixed hardwoods, red cedar or younger unthinned pine forests. In contrast, Minnesota residents rate red pine most preferable, white pine moderately preferable, and paper birch least preferable (Klukas & Duncan 1967).

Large Tree Dominance
A wide variety of research shows that mature and old growth forests of all types have higher scenic value (Brown & Daniel 1984, Brown & Daniel 1986, Brush 1978, Brush 1979, Klukas & Duncan 1967, Schroeder & Daniel 1981, Scweitzer et al. 1976, Herzog 1984). Hull and Buyhoff (1986) report that the presence of large trees is even more important within forest stands that have relatively few trees per acre. In this situation, tree size is most commonly estimated using standing volume and diameter at breast height (Arthur 1977, Brown & Daniel 1984, Daniel & Boster 1976, Daniel & Schroeder 1979, Schroeder & Daniel 1981, Vodak et al. 1985), but it has also been estimated using overall tree height or the distance from the ground plane to the top of the canopy (Klukas & Duncan 1967).

Although it is generally accepted that the presence of large trees within a given forest setting enhances scenic value, no research concerning the aesthetic relationship of varying numbers of large trees within different kinds of forest settings has been reported. As Ribe (1989: 62) notes that "mature forests may also tend to exhibit reinforcing scenic attributes, such as lower tree densities and understories." This question warrants more attention, since it could significantly influence management decisions.

Herbaceous Ground Cover
Arthur (1977) and Radar (1971) report that a herbaceous ground cover, including grasses, ferns, forbs, or seedlings, contributes positively to forest scenic value and is preferred to a shrub and sapling understory. This relationship has been observed in forest situations in which bare or disturbed soil conditions are compared to conditions with herbaceous ground covers (Brush 1978, Brush 1979, Echelberger 1979, Schroeder & Daniel 1981). Brown and Daniel (1984, 1986), and Daniel and Schroeder (1979) further report that vegetative ground cover is a primary contributor to scenic value. In addition, Daniel and Boster (1976), and Patey and Evans (1979) state that landscapes managed for grazing purposes and having an open park–like appearance receive positive scenic value ratings and indicate a preference for taller more irregular herbaceous vegetation. Overgrazing or scarification should be avoided, as it may have potential negative impact on perception of forest landscapes.

Downed Wood and Slash Residuals
Scenic value may be decreased by the presence of natural downed wood (Benson & Ulrich 1981). However, its presence is more acceptable than slash, which is perceived as evidence of mechanical disruption (Schroeder & Daniel 1981). Daniel and Boster (1976), and Ribe (1989) report that the reduction in scenic value from slash may be related to perceptions of landscape damage. The treatment of slash and other ground debris is the most important visual mitigation technique employed during timber harvests. It is therefore appropriate to consider routine lopping, removal, or chipping and respreading of downed wood in highly visible areas. Burning slash piles on site is not acceptable, since the charred remains also detract from scenic value (Benson 1974, Benson & Ullrich 1981, Schweitzer et al. 1976, Yeiser & Shilling 1978).

In humid eastern United States microclimates, regeneration of ground vegetation is faster, reducing the potential negative impact of slash (Ribe 1989) and in general slash height contributes to negative landscape perception (Vodak et al. 1985). In these forests, lopping tall slash near to the ground in anticipation of relatively swift revegetation may be the most effective visual mitigation technique. However, this approach is not recommended for arid western United States forests, where ground covers and forest regeneration are not as fast growing, thus leaving slash open to view for an extended period. In these areas, slash should either be removed from the

harvest site or be chipped and respread to reduce scenic value impacts. Brown and Daniel (1984, 1986) support removal of slash as an appropriate visual mitigation measure for ponderosa pine forests where slash volume was determined to be a primary cause of low scenic value.

Methods

Forest Scenes

Twenty-three views from within six northern hardwood sites are used for this study. The sites were level, without noticeable clumping or unusual species mixtures. They ranged from one to thirteen years since a partial harvest for firewood that left a residual basal area for the stand of approximately 70 square feet per acre. A permanent marker was established at each view point to allow it to be photographed during each season of the year. Photographs were taken on overcast days to minimize highly contrasting shadows. A single-lens reflex camera with a 35mm lens and Kodachrome film was used. The conditions represented by the four seasons are full-leaf summer, partial fall color, snow covered winter, and leafless spring.

Scenic Value Ratings

A ten point rating scale was used to measure scenic value. Between 84 and 171 college juniors majoring in landscape architecture or environmental studies evaluated the 23 scenes four times during the academic year. Of these, 36 students were identifiable as having evaluated all the scenes in all four evaluation sessions.

In an earlier study, Palmer (1990) found that scenic value varied significantly both by season of the photograph, as well as season of the judgment. Therefore, the 23 scenes from a particular season were evaluated only during the season in which they were photographed. Raw scores are used in the analysis in keeping with Schroeder's (1984) finding that "simple mean ratings produced results almost identical to more complicated scaling methods."

Forest Structure Measurements

The site data were measured during the summer within the 64 degree wedge 30 meters deep that corresponded to the photographed view. The following six measurements are used in this study.

1. Time refers to the number of years since the site was harvested.
2. Crown closure used a 2 inch vertical sighting tube at the apex and every 5 meters along the side and center lines of the site area. It is the percent hits of vegetation belonging to crown stems.
3. Ground cover used the vertical sighting tube at the same points to measure hits of ground vegetation.
4. Understory is a count of all stems with less than 4 inch dbh and 1 meter high. It only extends out 10 meters from the viewpoint.
5. Downed wood is a count of all stems crossed by the 30 meter side and center transects. It refers only to dead wood visible above the litter layer, whether natural or residual slash.
6. Large tree is a frequency count of all stems in large saw logs size class (18 to 24 inches dbh).

Analysis

The relationship between scenic value and these six structural variables is investigated using regression analysis. Palmer's (1990) investigation of the relationship of time since harvest and scenic value found that a third degree or cubic polynomial described a curve that could easily be related to forest growth and fit well with the empirical data. Therefore, both simple linear and cubic regressions will be used here. The best-fit third order polynomial curve for each analysis is plotted with the data in figure 1. The analysis is conducted using JMP 2.0 software on a Macintosh IIx computer (SAS 1989).

In evaluating the following results, the reader should be aware that the sites are not randomly sampled, nor do they form a balanced design. In addition, the sample is somewhat small, a topic that will be considered in the discussion section.

Results

Forest Scenic Value as a Function of Time Since Harvest

The results of linear and cubic regression analyses predicting scenic value over four seasons as a function of years since harvest is shown in table 2. The beta coefficient for the summer, fall and spring linear results are small and not significantly different from zero. However, the results for winter are very significant and account for 53 percent of the variation in scenic value. They indicate that for every year the forest ages scenic value decreases .13 points.

The beta coefficients for the cubic regressions are not significantly different from zero. However, the overall models for the fall and winter cubic regressions are significant and explain 36 and 54 percent respectively of the variation in scenic value. Fall scenic value appears to decline until 8 or 9 years since harvest, and then begins to improve. Winter scenic value sees a steady decline throughout the 13 years since harvest covered by these sites.

Table 2. Influence of years since harvest on forest scenic value.

	Summer	Fall	Winter	Spring
Linear:				
R^2	0.03	0.00	0.53	0.08
Intercept	6.37***	5.80***	7.73***	5.42***
beta(x)	$-0.02^{n.s.}$	$0.00^{n.s.}$	-0.13***	$0.04^{n.s.}$
Overall-*F*	$0.64^{n.s.}$	$0.01^{n.s.}$	23.3***	$1.79^{n.s.}$
Cubic:				
R^2	0.10	0.36	0.54	0.15
Intercept	7.12***	6.57***	7.37***	6.00***
beta(x)	$-0.63^{n.s.}$	$-0.15^{n.s.}$	$0.09^{n.s.}$	$-0.26^{n.s.}$
beta(x^2)	$0.10^{n.s.}$	$-0.02^{n.s.}$	$-0.03^{n.s.}$	$0.03^{n.s.}$
beta(x^3)	$-0.00^{n.s.}$	$0.00^{n.s.}$	$0.00^{n.s.}$	$-0.00^{n.s.}$
Overall-*F*	$0.71^{n.s.}$	3.49*	7.32**	$1.09^{n.s.}$

Significance: *** ≤ .001, ** ≤ .01, * ≤ .05, and $^{n.s.}$ ≥ .05

Forest Scenic Value as a Function of Crown Closure

The results of the regression analyses showing the relationship of crown closure on scenic value are given in table 3. Only the fall linear analysis is significant, accounting for 34 percent of the variation in scenic value. A 10 percent increase in crown closure is associated with a .3 increase in scenic value.

Fall is also the only significant cubic regression analysis, explaining 39 percent of the variation in scenic value. The best-fit curve in Figure 1 indicates that values of crown closure below approximately 50 percent have rapidly decreasing scenic value.

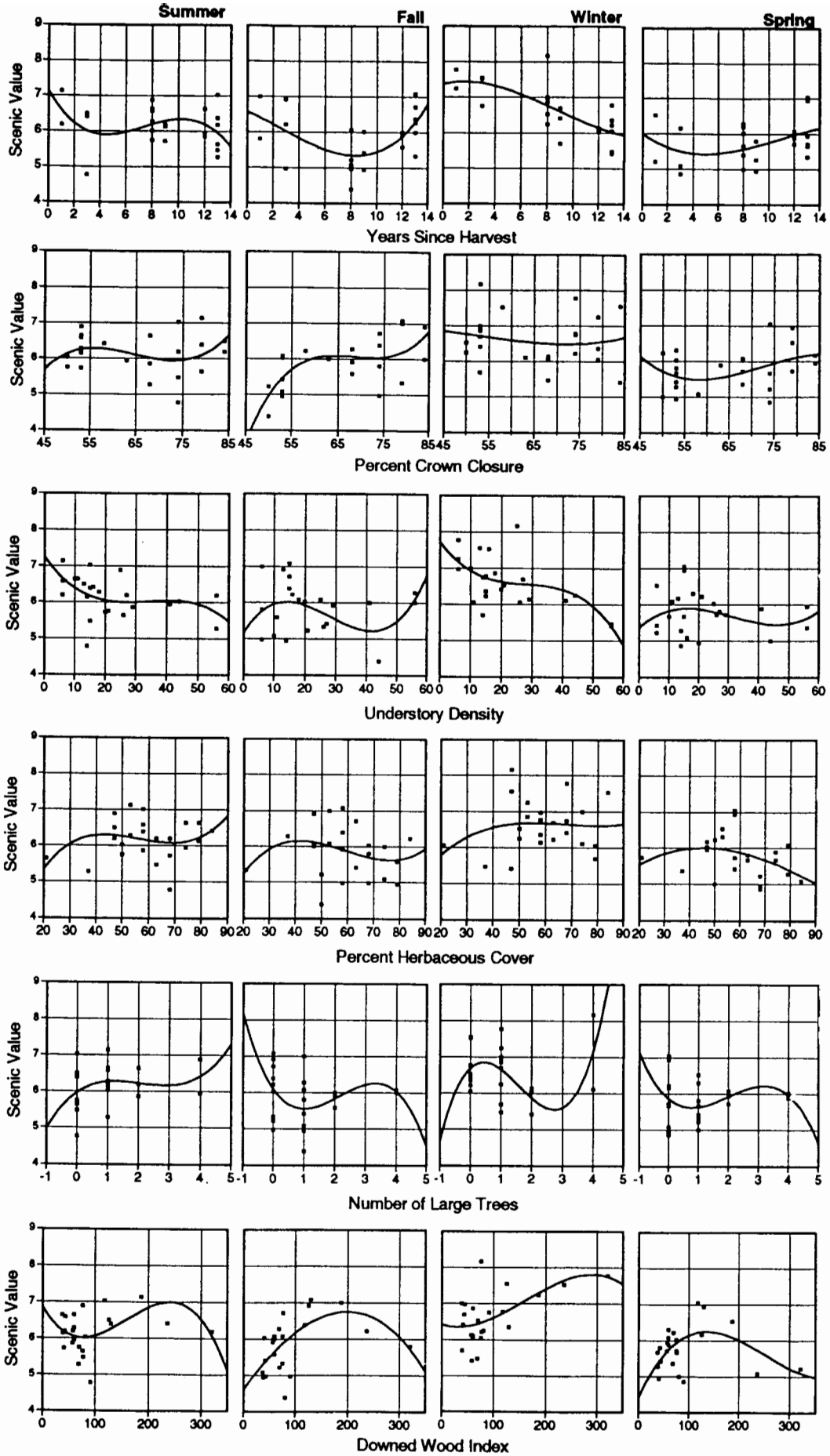

Figure 1.
Plots with a best-fit cubic curve showing the relationship of scenic value during four seasons to six measures of forest structure.

Table 3. Influence of crown closure on forest scenic value.

	Summer	Fall	Winter	Spring
Linear:				
R^2	0.00	0.34	0.01	0.12
Intercept	6.26***	3.57***	7.04***	4.65***
beta(x)	$-0.00^{n.s.}$	0.03**	$-0.01^{n.s.}$	$0.02^{n.s.}$
Overall-*F*	$0.02^{n.s.}$	10.60**	$0.26^{n.s.}$	$2.88^{n.s.}$
Cubic:				
R^2	0.09	0.39	0.02	0.15
Intercept	$-28.7^{n.s.}$	$-57.94^{n.s}$	$4.85^{n.s.}$	$27.91^{n.s}$
beta(x)	$1.68^{n.s.}$	$2.82^{n.s.}$	$0.14^{n.s.}$	$-0.99^{n.s.}$
beta(x^2)	$-0.03^{n.s.}$	$-0.04^{n.s.}$	$-0.00^{n.s.}$	$0.01^{n.s.}$
beta(x^3)	$0.00^{n.s.}$	$0.00^{n.s.}$	$0.00^{n.s.}$	-0.00
Overall-*F*	$0.59^{n.s.}$	4.11*	$0.14^{n.s.}$	$1.13^{n.s.}$

Significance: *** ≤ .001, ** ≤ .01, * ≤ .05, and $^{n.s.}$ ≥ .05

Forest Scenic Value as a Function of an Understory Layer

Table 4 shows the linear and cubic relationship of the density of an understory shrub and sapling layer with scenic value. Only the winter linear analysis is statistically significant, explaining 34 percent of the variation in scenic value. However, the summer analysis, with an r-squared of .14, would be significant if alpha were relaxed to the .10 level. In all seasons, scenic value decreases as the density of the understory layer increases.

Winter is also the only significant season in the cubic regression analysis. Scenic value decreases quite rapidly as the understory becomes established, at moderate densities it has only a small negative effect, and at higher densities it again decreases scenic value rapidly. This relationship accounts for 38 percent of the variation in scenic value. While a similar shape, though not as pronounced and not statistically significant, the r-squared for the summer cubic curve is .20.

Table 4. Influence of an understory layer on forest scenic value.

	Summer	Fall	Winter	Spring
Linear:				
R^2	0.14	0.01	0.34	0.02
Intercept	6.47***	5.94***	7.24***	5.91***
beta(x)	$-0.01^{n.s.}$	$-0.00^{n.s.}$	-0.03**	$-0.01^{n.s.}$
Overall-*F*	$3.28^{n.s.}$	$0.17^{n.s.}$	10.98**	$0.45^{n.s.}$
Cubic:				
R^2	0.20	0.11	0.38	0.05
Intercept	7.26***	5.15***	7.72***	5.36***
beta(x)	-0.12	$0.14^{n.s.}$	$-0.11^{n.s.}$	$0.07^{n.s.}$
beta(x^2)	0.00	$-0.01^{n.s.}$	$0.00^{n.s.}$	$-0.00^{n.s.}$
beta(x^3)	-0.00	$0.00^{n.s.}$	$-0.00^{n.s.}$	$0.00^{n.s.}$
Overall-*F*	$1.55^{n.s.}$	$0.81^{n.s.}$	3.88*	$0.32^{n.s.}$

Significance: *** ≤ .001, ** ≤ .01, * ≤ .05, and $^{n.s.}$ ≥ .05

Forest Scenic Value as a Function of Herbaceous Ground Cover

The results of the regression analyses describing the relationship of percent herbaceous groundcover to forest scenic value are given in table 5. None of these analyses is even close to being considered statistically significant. While the variability in groundcover among the sites is good, it appears to be nearly random in relation to scenic value.

Table 5. Influence of herbaceous ground cover on forest scenic value.

	Summer	Fall	Winter	Spring
Linear:				
R^2	0.02	0.01	0.02	0.06
Intercept	5.86***	6.17***	6.24***	6.37***
beta(x)	$0.01^{n.s.}$	$-0.01^{n.s.}$	$0.01^{n.s.}$	$-0.01^{n.s.}$
Overall-*F*	$0.36^{n.s.}$	$0.26^{n.s.}$	$0.35^{n.s.}$	$1.34^{n.s.}$
Cubic:				
R^2	0.11	0.09	0.06	0.15
Intercept	$1.90^{n.s.}$	$1.87^{n.s.}$	$3.86^{n.s.}$	$4.36^{n.s.}$
beta(x)	$0.26^{n.s.}$	$0.25^{n.s.}$	$0.13^{n.s.}$	$0.08^{n.s.}$
beta(x^2)	$-0.00^{n.s.}$	$-0.00^{n.s.}$	$0.00^{n.s.}$	$-0.00^{n.s.}$
beta(x^3)	$0.00^{n.s.}$	$0.00^{n.s.}$	$0.00^{n.s.}$	$0.00^{n.s.}$
Overall-*F*	$0.75^{n.s.}$	$0.62^{n.s.}$	$0.39^{n.s.}$	$1.08^{n.s.}$

Significance: *** ≤ .001, ** ≤ .01, * ≤ .05, and $^{n.s.}$ ≥ .05

Forest Scenic Value as a Function of Large Tree Presence

Table 6 lists the regression analyses predicting seasonal scenic value from the number of trees with diameters at breast height between 18 and 24 inches in the scene. While this is one of the more commonly cited relationships, no relationship is found in these data. Including trees with DBH above 12 inches does not improve the results noticeably. It may be that the trees on these sites are simply too small and among too many other small trees to create the necessary scenic effect.

Table 6. Influence of large tree presence on forest scenic value.

	Summer	Fall	Winter	Spring
Linear:				
R^2	0.06	0.00	0.00	0.00
Intercept	6.04***	5.88***	6.60***	5.75***
beta(x)	$0.12^{n.s.}$	$-0.04^{n.s.}$	$0.01^{n.s.}$	$0.03^{n.s.}$
Overall-*F*	$1.29^{n.s.}$	$0.08^{n.s.}$	$0.00^{n.s.}$	$0.06^{n.s.}$
Cubic:				
R^2	0.09	0.12	0.20	0.05
Intercept	5.97***	6.10***	6.69***	5.85***
beta(x)	$0.60^{n.s.}$	$-1.20^{n.s.}$	$0.79^{n.s.}$	$-0.67^{n.s.}$
beta(x^2)	$-0.34^{n.s.}$	$0.77^{n.s.}$	$-1.03^{n.s.}$	$0.53^{n.s.}$
beta(x^3)	$0.06^{n.s.}$	$-0.12^{n.s.}$	$0.22^{n.s.}$	$-0.09^{n.s.}$
Overall-*F*	$0.59^{n.s.}$	$0.89^{n.s.}$	$1.59^{n.s.}$	$0.33^{n.s.}$

Significance: *** ≤ .001, ** ≤ .01, * ≤ .05, and $^{n.s.}$ ≥ .05

Forest Scenic Value as a Function of Downed Wood

The results of the regression analyses relating the amount of downed wood or residual slash to seasonal scenic value are shown in table 7. Only the winter results are significant among the linear analyses, and the relationship is unexpectedly positive. This may be because under snow-cover slash produces wonderful sculptural forms and shadow patterns.

While the cubic regressions all have encouraging r-squared values, only the fall analysis is significant. A moderate amount of slash appears to increase scenic value in the fall, perhaps by increasing visual variety, but beyond that low level it has a negative value. A similar pattern is seen in the spring, while summer has a more equivocal pattern.

Table 7. Influence of downed wood on forest scenic value.

	Summer	Fall	Winter	Spring
Linear:				
R^2	0.05	0.13	0.31	0.00
Intercept	5.99***	5.50***	6.07***	5.78***
beta(x)	0.00$^{n.s.}$	0.00$^{n.s.}$	0.01**	-0.00$^{n.s.}$
Overall-*F*	1.09$^{n.s.}$	3.07$^{n.s.}$	9.31**	0.00$^{n.s.}$
Cubic:				
R^2	0.18	0.35	0.32	0.27
Intercept	6.87***	4.60***	6.41***	4.39***
beta(x)	-0.02$^{n.s.}$	0.02$^{n.s.}$	-0.00$^{n.s.}$	0.03$^{n.s.}$
beta(x^2)	0.00$^{n.s.}$	-0.00$^{n.s.}$	0.00$^{n.s.}$	-0.00$^{n.s.}$
beta(x^3)	-0.00$^{n.s.}$	-0.00$^{n.s.}$	-0.00$^{n.s.}$	0.00$^{n.s.}$
Overall-*F*	1.40$^{n.s.}$	3.42*	2.96$^{n.s.}$	2.31$^{n.s.}$

Significance: *** ≤ .001, ** ≤ .01, * ≤ .05, and $^{n.s.}$ ≥ .05

Forest Scenic Value as a Function of Structural Characteristics

The results of the linear regression analyses shown in table 8 predict seasonal scenic value from the six structural characteristics: time since harvest, crown closure, understory layer, herbaceous ground cover, large trees, and slash or downed wood. The results indicate a moderate level of explanation, particularly for winter, which is the only statistically significant model. The presence of an understory layer has a negative effect that is significant in the summer, winter and spring models. The presence of large trees has a positive effect that is significant in the summer and winter models. These results are in the expected direction. However, ground cover has a negative effect that is significant in the winter model. This is not an expected result. The other beta-terms are not significantly different from zero.

Table 8. Linear regression predicting seasonal scenic value from six structural characteristics .

	Summer	Fall	Winter	Spring
R^2	0.36	0.40	0.77	0.41
Overall-*F*	1.52$^{n.s.}$	1.78$^{n.s.}$	8.05***	1.88$^{n.s.}$
Terms:				
Intercept	6.78***	3.52*	9.17***	5.49***
Time	0.03$^{n.s.}$	0.05$^{n.s.}$	-0.06$^{n.s.}$	0.08$^{n.s.}$
Understory	-0.02*	-0.01$^{n.s.}$	-0.03**	-0.02*
Crown closure	-0.01$^{n.s.}$	0.03$^{n.s.}$	-0.02$^{n.s.}$	0.01$^{n.s.}$
Large tree	0.24*	0.07$^{n.s.}$	0.21*	0.15$^{n.s.}$
Ground cover	-0.01$^{n.s.}$	-0.00$^{n.s.}$	-0.02*	-0.01$^{n.s.}$
Downed wood	0.00$^{n.s.}$	0.00$^{n.s.}$	0.00$^{n.s.}$	0.00$^{n.s.}$

Significance: *** ≤ .001, ** ≤ .01, * ≤ .05, and $^{n.s.}$ ≥ .05

Discussion

The results reported here offer some encouragement that forest scenic value can be predicted using traditional measurements of the forest's structure. However, the more lasting contributions of this study are the demonstration that the relationship varies among the seasons, that the relationship may not be linear, and that more sites must be used in future studies to demonstrate these relationships.

Seasonal Variation

As previously shown by Palmer (1990) and Buyhoff(1979), this study demonstrates that the scenic value of a particular site varies through the seasons. Past studies have focused on the value of summer scenes, which this study suggests are the most difficult to predict from traditional forest structural attributes. This may be because foresters are normally not interested in the pattern, color, density or other features of foliage which dominates the summer scene. In addition, the effect of foliage varies greatly from spot to spot within a stand, while the structural variables of interest to foresters can be expected to be more consistent. It may be that the predominance of scenic use may occur during the summer and therefore this is a limitation that must be accepted. However, the correlation among the four seasons is somewhat modest (Pearson correlations range between .08 and .57). Where use during other seasons is important, such as for a ski resort area, it is clear that they must be represented to obtain an accurate analysis.

Shape of the Relationship

More consideration must be given to exploring relationships other than simple linear ones. In this study, a third order polynomial offered much greater descriptive power than the linearal relationship between scenic value and time since harvest, percent ground cover, the number of large trees present, and the amount of downed wood or slash residue. Such non-linear relationships may have clear and easily explained causes, such as the relationship between scenic value and time since harvest described by Palmer (1990). It is hoped that other investigators will continue to search for such relationships and their causes.

Necessary Number of Sites

The primary weakness of this study comes from the use of too few sites to demonstrate significant relationships. Power analysis tells us the probability that an analysis will yield significant results. It is based on sample size, the size of the effect in the model, the standard deviation of the model's residual error, and the alpha significance level. Using estimates based on the data used in this study, an estimate of the sample sizes needed for the linear regressions presented above to be significant at the .05 level were calculated in JMP (SAS 1989) and are presented in table 9. It is recommended that future studies consider sample sizes of between 50 and 100 in order to provide more powerful analyses.

Table 9. Minimum sample size needed to predict a significant linear relation between forest scenic value and structural characteristics.

	Summer	Fall	Winter	Spring
Time	146	6,131	7	52
Understory	29	517	11	200
Crown closure	3,753	11	345	33
Large tree	71	1,122	22,945	1,433
Ground cover	246	340	251	68
Downed wood	83	31	12	$\rightarrow\infty$
Overall model	37	32	12	31

Note: Based on an alpha of .05 and data from 23 sites.

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