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FEBRUARY 25-28, 1990

SARATOGA SPRINGS, NEW YORK

NORTHEASTERN RECREATION RESEARCH MEETING
POLICY STATEMENT

The Northeast Recreation Research meeting seeks to foster quality information exchange between recreation and travel resource managers and researchers throughout the Northeast. The forum provides opportunities for managers from different agencies and states, and from different governmental levels, to discuss current issues and problems in the field. Students and all those interested in continuing education in recreation and travel resource management are particularly welcome.

NERR STEERING COMMITTEE

The Steering Committee wishes to thank John Nelson for his assistance in developing the conference data base.

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State Parks Management and Research Institute

Saratoga Springs, New York

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NORM ACTIVATION AND THE ACCEPTANCE OF BEHAVIORAL RESTRICTIONS AMONG OVER SAND VEHICLE USERS

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This study examines the roles of ascription of responsibility (AR), awareness of consequences (AC), prior experience, motivations for visiting and beliefs about overuse on over sand vehicle (OSV) recreationists' willingness to accept restrictions on their behavior. Data for this paper come from a survey of 499 OSV users who visited two barrier beaches during the summer of 1988. Results confirmed the hypothesized relationships. Individuals who were aware of the negative environmental impacts resulting from OSV use and who personally ascribed some responsibility for the impacts were more likely to perceive overuse problems and accept restrictions on their behavior. People who made more visits to the barrier beaches and those who rated more highly the importance of their vehicle as a reason for visiting the area, were less willing to accept restrictions. The implications of these findings for theory and resource management are discussed.

Introduction

The presence of oversand vehicles (OSV) on barrier beaches can impact the stability of dune systems (Godfrey & Godfrey, 1981), adversely affect shorebird populations (Blodget, 1978), and may result in conflicts among recreationists (Noe, Hull, & Wellman, 1982). Efforts to prohibit OSV usage altogether or restrict such vehicles at certain times of the year (e.g., during critical nesting periods) have lead to conflicts between management agencies and the recreation public.

This paper examines the normative conditions which activate OSV users' willingness to accept restrictions on their vehicle usage at two barrier beaches -- Cape Poge Wildlife Refuge and Wasque Reservation. Both areas are located on Martha's Vineyard and are managed by The Trustees of Reservations. Cape Poge is 489 acres composed of 3 miles of barrier beach as well as salt marsh, fresh and brackish ponds and cedar thickets. Wasque is 200 acres and consists of heathland uplands, salt marsh, 2 fresh and brackish ponds and 2 miles of barrier beach. Cape Poge and Wasque are separated by 2 miles of privately owned barrier beach. In addition to providing opportunities for beach related recreational activities such as swimming, sunbathing, fishing, and 4-wheel drive usage, the two beaches contain populations of rare birds - piping plovers and least terns.

Norm Activation Theory

Efforts to understand the relationships between individuals' attitudes and behaviors have been a primary focus of social psychological research since LaPiere's classic 1934 study. Fifty years of research has shown that the relationship between attitudes and behavior are far from strong (Schuman & Johnson, 1976; Hill, 1981; Michener, DeLamater, & Schwartz, 1986); people often fail to act in accordance with the attitudes they hold. In response to the lack of attitude-behavior consistency in individuals, there has been considerable discussion of the intervening variables which suppress or enhance the attitude-behavior relationship.

In this tradition, Schwartz (1968, 1970, 1975) has hypothesized that there may be individual differences and situational factors which serve to activate a norm so that it influences behavior. The norm activation model proposed by Schwartz examined the influence of moral norms on prosocial or helping behaviors (e.g., donation of bone marrow). A moral norm was defined as culturally specified rules of what constitutes good and bad interpersonal interaction (1970; p. 128). Heberlein (1972) has argued that the growing concerns for environmental quality have made decisions regarding the environment a moral issue. For example, concern over the depletion of the ozone layer has stressed the consequences for both the natural environment (e.g., flooding of coastal resources due to rising sea levels), as well as the health and safety of individuals (e.g., increased skin disease). To the extent that concern for the well being of others is aroused, traditional moral norms which regulate interpersonal behavior are likely to influence environmental behaviors as well (Van Liere & Dunlap, 1978).

Norms are "activated" when certain conditions are met (Schwartz, 1970, 1975). First, individuals need to possess an awareness of the consequences their behavior has on the needs of others or on the physical environment. Second, individuals must accept some responsibility for their actions. The extent to which people are aware of the consequences (AC) and ascribe some personal responsibility (AR) influences how situations are evaluated. For example, acceptance of the rules and regulations regarding OSV use may depend to a significant degree on whether 4-wheel drive users are aware of the problems their actions may have on the environment as well as the experience of other recreationists, and whether they are willing to accept blame for those problems.

Previous Research

Although the norm activation model has been used primarily to explain norm-behavior consistency in helping behaviors (Schwartz, 1970, 1975), its usefulness in explaining environmental behavior has been suggested by several researchers. Heberlein (1975) shows norms, AR and AC are useful constructs in explaining variations in littering behavior, the purchase of lead-free gasoline and energy conserving behavior. The studies summarized by Heberlein (1975), however, are to some extent contrary to Schwartz's initial results. The influence of AR and AC varied depending on the strength of the norm and the type of behavior being studied. In situations where environmental norms were not widely held, evidence of high AC and AR sensitized individuals to the emergence of such norms, rather than activating existing norms.

Van Liere and Dunlap (1978) examined the influence of AR and AC on an established moral norm (i.e., respect for the health of others). At issue was the air pollution resulting from yard burning. Results indicated that AR was significantly related to burning behavior, however, AC was only weakly correlated with the activity. Similar to Schwartz's initial theoretical model, a significant interaction between AR, AC and yard burning was observed.

Noe and his associates (Noe, et al. 1982) tested the norm activation model on a sample of off road vehicles (ORV) users at Cape Hatteras National Seashore. Five indicators of ascription of responsibility were derived from a factor analysis of 12 Likert type variables. Factor 1, for example, was labelled *Unfairly Blame* and included statements that ORV users are unfairly blamed for litter, erosion and vandalism caused by other beach users. Awareness of consequences was operationalized in a similar manner. Six statements were factor analyzed to create 2 indicators of the concept. The primary dependent variables consisted of four normative options regarding regulating ORV usage. These options ranged from a complete closure norm to an elimination of regulations norm.

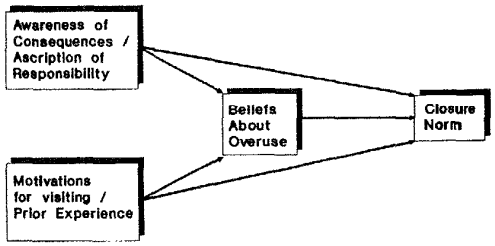
Separate regressions were run for each of the four seashore norms operationalized by Noe et al. (1982). The impact of the AR and AC indicators varied as a function of the type of norm under consideration. In general, the AR variables were significant when the ORV users sought to justify their participation through eliminating regulations or requiring a permitting system, however, the strength of the relationship was weak. When the normative situation referred to closing an area to ORV use or restricting ORV activity, the AC variables were better predictors than the AR indicators. Given the strength of the relationships, these authors conclude that the model may not be the most appropriate for predicting conformity to norms in a recreation situation, yet concede that a more rigorous test of the concepts may be needed.

Taken together, these findings suggest several general conclusions about norm activation. First, both AR and AC are important for norm activation, however, the strength of their impact varies considerably. In situations where a clearly defined norm exists (e.g., helping behavior, littering, air pollution), AR and AC serve to activate the established norm. In other situations where the norms for appropriate behavior are evolving (e.g., rules and regulations pertaining to recreation activities), AR and AC may sensitize individuals to the emergence of such norms. Awareness of negative consequences and/or acceptance of personal responsibility thus become prerequisites to initial awareness of a new norm rather than conditions necessary to activate existing norms.

Second, given the strength of the observed relationships, other individual difference variables may serve to activate or deactivate a person's norm in a recreation setting. Prior experience, for example, has been shown to directly influence visitor evaluations (Vaske, Donnelly, & Heberlein, 1980). Individuals who frequently visit an area are probably less willing to accept management actions that restrict their behavior than those who visit less often. Imposing use limitations represents a potentially greater impact for those with high visitation rates. Similarly, the motivations for visiting a recreation resource are equally important considerations. Individuals who consider their OSV to be an important reason for their visit are likely to be less supportive of restrictions on their use of the vehicle.

Third, awareness of consequences (AC), ascription of responsibility (AR), and the other individual difference variables (e.g., prior experience and the importance of the OSV) may not have the predicted influence on reactions to regulations if the visitors do not perceive that the resource is being overused or that the area is approaching the limit of the number of people the resource can tolerate. Such beliefs about overuse thus mediate the relationship between the individual difference variables and the activation of the norm (Figure 1).

Figure 1. Norm Activation Model



Hypotheses

Based on the norm activation research discussed above and the variable relationships outlined in Figure 1, the following hypotheses are offered to account for OSV users' willingness to accept behavioral restrictions on their activity. Acceptance of restrictions on OSV usage is:

H_1 positively correlated with awareness of the consequences (impacts) resulting from oversand vehicles

H_2 positively correlated with ascription of responsibility

H_3 negatively correlated with frequency of visiting the area

H_4 negatively correlated with the importance of four-wheel driving as a motivation for visiting

H_5 positively correlated with beliefs about overuse.

Beliefs about overuse are predicted to mediate the relationship between the individual difference variables and the respondents' willingness to accept constraints on their recreation behavior. Beliefs about overuse are hypothesized to be:

H_6 positively correlated with AC and AR

H_7 negatively correlated with the importance of four-wheel driving as a motivation for visiting

H_8 positively correlated with the frequency of visiting the area

As indicated earlier, hypothesis 6 is based on the assumption that awareness of consequences and ascription of responsibility sensitize visitors to overuse issues. Thus, people who report high AC and AR should also be more cognizant of impact conditions. Similarly, people who visit the area more frequently should be more aware of overuse. Hypothesis 8 is based on previous research that has shown that visitors perceptions of overuse are related to their own style of recreation (Lucas, 1979). The impacts associated with livestock use or motorized vehicles, for example, are more acceptable to horsemen and cyclists than to hikers (Kuss, Graefe, & Vaske, 1990). Thus, visitors who place a greater importance on 4-wheel driving are less likely to notice the impacts associated with 4-wheel driving.

Methods

A visitor use survey was conducted at Cape Poge Wildlife Refuge and Wasque Reservation during the summer of 1988 (Donnelly & Vaske, 1989). A total of 499 interviews were conducted with OSV visitors using a two page, self-administered questionnaire. Virtually all individuals contacted to participate in the study agreed to complete the survey.

Measures

Dependent Variable: The primary dependent variable refers to the visitors' willingness to accept restrictions on their usage of over sand vehicles at Cape Poge/Wasque. A scale was constructed from four variables, where each was coded on a four-point Likert scale ranging from strongly disagree (1) to strongly agree (4). The statements depicted increasing levels of restriction on OSVs ranging from prohibitions on use while shorebirds are nesting to a total ban of the vehicles. An item analysis including calculations of item-total correlations and Cronbach Alpha was conducted on the four variables to identify the best combination of scale items.

Independent Variables: The independent variables used in the analyses fall into two categories. The first category refers to a person's awareness of the consequences (AC) of using OSVs and his/her ascription of a personal responsibility (AR) for these impacts. The AC scale was constructed from two statements which evaluated the extent to which visitors believed that the number of four-wheel drive vehicles was harmful to the shorebirds and the dunes. The AR scale was created from four variables. Two of the statements read: I feel a strong personal obligation to protect the shorebirds (the dunes). The remaining two variables asked visitors if they would be willing to reduce the number of their visits if it meant protecting the shorebirds (the dunes). Responses to the individual AC and AR variables ranged from strongly disagree (1) to strongly agree (4). Item-analyses were again calculated for each scale.

The second set of predictor variables represented the other individual difference measures suggested by Figure 1. The perceived importance of the over sand vehicle to the individual as a motivation for visiting Cape Poge/Wasque was coded on a four-point scale ranging from not important (1) to very important (4). The respondents' number of annual visits was used as an indicator of prior experience.

Mediating Variable: As predicted by Figure 1, beliefs about overuse mediate the relationship between the individual difference / situational variables (AR, AC, prior experience and motivations) and the individual's acceptance of behavioral restrictions. An overuse scale was constructed from three Likert statements. Each of the separate items were again coded on a four-point scale from strongly disagree (1) to strongly agree (4). These statements were: Cape Poge/Wasque is approaching the limit of the number of people the area can tolerate; There are too many four-wheel drive vehicles using Wasque; and It would be more desirable if the number of visitors were reduced. Similar to the behavioral restrictions scale, an item-analysis was conducted on the belief scale to determine the best combination of variables.

Results

Responses to the four statements representing reactions to behavioral restrictions are shown in Table 1. The OSV users opposed a total ban on their activity but would tolerate some restrictions on their behavior. While only 8 percent accepted the idea of not allowing OSVs at Cape Poge and Wasque, 11 percent felt banning vehicles would be alright if a public shuttle were provided and 17 percent would accept restricting OSV use to Wasque. The highest support (42%) was given for restricting vehicles when the shorebirds are nesting. Reliability statistics (item-total correlations and Cronbach Alpha) calculated for the summated rating scale indicated that the four statements produced the best measure of the respondents willingness to accept constraints on their behavior. Deleting any item from the scale would lower the remaining scale's standardized alpha.

Table 1. Item Composition for Behavioral Restrictions Scale

Behavioral Restrictions	Percent Agreeing	Mean s.d.	Alpha if Item Deleted	Alpha
4-wheel drive vehicles should not be allowed at Cape Poge/Wasque	8%	1.32 .68	.71	.78
It would be OK to ban 4-wheel drive vehicles from the beach if a public shuttle were provided	11	1.37 .74	.68	
It would be OK to ban 4-wheel drive vehicles from Cape Poge, if they were allowed at Wasque	17	1.63 .86	.66	
4-wheel drive vehicles should not be allowed at Cape Poge when shorebirds are nesting	42	2.25 .96	.77	

Table 2 examines respondents' beliefs about overuse at Cape Poge and Wasque. A majority (51%) of the OSV users felt Cape Poge/Wasque is approaching the limit of the number of people the area can tolerate. About a third (34%) felt there were too many four-wheel drive vehicles using Wasque and a slightly higher percentage (41%) expressed a desire to reduce the current number of visitors. The standardized alpha for this scale was .71. Reliability analysis of these belief statements indicated that the three variables resulted in the highest Cronbach Alpha.

Table 2. Item Composition for Overuse Scale

Beliefs about Overuse	Percent Agreeing	Mean s.d.	Alpha if Item Deleted	Alpha
Cape Poge/Wasque is approaching the limit of the number of people the area can tolerate	51%	2.48 .97	.62	.71
There are too many 4-wheel drive vehicles using Wasque	34	2.10 .93	.63	
It would be more desirable if the number of visitors were reduced	41	2.26 .84	.59	

Many of the OSV users in this sample were aware of the consequences their vehicles can have on the environment. Sixty percent believe their vehicles are harmful to the dunes and half feel they harm the wildlife (Table 3). For analysis purposes, these two variables were combined into a single AC scale (Alpha = .91).

Table 3. Item Composition for Awareness of Consequences Scale

Awareness of Consequences	Percent Agreeing	Mean s.d.	Alpha if Item Deleted	Alpha
The number of 4-wheel drive vehicles is harmful to the *dunes*	60%	2.63 1.00	--	.91
The number of 4-wheel drive vehicles is harmful to *shorebirds*	51	2.46 .99	--	

The survey included four questions relating to the respondent's level of personal obligation to protect the area and their willingness to restrict their activities to achieve this goal (Table 4). The OSV users felt personally obligated to protect the birds (86%) and the dunes (89%), but were less willing to reduce their visitation to meet this end. Only about half of the respondents said they would be willing to personally reduce their visits if it meant protecting the birds (54%) and the dunes (55%). Taken together, these four variables constitute an indicator of the AR concept. The standardized alpha for this four item scale was .84.

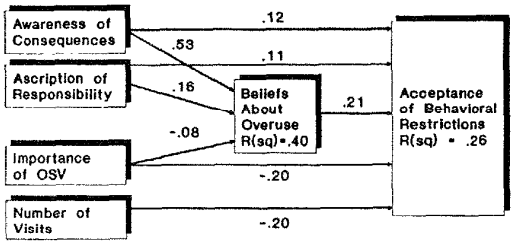
Table 4. Item Composition for Ascription of Responsibility Scale

Ascription of Responsibility	Percent Agreeing	Mean s.d.	Alpha if Item Deleted	Alpha
I feel a strong personal obligation to protect the *shorebirds*	86%	3.25 .78	.82	.84
I feel a strong personal obligation to protect the *dunes*	89	3.32 .77	.82	
I would be willing to reduce the number of my visits if it meant protecting the *shorebirds*	54	2.50 .99	.77	
I would be willing to reduce the number of my visits if it meant protecting the *dunes*	55	2.52 .99	.77	

Cape Poge and Wasque provide visitors with a variety of experiences. Over two thirds of the OSV users rated being near the ocean, seeing a unique area, sunning on the beach, fishing, swimming and four-wheel driving as a quite or very important reasons for visiting the area. The OSV users ranked four-wheel driving fourth in importance among the eight motivations listed as reasons for visiting, with 76 percent rating the vehicle as an important reason. Finally, many of the respondents in this sample visited Cape Poge/Wasque on a regular basis. The average number of yearly visits was 18.4 times per year and the standard deviation was 21.6 (range = 1 to 150).

The norm activation model proposed in this paper was examined using multiple regression techniques and the conventions of path analysis (Duncan, 1975; Heise, 1975). Figure 2 presents the standardized regression coefficients for the model. Acceptance of behavioral restrictions is the primary dependent variable. Independent variables include the scales for beliefs about overuse, AR and AC, as well as the two single item indicators of the perceived importance of the OSV and the frequency of yearly visitation. As predicted by hypotheses 1 through 5, each of the independent variables had a direct effect on the respondents' acceptance of behavioral restrictions. Beliefs about overuse, the importance of the OSV and the number of yearly visits had the strongest influence (B = .21, B = -.20, B = -.20, respectively). Individuals who believed that Cape Poge/Wasque was being overused were more likely to accept restrictions on their OSV use (Hypothesis 5). Conversely, visitors who placed a greater importance on using 4-wheel drive vehicles (Hypothesis 4) and who made more visits (Hypothesis 3) were less willing to have constraints placed on their use.

Figure 2. Norm Activation Path Model



Coefficients are standardized regression coefficients ($p < .05$)

As hypothesized by the norm activation model, AC and AR were also statistically significant and in the predicted direction. Individuals who were aware of the consequences of using OSVs (B = .12) and who ascribed a personal responsibility for protecting the environment (B = .11) were more accepting of use restrictions (Hypotheses 1 and 2, respectively). Taken together, the five independent variables explained 26 percent of the variance in the dependent variable.

Beliefs about overuse were predicted to mediate the relationship between the individual difference measures and the acceptance of behavioral restrictions (Hypotheses 6 through 8). For this set of analyses, beliefs about overuse was treated as the dependent variable, while AC, AR, perceived importance of the OSV as a motivation for visiting and frequency of visitation were independent variables.

Consistent with Hypothesis 6, awareness of consequences and ascription of responsibility were positively associated with beliefs about overuse. The influence of AC, however, was considerably stronger than AR (B = .53 versus B = .16, respectively). Similarly, the predicted inverse relationship between tl importance of the OSV as a reason for visiting and perceptions of overuse was supported by the data (Hypothesis 7; B = -.08). There was no relationship, however, between the number of annual visits and the overuse scale (Hypotheses 8). The three significant predictor variables in the equation accounted for 40 percent of the variation in the respondents' beliefs abo overuse.

Discussion

Seven of the eight hypotheses advanced by Figure were supported by the analyses. Individuals who were aware of the consequences of using OSVs, those who personally ascribed some responsibility for the impacts created by their vehicles and those who believed the area was being overused were more willing to accept at least some constraints on their OSV usage. In addition the importance of the vehicle as a reason for recreating and the frequency of annual visitation were, as predicted, negatively associated with the closure norm.

There was also support for the idea that beliefs about overuse mediate the relationship between the individual difference variables and the acceptance of behavioral restrictions. AC and AR had a positive influence on perceptions of overuse, suggesting that before individuals are willing to accept restrictions on their activity, they must perceive that an unacceptable impact condition exists. The importance of the OSV as a reason for visiting was negatively associated with overuse. This supports previous research (Lucas, 1979; Kuss et al. 1990) that shows the impacts associated with motorized activities are more acceptable to participant: in those activities. The impact of the number of annual visits on overuse was the only hypothesis that was not supported, a finding that will be addressed later.

Taken together, these findings suggest a number of considerations relative to norm activation and the management of barrier beaches. Consistent with the initial norm activation model proposed by Schwartz (1970, 1975), both AR and AC appear to be necessary t activate the norm. In this investigation, the relative contribution of AR and AC on the closure norm was approximately equal (B = .11 and B = .12, respectively) Previous environmental applications of the model have shown that the influence of these concepts varies depending on the strength of the norm and the type of behavior under consideration (Heberlein, 1975; Van Liere & Dunlap, 1978; Noe, et al. 1982).

Van Liere and Dunlap (1978), for example, found AR to be the strongest predictor of yard burning, while AC was only weakly correlated. Because the normative concern in their study was the health hazards associated with the activity, the moral norm is likely to have been

relatively strong. During the time of their investigation in Spokane, Washington, yard burning was a controversial issue in the community. Given that the topic had received considerable publicity in the local press, it may have been difficult for people to deny an awareness of the negative consequences associated with yard burning. Consistent with their findings, the easiest way to neutralize the moral norm under these circumstances would be to deny responsibility for those consequences. This conclusion is further supported by the lack of consensus that existed regarding an alternative to the activity and the unresolved debate over the contribution yard burning had on air pollution.

Similar to the research summarized by Heberlein (1975), the closure norm studied here represents more of an emerging norm rather than an established moral norm such as that reported by Van Liere and Dunlap (1978). Comparing Heberlein's lead-free gasoline findings to the present study leads to some interesting observations. The lead-free study was conducted at a time when individuals could choose between the purchase of lead-free and leaded gasoline. To the extent that a lead-free norm existed, it had only been adopted by a relatively small proportion of the population, had no formal legal support in 1973 when the data were collected and had received relatively little media coverage. This situation is similar to the conditions studied here. Other than the $45.00 yearly permit required for 4-wheel drive vehicles to use Cape Poge/Wasque, there are no formal constraints to using the property. In addition, there had been no media coverage to explain the possible ecological consequences of OSV use. Of the four variables included in our closure norm scale, only 42 percent of the respondents accepted the idea of restricting 4-wheel drive vehicles when shorebirds are nesting. The remaining variables in the scale were supported by even fewer individuals. Thus, to the extent that a closure norm exists, it might be considered relatively weak. In the lead-free study, both AR and AC influenced the emerging norm approximately equally and the size of the beta weights reported by Heberlein are consistent with those reported here.

The study reported by Noe et al. (1982) is most similar to the present investigation. The activity (4-wheel driving) and the setting (a barrier beach) were identical to our study. The closure norm in their investigation was an additive scale consisting of two items. Similar to the present investigation, one item represented a total ban of ORV use at Cape Hatteras National Seashore, while the second referred to a seasonal closure of the area to ORV activity during the summer months. Although the AR and AC factors employed by Noe et al. do not allow for a direct comparison between the two studies, two points are noteworthy. First, as with the investigation reported here, both AR and AC were significantly related to the closure norm at Cape Hatteras. Second, of the two AC scales -- detailed effects and general effects -- used by Noe and his associates, only the detail effects scale influenced the closure norm. This is consistent with the now well established social psychological finding that correlations between variables (e.g., attitudes and behavior, or in this case, awareness of consequences and a norm) increases when both variables are measured at the same level of specificity (Michener, et al. 1986).

In this study, the strongest predictor of the closure norm was a scale consisting of specific beliefs about overuse. In addition to supporting the general social psychological observation noted above, this also suggests that while AR and AC may be necessary conditions for norm activation, they may not be sufficient conditions. In addition to beliefs about overuse, other variables which should be considered include the person's prior experience with the area and their motivations for visiting.

Many of the OSV users at Cape Poge/Wasque expressed concern over protecting the environment. Eighty-nine percent felt personally obligated to protect the dunes and nearly as many (86%) reported an obligation to protect the shorebirds. This sensitivity to environmental / wildlife concerns can be partially explained by the OSV users' history of involvement with the area and their motivations for visiting Cape Poge and Wasque. The average number of yearly visits reported by the individuals in our sample was 18.4. Responses to other survey items indicated that over half had been visiting for more than five years and a quarter had more than 15 years of experience with the area. Seven percent owned property on the island and nearly 20 percent were members of The Trustees of Reservations, the agency responsible for managing the barrier beaches. This history of involvement is likely to have increased the visitors' commitment to protecting the resource. On the other hand, this level of prior experience may have accounted for visitors' reluctance to place restrictions on their behavior. Traditionally, the beach has been open to the public and many of the respondents may have felt that the status quo was appropriate. The observed negative relationship between number of annual visits and the closure norm, as well as the failure to find a relationship between frequency of visit and beliefs about overuse support this observation.

From a motivational perspective, only 11 percent of the OSV users considered 4-wheel driving as their *primary reason* for their visit. This means that although the OSV users accessed the area using a vehicle, driving along the beach was less important than other reasons for visiting. The vehicle served as a means to engage in a beach related activity such as fishing, rather than as a primary activity itself. However, because the distances between the access points and the favored fishing spots are considerable, and because the alternatives (e.g., a shuttle bus) suggested by the survey were largely unacceptable, the vehicle was still considered a necessary component of the recreation experience.

Data presented here suggests that although OSV users oppose a total ban on their activity, over 40 percent would tolerate restricting vehicles when shorebirds are nesting. Fencing, now in place at Wasque has effectively eliminated OSV traffic from selected wildlife management areas. By restricting use from nesting areas during critical seasons, as opposed to prohibiting use altogether, both the rare bird populations and humans can exist sympatrically. Support for these spatial and temporal restrictions is enhanced when beach closures are kept relatively small and recreationists understand the rationale for the closure.

Although ecologists continue to search for solutions to increase piping plover populations (Rimmer &

Deblinger, 1990), it is apparent that information regarding visitor norms and beliefs must be incorporated into that solution. At a time when the public's thirst for barrier beaches as recreational sites or locations for summer houses seems unquenchable, management strategies, such as beach closure, that are not consistent with visitor attitudes may be deleterious to wildlife in the long run. Conversely, the combination of visitor education and management techniques that balance preservation with recreation can result in a situation where piping plovers nests can be protected from predators and recreationists, and the visiting public can still enjoy the area.

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DELAWARE BEACHES, A VALUABLE RESOURCE: PERSPECTIVES OF PROPERTY OWNERS, RESORT MERCHANTS AND REALTORS IN SUSSEX COUNTY, DELAWARE

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To document the importance of Delaware's beaches as a tourism resource, a survey of property owners, resort merchants and realtors in coastal Sussex County, Delaware was conducted during the summer of 1987. The study identified the effects of beach erosion on the targeted groups. Results indicated that erosion affects residents' future plans for their property. Merchants indicated that beaches were important for their continued economic success. A majority of residents and merchants expressed a willingness to help finance worthwhile beach preservation projects.

Introduction

Delaware like many coastal states, is faced with the problem of erosion, and scientists have studied the natural processes that affect the state's coastline (Kraft 1971, Kraft et al. 1978). The physical effects of erosion--the movement of sand, displacement of dunes, increased flooding, property destruction, and saltwater intrusion--are well known (Titus 1986). Numerous reports and publications document the severity of the problem (Jensen et al. 1978, Maurmeyer and Carey 1985). A variety of shoreline protection measures, such as bulkheads, groins, and sand replenishment, have been employed to combat the physical effects.

As coastal development continues to increase, and coastal population centers continue to grow, major decisions are being made on how to battle coastline erosion. To date many of the decisions have been made by government agencies and vocal community interest groups. Often individual property owners or resort merchants with an interest fail to voice their concerns about erosion and issues related to beach management.

To obtain additional viewpoints, the University of Delaware Sea Grant Marine Advisory Service, with the support of officials in the Beach Preservation Section of the Division of Soil and Water Conservation, Department of Natural Resources and Environmental Control (DNREC) surveyed a sample of coastal interest groups. The survey questionnaires were designed to obtain attitudinal information that could assist resource managers in making current decisions and in implementing future policies about beach management issues.

The interest groups surveyed (property owners; resort merchants; realtors) were chosen in order to obtain a cross-section of views from individuals with different interests in and uses of the Delaware coastline. Some of the survey recipients had a strong economic and business interest; others had a personal and more emotional interest in the issue of erosion.

Methods

Mail surveys were sent to property owners, resort merchants, and realtors during the summer of 1987. The study team randomly sampled 441 property owners in Delaware's Atlantic coastal area; 184 coastal merchants from Rehoboth Beach, Delaware southward to Fenwick Island, Delaware; and 80 realtors who were active in the Sussex County, Delaware coastal area.

Included in each questionnaire was a cover letter explaining the study and a self-addressed business reply envelope. Three weeks after the initial mailing, a follow-up cover letter, replacement questionnaire and business reply envelope were mailed out to those who had not yet responded.

The response rate was greater than 50% for each group (property owners--66%, realtors--63%, resort merchants--55%). The lowest response rate for merchants could be explained by the fact that the survey was distributed during the summer months, which is the height of the summer tourist season.

Results

Coastal property owners were asked to rank by importance, 11 reasons influencing their decision to purchase coastal property. A rank of 5 was assigned to "extremely important" 1 to "not at all important." Restful and relaxing beaches scored the highest with an average ranking of 4.4 on the scale of importance. In addition, scenic beaches (4.2) and well-maintained beaches (4.1) were also viewed as very important reasons by owners. The reasons viewed as least important for buying coastal property were the availability of local activities and beach activities, scoring means of 2.7 and 2.9 respectively (Table 1).

Realtors were also asked to rank the same 11 reasons why they think people would purchase coastal property. In contrast to property owners, realtors ranked that buyers see coastal property as a good financial investment as the most important reason, with a mean score of 4.4.

Following closely, restful and relaxing beaches scored 4.3 and scenic beaches scored 4.2, which are consistent with those reasons ranked highest by property owners. These responses from property owners and realtors emphasize the importance of the beach itself to individuals buying coastal property (Table 1).

Table 1. Property Owners and Realtors' Reasons for Purchasing Coastal Real Estate.

Reasons	Property Owners	Coastal Realtors
Rest and Relaxation	4.4	4.3
Scenic Beaches	4.2	4.2
Well-Maintained Beaches	4.1	3.9
Financial Investment	3.7	4.4
Secure Property	3.7	3.2
Lifelong Dream	3.6	3.5
Close to Family/Friends	3.6	3.4
Lifeguards	3.5	3.4
Minimum Regulations	3.0	2.7
Beach Activities	2.9	3.4
Local Activities	2.7	3.3

Values given are mean scores from a scale ranging from not important (1) to extremely important (5).

A variety of businesses were represented in the survey. Restaurants made up the largest group (20.2%), followed by hotel/motel establishments (19.1%) and gift shops (14.9%). Clothing stores (10.6%), food/liquor establishments (7.4%), convenience/drug stores (7.4%), and resort-type businesses such as arcades, bait and tackle shops and recreational equipment rental shops (3.2%) represented the remaining businesses. An additional 17 percent of responding businesses were included in a miscellaneous category. These included such businesses as hairstyle shops, hardware stores, and basic repair shops.

Of the responding merchants, almost 98 percent were aware that erosion is a problem along the Delaware shoreline. For the most part, respondents stated that all aspects of erosion (storm-related, long-term and short-term/seasonal) were concerns to them.

Business owners and managers were asked to estimate how much of their business revenue was dependent on the existence of a wide sandy beachfront. Overall, approximately 75 percent of the responding merchants indicated that between three-quarters and all of their business activity is a result of the wide sandy beaches (Fig. 1). When asked whether their sales would suffer if the sandy beaches were no longer a part of the natural environment, greater than 94% of all the merchants responded "yes." These responses, in part, may suggest the economic importance of Delaware's sandy beaches and that a healthy tourist economy is directly linked to the beaches.

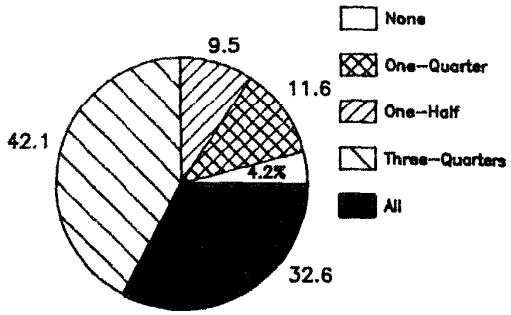

Figure 1. Percent of Merchants Responding How Much of their Business Activity Is Dependent on Sandy Beaches.

After establishing the importance of the beaches to interest groups and the economy, there was a need to find out how the groups felt about different beach erosion control measures. Interest groups were asked to rank various beach preservation measures as possible options for Delaware's Atlantic shoreline. A series of seven measures were listed. Respondents were asked to rate the variables from 1 "very much opposed" to 5 "very much in favor."

In nearly every case, the three interest groups favored measures that did not require major engineering efforts to accomplish the goal of preserving the beach. Dune stabilization (4.8), beach nourishment (4.5), zoning regulations, and setback lines (4.3) received higher mean ratings than structured methods such as building groins and jetties (4.1) or seawalls and bulkheads (3.2) (Fig. 2).

A two-part question asked all three interest groups who they felt receives benefits from Delaware's Atlantic beaches and who should help finance beach preservation efforts. Twelve distinct groups were listed on the survey questionnaire. The groups represented beach users, county residents, government units and various businesses.

Eighty-nine percent or more of all respondents mentioned that most of the groups listed benefitted by the presence of the Atlantic beaches. The federal government and large

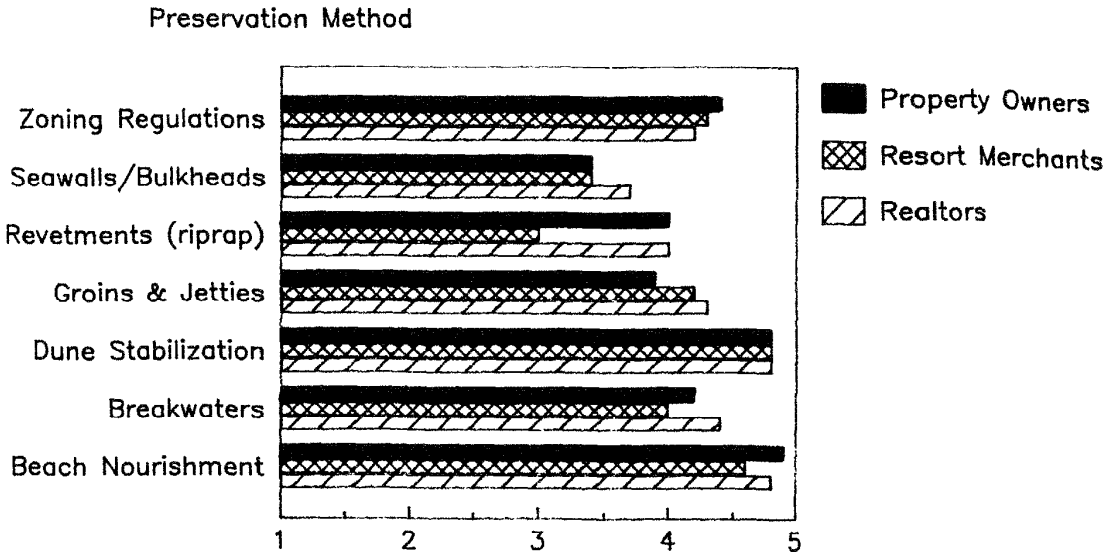

Figure 2. Property Owners, Merchants, and Realtors' Support for Beach Preservation Methods. Values are mean scores from a scale ranging from very much opposed (1) to very much in favor (5).

businesses and industries were the only groups to receive low support ratings from each of the responding groups.

When asked who should help finance beach preservation efforts, the following responses were provided. Property owners felt that state government (96%) and Sussex County government (96%) should be primarily responsible for financing beach preservation efforts. Property owners felt that large businesses and industries (69%) are least responsible (Table 2).

Resort merchants believed that Sussex County government (94%) should be primarily responsible for financing beach preservation efforts. Merchants least favored placing the responsibility on small resort businesses (76%) and large businesses and industries (68%) (Table 2).

Sussex County realtors supported state government (94%) for the primary responsibility of financing beach preservation efforts. Realtors felt that small resort businesses (65%), Sussex County residents (62%), the real estate industry (58%), and large businesses and industries (57%) should be least responsible for financing beach preservation efforts (Table 2).

After further analyzing the complete set of benefit/finance responses, another method of examining the responses was employed. The percentage response figure indicating "should finance" was subtracted from the percentage response figure indicating "receives benefits" from each group. The resulting differences lend themselves to further interpretation.

The closer the differences are to zero, after the subtractions, may provide a clearer indication of which groups should contribute financially to beach preservation efforts according to the interest groups. This is a clearer indication only if the percentage responses were high--in the 90 percent range (Table 3).

An important component of any proposed beach preservation plan is how it will be financed. Property owners and resort merchants were both asked whether they would personally be willing to contribute to funding worthwhile beach preservation measures. Eighty-seven percent of the property owners and approximately 85 percent of the resort merchants said that they would help finance worthwhile efforts.

When asked further as to the maximum amount they would be willing to pay annually, 36 percent of the property owners indicated greater than $500. The mean contribution for property owners lies between $200 and $250 (Table 4).

Table 2. Percentage of Property Owners, Resort Merchants, and Realtors' Responses to which Groups Benefit from the Atlantic Beaches and which Groups Should Help Finance Beach Preservation Efforts.

Group	Property Owners		Resort Merchants		Realtors	
	Benefit	Finance	Benefit	Finance	Benefit	Finance
Out-of-State Tourists	98	81	98	85	100	77
Delaware Tourists	98	83	97	84	100	80
Sussex Residents	92	80	91	79	88	62
Oceanfront Owners	92	84	99	90	98	77
County Government	98	96	95	94	94	91
Municipal Government	98	93	94	92	92	87
State Government	95	96	92	92	94	94
Federal Government	66	79	74	86	78	91
Hotels/Motels	98	92	100	87	98	71
Real Estate & Developers	99	93	98	88	96	58
Small Resort Businesses	97	88	98	76	94	65
Large Businesses/Industries	67	69	69	68	56	57

Table 3. Differences between Property Owners, Resort Merchants, and Realtors' "Receives Benefits" and "Should Finance" Responses.

Group	Property Owners	Resort Merchants	Realtors
Out-of-State Tourists	-17	-13	-23
Delaware Tourists	-15	-13	-20
Sussex Residents	-12	-12	-16
Oceanfront Owners	- 8	- 9	-12
County Government	- 2	- 1	- 3
Municipal Government	- 5	- 2	- 5
State Government	1	0	0
Federal Government	13	12	13
Hotels/Motels	- 6	-13	-27
Real Estate & Developers	- 6	-10	-38
Small Resort Businesses	- 9	-12	-29
Large Businesses/Industries	2	2	1

Zero value indicates benefits received and obligation to finance are equal.
Positive value indicates obligation to finance outweighs benefits received.
Negative value indicates benefits received outweigh obligation to finance.

Resort merchants expressed a somewhat lower interest in contributing to beach preservation efforts. Twenty-seven percent of the merchants said that they would contribute greater than $500. The mean contribution for resort merchants was between $100 and $150. It is understandable the higher amount that property owners are willing to pay to protect their property, since they have more of a personal investment than many of the merchants who may only lease the locations where their businesses are located (Table 4).

Table 4. Percentage of Property Owners and Resort Merchants Willing to Pay Annually for Beach Preservation Efforts.

$ Willing to Pay	Property Owners	Resort Merchants
0	2	4
1- 50	8	16
51- 100	14	17
101- 250	22	16
251- 500	18	19
501-1000	16	24
>1000	20	3

Each interest group was provided a listing of eight sources of revenue that could potentially be used to support beach preservation efforts. They were instructed to indicate which funding sources they could support. Property owners favored a "resort business tax" (68%) and "beach fees" (59%) as their most preferred financing methods. They least favored a "property tax increase" (31%) and increases in "municipal taxes" (31%).

Resort merchants lent their support to a "state tax increase" (51%) and "real estate transfer taxes" (45%). Merchants least favored a "resort business tax" (16%).

Sussex County realtors primarily supported "beach fees" (49%) and "municipal taxes" (41%). As would be expected, they least favored "real estate transfer taxes" (14%). Overall strong support was voiced, by all three groups for a "state tax increase" and "beach fees" to fund beach preservation efforts. Individually, each group supported the revenue source that had the least impact on them personally or as a group (Fig. 3).

Conclusions

The purpose of this study was to examine attitudes and opinions of coastal property owners, resort merchants and Sussex County realtors on various aspects of beach erosion and management issues. More specifically, the questionnaire responses characterized each interest group, provided information on practical management options, and suggested alternative funding strategies.

In general, survey respondents were well-informed, conscientious citizens with concerns about beach erosion and management issues. All three groups indicated they were aware of erosion as a problem along Delaware's Atlantic coast. The average resort merchant and property owner indicated that they had been working or living in coastal Delaware long enough to be aware of severe storm erosion and long-term erosional trends. In fact, many ranked the issue of erosion as important as any currently facing Delaware.

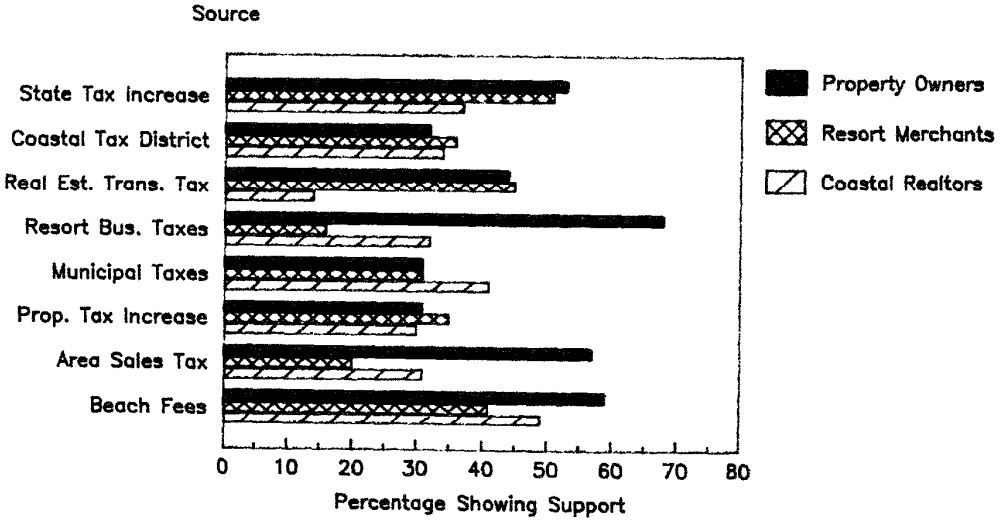

Figure 3. Percent of Property Owners, Resort Merchants, and Realtors Favoring Various Revenue Sources.

The survey results can be useful to resource managers at all levels of government as a valuable source of public opinion. Interest groups in the survey appeared amenable to new sources of revenue and innovative ideas to preserve what they consider a most important resource. Such results can be used as a foundation for identifying new funding sources. Also, the survey results help to establish the link between the coastal economy and a well-preserved beach. The information can be used by economists when assessing the cost and benefits of beach preservation efforts.

Much activity was occurring throughout the state of Delaware regarding beach preservation issues, at the time of this study. The study was not the catalyst for the movement; however it was viewed as an important report that documented the attitudes and opinions of groups that would be affected by management decisions made regarding beach preservation.

The Delaware Department of Natural Resources and Environmental Control (DNREC), Division of Soil and Water Conservation made a decision to begin "pumping sand" on the beaches in the southern part of the coastal area that was experiencing the most severe erosion. The state, the county, and municipal governments all were required to share in the cost of this replenishment effort. In addition, some unincorporated communities were also required to contribute private funds to replace eroded sand.

To begin planning for a long-range strategy to fund beach replenishment efforts in the future, a 1989 bill was introduced and passed by the Delaware General Assembly. House Bill 423 provided for a 2% increase in the state's lodging tax. One percent of these revenues are earmarked for beach preservation. The revenues are expected to net $750,000 annually.

Acknowledgments

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FACTORS AFFECTING BOATING SATISFACTION:

A REPLICATION AND COMPARATIVE ANALYSIS[1]

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Perception of boating quality is a multi-faceted and complex concept. Maintaining quality requires attention to the inter-related set of indicators that are most strongly associated with overall satisfaction. In Summer 1989, a study of 785 boaters was conducted at Berlin Lake, a Corps of Engineers reservoir located in eastern Ohio. A series of regression models were developed to identify the direct and indirect relationships between overall satisfaction and a pool of experiential impacts.

This work replicated a 1987 study of boaters at Raystown Lake, a comparable Corps of Engineers' facility located in central Pennsylvania. In an attempt to better understand and explain visitor satisfaction, the pool of independent variables was expanded in the 1989 study. Variables were added which dealt more specifically with certain types of impacts, as well as the frequency of occurrence and effect on enjoyment of selected types of boating encounters.

Although reported overall satisfaction was equivalent at Raystown and Berlin Lakes (i.e., an average score of 3.6 on a 5-point satisfaction scale), there was a general perception that conditions on Berlin Lake were less crowded. The contribution of the new model was the ability to more fully explain and better predict individual perceptions of crowding and the influence of others on the boating experience. The variables with the greatest influence on satisfaction, in both studies, included the perception that boating conditions were safe and various measures of visitor displacement. Although contributing relatively no more to the explanation of variance in satisfaction, the additional indicators do begin to address the more specific nature of impacts, boater interactions and quality of the boating experience.

Introduction

Satisfaction has often been identified as the principal product of the recreation experience and the major goal of recreation resource management (Driver and Tocher 1970). In fact, satisfaction is probably the most commonly used indicator of quality in the recreation experience. But determining what constitutes a quality experience has proven elusive to researchers and managers alike. Propst and Lime (1982) suggest that satisfaction is an intangible and difficult concept to define in general, not just in outdoor recreation.

Previous studies suggest that recreational satisfaction is influenced by a variety of objective and subjective factors. Graefe and Drogin (1989) integrated two lines of previous research to study satisfaction among boaters at Raystown Lake, a Corps of Engineers reservoir in Central Pennsylvania. These lines included studies focusing on the identification of determinants of satisfaction (e.g., Peterson 1974; Ditton, Graefe and Fedler 1981; Graefe and Fedler 1986) and studies focusing more specifically on the influence of crowding and other density-related impacts on satisfaction (Graefe, Vaske and Kuss 1984; Manning 1986; Shelby and Heberlein 1986). The Raystown Lake study found that 42 percent of the variance in boater satisfaction could be explained from a pool of independent variables that included measures of crowding, conflict, displacement, and safety-related considerations.

This paper reports a replication and extension of Graefe and Drogin's (1989) Raystown Lake study. Additional data were collected during Summer 1989 through interviews with boaters at Berlin Lake, another Corps of Engineers reservoir. Variables measured in the Berlin Lake study included the full range of experiential impacts from the earlier study at Raystown Lake as well as additional indicators dealing with certain types of encounters between boating parties. The objective of this paper is to compare and contrast the results of the two studies of boater satisfaction.

Methods

Study Setting

Raystown Lake is an 8,500 acre reservoir located in central Pennsylvania and managed by the U.S. Army Corps of Engineers. The reservoir was constructed primarily to provide recreation opportunities for residents in the region. Recreation use of the project increased from 475,000 recreation days in 1975 (the first year of operation) to 1,421,000 recreation days in 1986. This visitation includes a wide variety of recreation activities. Increases in boating activity over the years have led to concerns about congestion and the impacts of the numbers of boats on the quality of the boating experience. There are currently 950 marina slips and 150 dry storage slips available at the two marinas on the project. Ten boat ramps located at public recreation areas and three campgrounds provide additional access for boaters.

Berlin Lake is another Corps of Engineers reservoir, located near Youngstown, Ohio and about half of the size (3,590 acres) of Raystown Lake. Berlin Lake was created in 1943 for multiple purposes, including flood control, low flow augmentation, pollution abatement, recreation, conservation, and to enhance fish and wildlife habitat. As in the case of Raystown Lake, high levels of boating activity and localized congestion during peak use periods have historically been management concerns at Berlin Lake. Facilities at the lake include two commercial marinas, two campgrounds, two major public boat ramps and several additional unimproved ramps. Unlike Raystown Lake, there are also many private boat docks along the shores of Berlin Lake. These docks are allowed for adjacent land owners under permits issued by the Corps of Engineers. Some of these docks are maintained as boat clubs.

Data Collection

A combination of survey procedures was used to measure boating use patterns and visitor perceptions about the conditions they encountered. With a few exceptions, similar procedures were used at both study lakes. Peak use boat densities were identified through ground counts of vehicles at all major access points. Aerial photography of the lake's surface was also used at Raystown Lake. For both lakes, visitor perceptions were obtained through on-site personal interviews conducted at all major access points on selected weekend days. Sampling locations included public boat ramps, marinas, campgrounds, and for Berlin Lake, a sample of boat club properties.

Sampling of private docks required a different approach because these docks are widely dispersed around the lake's shoreline. A list of all private dock holders was obtained from the Berlin Lake project manager. All dock owners received a mail survey asking questions similar to those included in the on-site interviews conducted at major access points. Of the 295 surveys sent to dock owners, 224 were returned; a response rate of 76 percent. These procedures were used only at Berlin Lake, since there are no private boat docks on Raystown Lake.

Since the study focused on the assessment of peak use conditions, data collection was conducted on selected weekends. The sampling schedule was designed to represent the varying levels of weekend use. Data collection at Raystown Lake included a total of eight days during Summer, 1987, two of which fell during the Memorial Day and Fourth of July holiday weekends. Sampling at Berlin Lake involved six weekend days during the Summer of 1989.

[1] Support for this project was provided by the U.S. Army Corps of Engineers.

Description of Sample

Raystown Lake. The population of Raystown Lake boaters may be divided into three groups based upon their means of access to the lake: (1) boat ramp users who trailer their boats to the lake for the day (n=448), (2) those who store their boats for the season at one of the two marinas on the lake (n=334), and (3) campers who launch their boats at a boat ramp when they arrive at Raystown and keep their boats at or near the campsite until the end of their visit (n=368). Most boaters at Raystown Lake operate runabouts with an average length of 18 feet and an average of 128 horsepower. Ninety percent of those sampled had boats registered in the state of Pennsylvania. As well, 94 percent of the survey respondents reported that their primary home residence was in Pennsylvania. Boaters traveled an average of 90 miles from their homes to boat at Raystown. Raystown Lake boaters typically had ten years of boating experience and spent an average of 28 days per year boating, 19 of which were at Raystown Lake. Lake visitors participated in a variety of boating activities, the most popular of which was pleasure cruising (36%), followed by water skiing (23%), swimming (21%) and fishing (18%). Both trolling and swimming were mentioned more often as secondary activities than as primary ones, as were "other" activities such as jet skiing, sitting on the boat, skidooing, and picnicking. The majority of boaters at Raystown were in family groups with an average of 4.5 people.

Berlin Lake. Berlin lake boaters may be divided into five groups based upon their means of access to the lake: (1) boat ramp users (n=430), marina users (n=93), campers (n=84), members of boat clubs (n=35), and those that own private, individual docks on the lake (n=143). As was the case at Raystown lake, most Berlin Lake boaters use runabouts with an average length of 18 feet and an average horsepower of 137. Nearly all (98%) Berlin Lake boaters were Ohio residents living relatively close to the lake. The average distance between the lake and respondents' homes was 33 miles. Berlin Lake boaters reported that they participated in boating an average of 38 days per year, 25 of which were at Berlin Lake. The most popular boating activities on Berlin Lake were pleasure cruising (39%), fishing (22%), waterskiing (19%), and swimming (14%). The average party size was 3.7 people.

Independent Variables

Respondents were asked to reflect on their just-completed experiences to provide information about their boats, basic patterns of recreating on the lake and levels of past boating experience. In addition, perceptions of boating conditions on the lake and an evaluation of the boating experience were assessed in a variety of ways. Using a nine-point crowding scale, visitors were asked to describe the boating conditions at the launch area at the start and end of the trip and on the lake itself while boating. Boaters at Raystown were asked to assess conditions at stopping points on the lake, as well. Respondents were additionally asked to evaluate how the number of other boaters affected their experiences using a nine-point rating scale covering a range of three possible reactions: positive, neutral and negative. Additional statements dealing with various aspects of boating conditions, including safety, conflict with other boaters, and reasons for avoiding or not participating in boating activities were measured on a five-point Likert scale ranging from strongly disagree to strongly agree.

Berlin Lake boaters were asked an additional set of questions geared towards assessing their interaction with other users. While boating, how often were you within talking distance of jet skis, water skiiers and other moving boats? Also, how often was there a need to avoid physical contact and wakes from these user groups and how often were motors heard? These items were utilized to create a perceived frequency of contacts index. For each specific question, respondents also evaluated the effect of the contact on their enjoyment (i.e., added, detracted, neither added nor detracted). Based on these evaluations, three variables were calculated (i.e., experience-enhancing, experience-neutral, experience-disruptive). Computation of these scales is adapted from previous use and validation with canoers, kayakers and board sailers (Titre and Mills, 1981; Titre, 1983).

Dependent Variable

A scale comprised of six items probing the general degree of satisfaction with the boating experience was used to measure overall satisfaction. This satisfaction scale was adapted to boating from previous use and validation with fishermen (Graefe and Fedler 1986), hunters (Vaske, Fedler and Graefe 1986) and river users (Ditton et al. 1981).

Results

Overall Satisfaction

The satisfaction index used in this study was patterned after indices that have been used successfully in the studies cited above. The index includes six statements that are in essence different ways of measuring the extent of satisfaction with the overall boating experience. The index was computed as the mean of the responses to the six individual items.

All of the items in the satisfaction index were strongly intercorrelated, resulting in an overall reliability coefficient (Cronbach alpha) of .80 for Lake Raystown (Table 1). This level of reliability is consistent with that found in other studies using similar indices. The overall Cronbach alpha was .76 for data collected at Berlin Lake. This level was increased to .84 with the deletion of the item, "I cannot imagine a better boating trip." This item was therefore eliminated in subsequent analyses of Berlin Lake data.

Table 1. Reliability Statistics for Overall Satisfaction Index

Satisfaction Statement	Lake	Item Mean	Standard Deviation	Corrected Item-Total Correlation	Alpha If Item Deleted
I thoroughly enjoyed my boat trip today	Berlin	3.8	.89	.66	.65
	Raystown	3.9	.78	.65	.73
My boating experience was not as enjoyable as I expected it to be*	Berlin	2.5	1.04	.66	.64
	Raystown	3.8	.88	.61	.74
I cannot imagine a better boating trip	Berlin	2.6	1.10	-.04	.84**
	Raystown	2.6	.97	.41	.80
I do not want to go on any more boat trips like this one*	Berlin	2.1	.93	.56	.68
	Raystown	4.1	.70	.57	.76
My boat trip was well worth the money I spent to take it	Berlin	3.9	.80	.60	.67
	Raystown	4.0	.62	.56	.76
I was disappointed with some aspects of my boat trip*	Berlin	2.8	1.12	.58	.66
	Raystown	3.4	1.00	.54	.76
Overall Index	Berlin	3.6			.76
	Raystown	3.6			.80

* Scoring for these items was reversed in computation of statistics because agreement with these items indicated lower satisfaction.

** Item deleted from this index for further Berlin Lake calculations.

Both Berlin and Raystown boaters appear to be quite satisfied with their overall boating experiences. More than 80 percent agreed that they had "thoroughly enjoyed their trip today." An even greater proportion of the boaters felt their trip was well worth the money it cost them, and very few indicated they did not want to go on more trips like the one they had experienced that day. On the other hand, a majority of the respondents disagreed with the statement, "I cannot imagine a better boating trip." About one-third of the sample indicated that they were disappointed with some aspects of the experience. In

sum, boaters tended to report relatively high satisfaction, although for many the experience did not measure up to their ideal or best ever boating outing. The average score on the index comprised by all six statements was 3.6 on a scale ranging from one to five.

Experiential Impacts

Number of boats. Boating activity on Raystown Lake was measured using aerial photography and counts of vehicles parked at all major access points around the lake. Overall use levels, determined from aerial photos taken between 1:00 and 3:00 p.m., ranged from 794 to 1101 boats on the lake. The lowest boating densities were encountered on the last three sampling days. These lower use levels may reflect a normal tailing-off of boating activity toward the end of the season, coupled with unseasonably cold weather during August, 1987.

Aerial photography was not used in the Berlin Lake study, so no estimates of the total number of boats on the water at any one time are available. Ground counts of the peak number of vehicles and trailers parked at major access points on Berlin Lake ranged from 243 to 653 over the six sampling days. These counts represent a partial number of boats using the lake, as they do not include boaters coming from the campgrounds, boat clubs or private docks.

Crowding on lake. Several survey questions explored feelings of crowding among boaters (Table 2). Perceived crowding varied significantly at different points of the boating experience. At both lakes, boaters felt most crowded while actually out on the lake. On a scale of one to nine, with nine being "extremely crowded," 36 percent of Raystown and 30 percent of Berlin Lake boaters considered crowding on the lake to be a seven or greater. Respondents reported feeling least crowded at the access areas at the start of their trip. Only 13-15 percent reported crowding here as a seven or greater. These findings are consistent with previous research noting increased sensitivity to crowding at interior locations versus access points.

Table 2. Perceived Level of Crowding at Various Points during the Boating Experience (Values in Percent)

PERCEIVED DEGREE OF CROWDING

	Lake	Not at all Crowded 1	2	3	4	5	Extremely Crowded 6	7	8	9	N	$\bar{X}$
Crowding at the access area at the start of your trip.	B	31	14	18	6	6	11	3	4	6	706	3.4
	R	20	17	20	9	7	14	5	4	6	1145	3.8
Crowding on the lake while boating.	B	5	5	14	10	9	27	12	8	10	727	5.4
	R	4	5	10	10	12	23	14	13	9	1149	5.7
Crowding at the places where you stopped today while boating	B*											
	R	12	13	15	11	11	13	9	10	7	675	4.6
Crowding at the access area when you stopped boating	B	20	11	15	8	8	13	7	7	11	704	4.5
	R	17	17	15	8	10	13	8	6	7	1114	4.2

* This was not assessed in the case of Berlin Lake Boaters.

Influence of others. Another question related to crowding directly asked individuals how the number of boaters at the lake that day affected their overall boating experience. About half of the respondents reported that the number of boaters had no effect on their experience (Table 3). Consistent with the previous crowding data, those who did report an influence of others were more likely to indicate that the number of boaters reduced, rather than increased, their enjoyment. Forty percent of Raystown Lake respondents and 44 percent of Berlin Lake boaters indicated some reduction in their enjoyment, although relatively few of these reported a severe reduction.

Table 3. Responses to "How Did the Number of Boaters at the Lake Today Affect Your Overall Boating Experience"

ENJOYMENT

	Increased 1	2	3	4	No Effect 5	6	7	Reduced 8	9
Berlin Lake									
Number	20	27	24	22	309	78	120	61	59
Percent	3	4	3	3	43	11	17	8	8
Raystown Lake									
Number	13	18	29	29	581	131	208	79	39
Percent	1	2	3	3	52	12	18	7	3

Frequency of encounters and their effect on enjoyment. A perceived frequency of contacts index was computed for Berlin Lake boaters as the mean of responses to four, multi-part questions assessing the frequency of occurrence of various types of contacts with specific users (Table 4). The intercorrelation of the eleven items resulted in an overall reliability coefficient (Cronbach alpha) of .82.

Table 4. Frequency of Occurrence and Effects on Enjoyment of Selected Types of Boating Encounters (Values in Percent)

FREQUENCY OF OCCURRENCE

	Never	Occasionally	Often	Very Often
Being within talking distance of:				
Jet Skis	28	44	17	11
Water Skiiers	41	37	14	8
Other Boats	13	38	28	21
Avoiding contact with:				
Jet Skis	65	24	7	4
Water Skiiers	58	31	7	4
Other Boats	34	40	17	9
Avoiding wakes from:				
Jet Skis	50	30	12	8
Water Skiiers	41	35	16	8
Other Boats	10	28	33	29
Hearing motors from:				
Jet Skis	21	37	19	23
Other Boats	11	33	28	28

EFFECT ON ENJOYMENT

	Add	No Effect	Detract
Being within talking distance of:			
Jet Skis	13	59	28
Water Skiiers	12	69	19
Other Boats	8	60	31
Avoiding contact with:			
Jet Skis	14	66	20
Water Skiiers	11	74	14
Other Boats	8	66	26
Avoiding wakes from:			
Jet Skis	8	74	18
Water Skiiers	7	73	19
Other Boats	8	52	40
Hearing motors from:			
Jet Skis	6	74	20
Other Boats	6	78	16

The frequency of physical and visual contact with others (i.e., avoiding contact, avoiding wakes, being within talking distance of others) did not appear to be a significant issue, with between 50 and 89 percent of all respondents indicating occasional or no contact of this nature. Sixty-two percent did, however, report having to avoid wakes from other boats either often or very often. As previously noted, noise also appears to be a slight problem at Berlin Lake, where hearing motors from jet skis and other boats occurs frequently.

To assess the effect of the aforementioned contacts on enjoyment, three variables were calculated: experience-enhancing contacts as the sum of affirmative responses to "contacts added to my enjoyment," experience-disruptive contacts as the sum of responses to "contacts detracted from my enjoyment," and experience-neutral contacts as the sum of responses to "contacts neither added to nor detracted from my enjoyment." Although the majority of respondents indicated that specific interactions with other users had no effect on their enjoyment, there were a significant number (18 - 40%) reporting that certain types of contacts detracted from enjoyment (e.g., 52% of boaters noted that avoiding wakes from other boats had no effect on enjoyment, however 40 percent felt that such contacts were experience-disruptive).

Waiting time to get on the lake. Study respondents were also asked how they felt about the amount of time they had to wait to get on the water. Boaters at both lakes appear to be quite satisfied with the amount of waiting time they encountered, as less than ten percent of those sampled agreed or strongly agreed with the statement, "I did not like the amount of time I had to wait to get on the water today" (Table 5).

Displacement. Four statements were included in the survey to measure the types and extent of displacement experienced by boaters as a result of crowding. Some displacement does seem to be occurring, although few boaters indicate that they might stay away from the lake altogether due to crowding (Table 5). About one-fourth of the boaters at Raystown and one-third of those at Berlin reported being displaced from favorite parts of the lake (place displacement), displaced during peak time periods (time displacement), and had forgone some boating activity (activity displacement) because of crowding . There was little agreement, however, with the statement, "If I had known what it was going to be like here today, I would not have come on this visit." Overall, only five percent at Raystown and ten percent at Berlin agreed with this statement designed to measure the likelihood of complete displacement from the lake.

Noise. Noise appears to be a slight problem at Berlin Lake, with 18 percent reporting that noise from other boats reduced their enjoyment, in contrast to Raystown Lake where noise from other boats reduced the enjoyment of only five percent of the boaters interviewed (Table 5).

Behavior. More boaters expressed problems with the behavior of other boaters than with the noise from other boats (Table 5). Nearly one-fourth of the respondents at Raystown and one-third of those at Berlin indicated that the behavior of other boaters interfered with the quality of their boating experience. The most frequent types of behavior causing these reactions were boaters coming too close or going too fast, and boaters disobeying rules such as not observing speed limits in no-wake zones. Rude and careless behavior was also mentioned frequently as an interference with boating quality.

Safety. More than three-fourths of the boaters agreed with the statement, "Boating conditions on the lake today were safe" (Table 5). In support of the perception of safe conditions, less than 20 percent agreed or strongly agreed with the statement that "There was an unsafe number of boats on the water today." As well, boaters at Berlin Lake were queried as to the adequacy of patrols and assessment of near accidents (60 and seven percent agreement, respectively).

An additional question directly asked respondents whether other boats came too close to their boat. More than one-third of the sample felt that other boats had come closer than desirable (Table 5). This finding, coupled with the earlier observation that boats coming too close was one of the most frequently mentioned types of objectionable behavior, suggests that this may be the greatest safety concern among boaters at Berlin and Raystown.

Table 5. Summary of Responses to Indicators of Visitor Displacement, Conflicts and Perceptions of Safety (Values in Percent)

		RESPONSES						
	Lake	SD	D	U	A	SA	N	$\bar{X}$
I stayed off the lake during part of the day today because there were too many boats	B	8	52	4	18	18	739	2.8
	R	7	63	3	19	8	1141	2.6
I avoided my favorite parts of the lake today because there were too many boats there	B	10	54	8	20	8	730	2.6
	R	7	62	7	21	4	1142	2.5
I did not participate in some boating activities today because of crowded conditions on the lake	B	8	55	3	27	7	733	2.7
	R	5	70	2	20	3	1134	2.5
If I had known what it was going to be like here today, I would not have come on this visit	B	18	69	5	6	2	731	2.0
	R	16	77	2	4	1	968	2.0
I did not like the amount of time I had to wait to get on the water today	B	24	68	4	3	1	667	1.9
	R	12	81	2	5	1	1129	2.0
The noise of other boats reduced my enjoyment on the lake today	B	9	67	7	13	5	738	2.4
	R	10	82	3	5	0	1140	2.0
The behavior of other boaters interfered with the quality of my boating experience	B	9	51	5	26	8	736	2.7
	R	4	67	6	18	4	1140	2.5
Other boats came closer to my boat then I like	B	9	51	8	26	6	736	2.7
	R	2	60	4	27	7	1141	2.8
Boating conditions on the lake today were safe	B	4	12	11	66	7	733	3.6
	R	1	11	10	75	3	1135	3.7
There was an unsafe number of boats on the water today	B	10	61	9	15	4	737	2.4
	R	5	67	11	14	3	1144	2.4
I nearly had an accident on the lake today because of crowded conditions	B	24	67	2	5	2	738	1.9
	R*							
The number of boats on the lake reduced my enjoyment of the lake today	B	7	52	5	28	7	740	2.8
	R*							
There are adequate law enforcement patrols on this lake	B	11	15	12	53	9	738	3.3
	R*							

* This was not assessed in the case of Raystown Lake Boaters.

Regression Analysis

A series of regression models were developed to identify the direct and indirect relationships between overall satisfaction and the pool of experiential impacts. Standardized regression coefficients were used to assess the relative importance of each independent variable to the dependent variable. Zero order correlations were also reported to illustrate the bivariate relationships between key study variables. Results of the regression models and correlation analyses for Raystown and Berlin Lakes are shown in Tables 6 and 7, respectively.

In combination, the series of regressions form the basis for a model illustrating how people perceive satisfaction with the boating experience (Figures 1 and 2). Paths shown in these models represent

Table 6. Summary of Multiple Regressions of Boating Impact Variables on Overall Boating Satisfaction at Raystown Lake

INDEPENDENT VARIABLE	DEPENDENT VARIABLE: Perceived Crowding On Lake		Influence Of Others On Experience		Satisfaction Index	
	r	Beta	r	Beta	r	Beta
Enjoyment reduced by noise	.08		.15		-.23	-.09
Stayed off lake part of day because of too many boats	.35		.37	.11	-.41	-.13
Behavior of other boaters interfered with quality of boating experience	.29		.33	.09	-.39	
Boating conditions on lake perceived to be safe	-.37	-.14	-.38	-.14	.48	.23
Other boats came too close	.28	.08	.30		-.37	-.15
Perception of unsafe number of boats on the water today	.38	.14	.33		-.41	-.06
Avoided favorite parts of lake because of too many boats	.40	.20	.38	.13	-.39	-.07
Did not do some activities because of crowded conditions	.36	.15	.37	.12	-.40	-.10
Total number of boats on lake (from aerial photos)	.20	.14	.06		-.05	
Had to wait too long to get on the water today	.10	.06	ns		-.11	-.06
Perceived crowding on the lake			.46	.24	-.38	
Influence of number of boaters on overall boating experience					-.42	-.15
Percent of Variance Explained (R SQUARED)		.30		.33		.42

Table 7. Summary of Multiple Regressions of Boating Impact Variables on Overall Boating Satisfaction at Berlin Lake

INDEPENDENT VARIABLE	DEPENDENT VARIABLE: Perceived Crowding On Lake		Influence Of Others On Experience		Satisfaction Index	
	r	Beta	r	Beta	r	Beta
Enjoyment reduced by noise	.28		.39		-.48	-.14
Stayed off lake part of day because of too many boats	.34		.46		-.43	
Behavior of other boaters interfered with quality of boating experience	.37		.47		-.53	
Boating conditions on lake perceived to be safe	-.44	-.11	-.48	-.13	.55	.21
Other boats came too close	.33		.32		-.42	-.14
Perception of unsafe number of boats on the water today	.25	.09	.18		-.09	-.08
Avoided favorite parts of lake because of too many boats	.42	.12	.48	.08	-.52	-.14
Did not do some activities because of crowded conditions	.44	.11	.48		-.49	
Total number of boats on lake (Peak use counts)	.28	.20	.11		-.07	
Had to wait too long to get on the water today	.10		.08		-.17	
Nearly had an accident	.24		.26		-.37	-.10
Number of boats reduced my enjoyment of the lake	.49	.20	.60	.35	-.54	-.14
Adequate law enforcement patrols	-.09	.10	-.23		.29	
Experience-Enhancing	-.09		ns		.08	
Experience-Neutral	-.22	.10	-.37	-.09	.34	
Experience-Disruptive	.33		.46		-.47	
Perceived Frequency of Contacts	.41	.24	.44	.11	-.41	
Perceived crowding on the lake			.43	.12	-.37	
Influence of number of boaters on overall boating experience					-.49	-.12
Percent of Explained Variance (R SQUARED)		.39		.43		.44

only significant relationships between variables. Results showed that 42 percent of the variance in satisfaction could be explained by the pool of experiential impacts utilized at Raystown Lake. Similarly, 44 percent was explained by the expanded pool of impact variables utilized at Berlin Lake.

The satisfaction index tended to be highly associated with many of the impact variables. The variables most strongly related to satisfaction for both Berlin and Raystown boaters were the perception that conditions on the lake were safe ($r = .48_{Raystown}$, $r = .55_{Berlin}$), the influence of the number of boaters on the overall boating experience ($r = -.42_{Raystown}$, $r = -.49_{Berlin}$), and the various measures of visitor displacement (time: $r = -.41_{Raystown}$, $r = -.43_{Berlin}$; activity: $r = -.40_{Raystown}$, $-.49_{Berlin}$; place: $r = -.39_{Raystown}$, $r = -.52_{Berlin}$). Many of the impact indicators, however, had correlations with the satisfaction index that were nearly as high. The exceptions, or those variables most *weakly* associated with satisfaction, included waiting time to get on the lake and the actual number of boats on the lake.

The number of boats on the lake, as measured by aerial photos at Raystown Lake and ground counts at Berlin Lake showed a pattern of weak or insignificant relationships with the various impact indicators. Respondents were generally satisfied with conditions regardless of the number of boats at the lake. The number of boats did contribute, however, to the level of perceived crowding on the lake, although not as strongly as other indicators (i.e., displacement, safety). The number of boats, perceptions of safety and displacement accounted for 30 percent of the variance in crowding at Raystown (Table 6). Perceived crowding on the lake, in turn was relatively strongly associated (r=.46) with the reported influence of the number of others on the boater's experience. Results indicated that 33 percent of the variance in the influence of others at Raystown Lake could be explained by the perception of crowding, coupled with the direct impact of displacement and safety indicators.

In contrast, the frequency and evaluation of contacts with various user groups, along with perceptions of safety and displacement accounted for 39 percent of the variance in crowding at Berlin Lake (Table 7). The strongest predictor of both perceived crowding and the influence of others on the boating experience at Berlin Lake was the new item, "the number of boats reduced my enjoyment of the lake". This item, along with the frequency and evaluation of contacts measures which were added to the Berlin Lake study, largely accounted for the improved explanation of both perceived crowding and the influence of others at Berlin Lake.

Figure 1. Model of Boating Satisfaction at Raystown Lake

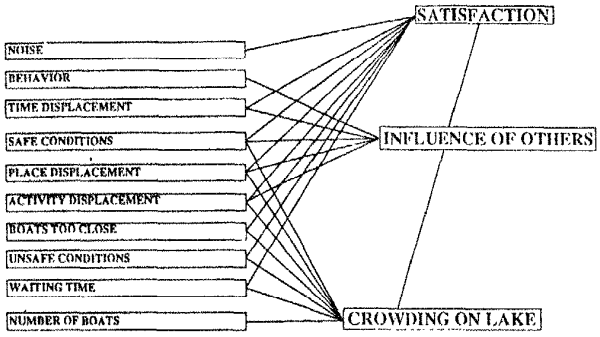
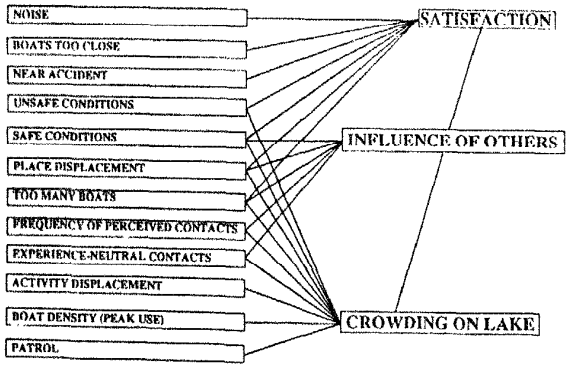


Figure 2. Model of Boating Satisfaction at Berlin Lake



Conclusions and Implications

This study focused on the relationships between a full set of experiential impacts and overall visitor satisfaction. Results of the visitor surveys suggest that both Raystown and Berlin Lake boaters were generally satisfied with their boating experiences regardless of the number of boats at the lake. However, boaters reported moderate levels of crowding on the lakes, and a significant proportion of those sampled reported experiencing inappropriate behaviors of other visitors, concerns over boating safety and having been displaced in some way.

Both studies resulted in relatively similar models of boating satisfaction (Figures 1 and 2). In both cases, satisfaction was directly affected by indicators of safety, displacement, and the influence of other boaters on this boating experience. Similarly, in both cases, density measures had no direct effect on satisfaction, but did play an indirect role through their influence on other variables that were directly related to satisfaction.

The biggest difference between the two models appears to be the roles played by the additional variables that were included in the Berlin Lake study. While these indicators added little to the explanation of overall satisfaction, they did contribute significantly to the explanation of perceptions of crowding and the influence of others on the boating experience.

Study results are consistent with several principles established in previous research. First, the regression models lend support to the notion that overall satisfaction can be understood in terms of user evaluations of specific elements of the recreation experience. Secondly, the results echo findings of other studies showing that relationships between visitor density and satisfaction are mediated by a variety of factors.

Management Implications

The results of these studies can be used to address a variety of management issues and decisions. An important result is the documentation of existing conditions on both lakes and the relationships between these conditions and peak use boat densities. This information provides a basis for: (1) evaluation of the acceptability of current conditions, (2) identification of management actions designed to improve current conditions, (3) evaluation of the probable impacts of various potential options for further facility development on Berlin and Raystown Lakes, and (4) development of procedures for monitoring the quality of boating at both lakes in the future.

Results suggest that current peak use conditions are acceptable to most boaters, however these conditions could be improved by focusing management on those indicators with the greatest influence on satisfaction (e.g., boats too close, behavior of others). Manipulating the number of boats on the lakes would have little effect since boater satisfaction is related more to the behavior rather than the number of boaters encountered. Expanding enforcement of existing regulations and offering educational programs aimed at making offending boaters aware of the impacts of their actions are more likely to bring about improvements in this situation.

In addition, the results of this study may be used as a basis for establishing quantitative standards of acceptability. Current management frameworks rely on standards to make the evaluation process objective and systematic. Standards provide a means of describing the type of experience that is to be provided in measurable terms. Problem identification then is based on the comparison of existing conditions and corresponding standards. Knowledge of the current level of various impact indicators provides a baseline upon which an initial set of standards can be determined, as well as a point against which future conditions can be compared.

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MODELING DAILY BOATING USE AT A NEW URBAN LAKE

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A multiple linear regression model was developed to predict daily on-site boat rentals during April-November on the basis of month, day, and weather. Rentals peak on sunny Sundays in June. The number of boats brought on site each day is closely correlated with daily boat rentals.

Introduction

We conducted a study to identify the amount and patterns of boating at a newly created lake in the Chicago suburbs. The research estimated the total amount of boating activity and developed a model for predicting the number of boat rentals on any given day. The pattern of boats brought into and out of the site, as well as the number of boats on site over the day, was also monitored. This information was gathered to document boaters' response to a new lake, as well as to guide the management of the lake and associated resources. The research is part of a larger study of the amount and patterns of use at Forest Preserve District facilities in the Chicago area.

Study Site

The research focused on Busse Lake, a 590-acre body of water opened to public use on September 1, 1980. The lake was created by a dam on Salt Creek, which flows through Chicago's western suburbs. To facilitate fishing, approximately 25 percent of the lake basin was deepened to more than 10 feet. To improve the habitat for fish, large areas were deepened to 4 to 6 feet. Stocking included largemouth bass, bluegill, redear, northern pike, brown bullhead, channel catfish, and crappie. Fishing is from the banks, fishing walls, and boats (electric trolling motors only). A boat rental is open from April through November, and there are two sets of boat launching ramps. The lake and adjacent recreation facilities were made possible through a cooperative program of the Forest Preserve District of Cook County, U.S.D.A. Soil Conservation Service, and Illinois Division of Waterways aimed at providing flood control and recreation opportunities. The Forest Preserve District manages the lake and associated resources.

Methods

On selected days during the summer of 1983, the number of boats entering and leaving the area was recorded at 15-minute intervals at the single access road leading to the two boat launching areas. In addition, numbers of daily boat rentals were obtained from the boat rental concession for the 1983 season (April through November). Our field observations indicated that most of the boats brought on site or rented from the concession were rowboats used for fishing, although there were some canoes, sailboats, and paddleboats used for general recreation.

Amount of Boating Use

During the season of April-November, there were more than 9,000 boat rentals and nearly 8,000 boats brought on site at Busse Lake -- a substantial amount of activity. If we assume two individuals per boat (a conservative estimate), this totals 34,000 individuals using boats during the boating season.

On a daily basis, boat rentals and number of boats brought on site are closely correlated ($r=0.90$), with up to 249 boats rented daily and up to 211 boats brought on site per day. Daily boating activity is highly variable, and we undertook an effort to develop a model that would enable managers and planners to predict daily boating under various circumstances. Because more complete data were available for boat rentals than for boats brought on site, we focused our attention on the development of a model to predict boat rentals. Given the close correlation between boat rentals and number of boats brought on site, a good estimate of total boating activity on a given day can be obtained by multiplying the estimate of boat rentals by 1.9.

Prediction of Daily Boat Rentals

We decided that the variation in daily boat rentals might be explained in terms of season, day of the week, and weather. We considered weather as influencing the desirability of boating experiences at the site, day of the week as influencing the availability of time to make a trip to the site, and of season as influencing general patterns of use over the year. Season includes a complex pattern of changes in weather,

day length, vacation, holiday, and outing schedules, and activities engaged in. More specifically, we hypothesized that there is a pattern of rentals over the season, with deviations about that pattern attributable to day of the week and deviations of weather from the seasonal average. We also expected that deviations from the seasonal pattern of rentals attributable to day of the week and departures from average monthly weather would vary by month over the boating season.

Developing the Model

Data on boat rentals were obtained from the concessionaire. Weather data were collected in the field and from official records for a nearby weather station (O'Hare Airport, Chicago, Illinois). Weather variables in the model included percent of the day that was sunny, cloudy, or raining; and temperature (Fahrenheit) at noon. These variables could be measured in the field or from official records, were predictable by managers and planners with acceptable certainty, and were useful in previous efforts to predict daily use of recreation facilities near the lake. Day of the week was categorized as weekday, Saturday, or Sunday/holiday because these groupings reflected the availability of time for trips to the site, as well as the framework for traditional outdoor excursions. Individual months were used in the model to represent seasonal change. Because there was essentially no change in site attributes or the availability of other sites in the general area during the period of study, these variables were not included in the analysis. Weather variables were entered in the model as deviations from the monthly averages to remove seasonal correlations between weather and month. The resulting model can estimate rentals under average weather conditions (i.e., no weather data entered into the model) or under special weather conditions (i.e., weather data entered). Because the effect of day of the week and weather on rentals might change over the season, interactions between these variables and month were built into the model.

The model was estimated with multiple linear regression techniques. The month and day-of-the-week variables were expressed in binary form (1 when applicable and 0 when not). The dependent variable (daily boat rentals) was transformed into its natural logarithm form, but there were no logarithmic transformations of the independent variables. This provided a better fit than the model with no logarithmic transformations. In this form the regression model minimizes the percent difference between actual and predicted rentals, and can be expressed in a "multiplicative" form. That is, the coefficients for the independent variables can be converted to "multipliers" that express the variable's association with rentals as a multiple of a base value. This seemed reasonable because over the year we would expect weather or day of the week to alter rentals by a multiple rather than by an added absolute amount. The model is summarized below:

$$U = MC_m DC_{m,d} TC_m^{(T-\bar{T}_m)} SC_m^{(S-\bar{S}_m)} RC_m^{(R-\bar{R}_m)}$$

Where U = Use (rentals)
MC_m = Constant for month m
DC_{md} = Day coefficient (Sat., Sun/Hol., or 1 for weekday)
TC_m = Temperature coefficient
SC_m = Percent sun coefficient
RC_m = Percent rain coefficient
$\bar{T}_m$ = Monthly mean temperature at noon
$\bar{S}_m$ = Monthly mean percent sun
$\bar{R}_m$ = Monthly mean percent rain
T = Actual temperature at noon
S = Actual percent sun
R = Actual percent rain

Results

The model will predict daily boat rentals on any day during the boating season, given data on month, day of the week, and weather. It assumes that site attributes and the availability of substitute sites remain constant. Consequently, the model cannot be used to predict changes in use that would accompany changes in the site or availability or character of substitute sites.

Coefficients for the daily boat rental prediction model are summarized in Table 1. To estimate rentals on a particular day, select the column that corresponds to the appropriate month. The constant represents estimated weekday rentals under average weather conditions. If estimates for a Saturday or Sunday are desired, multiply the weekday estimate by the appropriate coefficient. If weather deviates from the monthly average, raise the coefficient for weather (temperature, sun, or rain) to the power of the deviation and multiply the estimate of use by that number. For example, for May the constant is 19.511, indicating an estimate of 19 boat rentals on a weekday in May with average weather conditions (i.e., $\bar{T}$=64, $\bar{S}$=61, $\bar{R}$=10). To estimate Sunday use under average weather conditions would be (19.511 X 5.302) = 103. With a temperature of 74, or 10 degrees above the monthly average, use would increase by 79 percent (1.060^{10} = 1.79) to 185 rentals.

The coefficients of the model and the use patterns they imply are discussed below in an effort to identify important factors that influence use patterns and to provide insight into user behavior.

Seasonal Patterns

Under average weather conditions, daily boat rentals rapidly increase in the spring, peak in June, and decline slowly through November. This general pattern persists, with some important deviations, for weekdays, Saturdays, and Sunday/holidays (Table 4). The estimates of average daily use, by month, upon which Table 4 is based were developed from the coefficients in the first three rows of Table 1.

Weekend and Weekday Patterns

The model will predict higher levels of boat rentals on weekends (Saturday, Sunday/holiday) than on weekdays in all 8 months of the boating season provided that weather conditions are similar. Saturday use is slightly higher than Sunday/holiday use early in the season (April-May) as well as late in the season (November), but Sunday/holiday use exceeds Saturdays at other times. Weekday and weekend use are most similar in the middle of the summer (July) and most different late in the season. This pattern is attributable, in part, to restriction on weekday use in the spring and fall imposed by the limited availablity of leisure time.

Weather

The previous discussion of seasonal and day-of-the-week patterns in daily boat rentals assumed average weather conditions for each month. The following is an example of how weather influences predictions of rentals. If we assume average weather conditions, the model will predict 195 boat rentals on a Sunday in June (i.e., 45.879 X 4.242). If the temperature increases to 80, the percent sun to 85, and there is no rain, the estimate of use will increase to 257 rentals (i.e., 195 X 1.041 X 1.2098 X 1.046). But under poor weather conditions of 100% rain and 50°F there would be only 20 rentals (195 X .772 X .3138 X .4236). Thus ignoring weather variables can give predictions that are quite inappropriate for days when the weather conditions depart significantly from the monthly average.

Subsequent discussion focuses on the association between each weather variable and rentals, by month, given that all other weather, seasonal, and day-of-the-week variables are held constant. The variables are discussed in terms of decreasing contribution to the explanatory power of the model. Table 3 summarizes the percentage changes in rentals that are associated with specified deviations from average monthly weather. Table 2 presents the monthly averages used to calculate the deviations.

Temperature at noon. Deviations of the daily temperature at noon (Fahrenheit) from the monthly average contribute significantly to the explanatory power of our model, with the percentage change in daily rentals associated with a given deviation varying with month. The highest percentage increases in rentals with a given increment of temperature above the monthly average occur during the fall and spring; during the summer we find the smallest increases, and in July and August a decrease (Table 3). This suggests that temperature may be limiting use in the cooler months, but not necessarily in the warmer months. Hot weather in the summer may result in a shift to outdoor areas with more shade, or to air-conditioned environments.

Percentage of sun. Increases in the percentage of the day with sun above the monthly average are associated with increases in use during each month, but there is not a clear pattern in their magnitude over the season.

Percentage rain. An increase in the percentage of the day when it is raining above the monthly average tends to decrease use, particularly in the spring and fall.

Discussion

Boating activity at Busse Lake illustrates the increase in recreation activity that can accompany enhancements of urban water resources. The 17,000 boating occasions and 34,000 boaters over an 8-month period represent a significant amount of recreation activity, and it is only a portion of the recreation activity generated by this new 590-acre lake.

The model for predicting daily boat rentals explains 80 percent of the variance and provides good predictions. The coefficients for the seasonal, day-of-the-week, and weather variables are reasonable and offer some insight into boating behavior that seems consistent with analyses for other types of recreation behavior. The June peak in boat rentals appears consistent with the kind of fishing opportunities provided by the relatively shallow lake. It also conforms to the general pattern revealed by our monitoring of vehicles entering nearby areas and of bicycling on nearby trails. The seasonal peak in daily use is especially prominent with boat rentals, perhaps this is associated with the "seasonality" of fishing. A considerable amount of testing revealed one troublesome aspect of the model -- it tends to overestimate use on very warm and sunny days in June. This is the result of the unusual pattern of weather during June 1983 and the multiplicative form of the model. The problem is not viewed as serious because the model correctly identifies those days on which peak use occurs -- which is most critical to managers. The problem could be resolved with the addition of data from another year with slightly different weather patterns, but that information was not available. Analyses of other types of use with a similar model and multi-year data presented no such problems (Dwyer 1988).

The percentage difference between weekend and weekday use is more prominent for boat rentals than for other types of outdoor recreation use that we have monitored over time, such as bicycling on trails, use of swimming pools, and vehicles entering several kinds of sites. This is not surprising because renting a boat usually requires more time and effort than stopping to eat lunch, taking a short walk, using a swimming pool, or fishing from shore. Higher use on Saturdays than on weekdays and Sundays early and late in the season may reflect the popularity of Saturday outings for fishing. Bicycling also has a greater percentage difference between weekend and weekday use than is the case with general entry into nearby areas -- once again perhaps related to the commitment of a block of time, the use of equipment, etc.

Boat rentals are more responsive to weather, particularly temperature, than is overall use of the area. Warmer than average days in the spring and fall bring a large increase in boat rentals; warmer than average days in July and August decrease use. Rain in the spring and fall also brings large decreases in use. Responsiveness to temperature and rain conditions most likely occurs because boaters are exposed to the elements. Bicyclists are somewhat less sensitive to these conditions than are boaters, but swimmers at pools are more sensitive to temperature than boaters.

The number of boat rentals is highest on warm and sunny Sundays in June, with a general drop in activity through the remainder of the year. Activity is much higher on weekends than weekdays and is especially high on Sundays and holidays, as well as on Saturdays early and late in the season. With an overall understanding of use patterns and the ability to predict boat rentals on a particular day, managers can schedule their activities more effectively and concessionaires can adjust their staffing and other activities.

Documentation of urban boating activity, particularly its response to improvements in urban resources, would be useful in justifying additional expenditures to enhance urban opportunities. It is often very difficult to get counts of boating activity. However, in instances such as the one described here, much can be learned about the amount and patterns of use. This knowledge can support additional improvements in urban boating opportunities and guide resource management activities.

Additional studies at other areas are needed to identify variations in use patterns. Echelberger and Moeller (1973) explored the relationship between lake characteristics and variations in peak period boat-use intensity on Adirondack lakes. With sufficient studies across a wide range of lakes and associated environments, managers can begin to see how their policies and programs are likely to influence use. Other approaches to this same question would be to (1) ask boaters about the characteristics of sites that they use and do not use, or (2) describe different types of sites to boaters and ask them which they would prefer. Models developed from these efforts would enable managers to predict changes in the use of boating areas that can be expected to accompany changes in water resource characteristcs and management. This would make it possible for managers to fine-tune their efforts to understand user choices and perhaps influence those choices.

The needed research can build on previous studies of how site attributes influence satisfaction with choice of trout streams (Louviere 1974), trails (Allton and Lieber 1983; Lieber and Allton 1983; Lieber and Fesenmaier 1983), urban forest recreation areas (Peterson, Dwyer, and Darragh 1983), and parks (Curry, Louviere, Rauch, and Woodworth 1983; Louviere and Woodworth 1984; Louviere, Schroeder, Louviere, and Woodworth 1986; Schroeder and Louviere, 1986; Schroeder, Dwyer, Louviere, and Anderson 1990; Schroeder, Louviere, and Anderson 1989; and Dwyer, Schroeder, Louviere, and Anderson 1989). The basic task involves (1) identifying the attributes of urban lakes that influence people's choice of and satisfaction with those areas, and (2) building models that predict site choice or satisfaction from those site attributes. By including in the model characteristics of the fisheries resource (populations, species, sizes), water resources (size, type, quality), other site characteristics (terrain, ground cover, access), facilities (boat rentals, launching ramps), and rules and regulations (bag and length limits, use of boats and motors), it will be possible to evaluate the influence of water resource management options on user behavior. This will enable water resource managers to estimate user responses to various management options and to select a set of options that will provide for high levels of use, enjoyment, and user support.

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Table 1

Variable and coefficients for the daily boat rental prediction model

	April	May	June	July	August	Sept.	Oct.	Nov.
Constant[1]	7.838	19.511	45.879	38.978	22.897	5.703	3.452	.521
Saturday[2]	3.589	5.646	2.517	2.018	3.102	5.425	3.615	13.450
Sunday/holiday[2]	2.203	5.302	4.242	3.924	4.473	11.681	5.888	9.934
Temperature (noon) - $\overline{T}$	1.066	1.060	1.010	.983	.997	1.025	1.039	1.132
Percent sun - $\overline{S}$	1.007	1.002	1.016	1.002	1.011	1.014	1.005	1.003
Percent rain - $\overline{R}$	.986	.984	.991	.993	1.006	.998	.985	.978

[1] estimated weekday rentals
[2] 0=no; 1=yes

Table 2

Monthly average weather data used for the dai boat rental prediction model

	Temperature at noon (F) $\overline{T}$	Sun(%) $\overline{S}$	Rain(%) $\overline{R}$
April	53	42	11
May	64	61	10
June	76	73	5
July	81	72	6
August	81	69	6
September	71	58	7
October	59	45	12
November	43	32	2

Table 3

Percentage change in daily boat rentals associated with specified deviations from monthly average weather (assuming all other variables remain constant)

	+10 temperature at noon	+10% percentage sun	+10% percentage rain
April	90	7	-13
May	79	2	-15
June	11	17	- 9
July	-16	2	- 7
August	- 3	12	6
September	28	15	- 2
October	46	5	-14
November	45	3	-20

Table 4

Estimated boat rentals by month and day of the week under average weather conditions

	Boat rentals per day		
	Weekday	Saturday	Sunday/ holiday
April	8	28	17
May	20	110	103
June	46	115	195
July	39	79	153
August	23	71	102
September	6	31	67
October	3	12	20
November	1	7	5

RECREATION LAKE MANAGEMENT - AQUATIC PLANT REMOVAL STUDY

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ABSTRACT

Aquatic plant growth has become a serious problem in the recreational management of inland lakes of Ohio. Submerged and emergent plants have restricted swimming, boating, and fishing in sections of most lakes in the state. The Ohio Department of Natural Resources (ODNR) has responded to public pressure by initiating an aquatic weed harvesting program to control the plant's impact upon recreation. No information on the long term effectiveness of mechanical weed harvesting in Ohio was considered in the decision to implement the program. The Parks and Recreation Division of ODNR is interested in learning about the impact of its harvesting program. The School of Natural Resources is cooperating with ODNR in developing an economical air photo-based system for monitoring the aquatic weed control project.

Twelve test lakes and one control lake were selected throughout Ohio. Transects were established on each lake and the existing vegetation was inventoried by species. Nutrient levels and associated chemical and physical data have been collected for each lake to establish the baseline for measuring any impacts related to the weed harvesting. 35mm true color photography has been flown over each lake to test the effectiveness of film, filter, and scale in interpretation results. Photointerpretation of aquatic vegetation area spread by species will provide the ODNR with an accurate and efficient tool for evaluating the aquatic weed control program. Sufficient water penetration has been achieved to permit a real mapping of the submerged vegetation as well as the emergents.

Introduction

Ohio's Department of Natural Resources is engaged in a program to control aquatic macrophytes in its state park lakes by chemical treatment and by mechanical harvesting. The study described in this paper deals with monitoring the mechanical harvesting method being applied to lakes by ODNR's Division of Parks and Recreation. Decisions to control aquatic vegetation are politically based in response to demands from constituents. How the vegetation is controlled can have biological, social, economical, and political impacts. Knowing the long term effectiveness and the impacts of the control method used is important to proper management of the state park lakes and in supporting the political decisions.

Some inland lakes in Ohio are supporting colonies of aquatic macrophytes that are large and dense enough to cause major recreational problems. Dense and extensive growth of the macrophytes is choking out recreational use of some key areas of the lakes by blocking use of boat docks, fishing spots, and swimming beaches. The excessive plant growth can lead to fish kills through oxygen depletion, dangers to swimmers, and general degradation of the recreational experience.

The State purchased a weed harvester and embarked upon the effort of controlling aquatic plant growth through mechanical means in 1987. Mechanical harvesting is being tried as an alternative to chemical or biological controls of aquatic vegetation. Chemical controls can cause unwanted problems of oxygen depletion, uncontrolled kills, and environmental concerns.

Elimination of the plants is not the goal. Certain levels of macrophyte populations are desireable. Mechanical harvesting permits preselected harvesting levels without total kill and with no foreign substances being introduced into the water (Sassic 1982). Also, immediate relief from undesirable vegetation is obtained without closing the water to recreational use. Removing vegetation matter from the water might also remove enough nutrients to slow future growth and reduce the organic filling rate in the lake.

Sassic (1982) states that mechanical harvesting is cost ineffective, labor intensive, and an undesirable method for aquatic plant control. However, he lists the following three situations in which mechanical harvesting is an acceptable method of control:

1. In areas where water flow can disrupt the control needed with chemical herbicides.

2. In areas where fishing is the main use. Harvesting allows boat access but does not destroy the fish habitat.

3. In areas where water must flow immediately but where it has been restricted by vegetation.

Disadvantages and negative effects on the environment have been discussed at length in the literature (Cooke et al. 1986, Gangstad 1982, and Sassic 1982). The major disadvantages to mechanical harvesting of aquatic vegetation include the high costs involved, the possibility of plant parts spreading the infestations, shallow depth of harvest, limited area coverage, and dependence on favorable weather.

Several authors report that regrowth of cut aquatic plants occurs quickly but that there appears to be a significant lowering of growth in subsequent seasons (Mikol 1985, Kimbel and

Carpenter 1979). Differences in individual lake morphometry and harvesting techniques influences the impact of mechanical harvesting upon nutrient availability. Wile (1979) and Hutchinson (1957) found that phosphorus is the key nutrient and its removal can be maximized by timing of the harvest. However, the usefulness of harvesting as a nutrient removal technique is influenced by the size of the lake, the amount of plant biomass, external loading of nutrients, and the sediment nutrient supply (Wile 1979). Wile estimated that more than thirty years of harvesting would be needed to deplete the phosphorus content of Lake Chemung at the 1975 removal rate.

Purpose of the study

The Department of Natural Resources was interested in learning if and how effective the mechanical harvesting would be in controlling the aquatic plants in the state park lakes. The best way to determine that was to monitor the growth of the macrophytes over the years that the program was in operation. An effective and economical monitoring and mapping program was needed.

The Ohio State University's School of Natural Resources and the Ohio Agricultural Research and Development Center joined in a cooperative program with the Ohio Department of Natural Resources to look into the problem of developing a method for monitoring the effectiveness of the mechanical weed harvesting program.

An aerial photo based monitoring system would be needed to obtain the easiest to use and the most cost effective way of monitoring and mapping the aquatic vegetation areal spread in the harvested lakes. Resolution requirements and cost limits proscribed any satellite or other remote sensing systems. The seasonal requirements ruled out using standard photography from the High Altitude Photography Program or the county coverages of the Agriculture Stabilization and Conservation Service.

Study Design

Lake Analysis

Eleven Ohio State Park lakes were chosen as the test sites. Their selection was based upon the harvesting plans of the Division of State Parks and their locations throughout the state. A twelfth lake was selected as the control. The control Lake, Knox Lake, is managed by the Ohio Division of Wildlife and is not included in the aquatic weed control program. Most of the lakes were built in the early 1900s and average only ten feet or less in depth.

Water samples were collected in the area of harvesting each year. The samples, collected at a depth of 30 centimeters, were analyzed for pH, Nitrate-nitrogen, ammonium nitrogen, and phosphorus. A secci disk reading was used to measure transparency at each water sample collection. Also, the water temperature at 15 cm was measured. The sample areas were recorded so that future samples will be made at the same location. Plants growing in the areas to be harvested were identified and the areas were photographed for future reference. Table 1 lists the species of aquatic vegetation present in the study lakes.

Table 1. Aquatic vegetation found at each study lake

Vegetation type	Study lakes
Myriophyllum spicatum Eurasian milfoil	Alma, Burr Oak, Findley, Jefferson, Kiser, Logan
Nymphea odora Fragrant waterlily	Alma, Guilford, Jefferson, Kiser
Nuphar luteum Spatterdock	Alma, Indian, Loramie
Certophyllum demersum Coontail	Findley, Jefferson
Elodea canadensis Common eldodea	Findley, Jefferson
Nelumbo lutea American lotus	Burr Oak, Cowan
Potamogeton crispus Curly pondweed	Findley, Jefferson
Najas minor Prickley naiad	Pike

The ground level photography was accomplished using Ektachrome ASA 100 film. Kodachrome 64 film was tried. However, the Ektachrome film color saturation in the blue and green colors made it the more satisfactory film.

Aerial Photography

Near vertical 35mm photography was obtained of the lake areas in the harvesting program. Mid-September was selected for the season to photograph the lakes. That way harvesting would be over but the vegetation would still be growing. The camera was mounted in a through-the-floor configuration on a Cessna 172. Flight lines were planned to produce total coverage in one pass over the lake. Intentional 60 percent overlap was photographed along the flight line to assure coverage and to provide stereoscopic viewing if desired.

Ektachrome ASA 100 film with a haze filter was used and the photographs were underexposed by one f-stop to get better film density. Color

infrared film was considered for this project but rejected after inspection and because other studies did not recommend its use (Douglass 1973).

Each lake was flown at a predetermined scale. Two lakes were photographed at a representative fraction of 1:20,000, two at 1:30,000, and the rest at 1:40,000. To save money each lake was not flown at all scales. However, the different scales could be compared for effectiveness in locating, identifying, and mapping the aquatic vegetation over the entire project.

Base maps of the lakes were provided by ODNR. Selected frames of the 35mm photography that covered the areas harvested were projected onto the base maps. The interpretation and the mapping was done directly on the base maps thereby eliminating the step of transferring the interpretated data to a map.

Results

Introduction

As of this point, ground photography and water nutrient data have been collected for 1988 and 1989. Aerial photo coverage was taken in 1989. The results here represent the initial development phase of a longitudinal study and the effectiveness of the 35mm based aerial photo interpretation system in identifying and mapping the areal extent of the aquatic vegetation in the treated lakes.

Photo Interpretation

The photographs were projected onto the base maps and interpreted. The underexposing to achieve better density did not work out as an aid to interpretation. In the case of the darkest photos, interpretation of the submerged vegetation was very difficult. Most of the photos were close enough to the correct exposure to permit easy interpretation.

Emergent vegetation exhibited enough color differences among the species to allow species separation. Spatterdock shows up as dark green. Fragrant water lily is light green. And American lotus is blue-green. During the preliminary interpretation, a previously unknown infestation of American lotus was identified in a lake where the ground control had not recorded it.

The submerged vegetation could be located and mapped but it could not be separated by species. The submerged vegetation had begun to lose its color by the mid-September photo date. A mid-August photo mission might pick up more reflectance and help with species identification

The larger scale was the easiest scale photography to interpret. 1:20,000 scale photos provided the best pictures for interpretation and mapping. Most of the treated lake areas are upstream in the coves and narrow aras of the lakes where the access points are. Therefore, the smaller area covered by the 1:20,000 scale still permits complete coverage of the treated areas in one flight line if it is properly oriented.

Mapping

Vegetation information was transferred to base maps by matching the slides onto the base maps with a standard slide projector. Matching the shoreline on the slides with the shore line on the maps was easier and more exact than was anticipated. Photo displacements and distortions were not large enough to be noticeable. The state supplied maps were true enough to allow complete registration of them with the projected photographs.

Aquatic growth in the treated areas of the study and control lakes were mapped. Emergent vegetation was classified by species but submerged vegetation was not. Also, the dump sites for the harvested vegetation were mapped as they occurred around the edge of the lakes to track any influence that they might have on future aquatic weed infestations.

Costs

Based upon the costs incurred in the study to collect and to analysis the data, a projected annual cost for this project has been developed. In summary, the costs to complete this study in Ohio averages out to a cost of $307.00 per lake per year. Approximately two thirds of that cost is for obtaining the aerial photos. In a state the size and shape of Ohio, travel costs and employee salary per lake were a very low $45.50. Approximately one hour is needed on site to sample each lake. Travel time will depend upon the relative locations of the lakes being studied. In this study a total of five working days should cover all the lakes for sampling. Photointerpretation of each treated lake takes approximately one hour.

Conclusion

Mechanical harvesting may prove to be an effective means of aquatic vegetation control in problem areas of Ohio State Park lakes. However, several years of monitoring the affect of the program will be needed to ascertain if any measurable changes take place that can be attributed to the mechanical harvesting.

The results of this study indicate that the Division of State Parks could establish a longitudinal monitoring and mapping program to oversee the mechanical harvesting program for a reasonable cost per lake. When compared to the cost of running the $87,000 harvester for $37.50 throughout the growing season, a little over $300 per lake can be considered to be a reasonable cost.

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