

RESEARCH TO SUPPORT ANALYSIS AND MANAGEMENT OF CARRYING CAPACITY AT LAKE UMBAGOG NATIONAL WILDLIFE REFUGE, NEW HAMPSHIRE AND MAINE

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resources, and may also cause crowding and other social impacts that degrade the quality of the visitor experience. How many visitors can ultimately be accommodated on public lands? How much resource and social impact should be allowed? These and related questions are commonly referred to as carrying capacity (Graefe et al. 1984, Shelby and Heberlein 1986, Stankey and Manning 1986, Manning 1997, Manning 1999a, Manning 2001).

Abstract.—Lake Umbagog National Wildlife Refuge (New Hampshire and Maine) contains significant natural and recreational resources. The area accommodates an estimated 50,000 visits per year, with accompanying resource and social impacts. A 2-year study of the area was conducted beginning in summer 2006. The first year of the study focused on identifying indicators of quality for the refuge and the second year of research focused on determining standards of quality for indicators identified in first-year research. Visitor and camp/home owner surveys included normative questions addressing the maximum acceptable impacts to indicator variables. Findings from this study are being used to guide management of carrying capacity at the refuge.

1.0 INTRODUCTION

America's public lands contain natural and cultural resources of great importance to the nation and, in many cases, to the international community. Given the significance of this resource base, public demand to see and experience these areas is not surprising. Data on visitation to public lands dramatically support this premise.

The popularity of public lands presents substantial management challenges. Too many visitors may cause unacceptable damage to fragile natural and cultural

The U.S. Fish and Wildlife Refuge System, and Lake Umbagog National Wildlife Refuge in particular, can serve as case studies of the issues noted above. According to refuge estimates, the natural and recreational resources of Lake Umbagog National Wildlife Refuge attract more than 50,000 visits per year, which can result in substantial resource and social impacts. How much and what types of visitor use can ultimately be accommodated at Lake Umbagog National Wildlife Refuge?

1.1 Carrying Capacity Framework

Research on carrying capacity has led to development of several planning and management frameworks that can be used to analyze and manage carrying capacity. The most recent is the Visitor Experience and Resource Protection (VERP) developed by the U.S. National Park Service (National Park Service 1997, Manning 2001). As the name suggests, this planning framework is aimed at maintaining the quality of the visitor experience and protecting natural resources in the face of increasing visitor use. VERP is built upon the same basic principles and concepts that drive other contemporary carrying capacity and related public land planning/management frameworks, including Limits of Acceptable Change (Stankey et al. 1985) and Visitor Impact Management (Graefe et al. 1990). In VERP, management objectives must be formulated for the area. Management objectives are broad narrative

statements that define desired conditions. Indicators of quality—measurable, manageable variables that help define the quality of natural resources and the visitor experience—must then be developed. Standards of quality define the minimum acceptable condition of indicator variables. Research suggests that visitors and other stakeholders often have norms or standards about the resource and social conditions acceptable in a park or related area, and that such norms can be useful as a means of formulating indicators and standards of quality (Shelby and Heberlein 1986, Shelby et al. 1992, Manning et al. 1996a, Manning et al. 1996b, Manning 1999b, Lawson and Manning 2001, Lawson and Manning 2002, Manning and Lawson 2002).

1.2 Study Objectives

The overall purpose of this study was to gather information that would help support application of VERP to Lake Umbagog National Wildlife Refuge. Study objectives focused on identifying indicators and standards of quality for the visitor experience.

2.0 RESEARCH METHODS

Two surveys of representative samples of visitors to the refuge were conducted using self-administered questionnaires on-site at boat access areas. As visitors completed their visits, every visitor group was asked to complete a survey. One member of the group age 18 or older was asked to complete the questionnaire. The first survey was conducted on randomly selected days during July and August 2006 to measure indicators reflecting the quality of the visitor experience (Manning et al. 1996a, Manning et al. 2003). Both open- and close-ended questions were used to ask visitors to report variables that significantly added to and/or detracted from the quality of their experience. One hundred ninety-seven usable questionnaires were collected and a response rate of 77 percent was obtained for the survey.

The second survey was conducted on randomly selected days during July and August 2007 to measure standards of quality for selected resource and social indicators (Manning et al. 1996a, Manning et al. 2002, Manning et al. 2003). The same sampling procedures

as the first survey were used. A total of 193 usable questionnaires were collected, yielding a 76-percent response rate for this survey. When appropriate, visual approaches to measuring standards of quality were employed using computer-generated photographs to represent a range of visitor-caused impacts (Manning et al. 1996a, Manning et al. 1999, Manning and Freimund 2004).

A community resident survey was administered to members of communities in and immediately around the refuge in fall 2007. The survey was mailed to a census of residents derived from town property tax records and was addressed to the person listed on tax rolls for each property. The community resident survey was similar to the visitor survey described above. The purpose was to include this important interest group (residents) in refuge planning and management. A total of 132 completed questionnaires were returned and a response rate of 73 percent was obtained using slightly modified procedures described in Dillman (2000).

3.0 RESULTS

Results from the first phase of research to determine indicators of quality for Lake Umbagog are presented below. Only visitors to Lake Umbagog National Wildlife Refuge participated in the 2006 survey. Respondents were asked several open-ended questions to probe for potential indicator variables. The things visitors enjoyed most about their visit were wildlife-related encounters, participating in recreation activities while visiting the refuge, the peaceful nature of the refuge, and the natural beauty associated with it. About one in nine visitors reported that “motor boats” were the aspect of their visit that they enjoyed least. Improvement of facilities (e.g., docks, restrooms, aids to navigation) was a change recommended by 15 percent of respondents, while banning or limiting motorboats, limiting the size of motors, or having speed limits on the lake was recommended by 12.3 percent of respondents. Based on these responses, the number of motor boats on the waterways in the refuge and the ability to see wildlife are useful indicator variables.

Respondents were also asked close-ended questions about whether several issues caused problems at the refuge. The vast majority of respondents indicated that none of the issues were currently problems. More than a quarter of respondents, however, felt that too many motor boats on the lake, boats going too fast, and boats being noisy were either a small or big problem. A fifth of respondents thought that too many boats on the rivers and litter were small or big problems.

The surveys conducted in 2007 were used to help identify standards of quality for both visitors and residents. Respondents were shown a series of photographs depicting increasing levels of boat use on the lake, on the rivers, and in sheltered bays. Visitors

were also asked to respond to questions about the maximum acceptable number of boats in a group and minimum acceptable percentages of visitors who should see wildlife and catch fish.

Figure 1 shows the series of photographs depicting increasing boat use on the lake. Respondents were asked to evaluate the *acceptability* of the six photographs showing increasing levels of boat use on the lake (called “acceptability”). Acceptability was measured using a 9-point Likert-type scale ranging from -4 (“Very Unacceptable”) to 4 (“Very Acceptable”). Results from acceptability ratings are shown in Figure 2. In general, both residents and visitors found photographs with more boats less



Figure 1.—Photographs showing varying numbers and types of boats on Lake Umbagog.

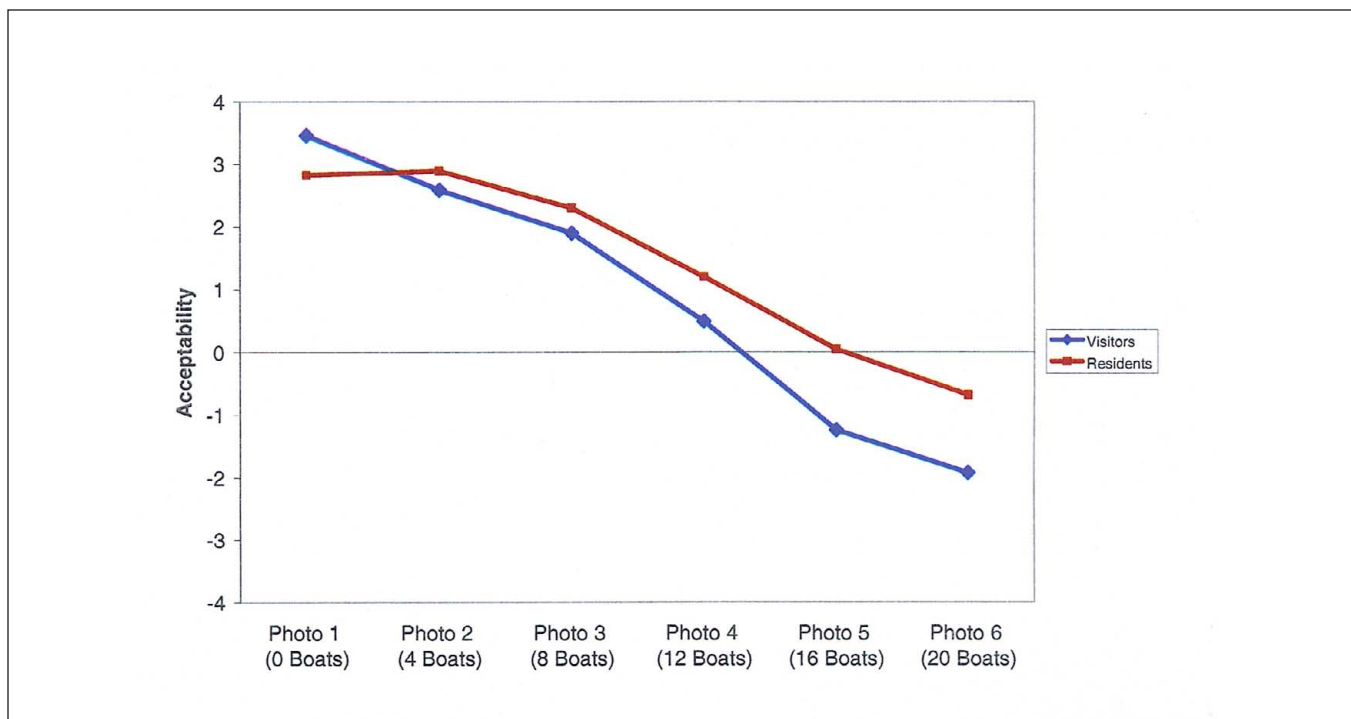


Figure 2.—Social norm curve for number and type of boats on Lake Umbagog.

acceptable than photographs with fewer boats, but residents found the photographs with 12, 16, and 20 boats significantly more acceptable than did visitors. Additionally, residents found the photograph with no boats significantly less acceptable than did visitors ($p < .05$).

Respondents were also asked a series of four additional questions to further elaborate their standards of quality using alternative evaluative dimensions (Manning et al. 1999). First, respondents were asked to indicate which photograph showed the number of boats on the lake that they preferred to see (called “preference”). Next, respondents were asked to indicate the photograph that showed the condition that would be so unacceptable that they would no longer visit Lake Umbagog National Wildlife Refuge (called “displacement”). Respondents were given the opportunity to indicate that “none of the photographs are so unacceptable that I would no longer visit this area.” The next question asked visitors to select the photograph representing the highest number of boats on the lake that they thought the Fish and Wildlife Service should allow, or the point at which visitor use

should be restricted (called “management action”). Respondents were given the opportunity to indicate that none of the photographs showed a high enough number of boats to restrict use or that use should not be restricted at all. Finally, respondents were asked to indicate the photograph that best represented the condition they “typically see/saw.” Residents found 8.6 boats on the lake at one time preferable, while visitors found 5.7 boats preferable. This difference is statistically significant ($t(266) = 4.57$, $p = .000$). No significant differences were found between visitors and residents for any of the other evaluative dimensions noted above. However, a significantly higher percentage of residents than visitors indicated that “none of the photographs are so unacceptable that I would no longer visit this area” ($\chi^2(1, N=333) = 49.28$, $p = .000$) for the displacement question. Additionally, a significantly higher percentage of residents than visitors indicated that “none of the photographs showed a high enough number of boats to restrict use” or that “use should not be restricted at all” ($\chi^2(2, N=333) = 45.63$, $p = .000$) for the management action question.

Similar questions were asked of respondents who used the rivers in the refuge (Figs. 3 and 4) and those who fished during their visit (Figs. 5 and 6) and similar patterns of results were found. Photographs depicting increasing numbers of boats on the rivers within the refuge are shown in Figure 3. Results from acceptability ratings for river users are shown in Figure 4. Again, both residents and visitors found photographs with more boats on the river less acceptable than photographs with fewer boats,

but residents found the photographs with 12 and 15 boats significantly more acceptable than did visitors. Additionally, residents found the photograph with no boats significantly less acceptable than did visitors. Residents found 5.3 boats on the rivers at one time preferable, while visitors found 4.1 boats preferable. This difference is significant ($t(213)=-2.46$, $p=.015$). Additionally, residents indicated that they typically see significantly more boats on the rivers than visitors do (5.3 vs. 4.3; $t(208)=-2.57$, $p=.011$). No significant

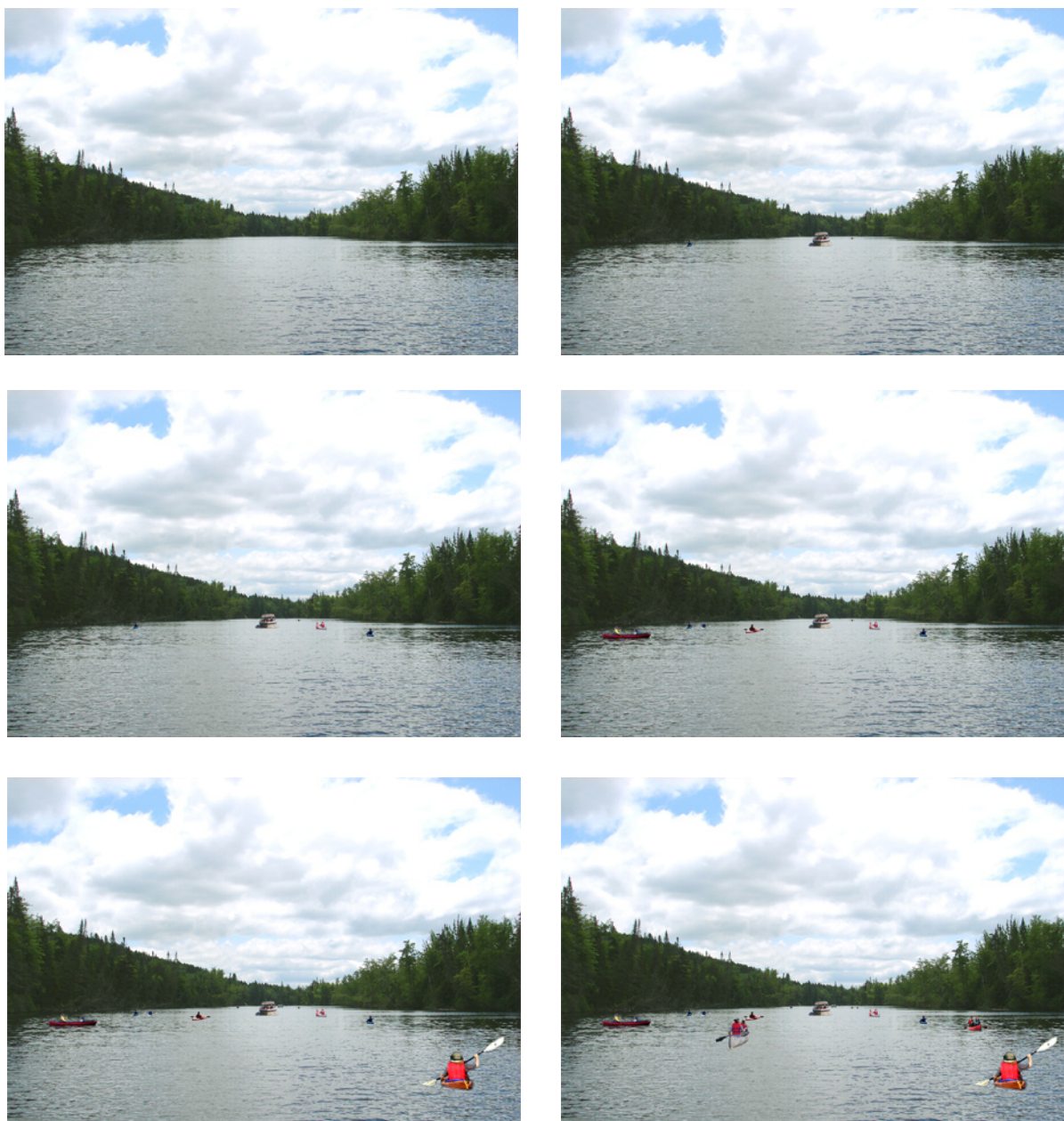


Figure 3.—Photographs showing varying numbers and types of boats on the river.

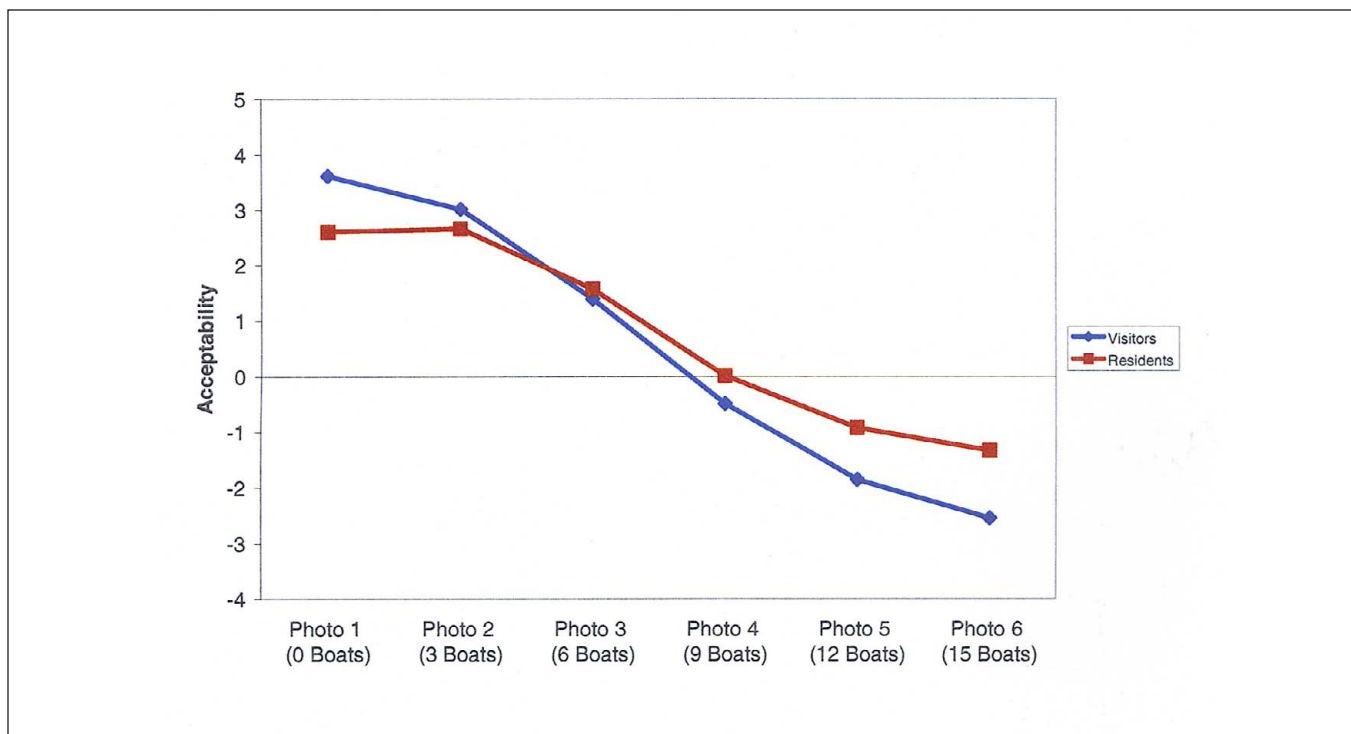


Figure 4.—Social norm curve for number and type of boats on the river.

differences were found between visitors and residents for any of the other evaluative dimensions noted above. However, like the questions about number of boats on the lake, a significantly higher percentage of residents than visitors indicated that “none of the photographs are so unacceptable that I would no longer visit this area” ($\chi^2(1, N=333) = 24.61, p=.000$) for the displacement question. Additionally, a significantly higher percentage of residents than visitors indicated that “none of the photographs showed a high enough number of boats to restrict use” or that “use should not be restricted at all” ($\chi^2(2, N=333) = 40.34, p=.000$) for the management action question.

Photographs depicting increasing numbers of fishing boats on the lake are shown in Figure 5. Results from acceptability ratings for river users are shown in Figure 6. Slightly different results were found for this question. Again, both residents and visitors found photographs with more boats less acceptable than photographs with fewer boats, but residents found the photographs with 0, 4, and 8 boats significantly less acceptable than did visitors.

There were no significant differences between the standards expressed by residents and visitors to the questions using alternative evaluative dimensions. However, like the previous two sets of questions, a significantly higher percentage of residents than visitors indicated that “none of the photographs are so unacceptable that I would no longer visit this area” ($\chi^2(1, N=333) = 35.69, p=.000$) for the displacement question. Additionally, a significantly higher percentage of residents than visitors indicated that “none of the photographs showed a high enough number of boats to restrict use” or that “use should not be restricted at all” ($\chi^2(2, N=333) = 58.06, p=.000$) for the management action question.

With regard to group size, both residents and visitors found larger groups less acceptable than smaller groups, but residents found group sizes of six boats or more significantly more acceptable than did visitors. Additionally, residents found group sizes of one or two boats significantly less acceptable than did visitors.

Questions that asked respondents to indicate the minimum acceptable percentage of visitors to the



Figure 5.—Photographs showing varying numbers of fishing boats on Lake Umbagog.

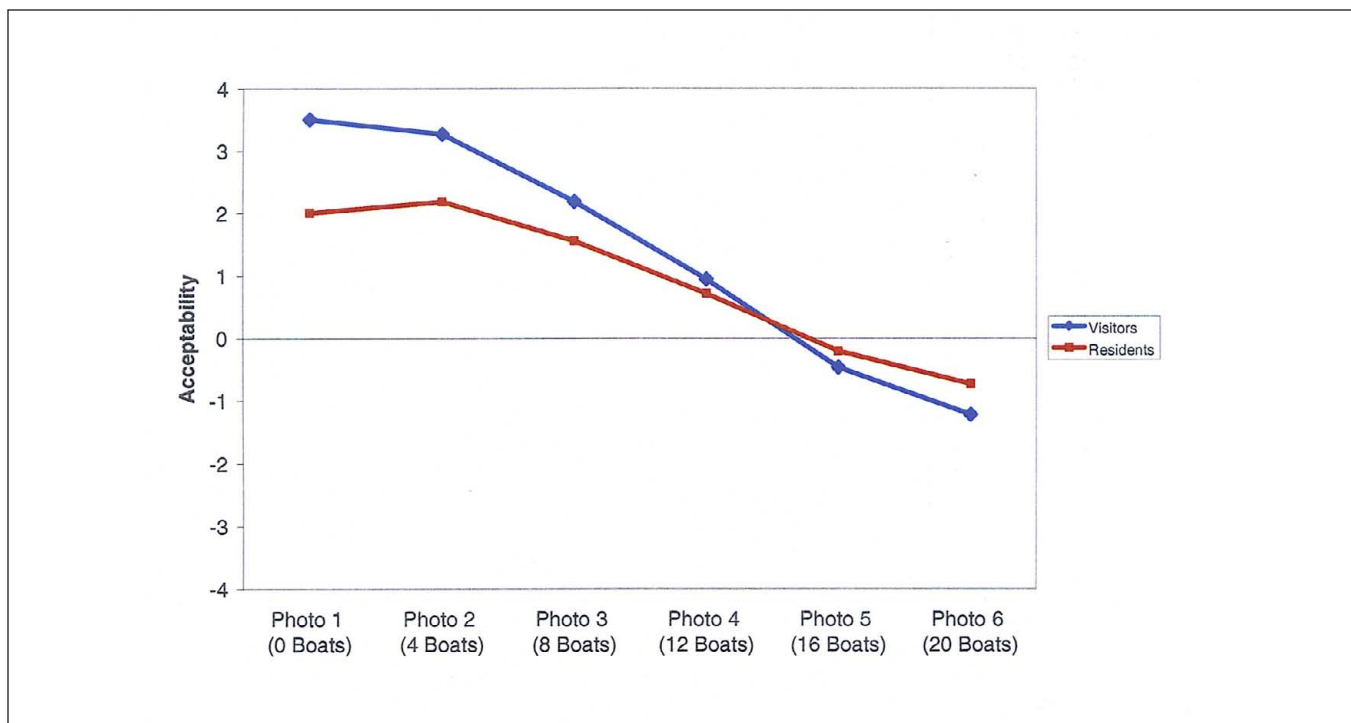


Figure 6.—Social norm curve for numbers of fishing boats on Lake Umbagog.

refuge who should see loons, eagles, osprey, other waterfowl, and moose found that on average, visitors and residents indicated similar percentages. They felt that at least two-thirds of visitors should see loons and other waterfowl, while at least half of visitors should see eagles, osprey, and moose. Questions that asked respondents to indicate the minimum acceptable percentage of visitors to the refuge who should be able to catch bass, trout, salmon, and other fish species found that on average, visitors and residents indicated similar percentages. Respondents felt that a minimum of just under two-thirds of visitors should be able to catch bass and other fish species, while at least half of visitors should be able to catch trout or salmon.

4.0 DISCUSSION AND CONCLUSIONS

Findings from the study help provide an empirical foundation for applying the VERP framework to Lake Umbagog National Wildlife Refuge. While all wildlife refuges are primarily managed to support and maintain diverse species of wildlife, considerable recreation is allowed and occurs in these areas. That recreation is typically focused on wildlife-dependent activities, with other types of recreation viewed as

secondary. However, when the VERP framework was applied to Lake Umbagog National Wildlife Refuge, results were similar to places where nonwildlife dependent recreational activities are primary. Many of the indicator variables identified at Lake Umbagog National Wildlife Refuge were similar to the indicator variables identified in more than 15 years' worth of research in national parks around the country. The number of other users present, the ability to enjoy the natural setting with a minimum of disruption from other visitors, availability of facilities like restrooms and campsites, and the ability to see wildlife in natural habitats are as important to visitors to this wildlife refuge as they are to visitors to many national parks. The similarity of priorities may explain why the VERP framework can be so readily applied to Lake Umbagog National Wildlife Refuge.

Residents who owned or rented year-round or seasonal homes adjoining the waterways within the refuge tended to be more tolerant of larger numbers of boats, and less tolerant of conditions with fewer boats than were visitors. No differences were observed between visitors and residents for minimum acceptable

percentages of visitors able to view wildlife or catch fish during their visits. This result seemed somewhat surprising since previous studies of residents who live near protected areas indicate that residents are sensitive to the effects of large numbers of visitors on their experience of the resource. In fact, evidence of substantial displacement and coping behaviors exhibited by residents of communities near Acadia National Park has been found in response to increasing recreation use (Manning and Valliere 2001). A possible explanation for the current finding is that residents and camp owners were responding strategically to preserve their access to the refuge.

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