

Final Report

A Multi-Method Assessment of Recreation Impacts at Rocky Mountain National Park¹

Sponsored by The National Park Service and conducted by

**Jeffrey J. Brooks²
John P. Titre³**

**The College of Natural Resources
Department of Natural Resource Recreation & Tourism
Colorado State University
Fort Collins, Colorado**

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Park visitor standing in a posted restoration area at Dream Lake taking a photograph.
Photo: Jeffrey J. Brooks

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Executive Summary

This assessment was the first in a suite of studies designed to address visitor experience, recreation related impacts, and perceptions of Backcountry/Wilderness management at Rocky Mountain National Park. The overall aim was to elicit salient information and possible research questions about visitation patterns, behaviors, experiences, and associated resource impacts to inform park visitor management and education. In addition, this independent research study provided the qualitative data that was interpreted for the in-depth visitor experience narratives (i.e., Ph. D. dissertation) and the development of many of the quantitative items used in two visitor surveys conducted in summer 2002, which employed larger probability samples. The major results, insights, and implications learned by conducting this assessment are highlighted in the bulleted list.

- Multi-method approaches permit triangulation of results, which helps to identify where there is agreement and disagreement among research participants and techniques.
- This assessment employed three independent methods (Table 1).
- During field observations (n = 378 sessions⁴, Method 1), we most frequently observed visitors going off trail, throwing things, feeding wild animals, and making purposive contact with water in lakes, streams, and waterfalls (Table 2).
- Method 1 results indicate that group size is positively related to relative frequency of occurrence for the main impacting behaviors (Table 3). Relative frequencies of occurrence, or rates, were calculated by dividing raw frequencies of occurrence by total hours of observation time for each group.
- During the free listing technique employed with park visitors (n = 56, Method 2), seeing litter and littering in the Park were mentioned most frequently (36% of the sample), impacts related to wildlife and vandalism were reported second by 20% of the sample each, 18% of the sample listed social trails and going off designated trails as impacts that they saw during their trip, and 27% reported seeing no impacts or undesirable behaviors (Table 4).
- During the free listing technique with key informants (n = 13, Method 3), social trails/off trail impacts (85%), people in general (69%), ecological perturbations (61%), litter (54%), and human waste (46%) were most frequently reported as problem issues at RMNP (Table 5).
- Going off trail, cutting trail, feeding wildlife, approaching wildlife, littering, removing resources, camping without permit, human waste, and taking dogs into the Park were observed with each of the three methods (Table 6).

- Methods 2 and 3 resulted in 15 general impact theme categories for both groups of participants. Visitors and key informants listed similar numbers of specific problems related to camping, litter, and noise. However, when proportion of responses relative to each group's sample size was examined, the key informants demonstrated a higher proportion of awareness for these impact issues than visitors (Figure 1).
- Going off trail in sensitive areas, feeding wild animals, and littering were found to be conspicuous, or salient, behaviors for visitors and key informants, thereby indicating agreement that these impacts may require attention at RMNP. Both visitors and park staff were aware of these impact issues, which also were frequently observed during fieldwork by researchers.
- General management concerns about noise related impacts at the Park were confirmed by each of the three methods.
- Impact issues surrounding camping in RMNP were reported by both groups of participants and primarily involved violating NPS regulations and failure to practice Leave No Trace techniques (Appendices F and G).
- Visitor interactions with nature in a tactile physical manner, especially for children, were frequently observed in the field. This often included throwing things picked up from the ground and touching the water in streams and lakes.
- This study provided evidence that exploration on the part of visitors is an important aspect of the experience at RMNP.
- Highly contextual assessment studies are appropriate for understanding impacts related to visitation and recreation in settings where complexity and uncertainty are common.
- Qualitative and quantitative methods can be complementary.
- Studies that employ multiple methods tend to generate new hypotheses, and they can inform the design of structured surveys.
- The underlying intent of multi-method assessments of this nature is to clearly describe and differentiate salient issues, from multiple directions, before implementing subsequent research and management actions.

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INTRODUCTION

The Problem

Impacts to natural resources related to recreation have unquestionably become a salient issue for scientists, managers, and conservationists (Cole, 1987; Leung & Marion, 2000; Noe, Hammitt, & Bixler, 1997). Parks and protected areas across the nation share general concerns over issues of crowding and capacity (Manning, 1999), while at the same time specific places struggle with unique physical and social problems associated with recreation and general visitation by members of the public. However, there is often limited scientific knowledge about recreation resource impacts for informing management decisions at these places (Leung & Marion, 2000).

Since 1994, visitation at Rocky Mountain National Park (RMNP) has exceeded three million annually, and between 1984 and 1998, there was a 28% increase in the number of backcountry permits issued (Department of the Interior, National Park Service, 2001). The need to better define and then address resource impacts associated with increased levels of visitation was clearly stated in the current Backcountry/Wilderness Management Plan and Environmental Assessment developed for RMNP:

“The population along the Front Range of Colorado continues to grow, ... As a result, day use and its associated impacts have increased significantly. Appropriate management actions are needed to protect the wilderness resources for present and future generations” (Department of the Interior, National Park Service, 2001, p. 1-5).

Visitors at protected areas such as RMNP physically interact with the recreation setting. These interactions, or behaviors are in essence what outdoor recreation is about (Schreyer, 1988). The nature of this interaction determines both the level of impact on park resources as well as the quality of the visitor experience. For example, the park visitor quoted below was disgusted by seeing evidence of the physical act of littering in his special place.

“Yes, I have seen litter in the popular sites. I look for that kind of stuff, maybe some people don’t see it, but ... this is like a surreal place. It puts us all in a good mood, and makes us feel a little bit higher than we usually are, and someone threw a bottle down” (Day Hiker in Wild Basin, August, 2001).

Scenic viewing and photography are two of the main visitor activities at RMNP (Appendix A). Alteration and loss of aesthetic quality represents a cost to the visitor experience. Behaviors such as feeding wildlife (leading to its habituation to the presence of humans and less natural conditions; Starkey & Larson, 1987) and physical changes such as trail deterioration, for example, tend to be associated with increased costs for staffing visitor education and trail repair and maintenance (Cole, 1987; Leung & Marion, 2000). The National Park Service (NPS) is mandated to manage both the social and physical settings at RMNP in a manner that preserves the integrity of the natural resource and the visitor experience (Department of the Interior, National Park Service, 2001; Leung & Marion, 2000).

Study Objectives

In accordance with their mandate, the NPS sponsored the research presented in this report as the initial phase of a larger study to address recreation impacts and the visitor experience. This report is a summary and synthesis of the findings from a two-month intensive assessment conducted by a team of researchers and their assistants during summer 2001 at RMNP. Broadly, the intent of the study was to identify pertinent issues and questions for current and future management and research. The work had two specific objectives:

1. The first objective was to apply multiple methods to illicit, identify, and describe salient human behaviors and associated impacts for both day and overnight visitors in primarily high use areas of the Park. A better understanding of behavior in recreation environments helps to manage people's actions and experiences while preserving the resource.
2. The second objective of this assessment was to inform the development of two subsequent, but independent, structured survey questionnaires to enhance their effectiveness and content validity. These were the follow-up survey for the Visitor Employed Photography study⁵ and the questionnaire entitled: A Survey of Overnight and Day Visitors in Backcountry/Wilderness at Rocky Mountain National Park each administered during summer 2002.

METHODOLOGY

Overview

Recreation impacts and the behaviors leading to them can be effectively studied using an array of research methods and approaches. This allows researchers to show evidence of what is on the top of the minds, or salient to, research participants and to clarify the nature of impacting behaviors, which ultimately increases knowledge of recreation behavior.

Employing more than one method enables verification by triangulation. Results are compared from each method for convergence and divergence. That is, we look for where findings from different methods agree and disagree. In a general qualitative sense, convergence is finding similar results, or knowledge, from more than one independent source. Divergence in findings provided by independent methods helps us to more clearly differentiate results and knowledge, but often leads to *new* questions about why results differ. In sum, triangulation of research methods can improve the quality of information and provides crosschecks (Beebe, 1995).

The assessment reported here used three independent methods each with three primarily separate samples (Table 1).

Table1. Summary of three independent methods employed to assess recreation impacts at RMNP during summer 2001.

| Task | Quantitative | Qualitative | Qualitative |
|-----------------|--|--|---|
| Data collection | (1) Structured field observations of visitor behavior (n = 378) ¹ | (2) Semi-structured interviews with park visitors (n = 56) | (3) Semi-structured interviews with key informants (n = 13) |
| Data management | Recorded on ethogram ² forms in the field | Tape recorded and transcribed | Hand written, edited, and typed |
| Data analysis | Spread sheet analyses (i.e., SPSS and Excel) | Content and categorical analyses of free list item | Content and categorical analyses of free list item |

¹ Sample sessions of observations were conducted with 139 family groups, 70 non-family groups, 111 couples, and 58 individuals.

² An ethogram is defined as “a thorough description of behaviors exhibited by individuals in specific situations” (Pellegrini, 1996, p. 80).

Sampling and Field Work

Systematic observations of visitor behavior (Burch, 1974; Suen & Ary, 1989) and semi-structured interviews (Bernard, 1994) were collected from both day and overnight visitors to the Moraine Park-Bear Lake and Wild Basin regions. In addition, data were collected in the far north at Mirror Lake and at Timber Lake and Lake Verna west side locations that receive lighter levels of visitation (see map in Appendix B).

Research teams of two to four individuals collected field observations and interviews with park visitors between June 16 and August 17, 2001. Teams were in the field during ten weekdays and six weekend days, which were pre-assigned by park administration to avoid conflicts with concurrent visitor surveys to reduce respondent overburden. Each team member collected data during three shifts at different locations during daylight hours. The sampling days were divided into morning (0800-1100), mid-day (1100-1500), and evening (1500-1800). Combinations of these day periods with certain locations were randomly drawn prior to the beginning of each day of fieldwork. Once at these randomly selected locations, we purposely selected individuals and groups to maximize variation in gender, age, and group size.

These locations included popular attractions for both day and overnight visitors and any nearby camping areas. For example, we sampled at destination points like waterfalls, scenic overlooks, picnic areas, campsites, and alpine lakes. The popular hiking corridors also were targeted. We recorded observations and conducted interviews between one-half mile and seven miles from main trailheads, thereby capturing a range in elevations. Appendix C lists the specific locations where information was collected.

Method 1: Structured Behavioral Observations with Park Visitors (n = 378 sessions²)

We applied focal individual and focal group time sampling (Altmann, 1974; Fry, 1990). Time is a key variable in this technique because it allows the researchers to estimate rates of behaviors. Observation sessions normally lasted five to ten minutes, and care was taken to record the time of initiation and duration of each observation session (Altmann, 1974; Suen & Ary, 1989). After each session, five to ten minutes were allowed to record data and to select the next focal group or individual. This sequence was systematically repeated for one to two hours for each sample period. We maintained constant view of the focal individual or group, which often required moving with them or shadowing. If the focal sample did not remain in view for at least five minutes, no observations were recorded. Observed occurrences of predetermined behaviors (e.g., cutting trail, littering) were systematically recorded to ethogram data sheets (Appendix D). For example, the number of times that a person fed wildlife during the ten-minute sample session was recorded. The reverse side was used to record emergent behaviors, unique observations, and contextual field notes; a sub-sample of these observations and notes were reported in Appendix E.

Method 2: The Free List Technique with Park Visitors (n = 56)

We interviewed visitors during these random sessions whenever possible, again selecting among individuals to maximize diversity (Beebe, 1995). To make contact, we approached visitors and campers with informal conversation about RMNP and the study. When minimal rapport was established, we asked people to participate. Most agreed, but we did record approximately ten refusals.

The interview guide used with visitors included a free list (Bernard, 1994) question about specific impacts; responses were content analyzed for this report:

“During this visit to RMNP, have you seen any negative signs of people who visited here?”

The free list technique is a powerful method for discovering group knowledge and the extent to which certain ideas or views about behavior may be shared among certain individuals. In addition, the free list technique can be used to find out where to concentrate effort in applied research, which was one of the goals of this assessment (i.e., objective two).

Method 3: The Free List Technique with Key Informants (n = 13)

Fourteen key informants were interviewed using an independent interview guide during summer 2001. These interviews included a free list item; responses were content analyzed for this report:

“... Please be specific and name as many of the impacts you are talking about when you mention these areas.”

Key informants are different from general park visitors because they typically possess greater levels of specific detailed knowledge and broad experience, which is *key* for addressing the research problem (Beebe, 1995; Bernard, 1994). This group of informants consisted of nine NPS employees, three park volunteers (two were interviewed together), one concessionaire, and one research scientist working at Colorado State University. The joint interview was analyzed as one for a total of 13 in the sample.

OVERALL RESULTS

Method 1: Structured Observations of Visitor Behavior

The research teams logged a total of 57.85 hours of behavioral observations at RMNP during summer 2001. We recorded behaviors for 139 family groups (see Appendix E), 70 non-family groups, 111 dyads (or couples), and 58 individuals for a total of 1212 people (589 females and 623 males). Table 2 presents impacting behavioral events⁶ that were most frequently observed in the field with an estimate of the overall rate of occurrence in hours. Rate of occurrence, or relative frequency, is defined as how often a behavior occurs per time unit (Altmann, 1974; Suen & Ary, 1989).

Table 2. Observed frequencies for impacting behavioral events (Method 1) at RMNP during summer 2001.

| Behavior ¹ | Frequency of Occurrence | Rate of Occurrence ² |
|-----------------------|-------------------------|---------------------------------|
| Off trail | 341 | 5.89 |
| Throw debris | 181 | 3.13 |
| Feed wildlife | 58 | 1.00 |
| Touch water | 47 | 0.81 |
| Cut trail | 16 | 0.28 |
| Yell | 16 | 0.28 |
| Litter | 14 | 0.24 |
| Enter water | 10 | 0.17 |
| Other | < 10 | ----- |

¹ Actual behaviors (i.e., events) that we observed and recorded in the field.

² Rates (or relative frequencies for observed occurrences) were calculated by dividing frequency of occurrence by 57.85 hours total observation time.

Going off trail, feeding wildlife, cutting trail, and littering were predetermined as behaviors that result in impacts to the resource or the experience during the design stage of the study.

Throwing stones or woody debris picked from the ground surface, touching/testing/tasting water from streams and lakes (a neutral behavior), yelling or talking loud, and entering bodies of water emerged during the course of fieldwork.

Other infrequently observed impacting behaviors included smoking both tobacco and marijuana, climbing rocks and trees, harassing wildlife, entering restoration areas, urinating, defecating, and digging into the soil. This report focused on behaviors that tend to be associated with impacts to resources or visitor experiences, but we recorded other behaviors such as taking pictures and watching wildlife, for example, to thoroughly describe visitor behavior (see Appendices A and E).

Impacting Behaviors by Type of Visiting Unit

A general trend, evidenced by Method 1, emerged where frequency of occurrence of observed behaviors was greater for groups than couples and individuals (Table 3). Reading across the table from left to right, rates of occurrence in parentheses (i.e., frequency divided by observation time) tended to be higher for groups than for dyads (i.e., couples) and for individuals. These results confirm that it is necessary for managers to consider group size, and perhaps group type, when designing interventions at the Park.

Table 3. Observed frequencies and rates of occurrence for impacting behavioral events by type of visiting unit at RMNP during summer 2001.

| Behavior ¹ | Family (2-10) ² | Non-family (2-16) | Dyad (2) | Individual (1) |
|-----------------------|-------------------------------|----------------------|-------------|-------------------|
| Off trail | 137 (6.9) ³ | 100 (9.0) | 68 (4.0) | 36 (3.7) |
| Throw debris | 163 (8.2) | 13 (1.2) | ----- | 5 (0.5) |
| Feed wildlife | 36 (1.8) | 15 (1.3) | 7 (0.4) | ----- |
| Touch water | 26 (1.3) | 6 (0.5) | 11 (0.6) | 4 (0.4) |
| Cut trail | 10 (0.5) | 2 (0.2) | 4 (0.2) | ----- |
| Yell | 9 (0.4) | 6 (0.5) | ----- | 1 (0.1) |
| Litter | 3 (0.1) | 5 (0.4) | 5 (0.3) | 1 (0.1) |

¹ Actual behaviors (i.e., events) observed and recorded in the field.

² Range in size (i.e., number of people) for each group type.

³ Cell entries represent frequency of occurrence with rate of occurrence in parentheses calculated based on these observation times: Family groups = 19.8 hours, non-family groups = 11.1 hours, dyads = 17.1 hours, and individuals = 9.6 total hours of observation, respectively.

Note: Cells that contain a dashed line indicate no observed occurrences.

Method 2: Free Listing of Impacts from Visitor Interviews

During semi-structured interviews, we asked 56 park visitors to list the impacts they had encountered during their visit (see p. 9 of methodology section). The primary author independently performed a content analysis of these responses. Listings of specific examples of behaviors were tallied for each visitor to reveal an array of impacts and grouped into impact categories to summarize the variation in responses (see Appendix F). Fifteen impact theme categories were identified. These were labeled and presented in Table 4.

The category of litter emerged most frequently. One park visitor listed human waste as an impact issue. Fifteen visitors reported seeing nothing in the way of impacts, or negative signs of people. Among those who listed nothing, some made the stipulation that their visits had just begun.

Table 4. Frequencies for impact categories reported by visitors (Method 2) at RMNP during summer 2001.

| Impact Theme Category ¹ | Frequency ² | Percent of Sample ³ |
|------------------------------------|------------------------|--------------------------------|
| Litter | 20 | 35.7 |
| Wildlife | 11 | 19.6 |
| Vandalism | 11 | 19.6 |
| Social Trails / Off Trail | 10 | 17.8 |
| Camping | 9 | 16.1 |
| Noise | 5 | 8.9 |
| People in General | 5 | 8.9 |
| Facilities | 4 | 7.1 |
| Pets | 4 | 7.1 |
| Resource Removal | 4 | 7.1 |
| Stock Animals | 4 | 7.1 |
| Ecological | 3 | 5.3 |
| Roads | 3 | 5.3 |
| Visual | 3 | 5.3 |
| Human Waste | 1 | 1.9 |
| Saw Nothing ⁴ | 15 | 26.9 |

¹ Researcher derived categories based on content analysis.

² Number of visitors who listed at least one impact in the context of that category.

³ n = 56 visitors asked the free listing question.

⁴ Visitors who reported that they had seen no negative signs of other visitors during this trip as of the time of the interview.

Method 3: Free Listing of Impacts from Key Informant Interviews

We asked park staff and other knowledgeable informants (n = 13) to list specific impacts that they thought were problems at RMNP (see p. 9 of methodology section). Fifteen theme categories emerged from the content analysis (Table 5). Detailed listings from the actual accounts were presented in Appendix G.

Most informants described impacts associated with social trails/hiking off trail, numbers of people in general, littering, and ecological impacts. Pets and their associated impacts were least salient for these research participants.

Table 5. Frequencies for impact categories reported by key informants (Method 3) at RMNP during summer 2001.

| Impact Theme Category ¹ | Frequency ² | Percent of Sample ³ |
|------------------------------------|------------------------|--------------------------------|
| Social Trails / Off Trail | 11 | 84.6 |
| People in General | 9 | 69.2 |
| Ecological | 8 | 61.5 |
| Litter | 7 | 53.8 |
| Human Waste | 6 | 46.1 |
| Visual | 6 | 46.1 |
| Wildlife | 6 | 46.1 |
| Facilities | 5 | 38.5 |
| Camping | 4 | 30.8 |
| Noise | 4 | 30.8 |
| Artificial Artifacts | 3 | 23.1 |
| Stock Animals | 3 | 23.1 |
| Resource Removal | 2 | 15.4 |
| Vandalism | 2 | 15.4 |
| Pets | 1 | 7.7 |

¹ Researcher derived categories based on content analysis.

² Number of informants who listed at least one impact in the context of that category.

³ n = 13 informants asked the free listing question.

RESULTS COMPARED ACROSS METHODS

Method by Impact Matrix

When results were compared across the three methods, agreement and divergence became apparent (Table 6). The first section of Table 6 presents impacts that were observed by each method. That is, cutting trail and littering, for example, were reported by and salient to both visitors and key informants, and these were observed in the field by the team of researchers. In other words, this table shows impacting behaviors that were evident to two independent samples of research participants (i.e., common awareness) and which were corroborated through field observations.

Table 6. Method by behavior triangulation matrix for RMNP, summer 2001.

| General Impact Behavior | Observation Source ¹ | | |
|--|---------------------------------|-------------------|-------------------------|
| | Direct observation | Visitor interview | Key informant interview |
| <u>Complete convergence</u> | | | |
| Off trail | X | X | X |
| Cut trail | X | X | X |
| Litter | X | X | X |
| Remove / displace resources | X | X | X |
| Feed wildlife | X | X | X |
| Approach / chase / harass / touch wildlife | X | X | X |
| Camp without permit | X | X | X |
| Take dogs into the park | X | X | X |
| Defecate/human waste | X | X | X |

¹ Cell entries indicate that a behavior was observed with that method.

Partial convergence. Partial agreement among methods indicates salience as well, but opens discussion to why certain observations of impacting behaviors were not recorded using certain methods.

Table 6 (continued). Method by behavior triangulation matrix for summer 2001.

| General Impact Behavior | Observation Source ¹ | | |
|---|---------------------------------|-------------------|-------------------------|
| | Direct observation | Visitor interview | Key informant interview |
| Yell / scream / talk loudly | X | X | |
| Climb rocks, trees | X | X | |
| Dig into soil | X | X | |
| Enter restoration area | X | X | |
| Start illegal fires | | X | X |
| Run recklessly on trails (children) | | X | X |
| Store food inappropriately | | X | X |
| Vandalize structures, graffiti, tree carvings | | X | X |

¹ Cell entries indicate that a behavior was observed with that method.



Ground squirrel at Bear Lake closely investigating a possible handout.

Divergence among methods. Some impacts and impacting behaviors were observed using only one method. In these cases, multiple methods showed complete divergence, which highlights distinct insights of each method. If only one method had been employed in this assessment, a substantial amount of diversity and richness in visitor behavior and salient issues would not have been recorded.

Table 6 (continued). Method by behavior triangulation matrix for RMNP, summer 2001.

| General Impact Behavior | Observation Source ¹ | | |
|--|---------------------------------|-------------------|-------------------------|
| | Direct observation | Visitor interview | Key informant interview |
| Enter lake, stream, or marsh | X | | |
| Smoke tobacco, marijuana | X | | |
| Throw stones, debris, ground cover | X | | |
| Urinate | X | | |
| Cross / walk roads carelessly to view wildlife | | X | |
| Dam streams to make pools for fishing | | | X |
| Develop new privies | | | X |
| Install climbing bolts | | | X |
| Install and leave research markers | | | X |
| Park vehicles on tundra | | | X |
| Play music, boom boxes | | | X |
| Wash dishes / pots in lakes or streams | | | X |

¹ Cell entries indicate that a behavior was observed with that method.

Free Listings: Park Visitors Compared to Key Informants

Figure 1 compares the relative proportion of responses listed in each impact category for visitors and key informants. Although visitors and key informants listed similar numbers of specific problems at RMNP for several categories such as camping, litter, noise (see Appendices F and G), when the raw listings were adjusted for relative proportion of responses out of each group’s size, it was demonstrated that the key informants listed substantially more specific problems per person than park visitors (Figure 1). In addition, key informants listed artificial artifacts such as scientific flagging as a concern whereas visitors did not. Visitors listed impacts associated with roads like elk-vehicle collisions, but key informants did not list specific problems related to roads. Questions asked of each group with all specific responses listed by park visitors and key informants appeared in Appendices F and G, respectively.

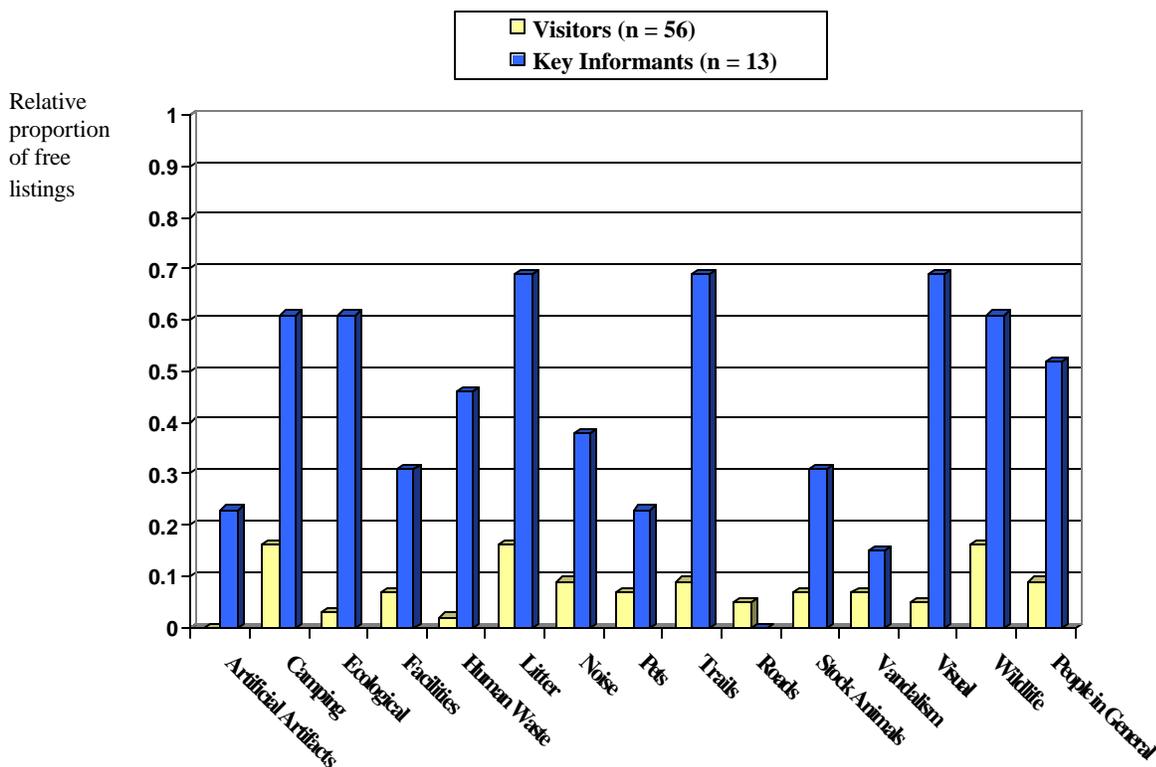


Figure 1. Free list comparison (Methods 2 and 3) for proportion of responses relative to sample size for visitors and key informants at RMNP during summer 2001.

Discussion of Results and Implications

This stand-alone assessment employed a mixed-methods approach (i.e., a study design that employed both quantitative and qualitative methods) to investigate impacts related to visitation and to inform the structured survey (which used a larger probability sample) of visitor perceptions of impacts at the Park administered during the following year. The study revealed contextual knowledge that may be unique to RMNP as a basis for a deeper understanding of recreation related impacts. Many of the findings reported here emanated from independent sources, and the analyses are informative because they provide evidence of commonality as well as divergence in results.

Overall, we frequently observed visitors going off trail (albeit sometimes in non sensitive areas) and feeding wild animals (Table 2). Visitors and key informants also spoke about leaving designated trails and feeding wildlife during their interview conversations (Table 6). We observed 14 instances of actual littering in the field during 58 randomly selected hours of observation. It is difficult to judge whether this estimate is high or low, however nearly 36% of the visitors (Table 4) reported seeing litter during their stay at the Park and about 54% of the key informants (Table 5) discussed litter and leaving trash at certain sites when asked to identify impacts at RMNP. The implication of these observations is clear: Going off trail in sensitive areas, feeding wild animals, and littering are salient issues, which can affect both visitor experience and park resources. This confirms mutual awareness of and concern over these problems and agreement that these impacts may warrant further mitigation at the Park.

Visitors were observed on multiple occasions (16 instances) yelling, shouting, or talking loudly. These sources of noise also were reported by visitors, but not by the key informants (Table 6). However, nearly 31% of the sample of key informants listed noise related impacts (e.g., playing music, crying babies, and airline over flights). These observations confirm concerns about noise related impacts addressed by managers in the recent Backcountry/Wilderness Management Plan and Environmental Assessment for RMNP (Department of the Interior, National Park Service, 2001).

Another general trend that emerged from the field observations (i.e., Method 1) was that rates of occurrence for the major impacting behaviors are somewhat exacerbated when groups are larger (Table 3). Raw frequencies of occurrence were divided by total hours of observation for each type of visiting unit to adjust for varying amounts of observation time. Families tended to demonstrate the highest rates of throwing debris, feeding wild animals, cutting trail, and touching water. Non-family groups, which represented the largest sized groups observed, were generally higher than dyads and individuals for all behaviors except touching water. The highest rate of going off trail was recorded for the non-family groups. The prevalent hypothesis that group size is positively related to impacts was reinforced in this study. However, we propose that focusing on numbers of people alone provides a narrow understanding of this relationship. Social interactions within groups, type of group, and how these interact with group size should also be considered. Perhaps group norms and family dynamics allow more freedom from restraint during an outdoor experience resulting in greater impact behavior. Park staff may need to pay greater attention to whether they are

speaking to families, clubs, couples, or individuals while communicating low impact messages to visitors at RMNP.

Results of the content analyses of the free listings made by visitors and key informants (Methods 2 and 3) showed similar categories of impacts and behaviors (Figure 1), and within each category specific listings overlapped in many cases, which indicates awareness for both visitors and key informants regarding broad areas of concern (Appendices F and G). These results also represent a rich diversity in responses. Numbers of distinct listings by category ranged from zero to nine for both groups. However, to account for unequal sample sizes, we divided frequency of response by the number of participants in each group to obtain the relative proportion of responses. This provided an indicator of degree of awareness, or saliency, regarding impacts at RMNP (Figure 1). For all categories of impacts, except roads, the key informants demonstrated higher proportions of listings of impacts associated with human behavior. Overall, the 13 key informants listed 87 distinct items whereas the 56 park visitors listed 69 responses. Although park personnel tend to be more intensely aware of impact issues because of their direct experience with these problems, they do share some awareness with the visiting public. It is critical to identify this overlap before “marketing” the concerns of park personnel among visitors. To build awareness, the Park needs to work within the framework of what visitors already understand about impacts and behaviors leading to undesirable conditions. Enhancement of visitor education will require more resources, time, and effort. Finding the overlaps in awareness thus becomes significant to cost effective visitor management.

It is also important to note that some specific issues were referenced in the context of more than one category of impacts. For example, park visitors referenced seeing bare ground at campsites whereas the key informants associated bare ground with social trails and hiking off trail. Negative ecological consequences of impacts and their associated behaviors were difficult to categorize because they were reported in several contexts. Many of the ecological problems listed are the result of trail and campsite deterioration, which have in the past been the most salient issues from the perspective of managers of parks and protected areas (Cole, 1987). Impact issues surrounding camping in RMNP were reported by both groups of participants in this study and primarily involved violating NPS regulations and failure to practice Leave No Trace (LNT) techniques (Appendices F and G). Often the long-term negative effects, or symptoms, of visitation and recreation behavior are highly visible at protected areas and usually demand the attention and time of managers. We are reminded that people’s attitudes and behaviors, which are not always visible, often underlie these perturbations. This highlights the importance of directing research, management, and education directly toward attitudes and behaviors.

One advantage of this study’s approach is the discovery of new information in the form of emergent non a priori results. Common every day behaviors that are taken for granted in some settings may have different consequences at protected areas such as RMNP. For example, we frequently observed visitors picking up things from the ground to throw such as stones, snow, and woody debris, but neither visitors nor key informants reported these actions as impacts during the interviews. In reviewing the abridged description of typical family group behavior observed at the Park (Appendix E), we first note that many family

groups that we observed included children. The need to interact with nature in a tactile manner, especially for children (which may be part of natural childhood development), was recorded as an emergent result for this study. Tactile interaction with nature on the part of people who visit RMNP may seem obvious to many natural resource professionals and outdoor educators. In the case of this study, however, these interactions often meant throwing things. Our study did not indicate the extent to which throwing debris enhances or disrupts the recreation experience, or what effect, if any, it has on park resources. These questions should be investigated in future research at the Park. On two separate occasions, however, we recorded observations of snowball throwing that included (1) a brief and playful snowball fight among a nuclear family of four and (2) an instance when an adolescent female was struck in the face (i.e., right eye) by a snowball thrown by a male visitor of the same age and party causing her to cry loudly, which required attention from one of the adults in that group. In another interesting (albeit extreme) case, we observed an individual child throwing some 60 stones in 10 minutes in an attempt to land one on a lily pad in Nymph Lake. These examples remind us that the behavior of young children and adolescents may be an overlooked aspect of the issue of visitor impacts at national parks and protected areas. Perhaps educational interventions such as LNT messages aimed at adults are only partially effective unless parents carry the message to their children. Sometimes parents and adult caregivers may recognize that their children are behaving inappropriately (e.g., feeding wildlife, throwing debris, etc.), but the outdoor vacation atmosphere of freedom and minimal control may encourage disobedience on the part of children. Parents may also find it difficult to correct children while in these settings, even if they do understand the proper behavior. After all (to use a cliché), kids are kids, and sometimes they behave irrationally.

If the assumption that recreation fulfills unmet needs is accepted as sound (Schreyer, 1988), it may help to explain two emergent themes: (1) the need to experience the setting in a tactile, physically interactive way and (2) the need to explore places off trail. In addition to throwing things, water seemed to draw both children and adults to experience nature in a physically interactive manner. Visitors were observed touching, tasting, and feeling water as part of their outdoor experience (Table 2). A second observation in this study is that people have a desire to explore and go off trail. For example, on the trail to Alberta Falls, near Glacier Gorge Junction, there is a stream crossing that provides an opportunity to cross the water on a bridge or walk on rocks. People seemed to enjoy both options. While many trails provide excellent views, going off trail, cutting trail, and feeding or approaching wildlife may be related to a need for adventure. Again, these behaviors displayed complete convergence using three independent methods of observation (Table 6). In other words, impact issues related to trails and wild animals were conspicuous to both visitors and key informants, moreover, they were directly observed in the field.

Whether visitors walk across meadows that are posted, “Restoration Area” or on broad flat granite surfaces, for example, they may be fulfilling a need to explore and to physically interact with the resource setting and its attributes. This is an important implication for the management of impacts at RMNP because physical interaction with the environment can lead to resource impacts. However, to expect people to proceed upward to see waterfalls, reach summits, and view vistas as if going up an escalator in an airport may be unrealistic. The

challenge for management is to allow for exploration, which seems to be a natural way to experience the Park, in locations that are less fragile and more resilient to traffic.

Conclusion

Managers are aware that recreation related impacts are an issue at places like RMNP. Moreover, the field of park and protected area management has amassed a respectable and growing literature base (e.g., Hammitt & Cole, 1998; Manning, 1999). However, there remains inadequate scientific knowledge for informing management about the nature of impacts, acceptability of impacts, and the types of human behaviors associated with them (Leung & Marion, 2000). Given that complexity and uncertainty are inherent in natural resource management and in sustainable policy making (Allen & Gould, 1986; Dovers & Handmer, 1993), research that identifies and describes both the subtleties and the conspicuous aspects of visitor management problems will unravel more of this uncertainty and clarify current knowledge, respectively.

Multi-method approaches and exploratory assessments identify occurrences and types of undesirable behaviors, generate tentative hypotheses and alternatives, and inform immediate management concerns. For example, the relationship between impacts and children warrants more investigation, yet immediate actions can be taken to communicate with parents and children about the consequences of impact behaviors, but managers must first know which undesirable behaviors families with children do most frequently and how these affect the resource and the experience of other visitors. It would be interesting to interview nuclear and extended families after observing them engage in some impact behavior in the field to find out what they understand about the relationship between impact conditions and undesirable behaviors. When implementing LNT or Authority of the Resource (Wallace & Gaudry, 2002) techniques, some messages might best be aimed at children either directly or through their parents.

We learned three important insights by conducting this assessment. Bias, in the form of incomplete information, may exist when a single method is used to gather information. Table 6 showed a continuum from complete convergence to complete divergence using independent methods. Had we only employed one method (e.g., key informant interviews) to describe the salient impacts and associated behaviors, we may have skewed our description of the situation at RMNP to favor perceptions of park staff, for example. Second, when reports from independent samples agreed, a stronger case could be made for equal awareness of impact issues for managers and visitors in this study. In addition, field observations confirmed the existence of certain types of impacts and conditions about which participants shared concern. Such convergence indicates common understanding and provides crosschecks of the data that enable effective visitor management. Third, a close examination of differences among the independent methods, or divergence, provides information about the distinct insights of each method. For example, we observed some things in the field that the participants did not talk about in the interviews such as smoking, throwing stones, and entering lakes and streams. For managers and visitors, divergence represents unequal awareness and concern about impacts and undesirable conditions at the Park. Knowing what

critical behavioral problems have escaped visitor awareness is the first step toward successful education and mitigation.

It could be said that trails and visitation areas represent a small part of the Park when revealed from a satellite photo, and that aggregate impacts are minor when viewed at the ecosystem level. However, humans and their social behaviors are part of the ecosystem (Brunson, 1995). Places in the ecosystem, such as RMNP, provide settings where people interact with one another and with the non-human components of the ecosystem. These interactions, overtime, create social and individual meanings for the place that enrich lives and provide well being; once people assign these meanings to protected places in the ecosystem, they may realize an array of environmental values (Page, 1992; Williams & Patterson, 1999) such as Rolston's (1985) aesthetic, recreational, spiritual, historical, intrinsic, and other values. In other words, place meanings that develop through both social and physical interactions with a protected setting are important because these meanings form the foundation of environmental values. It is important then, even in ecosystem management terms, that people can experience a relatively intact environment at special places like RMNP and be able to interact there. The same sites that attract visitors (e.g., lakes, streams, waterfalls, and tundra) also have added importance ecologically, even though they may not occupy much of the Park's surface area.

The finding that exploration is an important part of the visitor experience at RMNP may have implications for zoning and classification of hiking trails. It would seem prudent to provide places where visitors can enter a lake or walk across a minor stream on a footbridge or across rocks to fulfill the need to explore. Other locations where large rock outcroppings are present might allow for some exploration where impacts are negligible. Some visitors will not stay on designated trails at all times given the desire to explore and to physically interact with the setting. Also, certain social interactions among visitors may require the privacy offered during an off trail excursion. Behavior is an important part of the meaning that visitors assign to parks and protected areas. Genereux, Ward, and Russell (1983) concluded:

“Not only do people clearly distinguish places on the basis of related behavior, but their behavioral representations of places are substantially related to their global, overall cognition, or meaning of places” (p. 54).

Results from this and similar studies will likely require an active discussion among practitioners (and researchers) responsible for resource management, preservation, interpretation, and enforcement at protected areas. The goal was to more clearly describe and differentiate salient impact issues related to visitation and recreation, from multiple directions, before designing subsequent research and formulating management actions at the Park. It is important to keep in mind that these data were collected, analyzed, and presented in the spirit of rapid appraisal, which is a methodological “approach for developing a preliminary, [and often] qualitative understanding of a situation” (Beebe, 1995, p. 42). The assumptions behind this study are (1) all the relevant parts of the visitor impact situation at RMNP cannot be identified in advance, (2) the situation on the ground is best understood by combining the expertise of a diverse team of researchers, managers, and visitors, especially those who reside locally and who regularly visit the place, while combining information

previously documented, direct observations, and semi-structured interview data, and (3) time should be scheduled during the assessment for the team to interact as part of an adaptive process (Beebe, 1995, p. 43). These findings produced tentative hypotheses and insights about impact conditions and visitor behavior specific to RMNP that have already informed additional research at the Park. These insights can inform the decision processes of the managers and stimulate useful dialog, but more formal research is recommended before new policies are implemented.

Returning to the wisdom of the National Research Council (1986) on ecosystem management, we are informed that effective problem-solvers learn to expect the unexpected and often alter their responses as they learn more about the system. This suggests that adaptive strategies that include a view of the Park as a place to learn about human and ecosystem relations would benefit from a diversity of research approaches that aim to discover new insights to inform visitor management. A more complete understanding of human-environmental relations at protected parks and wilderness areas requires studying recreation behavior from a variety of perspectives and methodologies (Borrie & Birzell, 2001; Stynes & Stokowski, 1996). Seemingly unrelated observations may upon further inspection reveal solutions to unforeseen problems. One of the first writers to recognize the importance of collecting broad information to understand the relationship between humans and nature was George Perkins Marsh. He wrote:

“We are never justified in assuming a force to be insignificant because its measure is unknown, or even because no physical effect can now be traced to it as its origin. The collection of phenomena must precede the analysis of them, and every new fact, illustrative of the action and reaction between humanity and the material world around it, is another step toward the determination of the great question, whether [people are] of nature or above her” (quoted in Lowenthal, 1965, p. 464).

Managers at RMNP can cite these findings in future visitor management reports and use the insights reported here to guide dialog with the public and to inform future education and research needs. The triangulation of knowledge from different study methods is a powerful strategy for identifying overlap in awareness and concern about natural resource and visitor experience impacts. Moreover, subtle differences and unexpected findings are often described that can lead research and application in new directions.

Notes

¹ This report is the first in a suite of four visitor studies currently being conducted by Colorado State University in RMNP.

² Current affiliation for Dr. Jeffrey J. Brooks: Department of Journalism and Technical Communication, Colorado State University, Fort Collins, Colorado.

³ Current affiliation for John P. Titre: Parks Studies Inc., Windsor, Colorado.

⁴ The 378 sample sessions for behavioral observations averaged 10 minutes in duration. We observed a total of 1212 visitors in the following contexts: (1) family groups/units (n = 139), (2) non-family groups (n = 70), (3) couples/dyads (n = 111), and (4) lone individual visitors (n = 58).

⁵ The Visitor Employed Photography study that was conducted by the U. S. Geological Survey included a second phase mail back survey. Major sections of this survey were informed by the results of the assessment reported here. However, in the remainder of the report this survey is not discussed. Any mention of a second year survey refers to the general visitor survey conducted by Colorado State University during summer 2002.

⁶ An important distinction exists between behavioral *events* and *states*. “Events are instantaneous; states have appreciable durations.” (Altmann, 1974, p. 231). Since we observed impacting behaviors at the moment of their initiation, we were recording events. For example, each time we saw a visitor give food to a wild animal or go off a designated trail, we recorded the instance as one event of feeding or off trail, respectively. It is appropriate to calculate and present frequencies of occurrence and rates of occurrence for behavioral events. Appendix A displays several states of non-depreciative behavior, which were usually observed and recorded sometime after their onset. “Any question involving the duration of behavior, or the percent of time spent in some activity is a question about states.” (Altmann, 1974, p. 232). However, this report was primarily concerned with reporting frequencies of *events* of impacting behaviors (Table 2).

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DATA APPENDICES

Appendix A. Non impacting states of behavior observed at RMNP during summer 2001.

| Behavior ¹ | Frequency of Observation | Relative Frequency ² |
|--------------------------------|--------------------------|---------------------------------|
| Photographing | 491 | 8.49 |
| Scenic viewing | 470 | 8.12 |
| Watching wildlife | 143 | 2.47 |
| Resting | 86 | 1.49 |
| Relaxing | 29 | 0.50 |
| Fishing | 28 | 0.48 |
| Receiving interpretation | 11 | 0.19 |
| Picking up litter ³ | 4 | 0.07 |

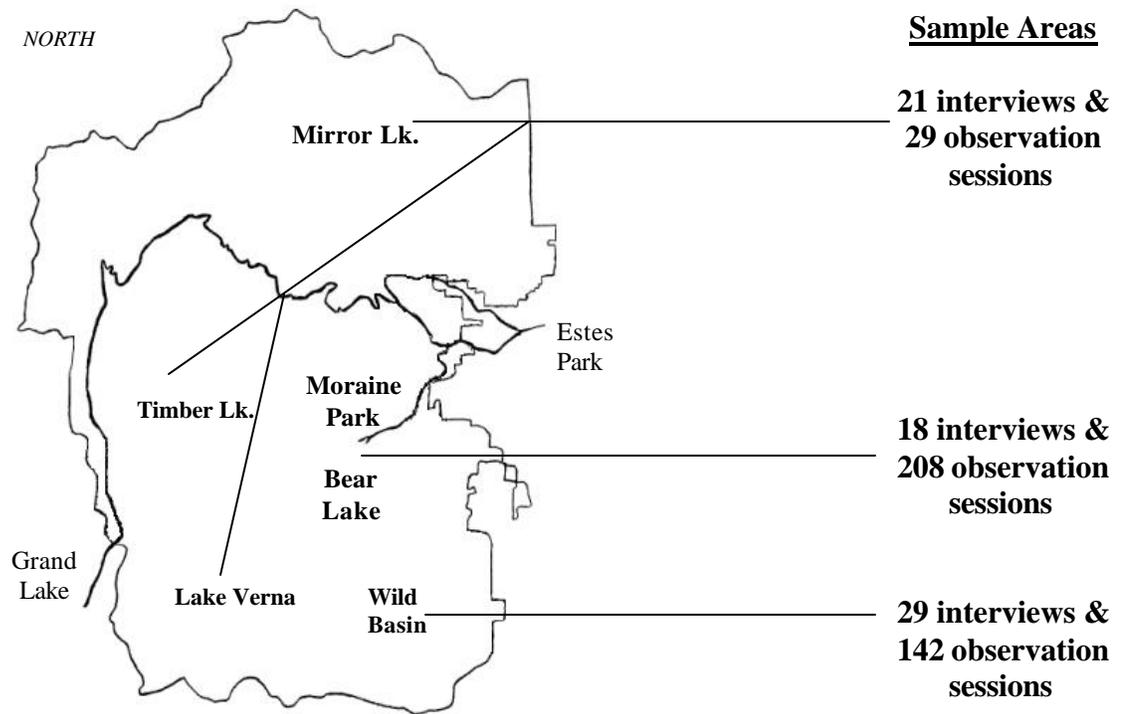
¹ Actual states of behavior that we observed and recorded in the field.

² Relative frequencies were calculated by dividing frequency of observation by 57.85 hours of total observation time as a standardization to account for differing durations for sample sessions.

³ Behavioral event.

Appendix B. Regions of RMNP with sampling distribution for all observations and interviews collected during summer 2001¹.

Map of Rocky Mountain National Park: Distribution of Sampling



Drawing by Peter Fix

¹ A total of 68 interviews were conducted, but only 56 of these included the free list question about impacts.

Appendix C. Specific locations in RMNP where observations were collected during summer 2001.

| Location | Frequency ¹ | Percent of Sample ² |
|-----------------------------------|------------------------|--------------------------------|
| Bear Lake Station 1 | 19 | 5.0 |
| Bear Lake Station 13 | 19 | 5.0 |
| Bear Lake Station 27 | 22 | 5.8 |
| Alberta Falls Overlook | 40 | 10.6 |
| Sheep Viewing Area ³ | 6 | 1.6 |
| The Loch | 11 | 2.9 |
| Sky Pond/Lake of Glass Area | 5 | 1.3 |
| Nymph Lake | 31 | 8.2 |
| Dream Lake | 11 | 2.9 |
| Emerald Lake | 6 | 1.6 |
| Cub Lake | 13 | 3.4 |
| The Pool | 12 | 3.2 |
| Fern Lake | 13 | 3.4 |
| Calypso Cascades | 73 | 19.3 |
| Ouzel Falls | 52 | 13.7 |
| Ouzel Lake | 13 | 3.4 |
| Lion Lake No. 1 | 3 | 0.8 |
| Thunder Lake | 1 | 0.3 |
| North and West Slope ⁴ | 29 | 7.7 |

¹ Number of sample sessions of behavioral observations conducted at that location.

² N = 378 total sample sessions conducted.

³ Place on trail between Alberta Falls and The Loch where visitors stop to watch sheep.

⁴ Mirror Lake camping area, Timber Lake, and Lake Verna.

Appendix D. Ethogram form used at RMNP, summer 2001

LOCATION _____

Date (mm/dd/yy) ___/___/___

Observer Name _____

AM MD PM

Choose One Family Group (F) Dyad (D) Individual (I)

Observations must be made **every 10 minutes**. Take the time to enumerate every applicable occurrence of behaviors listed on this ethogram. Make notes of additional information on reverse side making sure to list a corresponding time and place for the observation.

FW = FEEDING WILDLIFE, **PH** = PHOTOGRAPHING, **WV** = WILDLIFE VIEWING, **LT** = LITTERING, **SV** = SCENIC VIEWING, **TC** = TRAIL CUTTING, **OT** = OFF TRAIL, **TS** = THROWING STONES/DEBRIS, **PL** = PICKING UP LITTER, **F** = FISHING

| SS | Time | #People | F,D,I | #F | #M | Age Range | Time In | #FW | #P | #WV | #L | #SV | #TC | #OT | #TS | #PL | #F |
|----|------|---------|-------|----|----|-----------|---------|-----|----|-----|----|-----|-----|-----|-----|-----|----|
| 1 | | | | | | | | | | | | | | | | | |
| 2 | | | | | | | | | | | | | | | | | |
| 3 | | | | | | | | | | | | | | | | | |
| 4 | | | | | | | | | | | | | | | | | |
| 5 | | | | | | | | | | | | | | | | | |
| 6 | | | | | | | | | | | | | | | | | |
| 7 | | | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | | | | | | |

Appendix D (continued). Reverse side of ethogram form.

Location _____

Date (mm/dd/yy) ___/___/___

Observer Name _____

Please take the time to record any observations that do not fit into a category listed above. We want to hear about all concrete behaviors, events, or possessions/equipment that you observe.

1 _____

2 _____

3 _____

4 _____

5 _____

6 _____

7 _____

8 _____

9 _____

10 _____

Appendix E. Ethogram (detailed description of behavior) for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|---|
| 1 | 4 | 1 | 3 | 8-45 | 10 | .5 | ph, wv, sv, ot, ip | Family unit, read sign, took photos, jumped railing to get onto rocks. They misidentified a muskrat twice, first as a beaver, second as an otter. |
| 3 | 7 | 4 | 3 | 7-80 | 10 | .5 | fw, ph, wv, lt, ts, pl, rt | Extended family, 3 generations, eating lunch, feeding squirrels (before being reprimanded by VIP), one child continued to feed animals but adults stopped. Mother picked up her own litter, but grandmother littered peanut shells. [Field Log Entry: The grand parents started to feed wildlife with peanuts. A VIP in uniform approach after the children had started feeding the squirrels. She gave them a 'soft' reprimand and gave the kids cards about why not to feed wildlife. About 5 minutes after the reprimand, the grandfather announced 4 times to the group that they had just received a reprimand for feeding the animals. One of the young girls threw another nut to the animals despite the reprimand. The Father told her to pick it up, but she did not. Then, the grandfather reminded everyone that the VIP had specifically told them not to feed the squirrels.] |
| 4 | 6 | 3 | 3 | 6-45 | 5 | .5 | ph, wv, sv, tw | Family group came down to lake's edge to see/feel water. They saw a Clark's nutcracker and watched it with binoculars. |
| 5 | 3 | 2 | 1 | 6-40 | 5 | .5 | sv, ts, tw | Adults and one young boy all throwing stones into lake, and touching water. |
| 6 | 3 | 1 | 2 | 4-45 | 5 | .5 | ot, ts, | Two adults and small child off trail at lake's edge, mom gave girl stones to throw into water. She tossed 32 stones. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

³ fw=feeding wildlife, ph=photographing/videotaping, wv=wildlife viewing, lt=littering, sv=scenic viewing, tc=cutting trail, ot=off trail, ts=throwing stones/debris, pl=picking up litter, ur=urinating, rt=resting/break from hiking/eating/drinking, rx=relaxing/reading/meditating, sm=smoking, ip=reading interpretive sign/participating in a guided interpretive hike, yl=yelling/screaming/shouting/talking loud, tw=testing/touching/tasting water

Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|---|
| 7 | 6 | 2 | 4 | 4-75 | 6 | .5 | ph, ot, tw | Extended family of Chinese tourists stopped to take photos of one another at Bear Lake station 27. |
| 8 | 3 | 1 | 2 | 35-60 | 9 | .5 | ph, sv | Couple, male/female, with possible adult female parent, sitting on rock taking photos of one another. |
| 9 | 3 | 2 | 1 | 12-45 | 9 | .5 | ph, wv, ot, | On bridge between 27 and 13 at Bear Lake; a father, son, and daughter went off trail on stream bank to videotape/watch the spawning cutthroat trout. They walked upstream about 20 yards and observed the fish for 9 minutes. |
| 11 | 6 | 2 | 4 | 3-75 | 8 | .5 | ph, sv, ot | Extended family; three generations. |
| 12 | 5 | 2 | 3 | 16-50 | 7 | .5 | ph, wv, sv, ot, | This family was participating in the self-guided tour. They stopped at stations 12, 13, and 14 at Bear Lake. One of the group members was reading the guide out loud. |
| 14 | 4 | 2 | 2 | 7-40 | 8 | 3.1 | sv, ot, ur, | One male urinating 20 feet off trail at Loch Vale, in view for 8 minutes total then left. |
| 15 | 5 | 3 | 2 | 6-45 | 10 | 1.0 | ph, ot, tw | Group said they wanted to "taste the water"; they continued off trail to find a pool to fill their bottles. |
| 16 | 4 | 2 | 2 | 17-38 | 4 | 1.0 | ot, ts | Observer noticed a group across the river picking up sticks and throwing them in the river, trying to cross using a stick, after crossing they left. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

³ fw=feeding wildlife, ph=photographing/videotaping, wv=wildlife viewing, lt=littering, sv=scenic viewing, tc=cutting trail, ot=off trail, ts=throwing stones/debris, pl=picking up litter, ur=urinating, rt=resting/break from hiking/eating/drinking, rx=relaxing/reading/meditating, sm=smoking, ip=reading interpretive sign/participating in a guided interpretive hike, yl=yelling/screaming/shouting/talking loud, tw=testing/touching/tasting water

Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|---|
| 17 | 4 | 2 | 2 | 9-60 | 10 | 1.0 | ot, ts, rt, rx, tw | Relaxing/reading/meditating; played in water. |
| 19 | 6 | 2 | 4 | 11-40 | 4 | 1.0 | fw, ph, wv, ot, rt, | Kids feeding ground squirrels with mm's candy and touching squirrels with a stick. Adults were photographing and videotaping animals. |
| 21 | 3 | 2 | 1 | 25-45 | 7 | 1.0 | sv, pl | The female picked up litter at Alberta Falls. This group was hiking at a moderate pace. I followed for 7 minutes from lower falls to upper falls. |
| 23 | 4 | 1 | 3 | 14-40 | 10 | .5 | ph, yl | Screaming, loud in general; all photos taken in one location. They were shooting Bear Lake and Hallet's Peak. |
| 25 | 5 | 1 | 4 | 6-60 | 8 | .5 | ph, sv, ot, yl | Rock scrambling; lots of yelling from the children. |
| 28 | 5 | 3 | 2 | 1-40 | 10 | .5 | wv, tc, ot, ur, yl | Exploring, scrambling, yelling, urinating (shadowed from Bear Lake 13). |
| 30 | 4 | 3 | 1 | 7-38 | 10 | .5 | ph,ot, ts, rt, tw | Splashing/playing in water, resting; one child fell in the water at Bear Lake 1. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

³ fw=feeding wildlife, ph=photographing/videotaping, wv=wildlife viewing, lt=littering, sv=scenic viewing, tc=cutting trail, ot=off trail, ts=throwing stones/debris, pl=picking up litter, ur=urinating, rt=resting/break from hiking/eating/drinking, rx=relaxing/reading/meditating, sm=smoking, ip=reading interpretive sign/participating in a guided interpretive hike, yl=yelling/screaming/shouting/talking loud, tw=testing/touching/tasting water

Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|---|
| 33 | 4 | 3 | 1 | 7-38 | 10 | .5 | fw, ph, ts, rt | Resting; packed out apple cores; 2 stones thrown at ducks; I quit counting occurrences of FW when handfuls were thrown. |
| 34 | 4 | 2 | 2 | 5-40 | 10 | .5 | ph, wv, ot, ts, rt, tw | Splashed/played in water; resting; children whining about hiking; children really wanted to play in water. |
| 36 | 4 | 1 | 3 | 9-50 | 6 | .5 | wv, sv, tc, rt, | Resting; the two that did not cut trail scolded the two that did. |
| 44 | 3 | 1 | 2 | 17-45 | 10 | .5 | sv, ip, tw | Reading interpretive sign; dangling feet in water. |
| 45 | 6 | 5 | 1 | 17-19 | 10 | 5 | fw, ip | Reading interpretive sign; jogging on trail. |
| 46 | 3 | 3 | 0 | 10-40 | 6 | .5 | ph, wv, ts, rt | Father gave one of his sons a dollar bill when he spotted a Stellar's jay. They were in view for 6 minutes. |
| 47 | 4 | 2 | 2 | 12-40 | 10 | 1.1 | tc, ot, ts | Shadowed a family group for 10 minutes to Dream Lake from L in trail below; mother, father, son, and daughter; all 4 went off trail to play in snow and to have a 30 second snowball fight. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

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Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|---|
| 48 | 4 | 3 | 1 | 10-40 | 10 | .5 | ph, wv, sv, ot, yl | Oldest son and father arguing loudly; oldest son was annoyed with flies and was constantly swatting at flies and whining. |
| 49 | 4 | 2 | 2 | 35-60 | 10 | .5 | fw, wv, ot, rt | Two couples, mom/dad and son/spouse; they had a picnic, son fed ground squirrel and father tried to chase animals off; the father said, "You are not supposed to feed the wildlife." |
| 50 | 5 | 2 | 3 | 5-45 | 10 | .5 | sv, ot, ts | Two of the children were trying to throw (and land) stones onto lily pads, after 30 attempts, one stone made it. They continued to throw after one success. I counted greater than 60 throws during the 10 min. sample session. |
| 54 | 4 | 2 | 2 | 30-65 | 10 | .5 | sv, rx | Relaxing; picked wild strawberries, father left half way through sample session. |
| 55 | 5 | 4 | 1 | 2-55 | 10 | .5 | ph, ot, ur, tw | The children took shoes off and put feet in water. Urinating about 30 yards off trail. |

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² Distance in miles from nearest trailhead.

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Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|--|
| 63 | 7 | 3 | 4 | 6-75 | 5 | .5 | ph, wv, sv, ot, ip | This family spent time reading and discussing the interpretive sign at Bear Lake. |
| 65 | 9 | 2 | 7 | 4-70 | 5 | 2.7 | ph, sv, ot | Extended family group stopped at bridge; grandmother and small kids. Little boy asked mom what caused the holes in the rock (blast holes) she said it was man made. Grandmother made everyone sing a song on the bridge. |
| 68 | 5 | 1 | 4 | 10-48 | 10 | 1.8 | lt, ot, rt, sm | Spilled lots of lettuce and such from sandwiches and didn't pick it up. |
| 70 | 4 | 4 | 0 | 11-40 | 9 | 2.7 | sv | Father and three sons; father sent one son "exploring" a small trail up the creek, to see the falls in its entirety. Whole group went up the creek when the son returned. |
| 71 | 10 | 4 | 6 | <1-45 | 10 | 1.8 | fw, ph, wv, sv, ot, | Large group of 2-3 different families picnicking on rock. Some were feeding the squirrels and watching jays. One man discouraged the kids from feeding the animals. |
| 78 | 4 | 4 | 0 | 7-70 | 10 | 1.8 | sv, ot, tw | Sub-group of a family reunion of approximately twenty people. The sub-group was a grandfather and three grandsons. The boys were playing in and touching the water from the rocks off the trail. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

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Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|---|
| 80 | 4 | 3 | 1 | 4-35 | 10 | 1.8 | ph, wv, sv, ot, | Nuclear family snacking, watching jays, lounging together in the sun. They had a water jug that almost fell into the river. Mother wearing long skirt and a white head piece. |
| 82 | 4 | 2 | 2 | 15-45 | 5 | .5 | ph, wv, ot | Walking through the marsh and on the west side of the lake in the trees. |
| 83 | 6 | 4 | 2 | 19-50 | 9 | 1.1 | fw, ph, wv, lt, sv, | No comments recorded. |
| 84 | 5 | 3 | 2 | 8-60 | 10 | 1.8 | ph, ot, yl | They were digging holes in the ground with their feet, being very noisy, and shaking a tree. |
| 85 | 5 | 2 | 3 | 10-40 | 10 | 1.8 | ph, ot, ts, yl | They were yelling across the lake to two people who were climbing in a boulder field across the lake. They were also spitting in the water. |
| 86 | 3 | 1 | 2 | 10-60 | 10 | 1.8 | wv, sv, ts | Chasing birds and ground squirrels; also were eating lunch. |
| 88 | 7 | 6 | 1 | 7-65 | 10 | 1.0 | ph, wv, sv, ot, tw | Large extended family group walked up to the mid falls. Two individuals reached into the stream to touch the water. |
| 90 | 5 | 1 | 4 | 16-50 | 9 | 1.0 | ph, wv, sv, tc, ot | Nuclear family. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

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Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|---|
| 91 | 4 | 2 | 2 | 11-45 | 5 | 4.6 | tc, ot, | Nuclear family walked half way around Sky Pond. |
| 92 | 6 | 2 | 4 | 6-60 | 8 | 3.1 | ph, wv, sv, ot, ts, tw | Extended family group. Both boys wading in the lake and playing in the water, boys were age 5-7. |
| 93 | 4 | 2 | 2 | 10-40 | 10 | 3.8 | wv, ot, tw | Wading in water by "bridge," kids playing in water with logs. |
| 95 | 4 | 3 | 1 | 17-65 | 10 | 2.3 | ph, wv, sv, tc, tw | Father, son, daughter with another male. The girl tested and smelled the water. The group watched ducks and nutcrackers. |
| 96 | 8 | 2 | 6 | 10-50 | 10 | 2.3 | ph, wv, sv, ot, rt, yl | Large group watched ducks, chipmunks, and a nutcracker. They snacked, talked, took photographs, and planned rest of the day. One male told everyone not to feed the animals. One female told kids to practice trail etiquette. Girls were making duck-like noise. |
| 98 | 5 | 2 | 3 | 11-45 | 10 | 2.3 | ph, wv, sv, ot | Family group watched ducks very intently during the sample session. They had two cameras and binoculars. They photographed lilies and ducks. |
| 101 | 4 | 2 | 2 | 30-40 | 10 | 6.9 | sv, ot, rx | This group was observed from about 150 yards. They are probable day only visitors, but I saw one with empty backpack. Mike talked to them and they are from Michigan. They were relaxing by lakeshore. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

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Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|--|
| 103 | 2 | 1 | 1 | 6-35 | 10 | .5 | fw, tc, ot, ts, tw | Testing water and splashing it with a stick. |
| 106 | 5 | 3 | 2 | 6-60 | 15 | 1.7 | wv, sv, | A family with two kids (male & female), Mom & Dad, and grandpa? The boy was trying to get as close as possible to the ground squirrels. He tried to get the girl interested, but she wasn't. |
| 111 | 3 | 3 | 0 | 10-35 | 10 | 4.6 | ph, sv, ot, ts | Three more anglers joined group #2. Possible father with two sons on the north side of the lake. Father had a fly rod, both boys carried spin cast rods. No one fished during the sample session; stayed at Timber Creek. |
| 112 | 3 | 3 | 0 | 8-45 | 10 | 4.6 | ph, wv, sv, ot, rt, sm, tw | Possible father w/ 2 sons. Were on the north side of the lake, feet in the water, eating a snack, observing fish jumping & worms in lake bottom, were staying at Timber Creek. After the timed sample session the youngest went into the trees to defecate, oldest smoked pot. |
| 114 | 9 | 7 | 2 | 10-60 | 9 | 1.8 | ph, sv, ts | One kid dug a small hole with a stick, and hit the railing with a stick once. Turns out to be a family group in the area from a family reunion. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

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Appendix E (continued). Ethogram for 64 family groups observed during summer 2001 at RMNP.

| Case | # of people | # males | # females | Age range | View time ¹ | Miles in ² | Observed behaviors ³ | Comments |
|------|-------------|---------|-----------|-----------|------------------------|-----------------------|---------------------------------|--|
| 117 | 3 | 1 | 2 | 12-35 | 10 | 1.8 | fw, sm | Smoking. |
| 120 | 3 | 2 | 1 | 12-40 | 10 | 1.8 | ph, ot | This is a mom and her kid and her kid's friend, in fact, the kids are the 1st set of observed kids at Ouzel Lake. They went off the trail (kids) and mom took some photos of them. |
| 127 | 4 | 2 | 2 | 12-45 | 15 | 2.7 | fw, ph, ot | Mother with three kids. One fed the chipmunks, crazy amount of feeding. They were taking photos. They went above the falls onto the cliff. |
| 128 | 4 | 1 | 3 | 15-40 | 27 | 1.8 | ph, sv, ot, yl | Family yelling at each other. |
| 132 | 3 | 2 | 1 | 7-35 | 8 | 1.8 | fw, ph | Mother, father, and young son feeding grapes to the chipmunks. Chipmunks don't seem to like grapes! |
| 135 | 3 | 2 | 1 | 10-45 | 7 | 2.7 | ph, wv, sv, rt, | Nuclear family stopped for a rest and some water just above the falls. Man took two photos. They watched a ground squirrel; the boy swung and jabbed a walking pole at the animal twice. |

¹ Sample session duration in minutes.

² Distance in miles from nearest trailhead.

³ fw=feeding wildlife, ph=photographing/videotaping, wv=wildlife viewing, lt=littering, sv=scenic viewing, tc=cutting trail, ot=off trail, ts=throwing stones/debris/snow, pl=picking up litter, ur=urinating, rt=resting/break from hiking/eating/drinking, rx=relaxing/reading/meditating, sm=smoking, ip=reading interpretive sign/participating in a guided interpretive hike, yl=yelling/screaming/shouting/talking loud, tw=testing/touching/tasting water

Appendix F. Detailed results of free listing technique with visitors to RMNP, summer 2001.

“During this visit to RMNP, have you seen any negative signs of people who visited here?”

The question above served as the free list item asked during interviews with park visitors in the field. Bulleted responses were displayed verbatim or paraphrased from the actual accounts. Individual responses are listed in this appendix under each impact category as presented in the overall results section in the body of the report (Table 4). Each entry is followed by location and visitor type codes, which are keyed in the box below.

| | |
|--|---|
| <p>Location Codes: wb = Wild Basin mb = Moraine Park – Bear Lake mvt = Mirror – Verna – Timber Lakes</p> | <p>Visitor Type Codes: D = Day Visitor O = Overnight Visitor</p> |
|--|---|

Camping

- Loss of small ground covering plants at campsite; wb, O
- Bare ground; wb, O
- Camping without a permit, mvt, O
- People who do not know or follow the regulations, mvt, O
- Dogs in the campground, mvt, O
- Trash left in sites (i.e., empty food cans, peanut shells); mvt, O
- Food left hanging no more than two feet from the tree; mvt, O
- Fire rings where fires are not allowed; mvt, O
- Partially burned wood in campsite; mvt, O

Ecological

- Digging into soil; wb, D
- Erosion; wb, O, mb, O

Facilities

- Parking not adequate; wb, D
- Shuttle system has decreased parking/traffic problem; wb, mb, O, D
- No hot water in restrooms; wb, D
- No heat in restrooms; wb, D

People in General

- Crowding at Emerald Lake; wb, O
- Lots of people visiting/crowds at trailheads; wb, mb, mvt, O, D
- Some people with a lack of manners/behaving rudely; mb, D

- People should follow the rules, so all can enjoy; mb, D
- Self-centered people; mb, D

Human Waste

- More people need to learn how to poop in the woods; wb, O

Litter

- General leaving or throwing trash/littering in park or on ground; wb, mb, mvt, O, D
- Micro trash (i.e., gum, cigarette butts/boxes, candy wrappers); wb, mb, O, D
- Accidental dropping; wb, O
- Water bottles in streams and on trails (i.e., Aquafina, Dasani); wb, D
- Fruit peelings; wb, D
- Tin food cans left in camp/fire ring; mvt, O
- Vehicle emissions; mvt, O
- Failure to clean up after pets; mvt, O
- High altitude, blown in trash (i.e., deflated Mylar birthday balloon); mvt, O

Noise

- People yelling/screaming; wb, O
- Loud talking on trails in presence of another group or individual; wb, O
- Cars on road can be heard in Moraine Park campground; mb, O
- Barking dogs; mvt, O
- No radios should be allowed; mvt, O

Pets

- Camping with dogs; mvt, O
- Dogs of leash; mvt, O
- Dog feces; mvt, O
- Dogs carry giardia, mvt, O

Resource Removal

- Picking wildflowers; wb, O
- Taking rocks; wb, D

Roads

- Scrambling across roads to see wildlife (i.e., Trail Ridge/Bighorn Sheep); wb, D
- Elk – vehicle collisions; wb, O
- Many cars up in the alpine tundra region; mb, O

Social Trails/Off Trail

- Kids running as fast as they can; wb, O
- People making their own trails; wb, D
- Entering/hiking through restoration areas; wb, mb, D

- Short cutting trails; wb, O
- Venturing off trail/bushwhacking; wb, mb, mvt, D, O

Stock Animals

- Hiking over horse shit on trails; wb, mb, O
- Allowing horses on trails that I would think should not have horse use; wb, D
- Day use of horses that pack no gear; mb, O
- Trail erosion from hooves; mb, O

Vandalism

- Tree carving/cut marks; wb, mb, mvt, O, D
- Carving/cut marks on bridges; wb, O
- Painted initials on rocks; mvt, O
- Stealing signs; wb, O

Visual

- See people climbing in trees or on rocks; mb, D
- Dog poop; mvt, O
- Horse poop on trails; wb, mb, O

Wildlife

- Approaching or getting too close to large wildlife (i.e., elk, sheep); wb, O, D
- Wildlife approaching people/camps; wb, mvt, O
- Feeding wildlife; wb, D, O
- Animals die when they eat things that they can not digest; wb, O
- Improper food management in back country alters animal behavior; mvt, O
- Lack of wildlife; wb, D
- Large and small mammals are tame; wb, D, O
- Elk – vehicle collisions; wb, O
- Dogs chasing wildlife; mvt, O

Listed as Non-Problems by some Visitors

- Crowds, mvt, O
- Litter; wb, mb, mvt, O, D
- Trash, wb, mvt, D, O
- Tree carving/cut marks; wb, D
- Noise; mvt, O

Appendix G. Detailed results of free listing technique with key informants at RMNP, summer 2001.

“Please be specific and name as many of the impacts that you are talking about when you mention these areas of RMNP.”

The question above served as the free list item asked during interviews with key informants at RMNP. Bulleted responses were displayed verbatim or paraphrased from the actual accounts. Individual responses are listed in this appendix under each impact category as presented in the overall results section in the body of the report (Table 5).

Artificial Artifacts

- Installing climbing bolts
- Drilling holes in rock face for bolts
- Leaving/installing research markers (i.e. flags, rebar, enclosures)

Camping

- Camping without a permit
- Illegal campfires in sites not permitting fire
- Leaving large partially burned pieces of wood in fire rings
- Camping in inappropriate spots
- Camping beyond the fifteen foot allotment
- Use of fuels
- Camping on non-durable surfaces (i.e., tundra)
- Backpackers going in without proper information about regulations

Ecological

- Loss of vegetation on stream banks
- Soil compaction and trampling around lake edges and streams/bank collapse
- Invasive/Exotic vegetation
- Vegetation loss
- Erosion
- Sedimentation in lakes and streams
- Fragile soils trampled
- Damming streams and rivers for fishing/introduction of exotic fish

Human Waste

- Developing new privies
- Inappropriately placed privies
- Water quality
- Leaving toilet paper and feces on ground (i.e., toilet paper blooms)
- Digging inappropriate cat holes
- What to do with diapers from small children

People in General

- Crowding/numbers of people up park wide
- Lowers wilderness aspect
- Impact to sense of solitude
- Displacement of recreationists
- Vehicle traffic in the park
- Vehicle emissions and air pollution from the Front Range
- Air quality

Litter

- Leaving trash in privies
- Leaving trash in fire rings and campsites
- Leaving trash near campsites
- Leaving food
- Disposal of cleaning water
- Washing dishes/pots in streams or lakes
- Trash in the parking lots
- Micro trash on trails
- Vehicle emissions and air pollution from Front Range

Facilities

- Not enough interpretation
- Not enough parking
- Not enough picnic areas
- Too much demand on existing facilities

Noise

- Barking dogs
- Playing music/boom boxes
- Crying babies
- Parking lots, vehicles, shuttle stops
- Commercial airline flyovers

Pets

- Leaving pets unaccompanied or off leash
- Dogs running on trails
- Dogs chasing wildlife

Removal of Resources

- Plant harvesting (i.e., marijuana)
- Picking wild flowers

Social Trails/Off Trail

- Cutting trail/switchbacks
- Trail braiding
- Bare ground
- Illegal fires/fire scars
- Satellite or bivouac sites
- Removing vegetation from rock face on purpose while climbing
- Using stock animals off trail
- Children running out of control
- Illegal parking on the tundra

Stock Animals

- Riding on side of trails/off trail
- Hitching to trees instead of designated posts
- Conflicts/accidents with hikers
- Pirate guides

Vandalism

- Carving on trees, tables, and signs
- Kicking over privies

Visual

- Beach balls
- Umbrellas
- Wagons
- Lawn chairs
- Squirrels running on people's arms
- Parking lots and shuttle stops
- Air planes
- Illegal climbing bolts on Lumpy Ridge
- Large bright backpacks spook horses

Wildlife

- Feeding wildlife
- Dogs chasing wildlife
- People allowing wild animals to climb on their bodies
- Storing food inappropriately

- Unintentional feeding/accidental dropping of food particles
- Wildlife eating research flags or markers
- Human presence/stress from too many people
- Habituation

Listed as Non-Problems by some Informants

- Airplane over flights
- Litter
- Tree carving
- Illegal fishing
- Signage