A Comprehensive Study of Visitor Safety in the National Park System:

Final Report

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Executive Summary

Each year members of the public die during visits to units of the National Park Service (NPS) and many more suffer injuries and illnesses. While considerable information about these accidents is gathered at each of the NPS sites, there has been little systematic analysis of these data for the NPS as a whole. The National Park Service commissioned a team of researchers at The George Perkins Marsh Institute, Clark University, to conduct a comprehensive assessment of visitor safety at a sample of 30 of the National Parks. The project was conducted between April 1, 2000 and April 15, 2002 and involved four primary tasks:

- An extensive review of the social science research literature that is presented in the report entitled *A Review of the Literature for a Comprehensive Study of Visitor Safety in the National Park System*;
- The collection and analysis of data on almost 20,000 visitor accidents over the period 1993 to 1998 that are described in the report entitled *An Analysis of Visitor Accident Risk in the National Park System*;
- An inventory of hazards and risk conditions in the 30 parks that is presented in a report entitled *An Inventory of Hazards and Risk Conditions in the National Parks*; and,
- The development, distribution, and analysis of an extensive survey of visitors in the 30 parks that is described in the report entitled *A Survey of Visitor Safety in the National Park System*.

This final report summarizes each of these reports, presents fifteen major findings, and makes seventeen recommendations.

Major findings:
The findings are divided into three topical areas: causes and contributory factors in visitor accidents; risk management for visitor safety; and, gaps in data and knowledge.

Causes and contributory factors in visitor accidents

1. Many of the accidents that involve visitors are relatively minor and mundane. Falls of various kinds result in about 24% of all injuries and illnesses and motor vehicle accidents result in about 19% additional injuries and illnesses.

2. The broad pattern of risks in the parks can be summarized in the form of risk ratios, such as the number of accidents per 100,000 visitors. Better measures of risk would incorporate measures of the degree of exposure, such as the amount of time people are engaged in a given activity, but these kinds of data are not available.

3. Visitor activities, risks, and risk conditions and visitor opinions about risk and safety vary considerably from park to park so that aggregating data across all parks may be misleading.

4. Visitor concerns about hazards are broadly consistent with the accident data for individual parks, although there are notable exceptions. Over-confidence about familiar risks was found in some cases.

5. There is general consistency between the accident database and the assessments provided by park staff with regard to the activities associated with most accidents. This finding suggests that the park personnel surveyed have a very good understanding of the most important activities associated with most visitor accidents in their park.

6. A variety of individual characteristics can influence the risk to visitors at national park units. Many studies have shown that harsh environments, attitudes toward recreational risk, physical stress and fatigue, and a variety of other factors can limit preparedness, capabilities, and response to accidents. The ways that individuals react to such risk factors can also vary widely. However, gaps in research occur because certain behaviors or situations have not been studied in full detail.

7. Park staff responding to the inventory questionnaire often identified visitor characteristics as significant risk conditions. Staff rarely rated communication or infrastructural hazards as important conditions contributing to visitor accidents.

8. Park staff and visitors have different perspectives on conditions that influence accident rates. Park staff members believe that visitor preparedness and level of experience in a given activity are important contributors to visitor accidents. Most visitors, however, considered themselves experienced in their chosen activity and many indicated that they were well prepared. Also, park staff considered visitor center/indoor conditions of low importance as a contributor to visitor accidents. Most falls, however, occur on prepared surfaces.

Risk management for visitor safety

9. The 30 parks may be grouped into six clusters according to the types of activities associated with the largest numbers of visitor accidents. These clusters are: frontcountry activities, motor vehicle operation, backcountry activities, water-related activities, and a mix of activities.

10. Visitor opinions about the locus of responsibility for safety varied substantially from park to park. In general, larger numbers of people in backcountry parks believe the visitor is responsible for safety. More respondents at frontcountry parks place the burden of responsibility on both the visitor and the park staff.

11. Across the board, there is substantial public support for more rangers, more brochures warning about hazards, and greater enforcement of alcoholic beverage restrictions as means for improving visitor safety.

12. The sources of safety information that most people consistently rate as the most helpful include trail/directional signs, warning signs, and uniformed park personnel.

Gaps in data and knowledge

13. We found little evidence that the Park Service is *systematically* accumulating knowledge about visitor risk and safety nationwide.

14. Much of the data that would be useful for assessing visitor risk and safety in the National Park System are either not collected or are missing from park accident records.

15. Data about visitor "exposure" to risk are limited. Without more precise estimates of the numbers of people engaged in a particular activity, the length of time that they are "exposed," and the number of people injured, it will not be possible to derive more precise risk estimates.

Recommendations:
The recommendations are divided into four topical areas: data collection and information management; risk management interventions; technology and information transfer; and future research. They are *not* listed in any order of priority.

Data collection and information management

1. Improving the accuracy and reliability of information will require the establishment and maintenance of an accident reporting system that is both useful and user friendly. Whatever reporting system is developed in the future, it should be adaptable to local and regional needs and conditions.

2. The NPS should collect more detailed data about the numbers and socio-demographic characteristics of visitors and the nature of the activities they pursue. The kinds of data to be collected should be determined in close consultation with park staff, and should reflect local and regional needs and conditions.

3. The NPS should develop better mechanisms for systematically sharing information among parks and with managers in Washington, DC.

4. The NPS should develop mechanisms for on-going systematic analysis and evaluation of visitor accident data.

5. Interdisciplinary teams of park staff should be established to conduct inventories of risk conditions at each park.

6. The results of the project survey and risk analysis should be reviewed and evaluated carefully by the 30 parks in the sample to identify park-specific problems and opportunities.

Risk management interventions

7. The NPS should develop a method for categorizing parks that is specifically related to visitor risk and safety.

8. The NPS should focus effort on developing and testing innovative methods for educating visitors about risks and encouraging changes in behaviors to improve safety. These efforts should be adapted to regional and park-specific conditions and the characteristics of activities and visitors in each park.

Technology and information transfer

9. Mechanisms should be established to ensure better translation of research into practice and guidelines for park management and staff. Workshops and guidance manuals should be adapted to regional and park-specific conditions.

10. The NPS should use existing risk management frameworks to identify management options whose effectiveness has been validated by prior research. These frameworks should be adapted to regional and park-specific conditions.

Future research

11. The National Park Service in general and each park in particular needs to conduct further analysis to determine how to set risk management priorities. In some cases, the problems associated with the "high risk/low volume" activities may be more tractable. In other cases, it may be more cost effective to focus on the "low risk/high volume" activities. In most cases, however, it is likely that strategies to deal with a "mixed portfolio" of risks may be most appropriate.

12. The National Park Service in general and each park in particular should conduct further research on strategies to handle "high profile" risk events (such as wildlife attacks) because such events will necessarily attract disproportionate media and public attention and they may be more amenable to risk management interventions.

13. The National Park Service should closely examine management strategies designed to make activities "goof proof" so that serious consequences do not occur from inevitable accidents.

14. Research is necessary to determine the association between visitor preparedness and visitor accidents.

15. The collective knowledge of park staff about accident causes and contributing factors should be used to supplement the information available in park records and sampled in the accident database.

16. The NPS should consider sponsoring research on key factors that may contribute to accidents.

17. The inventory, literature review, and visitor survey demonstrate the need for improved safety-related communication programs. While much research has been conducted on the design and implementation of risk communication programs, good information about NPS-specific contexts is lacking. Research on effective risk communication strategies that can be adapted to regional and park-specific conditions should be pursued

1.0 Introduction

Each year members of the public die during visits to the various units of the National Park Service (NPS) and many more suffer injuries and illnesses. For example, between 1993 and 1998, 870 people died during visits to NPS sites. This number may seem large, except when one considers that there were 287 million recreational visits to NPS sites in 1998 (www.nature.nps.gov/stats/summary98.htm). Indeed, the numbers of fatalities per million visits declined from 1971 through 1988, although there has been a slight upward trend since 1989.[1] Sensational fatalities, such as the deaths of individuals involved in extreme sports or those mauled by bears, account for a tiny fraction of all fatalities in the National Parks. They can also generate enormous public attention. While the NPS must do all that it can to prevent such deaths, most visitor fatalities result from more mundane causes that receive far less media attention and public scrutiny.

Fatalities, of course, represent only the tip of the iceberg. Many more members of the public suffer injuries or illnesses during their visits to the NPS sites. While considerable information about these accidents is gathered at each of the NPS sites, there has been little systematic analysis of these data for the NPS as a whole. Concern about visitor safety will continue to grow as the number of visitors continues to rise. This concern is exacerbated by the growing popularity of extreme sports, the media attention to any wildlife encounters, and the growing body of tort cases.

Concerns about visitor safety are closely interrelated with concerns about occupational safety and health. For example, hazards and hazardous conditions that pose threats to visitors (e.g., rock falls, avalanches, adverse weather, motor vehicles) also pose risks to NPS employees in their day-to-day activities. NPS employees, however, are also obliged to assist visitors in distress. While most of these accidents are relatively minor, park personnel frequently find themselves assisting visitors in extraordinarily dangerous situations. Obviously, this is epitomized in the many search and rescue missions conducted each year. For example, in FY98 5,554 search and rescue efforts were conducted (www.nps.gov/refdesk/npsfoia). Such search and rescue efforts not only endanger park personnel, but they also place a significant strain on park budgets.

Recognizing these concerns NPS has established a management policy that states that

> *The saving of human life will take precedence over all other management activities. The National Park Service and its concessionaires, contractors, and cooperators will seek to provide a safe and healthful environment for visitors and employees. The Park Service will work cooperatively with other federal, state, and local agencies, organizations, and individuals to carry out this responsibility. However, park visitors assume a certain degree of risk and responsibility for their own safety when visiting areas that are managed and maintained as natural, cultural, or recreational environments.* (www:nps.gov/planning/mngmtplc).

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[1] The number of visitor fatalities per million visits declined from a high of 1.09 in 1971 (167 fatalities/154 million visits) to a low of 0.44 in 1988 (125 fatalities/282 million visits). Since 1988 the ratio has climbed again to 0.63 in 1997 (173 fatalities/274 million visits) (Wadlington 2000).

In an effort to implement this policy and in response to the Government Performance and Results Act (GPRA), the NPS developed the 1997 NPS Strategic Plan (NPS 1997). This establishes Mission Goal IIa2 to reduce the visitor safety accident rate by 10% from the NPS five-year (1992-96) average. Accordingly, each park "will determine their five-year (1992-96) average visitor accident rate, based on 100,000 visitor-days, to determine their baseline for their 10% reduction. Analysis of case incident report files will identify the primary sources of accidents and where the greatest improvements in visitor safety can be made" (NPS 1997, 24). These goals have been incorporated into customized planning documents for many of the individual NPS units.

Two Director's Orders provide operational policies, practices, and procedures to implement these management directives. Director's Order #83 establishes policies regarding public health and the operations of systems such as water supply, waste management, and food services (NPS 1999a). Director's Order and Reference Manual #50B (approved December 22, 1999) addresses mostly occupational safety and health issues, but section 14 deals with public safety and health. The document states

> It is the policy of the National Park Service (NPS) to provide for an opportunity for the public to have an enjoyable experience while visiting National Park Service sites. Recognizing that accidents and injuries can compromise that experience, the NPS will provide information on risks in the recreating environment, maintain structures and facilities in safe condition, and generally provide for the safety of the visitor while recognizing our mandated responsibility to protect the resources and natural processes which can be inherently dangerous to the unwary. (NPS 1999b, 34-35)

These policies, plans, and procedures are consistent with the NPS mission established in the Organic Act of 1916 (16 U.S.C., Sec. 1).

To help meet these goals and implement the various policies effectively the NPS funded the comprehensive assessment of visitor safety conducted by the George Perkins Marsh Institute at Clark University (Worcester, MA). While many academic studies have examined the potential adverse impacts that large numbers of visitors may have on parks and other wilderness areas and the risks to individuals engaged in certain recreational activities, there have been few studies of the potential risks these areas may pose for visitors. In sum, there has been little systematic study of the nature of the risks in the NPS. The research reported here helps to fill this gap and provide the NPS with information necessary to achieve its strategic goals.

1.1 Definition of visitor accidents

There is some debate in the research literature about the appropriate definition and use of the term "accidents" or what is meant by "safety." Following the advice and recommendations of risk managers in the Park Service, the operative definition for "visitor accidents" used in the project includes events that:

- involved the direct use of, or interaction with, park facilities or resources;
- required first aid;

- resulted in serious injury, illness, or death of a visitor (including injuries, illnesses, and deaths resulting from vehicle and vessel operation); and,
- in the case of serious injury or illness, required immediate transportation to a medical facility.

By this definition, the project does *not* include information or discussion about:

- accidents involving on-duty NPS, Volunteer-in-Parks (VIP), Student Conservation Association (SCA), Youth Conservations Corps (YCC), cooperating association, contractor, or concession employees;
- accidents arising from pre-existing medical conditions (e.g., strokes);
- property damages or losses at any level;
- crashes of aircraft not engaged in sight-seeing activities or other recreational activities directly involving park lands and waters;
- injuries, illnesses, or deaths resulting from criminal activities (e.g., homicide, suicide, assault, robbery, vandalism); and,
- individuals getting lost in the park.

No specific definition was developed for "visitor safety" as it was generally understood to refer to the absence of visitor injuries and illnesses. Of course, safety can mean more than the absence of an injury or fatality. In some cases safety may be compromised even if no injury or fatality occurs or is reported. However, such a broad definition of "safety" was not a measurable concept within the scope of the project and the availability of data. Furthermore, it should be noted that the scope of the project did not extend to consideration of emergency planning and preparedness.

1.2 Selection of park units for study

A purposive sample of 30 (Table 1.1) of the 378 NPS units was chosen by NPS program and park managers, in close consultation with the project team (Task 1). There is an enormous range of diversity of park types and conditions, and the sample was chosen broadly to reflect this diversity. The sample includes parks in which visitor activities are primarily natural resource-based, activity-based, historical/cultural, and drive-through. Visitation rates at the parks in the sample range from very high to more modest, and the sample includes a mix of parks that are near urban areas and those that are more remote. The parks in the sample are broadly distributed geographically.

The sample was used to analyze visitor safety. Accident data were gathered from each of the 30 parks during the summer of 2001. Information on hazards and risk conditions was gathered from a survey of park personnel at each park during the summer of 2001. Visitor surveys were distributed at the 30 parks during the summer of 2001. In addition, visitor surveys were also distributed at 7 of the 30 parks with significant winter visitation during the winter of 2000-2001. Given the nature of diversity in the parks and the way in which the sample was selected, the sample cannot be said to be statistically representative of all parks in the National Park System. Thus, the degree of generalization that can be made based on the sample is limited.

Table 1.1: The Sample of 30 Parks

	CODE	NAME
1	ASIS	Assateague Island National Seashore
2	BADL	Badlands National Park
3	BIBE	Big Bend National Park
4	BLRI	Blue Ridge Parkway
5	CANY	Canyonlands National Park
6	CAHA	Cape Hatteras National Seashore
7	CAVE	Carlsbad Caverns National Park
8	CURE	Curecanti National Recreation Area
9	CUVA	Cuyahoga Valley National Recreation Area
10	DEWA	Delaware Water Gap National Recreation Area
11	DENA	Denali National Park and Preserve
12	EVER*	Everglades National Park
13	FOSU	Fort Sumter National Monument
14	GETT	Gettysburg National Military Park
15	GRTE	Grand Teton National Park
16	LAME*	Lake Mead National Recreation Area
17	LIBI	Little Bighorn Battlefield National Monument
18	LOWE	Lowell National Historic Park
19	MEVE	Mesa Verde National Park
20	MORA*	Mt. Rainier National Park
21	MORU	Mt. Rushmore National Memorial
22	NATR	Natchez Trace Parkway
23	OLYM	Olympic National Park
24	OZAR	Ozark National Scenic Riverways
25	PAIS	Padre Island National Seashore
26	PORE	Point Reyes National Seashore
27	ROMO*	Rocky Mountain National Park
28	SAGU*	Saguaro National Park
29	STLI*	Statue of Liberty/Ellis Island National Monument
30	YOSE*	Yosemite National Park

* Seven parks included in winter survey

1.3 Structure of the project and final report
This final report summarizes the main tasks completed as part of the project. The project was conducted between April 1, 2000 and April 15, 2002 and involved four primary tasks in addition to the selection of the 30-park sample (Figure 1.1).

Following the sample selection, a review of the research literature relevant to visitor safety, risk management, and risk communication was conducted, including theoretical, methodological, and empirical studies of high-risk visitor populations, activities, environments, and other factors contributing to risk (Task 2). A summary of the findings is presented in Section 2 below. The complete findings are presented in a report entitled *A Review of the Literature for a Comprehensive Study of Visitor Safety in the National Park System,* which is available from the NPS Social Science Program.

During the summer of 2001, data on visitor fatalities, injuries, and illnesses for the years 1993 to 1998 were assembled from Case Incident Reports (CIRs) and other sources at each of the 30 park units (Task 3). The database was used to examine the pattern of fatalities, injuries, and illnesses according to demographic characteristics, visitor activities, environments, apparent causes, and other contributing factors or relevant conditions. A summary of the findings is presented in Section 3 below. The complete findings are presented in a report entitled *An Analysis of Visitor Accident Risk in the National Park System,* which is available from the NPS Social Science Program.

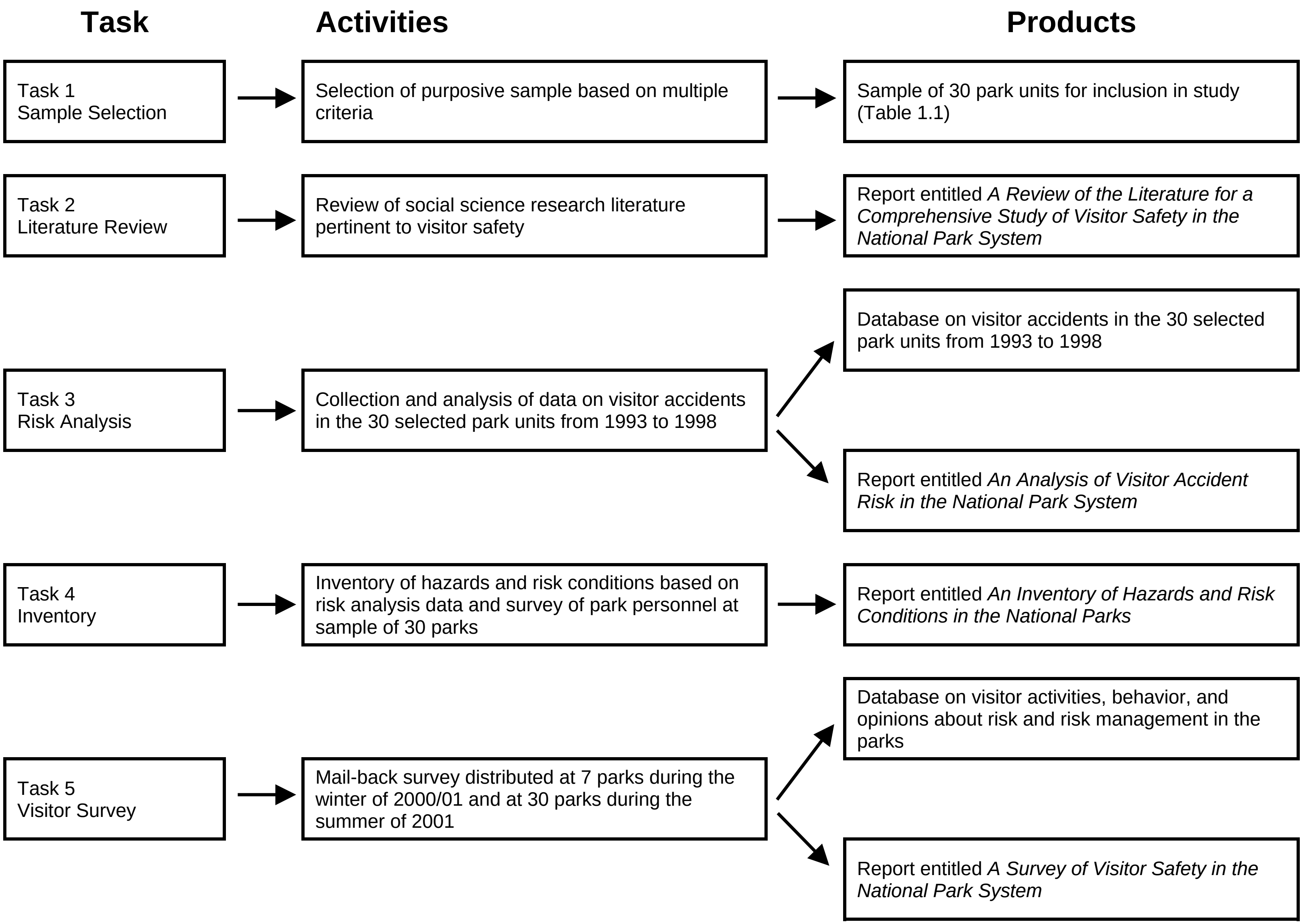
During the summer of 2001, a comprehensive inventory of hazards and risk conditions currently found at the 30 NPS units was completed (Task 4), with a special emphasis on the high-risk conditions found in Tasks 2 and 3. A summary of the findings is presented in Section 4 below. The complete findings are presented in a report entitled *An Inventory of Hazards and Risk Conditions in the National Parks*, which is available from the NPS Social Science Program.

Finally, a questionnaire was used to gather information on visitor activities, behavior, and opinions about risk and risk management at each of the 30 NPS units during the summer of 2001 (Task 5). Visitor surveys were also conducted during the winter of 2000/01 at 7 of the 30 park units with significant winter visitation (Task 5). A summary of the findings is presented in section 5 below. The complete findings are presented in a report entitled *A Survey of Visitor Safety in the National Park System*, which is available from the NPS Social Science Program.

Two major datasets were assembled in addition to the reports noted above (see Figure 1). One comprises data on visitor fatalities, injuries, and illnesses between 1993 and 1998 for the 30 park units in the sample (Task 3). A second comprises visitor responses on the winter and summer safety surveys (Task 5). These datasets are also available from the NPS Social Science Program.

The remainder of this report summarizes the purpose, methods, limitations, and major findings of each primary task, as presented in each of the reports indicated above. It ends with a set of overall conclusions and recommendations based on these findings.

Figure 1.1: Project Tasks, Activities, and Products



2.0 Literature Review

A review of relevant literature related to visitor safety in the National Park Service was conducted as part of Task 2. We conducted a review of *selected* social science research relevant to NPS visitor safety and a *comprehensive* review of research that is directly concerned with NPS visitor safety. We summarize the highlights of the literature review in the following sections. The complete literature review is provided in the report *A Review of the Literature for a Comprehensive Study of Visitor Safety in the National Park System.*

2.1 Overview

The bulk of the literature review examines the findings of social scientists on the factors that may contribute to visitor risk, including visitor characteristics, environmental conditions, and infrastructural factors. Peer-reviewed journal articles, books, government and non-government organizational reports, student theses, and conference proceedings were reviewed for this report.

The literature review reveals that social scientists have conducted an enormous amount of research on leisure and recreational activities, including the safety of participants. In addition, a large body of research is available on the causes, consequences, assessment, and management of a broad array of natural and technological hazards. Little research is available that is specific to NPS visitor safety and risk. Most of what is related to the NPS has been conducted for specific units within the park system.

Section 2.2 portrays the visitor “activity system” as part of a larger framework on human-activity "mismatches" that extends our understanding of contributory factors, and provides an organizing framework for the review. Section 2.3 identifies five types of factors that contribute to visitor accidents, including: individual characteristics, social characteristics, environmental conditions, infrastructure/organizational characteristics, and equipment characteristics. Section 2.4 discusses hazard management research with a special emphasis on the causal structure of hazards. Section 2.5 summarizes findings from the literature related to risk communication.

2.2 The visitor “activity system”

The activities of visitors to national parks occur within a larger system. Visitors are within a natural or built environment, which is managed by an organization (the National Park Service). The activity can depend on the actions of others, including NPS staff, concessionaire employees, and other visitors. This approach is compatible with the longstanding understanding in research on natural and technological hazards that hazards arise from the interactions of physical/natural systems and social systems.

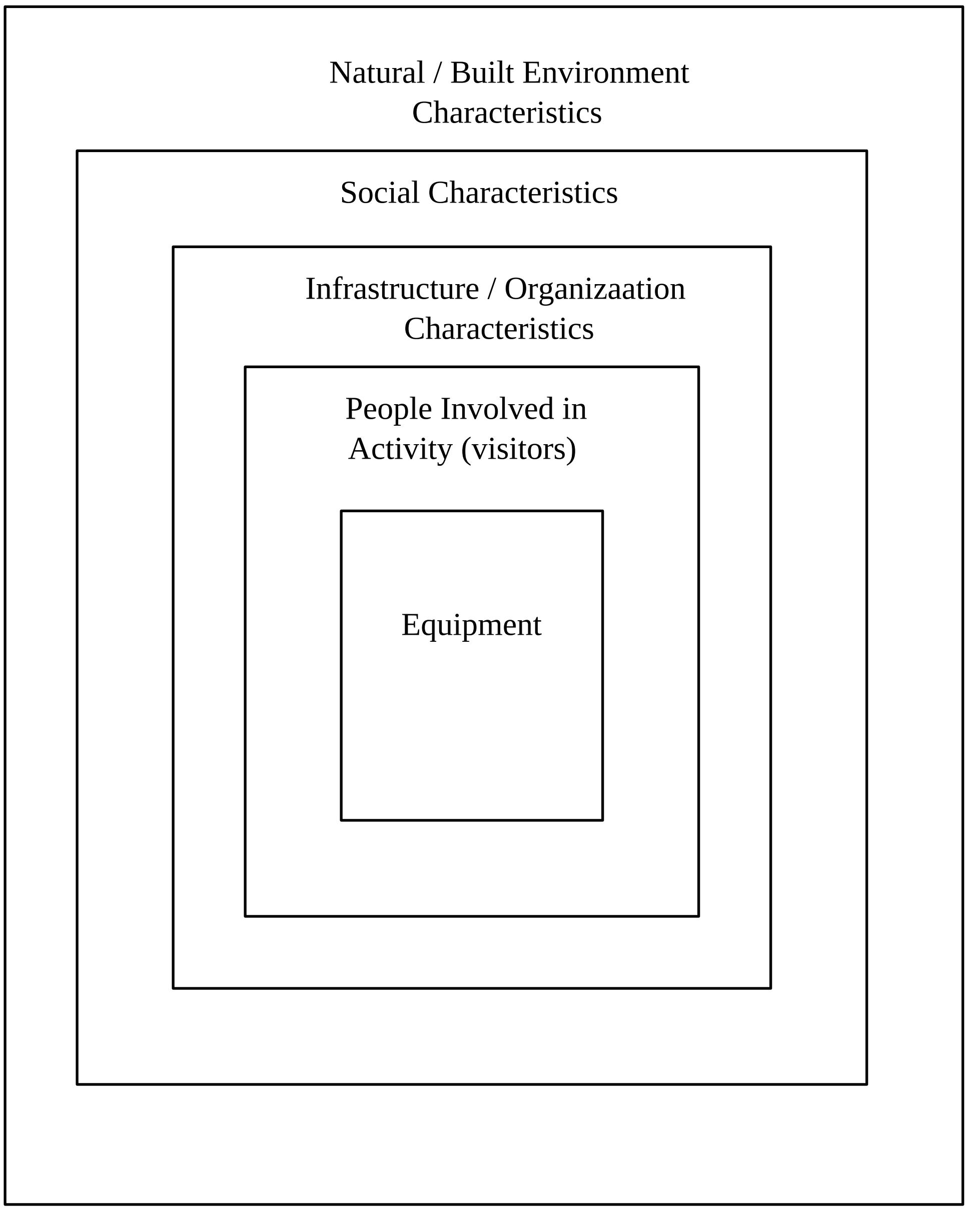
Literature on human factors suggests that any attempt to eliminate and control contributory causes to accidents must consider a recreational activity within a total activity system (Capper 1996, National Research Council 1988, Robinson 1982). As shown in Figure 2.1, such systems combine five elements:

1. mechanical and equipment components;
2. participating people (individuals and groups);
3. organizational and institutional infrastructure;

4. social and economic factors; and the
5. natural or built environment in which activity occurs.

At each level, and within the interactions among them, are factors that can cause or contribute to accidents/incidents (Rasmussen 1982, Hofmann et al. 1995).

Figure 2.1: Activity System



Following Figure 2.1, organizational, social, equipment, and environmental characteristics may have significant influences on safety in recreational activities. Features of people's recreation environment can contribute to accidents because they influence how the activity is conducted (Hofmann et al. 1995, Perrow 1984). For example, lighting may be poor in the staircase of a visitor center, trails may be slippery after rain or snowfall, or visibility may be limited due to fog. Inappropriate shoes (i.e., a form of equipment) may be worn by a visitor in wet and slippery conditions. Managerial, bureaucratic, and political pressures can directly affect safety (Capper 1996). For example, management may influence the readiness of search and rescue personnel, and political pressures can affect budgetary allocations for safety-related improvements (Sherwonit 2000).

"Human errors" or mismatches occur every day during the normal activities people pursue. Mismatches can also occur during non-routine activities (e.g., emergency response, search and rescue). Behaviors play an important role in most accidents, which are "typically not due to particularly exotic errors or mistakes, but to slips and misunderstandings which are commonplace in normal human activity and which have their tragic effects only under particular circumstances" (Holmes 1987). In fact, mismatches are often the result of many interacting individual and contributing factors. Thus, attempts to improve safety, reliability, and performance in visitor related tasks and activities are fundamentally linked to the elimination or control of contributory factors.

A broad view of safety that looks at the links between equipment, individuals, infrastructure, social, and environmental features has proven useful in the design, evaluation, and management of safety in a variety of large scale technological systems. Examples of such systems include nuclear power plants, chemical processing plants, offshore oil platforms, firefighting, resource extraction, and air, marine, and vehicle transportation systems (Reason et al. 1990, Slappendel et al. 1993, TriData 1996, Tuler, et al. 1993) and "has great potential for delivering results that yield useful recommendations for safety improvements" (National Research Council 1988, 12). This approach has also been used to evaluate the causal factors in the Cave Creek Tragedy in New Zealand where an observation platform collapsed and fourteen visitors fell to their deaths in 1995 (Capper 1996). However, this broad perspective has rarely been explicitly applied to recreation safety. Visitors engage in a variety of simple and complex activities ranging from strolling around exhibits to technical climbing and the operation of complex technologies, such as automobiles, snowmobiles, and motorboats. Visitor safety can be usefully addressed by considering the behaviors of individual visitors, the influences of agency personnel and management on the way activities are performed, environmental and infrastructure conditions, and other contributory factors.

2.3 Contributory factors to visitor accidents

In the literature review the five elements of an activity system are used to organize the vast body of research findings that are relevant to understanding how visitor accidents occur. Table 2.1 lists the topics covered in each section of the report.

Table 2.1: Contributory factors to visitor accidents

Elements in activity system	Topics covered in report	Examples of factors
Equipment characteristics	Equipment and technological innovations	Availability of new equipment Improper functioning
Visitor characteristics	Types of visitors Prior experience Risk perceptions Hazard recognition Judgment and decision-making Action and behavior Sensation seeking/risk-seeking behavior Stress factors	Age Skill level Familiarity of risk Desire for high excitement/adventure Ability to recognize threats/problems Improper implementation of plans Fatigue Time pressures
Social characteristics	Social groups Crowding Recreational conflict Social amplification of risk	Improper group planning Peer pressures Numbers of visitors in area Conflicts between bikers and hikers
Infrastructural and organizational characteristics	Roadway conditions Trail safety NPS employees	Quality of roadway maintenance Quality of trail maintenance Quality of building maintenance Quality and availability of information Employee behaviors
Natural/built environment conditions	Natural hazards Wildlife Viruses, bacteria, and parasites	Wildlife attacks Viruses and parasites Snow Fog High temperatures Steep terrain

Many studies have shown that people are capable of completing complex activities in difficult environments. The studies also show that people vary in their capabilities. Such variability can interact with activity requirements and equipment in such a way that accidents and mishaps occur. As activities are made more complex and occur in more difficult situations, the likelihood grows for accidents or mishaps.

Individual and group capabilities are degraded in unfavorable situations. Many studies have shown that harsh environments, physical stress and fatigue, mental workload, time pressure, and a variety of other factors can limit capabilities. While these factors are often found to be contributors to accidents, their effects are not the same for all individuals. In addition, individuals do not always react to these "stressors" in the same manner and other factors, both within and outside the activity environment, can affect how individuals react to and attempt to overcome them.

2.4 Hazard management

Kasperson *et al*. (1985, 43) define hazard management as "the purposeful activity by which society informs itself about hazards, decides what to do about them, and implements measures to control them or mitigate their consequences." Hazard management comprises several functions that operate at the different stages in the causal sequence of hazards (Figure 2.2). Hazard assessment and control analysis are processes of data gathering to determine the nature of the hazards and the options for controlling them. Implementation, evaluation, and strategy selection are management actions that can be undertaken once the hazards are understood.

The "causal chain framework" may be used to describe the ways hazards can lead to adverse outcomes. An important lesson from the research is that visitor accidents arise from many interacting factors. The "causal model" provides a means for examining the underlying structure of different kinds of hazards (Figures 2.3 and 2.4 present two different hypothetical accidents by way of illustration). Contributory factors arise "early" in the causal chain, when a person chooses an activity or when the activity or technology is designed. Most importantly, the causal model assists in the identification of alternative management interventions to control hazards and their consequences. It was developed in studies of natural hazards (Kates 1970), but has also been used to study other hazards, such as the hazards of automobiles, nuclear power, airborne mercury, and the Bhopal chemical accident (Kasperson, Kates, and Hohenemser 1985, Bowonder, Kasperson, and Kasperson 1985).

Figure 2.3 illustrates how the causal model may be used to tease apart a hazardous sequence of events using the example of a visitor who becomes injured by falling down some steps, which is a relatively common occurrence in the National Parks. The diagram begins with the "choice of activity" on the left side and ends with a set of consequences on the right. In this case the choice of activity is "viewing exhibits." Most visitors will complete their visit to the park without adverse consequences (i.e., the pathway at the top of the diagram). For some small fraction of visitors, however, there is a set of necessary and sufficient initiating events or conditions (i.e., wet steps, visitor fatigue, and inappropriate foot-ware) that lead to an outcome (i.e., a fall) with a set of adverse consequences (i.e., abrasions and a broken ankle). Without appropriate intervention and medical treatment, these primary consequences could lead to secondary consequences, such as an infection and long-term disability. This describes the primary causal sequence.

Figure 2.3 illustrates possible management interventions to prevent or remedy subsequent consequences. Attempts to improve safety and reliability in the performance of activities and tasks (e.g., vehicle driving, rock climbing, canoeing) are fundamentally linked to the elimination or control of factors that may contribute to accidents (Kasperson, Kates, and Hohenemser 1985, National Research Council 1988). In general, exposure to a risk can be limited or eliminated and consequences of the risk can be mitigated or controlled (Kasperson et al. 1985, Bick et al. 1985).

Activities can also be structured so that they are less sensitive to errors and by providing opportunities for activity participants to correct errors before an accident occurs. All of these options are important for promoting visitor safety in the national parks. Figure 2.3 also illustrates how hazards arise can arise from interactions of physical/natural systems and social systems -- and that management interventions can focus on the physical/natural system, the social system, or their interactions in efforts to reduce or eliminate consequences.

In our example, replacing the steps with a ramp, improving lighting, and adding warning signs may help to prevent the initiating events and block the causal sequence, thus pushing the sequence of events to the upper branch. Adding a handrail may not prevent the initiating events, but it may prevent the outcome (i.e., a visitor falling). Redesigning the steps and changing the materials may help to minimize the adverse consequences if someone does fall. Prompt and appropriate responses by park personnel may help to prevent secondary consequences. For completeness, we include compensation of the injured party as the management option of last resort.

Figure 2.3 illustrates a fairly simple hazard sequence. The model can be expanded extensively to accommodate more complicated hazard sequences. For example, Figure 2.4 illustrates another hypothetical example involving a boating accident. In this case, the release of energy (kinetic and thermal) and materials (oil and smoke) may lead to adverse consequences for humans and environmental resources, depending on the route of exposure. Thus, it is useful to add a “stage” for exposure. The exposure stage highlights the pathways by which humans, flora, fauna, and other parts of the environment may be exposed to the energy and materials released. Humans involved in the crash may suffer traumatic injuries from the kinetic energy of the crash and burns from the ensuing fire. They may also be drowned by inhalation of water. Flora and fauna may suffer adversely from oil released into the water. People nearby may suffer adversely from inhalation of smoke in the air. The primary reason for adding another stage for exposure is to elucidate the hazard sequence in more detail and to identify distinctive management interventions that may be possible. For example, to minimize inhalation exposures to the smoke people can be evacuated from the immediate area of the accident. Finally, one management option available here that was not available in Figure 2.3 is the possibility of banning the activity in question.

As illustrated in Figures 2.3 and 2.4 the causal model can be used to map out the myriad factors that can contribute to visitor accidents and to indicate some of the ways they can be eliminated or controlled through hazard management activities

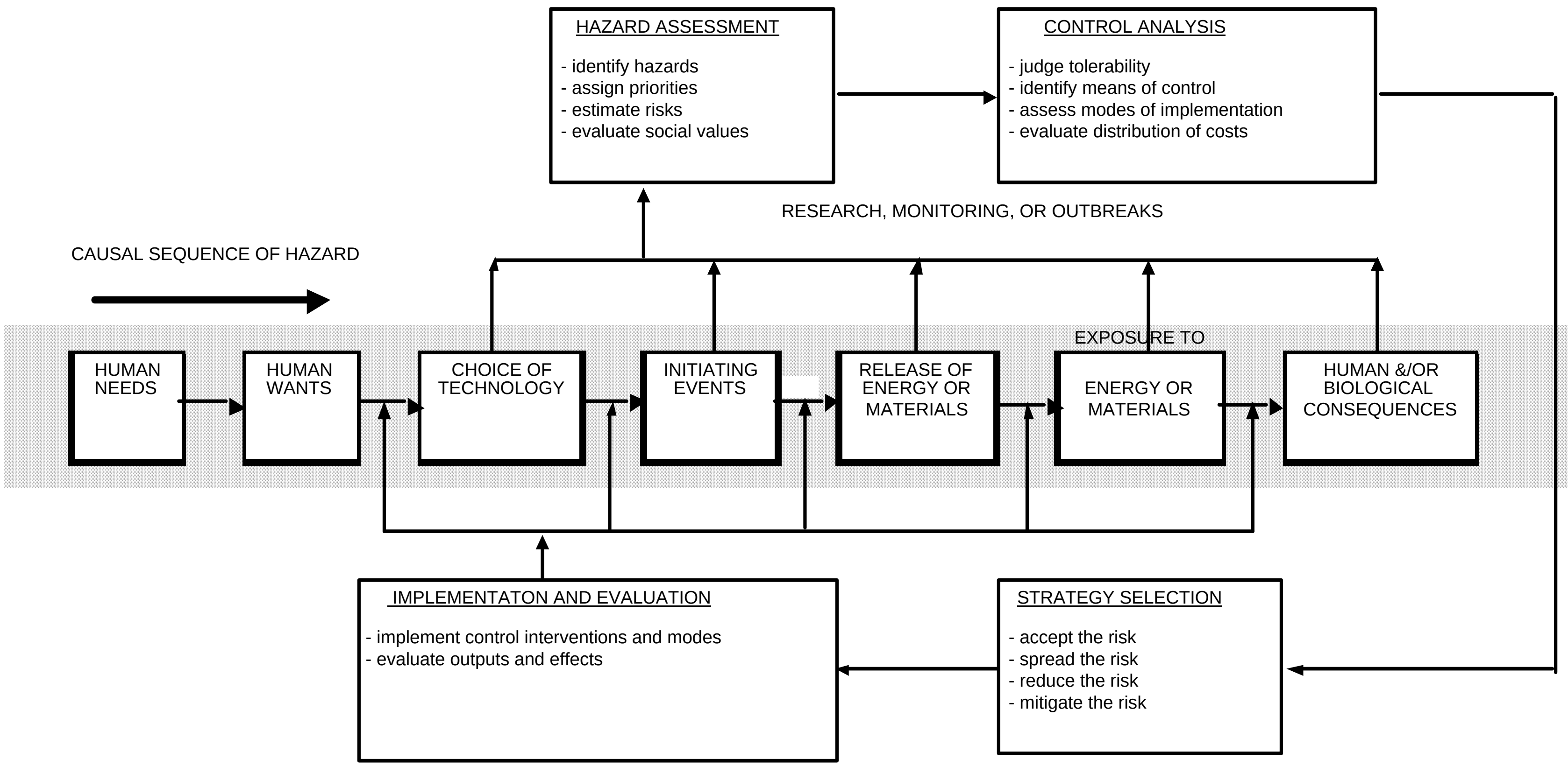


Figure 2.2: Flow Chart of Hazard Management (Source: Kasperson, Kates, and Hohenemser 1985)

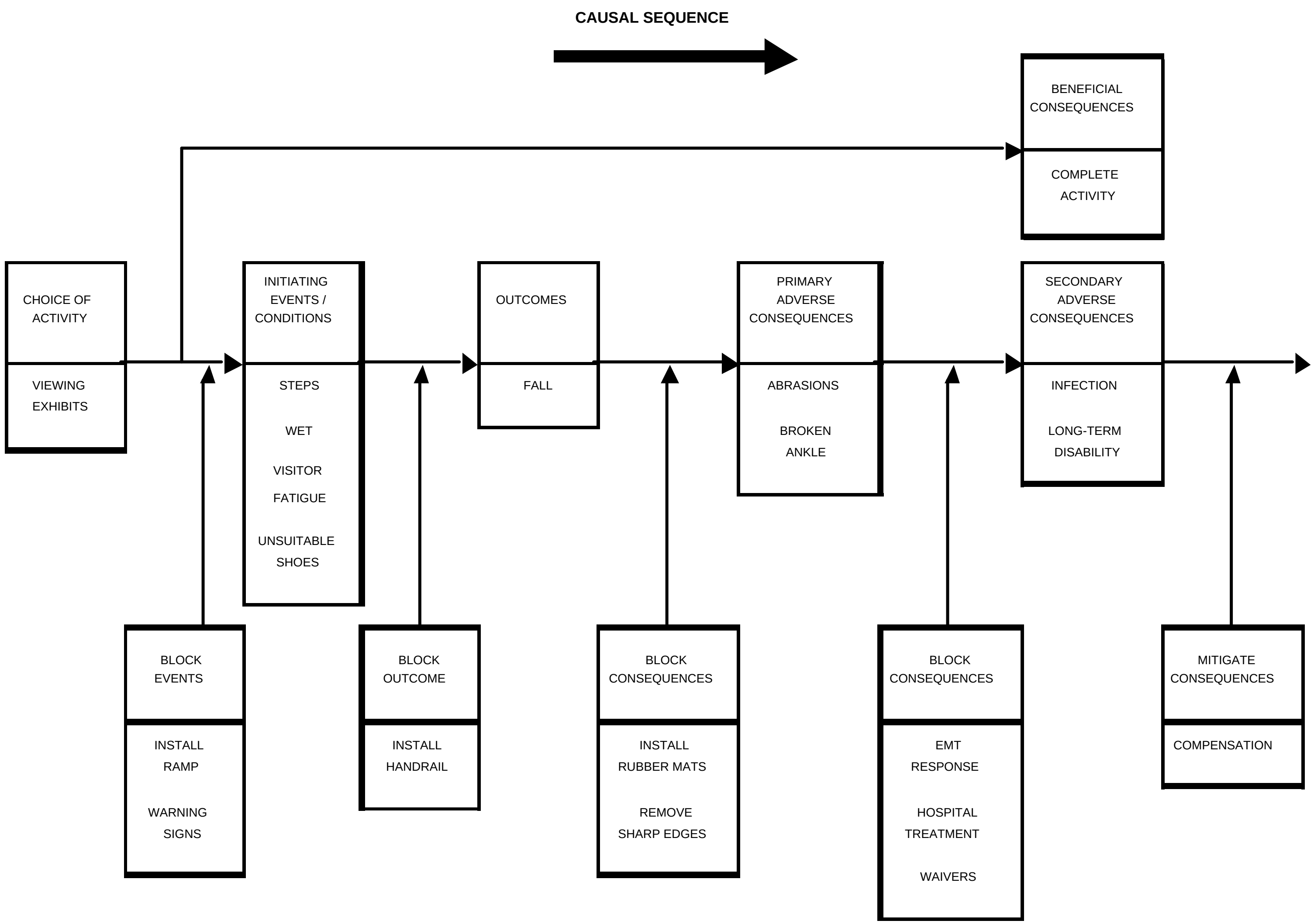


Figure 2.3: Management Interventions to Prevent Falling on Steps

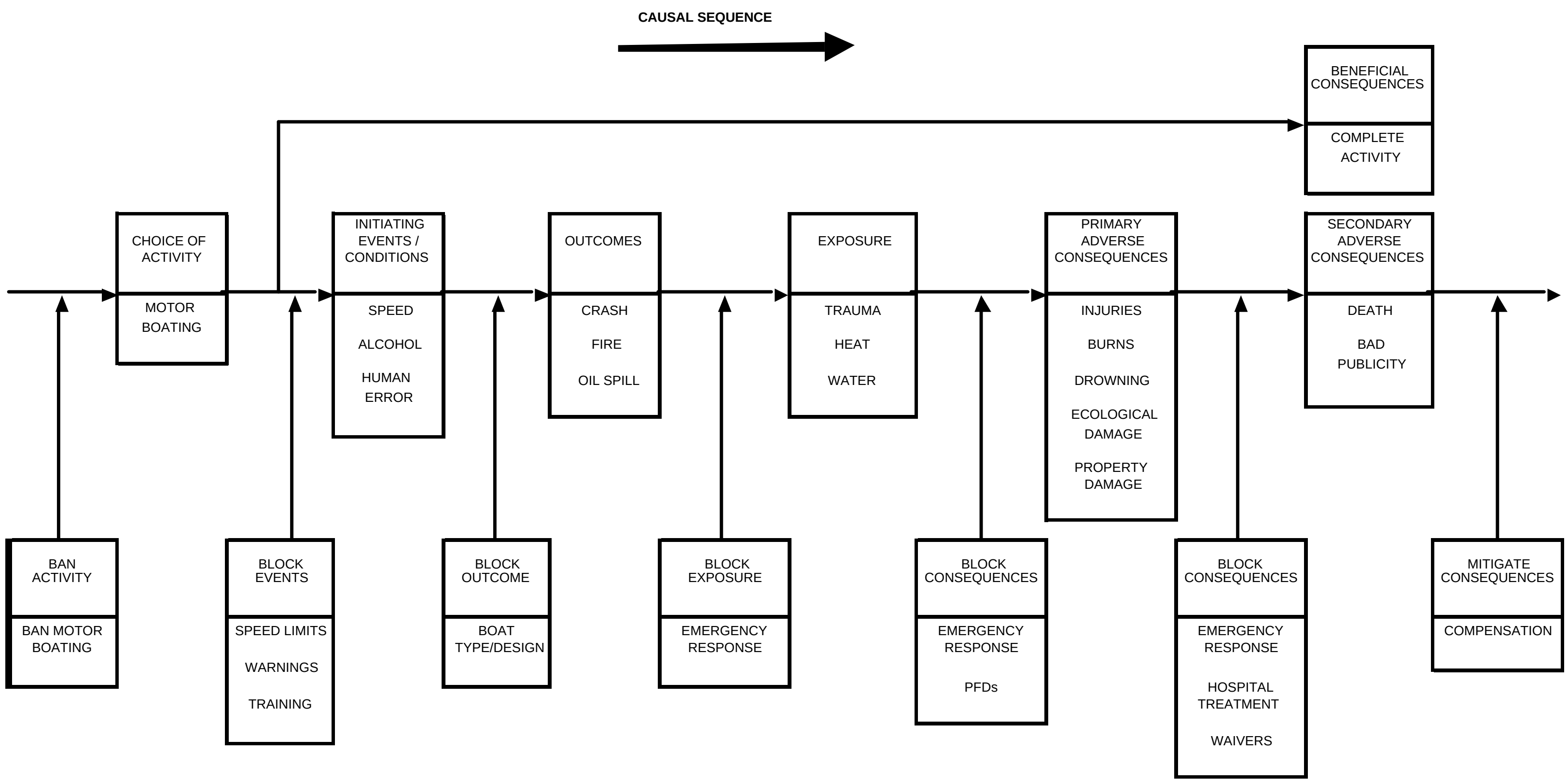


Figure 2.4: Management Interventions to Prevent Boating Accidents

Considerable research has shown that it is possible to control factors that may contribute to accidents. Mismatches may occur at any time. The best ways to decrease their effects are to design systems that remove the opportunities for weaknesses to matter. Such systems provide a "buffer zone" for human variability in performance (Pitz 1992, Rasmussen and Goodstein 1987). These controls can be achieved by removing the contributing factor, by making the "activity system" less sensitive to errors, and by providing opportunities to correct errors before they result in an accident. The Parks Canada Agency (formerly the Canadian Park Service 1995, 2) identifies a similar breakdown of options: eliminating the hazards; imposing barriers between visitors and hazards; regulating visitor behavior and access; and using persuasive safety messages. These are all options that can be important to the promotion of visitor safety. They are important in both normal "routine" conditions and unexpected or emergency situations (e.g., backcountry avalanche). As discussed above, factors that may contribute to mismatches and error recovery are found at all levels of the "activity system" (Rasmussen 1982, Reason et al. 1990, Slappendel et al. 1993; see Figure 2.1 above).

2.5 Risk communication

One of the most important opportunities for NPS managers to reduce risks to visitors occurs through communication and education programs. The National Research Council (NRC) has defined risk communication as "an interactive process of exchange of information and opinion among individuals, groups, and institutions" (NRC 1989, 2). Over the past 20 years, risk communication has evolved from early efforts based on the simple source-message-channel-receiver model to more recent efforts to involve members of the public in complex participatory exercises that seek to make the public part of the decision-making process. Thus, risk communication covers a wide array of methods, including warning signs and labels, informational brochures, public service announcements, public meetings, and citizen advisory boards. Whatever the method used, there are four primary objectives (Covello, von Winterfeldt, and Slovic 1986):

1. to inform and educate (e.g., product labeling);
2. to change behavior and encourage protective actions (e.g., to encourage people to wear seatbelts and appropriate footwear);
3. to warn people about disasters and other emergencies (e.g., floods, earthquakes, tornadoes); and,
4. to involve the public in joint problem solving and conflict resolution (e.g., public meetings about a new hazardous waste facility).

While some risk communication programs will have one primary goal, others may have multiple goals. Much of the research on risk communication is of limited direct relevance to the National Park Service because the problems addressed in the literature are often related to technological systems (e.g., nuclear power risks) and public health (e.g., radon and AIDS education campaigns). Nevertheless, research has given some attention to risk communication efforts aimed at personal actions (i.e., changing behavior and encouraging protective action). Often such efforts in risk communication are based on messages that offer information, advice, warnings, or recommendations regarding risky individual actions. The National Research Council Committee noted, however, that "getting recipients' attention and comprehension poses significant barriers to risk communication, especially in the arena of personal action, where many recipients customarily act without carefully considering risks and benefits" (NRC 1989, 79).

This Committee further emphasized that "risk communication in the setting of personal choice [is] successful only if it adequately informs the individual for making a choice among alternatives" (NRC 1989, 78). The Committee points out, however, that it is insufficient to assume that a change in behavior implies that an individual is fully informed, and conversely that a failure to change behavior implies that an individual is not fully informed. The Committee identified a variety of methods that may be used to influence decisions and behavior, such as the way information is framed, making risk comparisons, and appealing to emotions. For most of the problems that the Park Service encounters, the choice of what information to highlight and in what ways will be the most pertinent method.

Several manuals have been written that offer advice about how to design and implement effective risk communication. Much of this advice is aimed at very controversial kinds of hazards, such as siting hazardous waste facilities. The kinds of hazards typically found in the national parks, however, tend to be less controversial, and the problem is not how to calm down an angry and outraged public (Sandman 1987), but rather how to ensure that members of the public pay attention to the messages and change their behavior accordingly.

A growing body of theoretical and empirical research exists on the communication of information to recreationalists. Studies have addressed the sources of information, characteristics of the visitors that influence reception and understanding of messages, and different approaches to providing information. Although research has not always focused on risk and safety, it has been *applied* to issues of risk and safety. Other applications of the research include influencing visitors to use low-impact resource use, theft of natural resources (e.g., petrified wood), and off-trail hiking.

Much of the recreation-related research is based on the standard "sender-receiver" model from communication theory. A second set of research is based on notions of persuasion. While the research results are not always consistent, they provide important insights into the importance of information programs and the factors that influence their success.

2.6 Summary

Because of variability among individuals' behaviors and the variety of contributory factors, it is impossible to eliminate all sources and causes of accidents. It has been observed that the only way to avoid potentially harmful effects of "human errors" is to make systems "goof proof" so that they do not fail in ways that can cause serious accidents. An important area for further research is to identify methods for creating activity systems that are more "goof proof."

In spite of considerable effort, research on hazards and their causes cannot explain exactly why or when accidents may occur; how the effects of prior experience, risk perceptions, and stress factors influence *particular* individuals or groups; or why the reactions of individuals and groups can vary when exposed to similar conditions. Research on the risk and safety of visitors to National Park units is no exception.

Much of what is unknown relates to the many variables that influence decisions and behaviors of specific individuals in specific situations. Gaps in research occur because certain behaviors or situations have not been studied in full detail. Limited research has addressed the unique combinations of activity requirements, social and physical environments, and individual and group behaviors that may occur in many of the activities performed by visitors to park units. Limited research is also available about the effect of different hazard management strategies for specific park contexts. Overall, the social science literature offers an extensive body of findings that highlight the range of factors that can be important to the causes and consequences of visitor accidents.

The findings from the literature review were used in subsequent tasks. Coding protocols for visitor accident data were informed by the literature review (Task 3). A questionnaire distributed to NPS staff about risk of visitor activities and factors that contribute to accidents and injuries was based on information obtained in the literature review about important risk conditions for recreational activities (Task 4). The design of the visitor survey (Task 5) was also informed by the findings of the literature review.

3.0 Risk analysis

Visitor fatality, injury, and illness data collected by the NPS were coded and analyzed as part of Task 3. The analysis was based on a sample of accident reports from each of the 30 park units during 1993-1998. The analysis of visitor accidents is provided in the report *An Analysis of Visitor Accident Risk in the National Park System.* The data were collected during visits to each of the parks between May and September 2000. The data were analyzed between September 2000 and March 2001.

3.1 Overview

Various accident data for NPS visitors are available for the period from 1993-98, but the project used primarily the following sources: *Emergency Medical Services Reports (EMSRs) or "Run Sheets;" Case Incident Reports (CIRs); and, Morning Reports.* The definition of visitor accidents described in section 1.1 was used to identify specific cases.

Typically, National Park Service (NPS) personnel who respond to a visitor accident will complete an *Emergency Medical System Report* (EMSR) in the field, indicating briefly the nature and the location of the accident, basic medical and demographic information pertaining to the victim, and a summary of NPS personnel responses. NPS personnel may subsequently complete a *Case Incident Report* (CIR). These records are filed at the NPS unit concerned.

CIRs are supposed to be filed for all visitor accidents that require the assistance of park personnel. CIRs provide space for standardized categories of information, such as the time, date, location, and type of the accident, as well as a narrative description of the sequence of events, contributing factors, parties involved, and personnel responses. CIRs may also include additional information, such as photographs of the scene. The level of detail reported, however, varies according to the nature of the accident, who files the report, the amount of time available to complete the report, and other competing demands on that person's time.

The more serious accidents that meet criteria set down by the NPS and the Department of the Interior (DOI) also appear in the NPS *Morning Reports*. These include Level 1 reports (such as those reporting employee fatalities, property damages in excess of $100,000, and major natural or man-made disasters) and Level 2 reports (such as those reporting visitor fatalities, wildlife attacks, major search and rescue efforts, aircraft accidents, multiple injuries, and structural fires). Presently, visitor *fatality* data are tracked by the DOI's Office of Managing Risk and Public Safety (MRPS). Data on visitor fatalities are extracted from the NPS *Morning Reports* and maintained as a set of spreadsheets that can be sorted by various categories, such as the region and park unit involved, the primary cause of the fatality, the name, age, and sex of the victim, and whether drug and/or alcohol use was a contributing factor.

Aside from the *Morning Reports,* these data sets are accessible only at the individual NPS units, which necessitated on-site visits to each park to gather the relevant data. The ways in which the data are maintained varies enormously from park to park and from year to year. The older data are primarily in paper form, whereas some or all of the more recent data may be computerized. The paper records are often the most complete sources of information, although there were inevitably problems with missing files at some parks. Crosschecking between the paper and computer records allowed some but by no means all of these gaps to be filled.

3.2 Methodology

Methodologically, the analysis involved developing a sampling strategy and coding protocols for the collection and coding of the data. The analysis used frequencies, cross-tabulations, and simple statistics to explore the patterns and relationships among the data.

3.2.1 Sampling strategy

The number of CIRs at any given NPS unit can be quite large, although only a portion pertains to visitor accidents. For example, Yosemite often has over 4,000 CIRs on file for each year, but only about 500 per year pertain to visitor accidents. Consequently, the project team adopted a *systematic* random sampling strategy to select relevant cases for inclusion in the database. The desired sample size for each park unit was originally set at 100 for each of the six years (1993 through 1998). Many parks, however, average 50 or fewer visitor accidents per year and we found that it was not feasible to gather adequate information on 100 accidents with the time and resources available. Consequently, the sample size was reduced to 50 visitor accidents per park.

If there were 50 or fewer visitor accidents per year for a particular park, then the CIR numbers were used to identify the relevant files and data for each accident were entered in the database. Any accidents involving fatalities were treated separately. For example, a park might have 3 accidents that involve fatalities and 50 that involve only injuries and illnesses during a particular year. This gives a total of 53 visitor accidents for a given year in our sample. If there were more than 50 non-fatal visitor accidents in a year, the data gatherers would calculate a sampling ratio. For example, if the annual log indicated 100 visitor injuries in a particular year, we would record every other accident in the database. In this fashion we would be sure to have a random sample of accidents distributed broadly over the entire year.

Accident rates tend to reflect visitation rates, which vary over the year. In some parks, peak visitation may occur in the summer months, whereas in other parks the fall may be the peak season. Because of the sampling strategy used, the numbers of accidents recorded for any individual park will generally reflect visitation rates. In the full report, accident data are graphed along with visitation data for each park, and this relationship is clearly displayed. In some parks, however, there may be a peak in accidents that appears to be out of phase with visitation rates. These disjunctures may indicate high risk conditions and/or high risk visitor groups. For example, at Lowell there is a spike of accidents in May, but the peak in visitation occurs in July. The spike in accidents appears to be related to the large number of school field trips that occur during the month of May. Similarly, in Denali there is a peak in fatalities in May and June that precedes the peak visitation in July and August. It appears that the fatalities occur among the younger, more adventurous male visitors who come to Denali ahead of the main tourist season when conditions may also be more dangerous.

Visitor fatalities comprise only a small proportion of CIRs, but they are obviously of significant concern to the NPS. Unfortunately, some of the fatality data were incomplete or unavailable in several of the parks. Consequently, the project team supplemented the CIR data gathered with the information available from the *Morning Reports*.

3.2.2 Coding protocols

The project team reviewed the literature on visitor safety as well as a selection of CIRs and the *Morning Reports* to identify the kinds of information available in the NPS records that would be most pertinent to a comprehensive risk analysis on visitor accidents. The database developed includes information, where available, on:

- the date, time, and location of the accident;
- the nature and severity of the harm and the number of people involved;
- the demographic characteristics of those involved (e.g., age, sex, race);
- the nature of activities in which the victims were engaged (e.g., wildlife watching, snowmobiling, rock climbing, backcountry hiking);
- the nature of the environment at the accident site (e.g., river, cliffs, steep paths);
- the apparent cause of the harm (i.e., primary and secondary initiating events);
- other contributing factors or relevant conditions (e.g., fog, snow); and,
- actions taken in response to the accident by park personnel and others.

Coding protocols were developed and incorporated into a computerized data entry form to allow for the efficient and consistent coding and entry of accident data in the field using laptop computers.

3.2.3 Analysis of data

The risk analysis report presents brief summaries of the results of the analysis for each individual park in our sample. The summary for each park is organized in a similar fashion, although each summary is tailored to highlight any distinctive patterns and relationships for that park. The individual park summaries are similar in format to the 30-park summary presented below (section 3.3). Each summary describes the total number of visitor accidents, the number of fatalities, and the number of non-fatal injuries and illnesses. As an overall indication of the level of risk associated with each park we also present these data as rates per 100,000 visitors and per 1,000,000 visitor hours.

Accidents involving fatalities are separated out for two reasons: (1) they are qualitatively distinct from other accidents because of the severe nature of the consequences; and, (2) because we believe we have a relatively complete set of information on all visitor fatalities between the years 1993 and 1998, as distinct from a sample.

Information about the nature of visitor accidents that involve *only* injuries and illnesses is also provided for each park. Each summary includes an examination of the patterns of injuries and illnesses according to demographic variables (such as age, gender, race, and nationality), temporal variables (such as day, time of day, and month), activities, primary initiating events, contributing factors, nature of injury or illness, and response. Each summary highlights the "high risk" populations, activities, environments, and conditions.

Because we have only a sample of the visitor accidents at many of the parks, we used a process of weighting to produce the frequency and cross-tabulation results. Weighting was necessary in two situations: (1) where a park has more than 50 visitor accidents in one or more of the years in questions; or, (2) where the number of accidents in the database is less than the total number of visitor accidents reported in the logs. In these cases, the information in the database represents only a sample of the accidents at that park.

3.3 The 30-park sample

The park specific findings from the analysis of visitor accident and injury data are provided in the full report. In this section, we provide a summary of the findings for the combined analysis of the 30-park sample. The individual park summaries found in the full report follow a similar format.

Overall, between 1993 and 1998, there were 19,365 visitor accidents in the 30 parks, resulting in 443 fatalities and an estimated 24,746 non-fatal injuries and illnesses Table 3.1). Since there were 446,961,159 visitors to the 30 parks during this period for a total of 2,851,580,367 visitor-hours, this results in an average of 4.33 accidents, 0.10 fatalities, and 5.54 injuries and illnesses per 100,000 visitors, or an average of 6.79 accidents, 0.16 fatalities, and 8.68 injuries and illnesses per 1,000,000 visitor hours. The visitation data used to calculate the risk ratios have been adjusted to allow for missing data in individual parks.

3.3.1 Accidents involving fatalities

Between 1993 and 1998, there were 384 accidents that resulted in a total of 443 fatalities in the 30 park units we studied. Forty-six percent of the victims were between 21 and 40, and 86% were male. Figure 3.1 shows the distribution of fatalities by age.

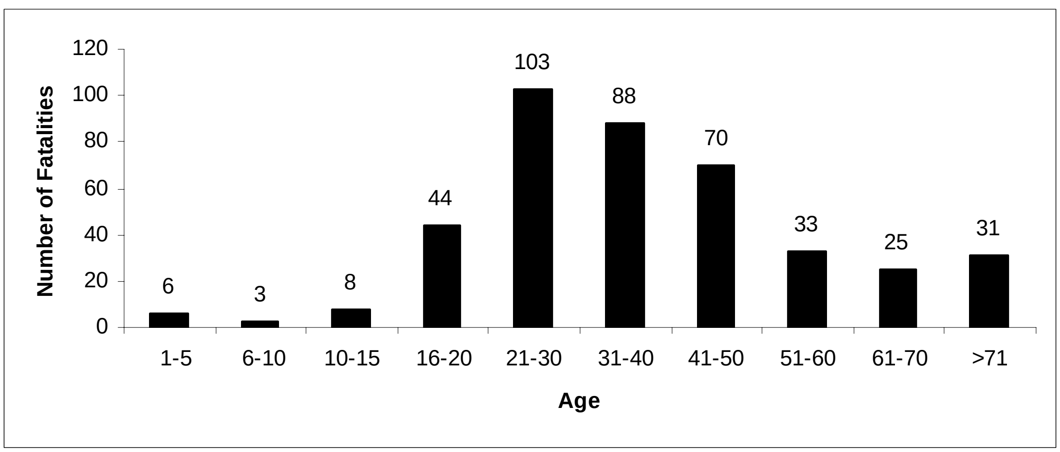


Figure 3.1: Number of Fatalities by Age (N=411)

Ninety-two percent of all fatalities were U.S. residents, with 1% from Mexico, Germany, and the UK respectively, and 5% from various other countries. Sixty-nine percent of all fatalities were white, 5% Hispanic, 3% Asian, 3% African-American, and 20% of unknown ethnicity. Fifty-six percent of the fatalities occurred on weekdays, with 48% occurring between 12:00noon and 6:00pm, 21% between 6:00am and 12:00noon, and 22% between 6:00pm and midnight. The number of fatalities closely follows the distribution of visitors by month.

Park code	Number of Fatal Accidents	Number of Non-fatal Accidents	Total Number of Accidents	Number of Fatalities	Number of Injuries & Illnesses	Number of visitors	Accidents/ 100,000 visitors	Fatalities/ 100,000 visitors	Injuries & Illnesses/ 100,000 visitors	Number of visitor-hours	Accidents/ 1,000,000 visitor-hours	Fatalities/ 1,000,000 visitor-hours	Injuries & Illnesses/ 1,000,000 visitor-hrs	Missing data*
ASIS	0	900	900	0	906	11528302	7.81	0.00	7.86	100129923	8.99	0.00	9.05	
BADL*	3	105	108	5	106	4410191	2.45	0.11	2.40	19864525	5.44	0.25	5.34	1997-98
BIBE	9	320	329	9	335	1877562	17.52	0.48	17.86	56586960	5.81	0.16	5.93	
BLRI	35	915	950	36	1222	106802332	0.89	0.03	1.14	672527208	1.41	0.05	1.82	
CAVE	1	346	347	1	348	3512947	9.88	0.03	9.91	13462234	25.78	0.07	25.87	
CAHA	15	172	187	15	158	14636238	1.28	0.10	1.08	69050860	2.71	0.22	2.29	
CANY	7	224	231	8	234	2630282	8.78	0.30	8.90	26716869	8.65	0.30	8.76	
CURE	7	78	85	8	79	6104296	1.39	0.13	1.29	28212573	3.01	0.28	2.80	
CUVA*	2	184	186	2	193	16912430	1.10	0.01	1.14	50264071	3.70	0.04	3.84	1993
DENA	22	371	393	36	412	2607367	15.07	1.38	15.81	35694533	11.01	1.01	11.55	
DEWA	9	426	435	10	538	28096558	1.55	0.04	1.91	126274177	3.44	0.08	4.26	
EVER	1	214	215	1	246	5678541	3.79	0.02	4.32	31194566	6.89	0.03	7.87	
FOSU*	0	32	32	0	32	1684302	1.90	0.00	1.90	1944206	16.46	0.00	16.46	1996
GETT	2	255	257	2	280	9790417	2.63	0.02	2.86	30698619	8.37	0.07	9.14	
GRTE	25	756	781	28	827	15989664	4.88	0.18	5.17	115579137	6.76	0.24	7.15	
LAME*	91	1979	2070	106	3560	36506024	5.67	0.29	9.75	304091998	6.81	0.35	11.71	1993-94 injuries
LIBI	0	12	12	0	12	2233285	0.54	0.00	0.54	2237111	5.36	0.00	5.36	
LOWE	0	42	42	0	46	3147809	1.33	0.00	1.46	4276433	9.82	0.00	10.76	
MEVE	0	298	298	0	307	3864515	7.71	0.00	7.94	32517232	9.16	0.00	9.44	
MORA*	4	235	239	4	253	4008527	5.96	0.10	6.30	49275265	4.85	0.08	5.13	1993-95
MORU*	0	179	179	0	183	9318575	1.92	0.00	1.96	12271760	14.59	0.00	14.91	1998
NATR	40	372	412	41	685	34781424	1.18	0.12	1.97	140693790	2.93	0.29	4.87	
OLYM	17	695	712	20	723	20492225	3.47	0.10	3.53	115787615	6.15	0.17	6.24	
OZAR	6	107	113	7	107	9007731	1.25	0.08	1.19	25491126	4.43	0.27	4.20	
PAIS	2	1823	1825	2	1843	4663531	39.13	0.04	39.52	32783081	55.67	0.06	56.21	
PORE	6	233	239	7	247	14491489	1.65	0.05	1.70	69638923	3.43	0.10	3.55	
ROMO	21	979	1000	22	1317	17551492	5.70	0.13	7.50	127229570	7.86	0.17	10.35	
SAGU	4	95	99	4	132	4456978	2.22	0.09	2.96	6205170	15.95	0.64	21.27	
STLI	2	2974	2976	2	5302	27042648	11.00	0.01	19.61	81127944	36.68	0.02	65.35	
YOSE	53	3660	3713	67	4114	23133477	16.05	0.29	17.78	469752888	7.90	0.14	8.76	
	384	**18981**	**19365**	**443**	**24746**	**446961159**	**4.33**	**0.10**	**5.54**	**2851580367**	**6.79**	**0.16**	**8.68**	

Motor vehicle accidents are responsible for 29% (127/443) of all fatalities, with 18% from swimming, wading, and surfing; 15% from climbing accidents; 11% from boating, and; 10% from hiking. Falls account for 22% of fatalities, including falls while climbing (12%), hiking (7%), and walking (2%). Of the 124 motor vehicle accidents for which we have information, 40% involve accidents without collisions (e.g., running off the road); 30% involve collisions with fixed objects, and; 29% involve collisions with other vehicles. In the 170 fatalities involving automobiles, boats, and bicycles, 56% of all fatalities were due to driver-related factors (e.g., falling asleep while driving, loss of vehicle control), while in 32% of all cases the primary contributing factors were unknown or unreported. Of the 443 fatalities, 244 (55%) required search and rescue efforts. Twenty nine percent (129/443) of the victims were transported by ambulance and subsequently died, and 60% were dead at the time park personnel arrived on the scene.

3.3.2 Accidents involving no fatalities

There were 24,746 injuries arising from 18,981 accidents that did not involve fatalities (see Table 3.1 above). Forty-eight percent of the victims were male, 49% were female, and in 3% of cases the sex of the victim was not reported. The distribution of victims by age is shown in Figure 3.2. Assuming that the number of visitors by age is normally distributed, the number of injuries and illnesses suffered by visitors between 16 and 20 years of age appears to be lower than would be expected. This may merely reflect the lower visitation rates among this age group. Without better data on the age distribution of visitors, we cannot tell.

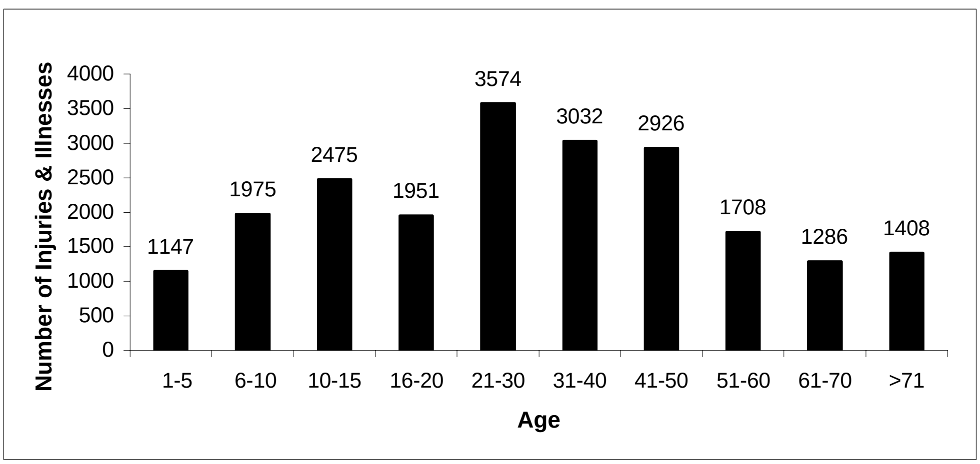


Figure 3.2: Number of Visitor Injuries and illnesses by Age, 1993-98 (N=21481)

Almost 90% of those visitors that suffer injuries and illnesses are from the United States, 1% are from the UK, 0.5% from Canada, and 0.5% from Germany. Fifty-five percent are white, 3% Hispanic, and 3% Asian. These results are highly uncertain, however, because the race and ethnicity is unknown in almost 40% of cases.

Sixty percent of the injuries and illnesses occurred on weekdays, with 59% occurring between 12:00 noon and 6:00 pm, 26% between 6:00am and 12:00 noon and 11% between 6:00pm and midnight. The distribution of injuries and illnesses by month closely reflects the numbers of visitors.

Figure 3.3 shows that 20% of all visitor injuries and illnesses occur while driving or riding in motor vehicles, 19% arise during walking on prepared walkways and around exhibits, 9% while hiking, 8% while swimming, and 6% while boating (both motorized and non-motorized). In 14% of cases the primary activity of the victim was unknown.

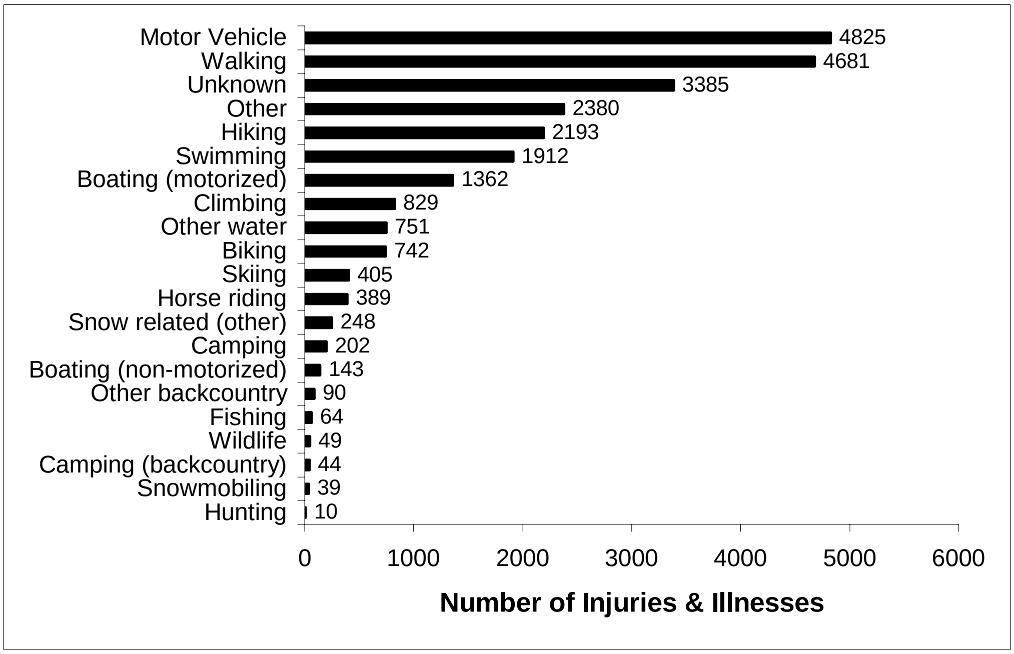


Figure 3.3: Visitor Injuries and Illnesses by Activity, 1993-98 (N=24746)

Visitors may be injured in different ways while engaging in various activities. For example, hikers may trip and fall or be stung by insects. The primary event leading to an injury or illness is shown in Figure 3.4.

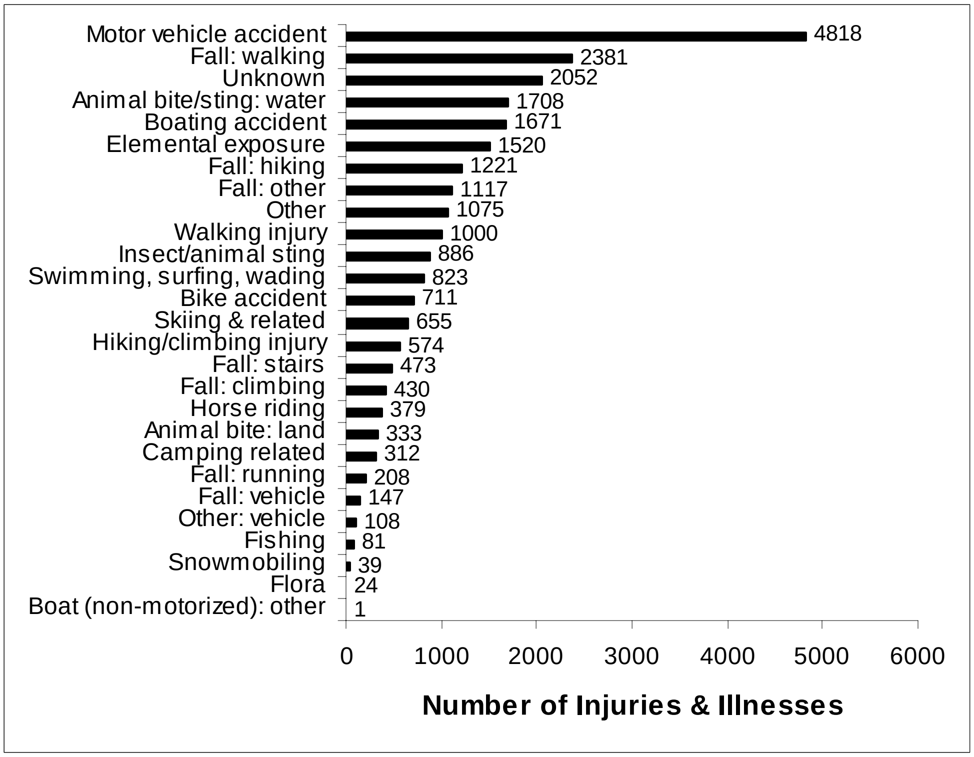


Figure 3.4: Primary Event in Visitor Injuries and illnesses, 1993-98 (N=24746)

Falls of various kinds result in 5977 injuries or about 24% of the total injuries and illnesses. Motor vehicle accidents result in 4818 injuries (19%) and all water and land-based stings and bites account for about 2766 (11%) injuries and illnesses. Figure 3.5 shows the breakdown of falls by different kinds of activities. Figure 3.6, shows that 23% of the motor vehicle injuries arise from accidents that do not involve collisions, 6% involve collisions with other vehicles, and 6% involve collisions with fixed objects.

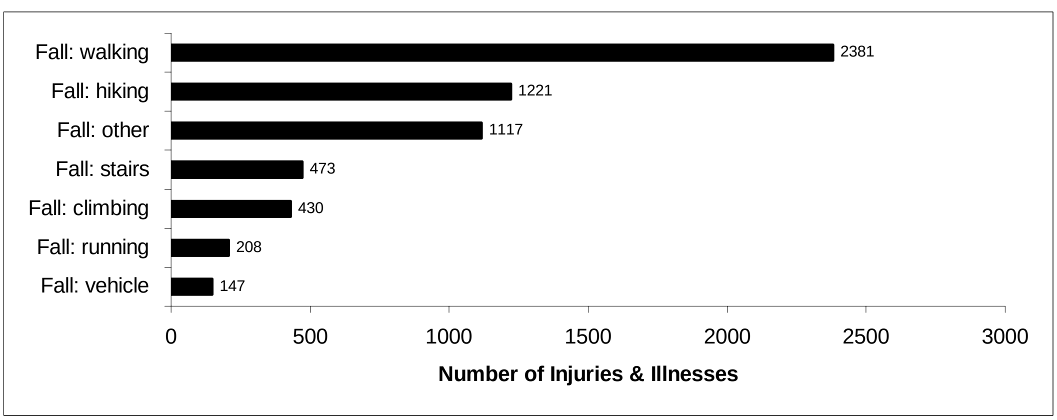


Figure 3.5: Visitor Injuries from Falls, 1993-98 (N=5977)

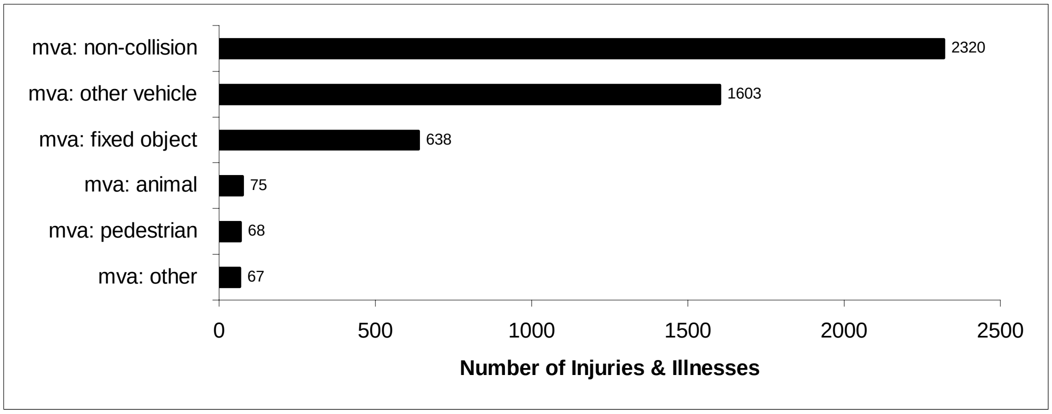


Figure 3.6: Visitor Injuries from Motor Vehicle Accidents, 1993-98 (N=4769)

Figure 3.7 shows the kinds of injuries and illnesses experienced, including cuts, abrasions, and bruises (28%); stings and bites (11%); and broken bones and fractures (9%). In 14% of cases the injury is unspecified.

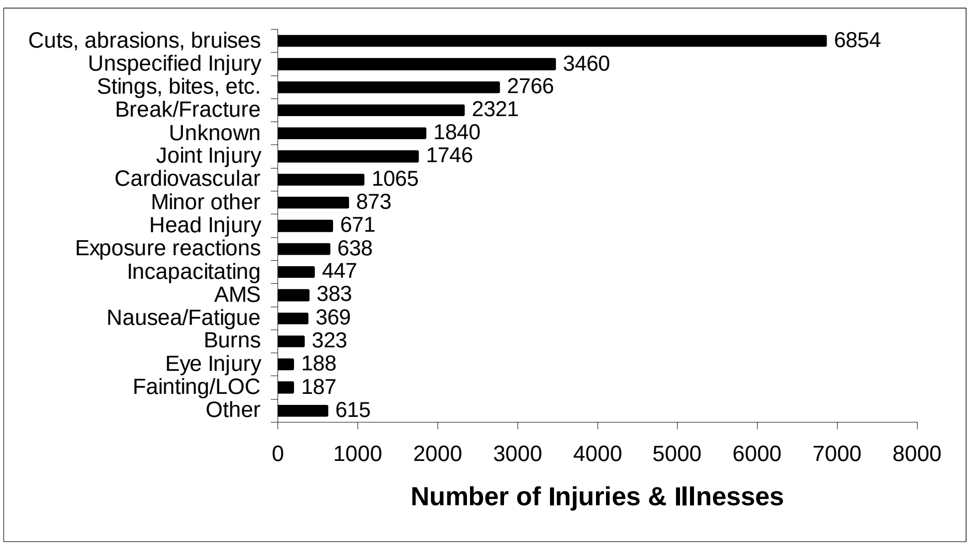


Figure 3.7: Types of Visitor Injuries and illnesses, 1993-98

Absent accurate medical diagnoses it is difficult to gauge the seriousness of individual visitor injuries and illnesses. Nevertheless, there are data on the kind of response taken at the scene. Of the 24746 injuries and illnesses occurring during this period, 10986 (44%) could be considered less serious because the visitors were treated and released, and 10143 could be considered more serious since the injured visitors required transportation to a medical facility. Thirty percent (7369/24746) were transported by ambulance, and 2774 (11%) were transported by privately owned vehicle. Nine hundred fifty-one (4%) refused treatment and in 1502 (6%) cases it is unknown what if any response was taken.

There is relatively little information about contributing factors; data are available for only 28% of injuries and illnesses that resulted from biking, boating, and motor vehicle accidents. For those 6907 injuries and illnesses on which we have information, 53% are driver related, 11% refer to road conditions, 2% involve equipment failures, and 1% involve environmental factors.

3.4 Findings from risk analysis

The National Park Service has an enormous amount of data on visitor accidents at each of its park units. We have been able to assemble and analyze only a small portion of these data for a relatively brief period (1993-1998) and for a relatively small number (30) of the total number of park units in the National Park System. Nevertheless, the database assembled includes a substantial amount of information on almost 20,000 visitor accidents and much important knowledge can be gained from analyses of the database. The knowledge can be useful for NPS and park unit management efforts to better understand visitor safety and to improve visitor safety management programs. This is the first study to date that has evaluated visitor accidents across multiple parks for multiple years using the data collected routinely by NPS units (other studies have been conducted for specific parks). As such, the study also provides important information to managers about the quality of the data being retained by parks and its usefulness for future analyses.

There are also limitations to the database. Much of the information that we would like to use in the evaluation of visitor accidents is missing from park records. For example, data about ethnicity are missing in more than 40% of the records and data on contributing factors are often collected for only a small subset of visitor activities, such as biking, boating, and motor vehicles. There can be many reasons for this, not the least of which is that the cumbersome nature of the visitor accident recording system means that the reports entered are frequently incomplete and, for example, often lack complete narrative accident descriptions.

Many NPS staff that we encountered expressed frustration with the current CIR system, and complained that it was cumbersome to use and did not allow for easy retrieval of information in ways that would be most useful to the users. Given the difficulties of using the CIR system, some parks have begun to develop their own accident databases (e.g., the CRIME System developed at Mount Rainier National Park). This also means that data are not entered fully or accurately. Improving the accuracy and reliability of information will require the establishment and maintenance of an accident reporting system that is both useful and user friendly.

In spite of these caveats, broad patterns begin to emerge from these data. In particular, the patterns and rates of accidents vary substantially from park to park (see Table 3.1). In large part this reflects the specific characteristics and uses of a park (e.g., urban vs. rural, recreation area vs. national monument). In most parks we find that a relatively small number of activities account for a large share of visitor accidents. For example, motor vehicle, hiking, and walking accidents account for a substantial fraction of the injuries and illnesses in many of the parks we studied. Table 3.1 presents summary data by park, but given the very different nature of individual parks and the kinds of activities pursued, we believe it would be misleading to try to rank parks on the basis of relatively simple measures of visitor risk.

In an effort to identify some of the most important patterns between and among the 30 parks, we conducted a hierarchical cluster analysis using the widely available statistical analysis program SPSS. We began the cluster analysis by looking at how parks cluster according to the types of activities associated with most injuries and illnesses. Next, we examined how the parks clustered according to the sex and age of the victims. Finally, we conducted a cluster analysis using all of the variables (i.e., activity type, sex, and age). In conducting these analyses we excluded all records in our database for which the values of the variable under consideration were "unknown" and "other."

The cluster analysis grouped the thirty park units into five major categories:[2]

1) Parks in which ***motor vehicle operation*** accounted for the largest number of injuries and illnesses to visitors (BLRI, NATR, DEWA, SAGU, CURE);
2) Parks in which ***frontcountry activities*** accounted for the largest number of injuries and illnesses to visitors (LOWE, STLI, CAVE, FOSU, GETT, MORU, LIBI);
3) Parks in which ***backcountry activities*** accounted for the largest number of injuries and illnesses to visitors (CANY, PORE, OLYM, ROMO, BIBE, GRTE, MORA, YOSE, BADL, DENA);
4) Parks in which ***water-related activities*** accounted for the largest number of injuries and illnesses to visitors (CAHA, OZAR, ASIS, PAIS, LAME); and,
5) Parks in which ***a mix of activities*** accounted for the largest number of injuries and illnesses to visitors (EVER, MEVE, CUVA).

For each of these groups, however, sub-groups associated with the variables of age and sex can be defined. These subgroups illustrate that visitor accident characteristics can be defined for sets of park units on the basis of visitor activities and visitor characteristics. An understanding of these groupings could be useful for improving park management visitor safety programs.

Parks in which ***motor vehicle operation*** accounted for the largest number of injuries and illnesses to visitors include BLRI, NATR, DEWA, SAGU, and CURE. These park units may be grouped into two sub-groups. First, the visitors suffering injuries and illnesses in BLRI and NATR are primarily of the ages 16-60 and proportionally more likely to be male (57% and 56%, respectively). Second, visitor accidents at the three other park units (DEWA, SAGU, and CURE) are more likely to involve middle-aged adults (31-60) with a secondary population of children (0-15 years old). Again, males are more likely to suffer the injuries and illnesses (57%, 59%, and 60% respectively). It would appear that families with children may be more likely to be victims in these three parks than in BLRI and NATR.

Parks in which ***frontcountry activities*** accounted for the largest number of injuries and illnesses to visitors include LOWE, STLI, CAVE, FOSU, GETT, MORU, and LIBI. The visitors suffering from injuries and illnesses at these parks are more likely to be children (ages 0-15). These park units may be grouped into two sub-groups based on other features of the visitors. First, after children (ages 0-15), middle-aged adults (31-60 years old) account for the highest proportion of visitor injuries and illnesses at STLI, CAVE, GETT, MORU, and LIBI. At each of these parks, the victim is more likely to be a female, as well (with respectively 64%, 66%, 67%, 60%, and 75% of the victims being female). LIBI is unique among these parks because no

[2]We use the 4-letter codes here for the sake of brevity and clarity. See Table 1.1 for a listing of the 30 parks and their 4-letter codes.

young adult (16-30 years old) suffered an injury or illness during their visit. Second, after children (ages 0-15), elderly adults (ages 61 and over) account for the highest proportion of visitor injuries and illnesses at LOWE and FOSU.

Parks in which ***backcountry activities*** accounted for the largest number of injuries and illnesses to visitors include CANY, PORE, OLYM, ROMO, BIBE, GRTE, MORA, YOSE, BADL, and DENA. These park units may be grouped into two sub-groups based on other features of the victims. First, at BIBE, GRTE, MORA, and YOSE, there are more middle-aged adult victims (31-60). Males were more likely to be among the victims at MORA (58%), but females were more likely to be victims at YOSE (54%). At GRTE and BIBE there was an even split among females and males (with 52% and 50% females, respectively). Second, at CANY, PORE, OLYM, BADL, DENA, and ROMO, a combination of middle-aged visitors (ages 31-60) and those from other younger age groups (0-15 or 16-30) suffer the most injuries and illness. Males were proportionally more represented as the victims of visitor accidents at CANY (55%), DENA (76%), BADL (53%), OLYM (56%) and PORE (53%). At ROMO there was an even split among females and males.

Parks in which ***water-related activities*** accounted for the largest number of injuries and illnesses to visitors include CAHA, OZAR, ASIS, PAIS, and LAME. These park units may be grouped into three sub-groups based on other features of the visitors. First, visitors suffering injuries and illnesses at ASIS and PAIS are most often children (ages 0-15) who were swimming or wading. Second, victims at CAHA and OZAR were more likely to be middle-aged adults (ages 31-60) who were boating or swimming. Third, many (63%) of the victims at LAME were males, who were aged 16-60 and engaged in activities using motorized boats.

Parks in which ***a mix of activities*** accounted for the largest number of injuries and illnesses to visitors include EVER, MEVE, and CUVA. At CUVA biking is the activity associated most often with visitor injuries and illnesses, with walking the second most significant activity. At EVER walking along paved areas and interpretive trails, as well as biking and water-related activities accounted for most visitor injuries and illnesses. And, at MEVE walking along paved areas and interpretive trails and indoors at the visitor center accounted for most accidents, but backcountry activities and motor vehicle operations were also important factors. This final category can be thought of as including "outliers" that are distinct from the other parks in our sample. According to the hierarchical cluster analysis they are most closely aligned with the parks in the group defined by backcountry activities, described above.

4.0 Inventory of risk conditions

An inventory of hazards and risk conditions in 30 National Park units was conducted as part of Task 4. The findings are discussed in detail in the report entitled *An Inventory of Hazards and Risk Conditions in the National Parks* and summarized here.

4.1 Overview

The inventory is based on the analysis of a sample of park records on visitor accidents and input from park and program managers. Lists of activities, hazards, and other contributory factors were developed from a review of the literature (see Section 2 above). The lists were modified with input from Park Service personnel, and based on the knowledge gained during an extensive examination of visitor accident data at the 30 parks (see Section 3 above).

4.2 Methodology

Each activity, hazard, and contributory factor was rated in terms of its contribution to the proportion of visitor injuries and illnesses arising out of accidents.[3] Ratings were conducted by members of the project team and by staff at the parks who were most knowledgeable about visitor safety.

Contacts at each of the 30 park units were asked to respond to a short questionnaire. The individuals contacted were those originally suggested by Dick Powell (Program Manager, Risk Management Division) and Gary Machlis (NPS Visiting Chief Social Scientist), and with whom the project had been working in regard to the risk analysis. They included safety officers, park rangers, and other park staff familiar with visitors and visitor accident characteristics. Of the 30 parks contacted, 22 responded to the survey.[4] We attempted to increase the response rate by contacting staff at each park unit at least three times via email. In spite of our efforts, eight parks did not respond to our questionnaire.

Three types of information were sought with the questionnaire:

1) *Sources of visitor injuries:* In the survey, park contacts were first asked to rank the sources of visitor injuries and illnesses as low, medium, and high, based on their experience and professional judgment. **Low hazard (L)** activities were defined as those that resulted in less than 5% of all injuries and illnesses. **Medium hazard (M)** activities were defined as those that resulted in 5% to 25% of all injuries and illnesses. Activities with **high hazard (H)** were defined as those that resulted in 25% or more of all injuries and illnesses. Respondents were also asked to rate their level of confidence in the estimates and judgments they made. With a high level of frequency respondents indicated that they had high levels of confidence in their ratings. No respondent indicated a low level of confidence in his or her ratings. Most of those indicating a medium level of confidence did so on just a few items. In some cases, respondents also indicated “don’t know.”

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3 As noted in Section 1, visitor accidents exclude those associated with criminal activities and park and concession employees.

4 Twenty-five individuals responded from 22 parks, including three respondents from Lake Mead NRA.

2) *Importance of contributory factors:* In a second question, respondents were asked to rate the importance of various contributory factors to visitor risk associated with various activities at the park. Respondents were asked to rate as low, medium, or high those factors that, in their view, were substantial contributors to visitor accidents. The questionnaire asked park respondents to rank the importance of 38 risk conditions. Risk conditions were divided into six categories, based on our review of relevant research literature and the visitor risk analysis. Thus, the six categories and 38 conditions share similarities with other taxonomies that have been developed (e.g., Canadian Park Service 1996). The risk conditions and six categories are shown in Table 4.1. Respondents were told that factors of **low importance (L)** were those factors that played, in their opinion, a *substantial* role in less than 5% of all visitor injuries and illnesses. Of **medium importance (M)** were those factors that played, in their opinion, a *substantial* role in 5% to 25% of all visitor injuries and illnesses. Factors with a **high level of importance (H)** were those that played, in their opinion, a *substantial* role in 25% or more of all visitor injuries and illnesses. Respondents were also asked to rate their level of confidence in the estimates and judgments they made. With a high level of frequency respondents indicated that they had high levels of confidence in their ratings. No respondent indicated a low level of confidence in his or her ratings. Most of those indicating a medium level of confidence did so on just a few items. Some respondents also indicated "don't know."

3) *Key activities causing most injuries:* In a third question, the park contacts were asked to identify what, in their judgment, were the *three* visitor activities associated with the largest proportion of visitor injuries and illnesses and to list the three most important factors that contributed to visitor accidents in each activity.

In all questions, the respondents were asked to base their responses on events in the park over the last five years. Although these years are different than those for which data were collected as part of Task 3 (1993-1998), we hoped to minimize problems associated with remembering early years and not mixing up opinions about more recent years.

The project team rated each of the activities, hazards and other contributory factors based on an examination of the visitor accident data collected under Task 3 of the project. They were ranked as low, medium, or high using the same definitions given in the questionnaire to the park respondents (see above). The visitor accident database developed by the project provides information on the frequencies of visitor accidents in relation to a set of factors, including:

- type of activity;
- individual characteristics (e.g., age, gender);
- contributory factors (e.g., primary initiating event, driver related factors, etc.); and
- characteristics of the accident (e.g., time of accident, type of injury).

Table 4.1: Risk conditions listed in the questionnaire and rated by park staff.

Infrastructure Hazards Boat launch and dock conditions Camping and picnic site conditions Conditions at concessions and services (e.g., food service, tour boat operations, grocery stores, bathrooms) Cultural resources (e.g., statue, historic house) Maintenance and operational hazards (e.g., snow removal vehicles) Paved area conditions (e.g., walkways, parking lots) Road conditions (e.g., bridges, potholes) Swimming facility conditions (e.g., pool, beach) Trail conditions (e.g., washed-out path, obstacles, loose footing)) Visitor center and other indoor facilities (e.g., poor lighting, steep stairs, wet floors) **Communication Hazards** Road signs (e.g., missing, misinterpreted, not seen, seen too late) Trail signs (e.g., missing, misinterpreted, not seen, seen too late) Brochures, maps, and other printed information (e.g., unavailable, misinterpreted, not found, received too late) **Technological Hazards** Motor vehicle malfunction Other vehicle malfunction (e.g., bike, boat, snowmobile) Lack of use or failure of appropriate safety related equipment (e.g., PFDs, seatbelts, safety ropes)	**Environmental Hazards** Faunal hazards (e.g., bears) Floral hazards (e.g., poison ivy, mushrooms) Insects, spiders, and scorpions Meteorological conditions (e.g., snow, fog) Hydrological conditions (e.g., strong surf, flooding) Other natural hazards (e.g., avalanche, fire) Topographical conditions (e.g., steep slope, drop-offs) Viral, bacterial, parasite hazards (e.g., giardia) **Visitor Characteristics** Age Behavioral (e.g., playing, running) Drug/alcohol Gender Non-compliant behaviors (e.g., off-trail hiking) Performance (human) error Stress related (e.g., time pressure, fear of heights) Level of visitor experience in activity Level of visitor preparedness for activity **Social Hazards** Peer pressure Recreational conflict among visitors (e.g., mountain bikers vs. hikers) Size of group (e.g., individual, small, large) Visitor crowding (e.g., # of people on trail) Type of group (e.g., family groups, tour groups)

The results from these rating exercises are presented in separate chapters for each park in the report entitled *An Inventory of Hazards and Risk Conditions in the National Parks*. Parks that did not respond to the questionnaire were rated by the project team according to the information available in the accident database only. Each park summary is organized in a similar fashion, although each is tailored to highlight any distinctive patterns and relationships for that park. Each summary describes the activities during which most visitor injuries and illnesses occur. The three activities contributing to the most visitor accidents in the database are identified. If we received a reply from the park respondent the three activities they ranked as most significant were compared with those from the database. Then, the rankings of the degree of hazard associated with the activities performed by visitors to the park are described. If the park respondent replied to the questionnaire, then the rankings from the two sources are compared. The final section of each park-specific chapter describes the risk conditions in each park. Ratings of their importance as contributors to visitor injuries and illnesses are based on the database, and where available from a park respondent. In the 22 parks for which we received a completed questionnaire, the risk conditions of the three most hazardous activities are also described.

4.3 Findings from inventory of risk conditions

The questionnaire asked park staff to identify the three activities associated with the largest proportion of visitor accidents during the last 5 years. Responses were compared with the three activities associated with the largest proportion of visitor accidents in our database. In 6 of the parks there was complete agreement on all three activities, in 8 parks there was agreement on two of the activities, and in 8 parks there was agreement on only one of the activities. Some differences between the two sources may be an artifact of the data. Ranked activities are separated by only a small number of injuries and illnesses in some cases. For example, at Cape Hatteras National Seashore motorized boating resulted in slightly more injuries than motor vehicle operation. The park respondent, however, identified motor vehicle operation as one of the three most important activities in terms of injuries and illnesses. This cannot really be called an “error” of judgment or estimation. Had we asked respondents to identify the top four activities the differences might have disappeared. Similarly, if the accidents comprising our sample of CIRs records had been slightly different the differences might also have disappeared. Similar discrepancies occurred in four additional parks (in three of which there was agreement on two activities and one for which there was agreement on one activity).

The questionnaire also asked park respondents to rank the importance of 38 risk conditions (see Table 4.1 above). Sixteen of the risk conditions were rated as having *low* importance by 75% or more of the 22 respondents (Table 4.2), while five conditions were ranked as having medium or high importance by more than 75% of the respondents (Table 4.3). Another way of looking at these data is shown in Table 4.4, which lists the risk conditions most often ranked high by the respondents. Clearly, many park staff believe that human error, failure to use safety equipment, lack of preparedness, and lack of experience are the most salient contributors visitor accidents.

Additional data gathered as part of the questionnaire reinforce the conclusion that visitor characteristics are perceived to contribute much more to visitor accidents than other risk conditions (i.e., infrastructural hazards, communication hazards, environmental hazards, social hazards, and technological hazards). Specifically, the third question in the questionnaire asked respondents to list the risk conditions that play the most significant role in visitor accidents in the three most hazardous visitor activities. For each activity we coded which category of factors contributing to visitor accidents was listed. Table 4.5 shows how often each category was mentioned. Visitor characteristics were identified more than twice as often as the next largest category, environmental hazards. Social hazards were the least likely to be mentioned by the respondents, but for some activities they played key roles as contributors to visitor accidents (e.g., OZAR, where peer pressure is perceived to lead to high risk activities). Technological hazards are usually related to lack of use or improper use of appropriate safety equipment. Interestingly, communication hazards were never perceived to be important factors contributing to visitor accidents in the most hazardous activities. However, it should be noted that some factors perceived as problems related to visitor judgments and behaviors could also be understood as failures in communicating relevant information successfully to visitors (e.g., “failure to use common sense and follow signs and directions,” “unfamiliarity with environmental and terrain factors,” “ignorance of regulations”).

Table 4.2: Risk conditions ranked as having low importance by 75% or more of the respondents

Factor contributing to visitor accidents	Respondents ranking factor as low (%)
Conditions at concessions and services (e.g., food service, tour boat operations, grocery stores, bathrooms)	100%
Floral hazards (e.g., poison ivy, mushrooms)	100%
Road signs (e.g., missing, misinterpreted, not seen, seen too late)	95%
Viral, bacterial, parasite hazards (e.g., giardia)	94%
Camping and picnic site conditions	94%
Cultural resources (e.g., statue, historic house)	93%
Other natural hazards (e.g., avalanche, fire)	89%
Faunal hazards (e.g., bears)	87%
Visitor center and other indoor facilities (e.g., poor lighting, steep stairs, wet floors)	86%
Trail signs (e.g., missing, misinterpreted, not seen, seen too late)	84%
Other vehicle malfunction (e.g., bike, boat, snowmobile)	83%
Size of group (e.g., individual, small, large)	81%
Boat launch and dock conditions	80%
Brochures, maps, and other printed information (e.g., unavailable, misinterpreted, not found, received too late)	80%
Recreational conflict among visitors (e.g., mountain bikers vs. hikers)	80%

Table 4.3: Risk conditions ranked as having medium or high importance by more than 50% of the respondents

Factor contributing to visitor accidents	Respondents ranking factor as medium or high (%)
Performance (human) error	100%
Behavioral (e.g., playing, running)	82%
Age	81%
Level of visitor preparedness for activity	79%
Level of visitor experience in activity	75%
Lack of use or failure of appropriate safety related equipment (e.g., PFDs, seatbelts, safety ropes)	67%
Trail conditions (e.g., washed-out path, obstacles, loose footing))	62%
Drug/alcohol	61%
Non-compliant behaviors (e.g., off-trail hiking)	58%
Meteorological conditions (e.g., snow, fog)	58%
Topographical conditions (e.g., steep slope, drop-offs)	53%

Table 4.4: Contributory factors most often ranked high by the respondents

Contributory factor	Respondents ranking factor as high (%)
Performance (human) error	59%
Lack of use or failure of appropriate safety related equipment (e.g., PFDs, seatbelts, safety ropes)	44%
Level of visitor preparedness for activity	42%
Level of visitor experience in activity	35%
Behavioral (e.g., playing, running)	27%
Age	24%
Drug/alcohol	22%
Hydrological conditions (e.g., strong surf, flooding)	19%
Swimming facility conditions (e.g., pool, beach)	17%
Non-compliant behaviors (e.g., off-trail hiking)	16%
Topographical conditions (e.g., steep slope, drop-offs)	16%

Finally, we conducted a cluster analysis and factor analysis on the risk conditions rated by the park respondents. However, no clusters or patterns were observed that help us group parks with similar patterns of contributory factors. Two reasons for this result might be:

- the small number of responses (22) relative to the number of factors evaluated (38); and,
- the extreme dominance of visitor characteristics over all other contributory factors.

Table 4.5: Number of times a category of factors was mentioned (N=119)

Factors contributing to visitor accidents	Number of times mentioned	Percent of total
Infrastructural hazards	9	8%
Communication hazards	0	0%
Environmental hazards	23	19%
Visitor characteristics	63	53%
Social hazards	7	6%
Technological hazards	17	14%

The questionnaire responses reveal that park personnel are acutely aware of many of the risks and risk conditions that pose the greatest problems in the parks. The Inventory of Risk Conditions provides useful insights into park employees' perceptions of hazards to visitors at twenty-two NPS units.

4.4 Comparison of risk and analysis and inventory of risk conditions

As part of our analysis we explored the similarities and differences among the ratings from the park respondents and the findings from the risk analysis (Task 3). As part of our analysis we compared the ways that park respondents rated the degree of hazard associated with various activities and the importance of risk conditions and the data obtained from each park as part of the risk analysis. We used multiple methods to make comparisons.

Although differences were frequently found between the park staff responses on the Inventory Questionnaire and our findings in the visitor risk analysis of visitor injuries and illnesses, the differences are often minor. For example, although rankings of the activities associated with the most injuries and illnesses may differ because the frequency of accidents occurring in two activities may differ by less than one or two percent in the database of CIRs records. In our visitor risk analysis we used the higher of the two, while a park respondent might have used the lower.

Differences between ratings from the visitor accident database and park respondent may arise for a variety of reasons. Indeed, these differences may reflect characteristics of our in the database. For example, the database comprises a *sample* of all activities and visitor accidents. As discussed in the visitor risk analysis report, data on contributory factors are very limited. In addition, the years covered by the database (i.e., 1993-1998) differ from those on which the respondent based judgments (i.e., during the last five years) and differences may arise in subjective evaluations. They may also differ because of recall bias by the respondent. They might have more personal experience with a particular activity, accident type, or visitor (e.g., children, young males).

With such caveats in mind, we found there to be general consistency between ratings of the most hazardous activities associated with visitor injuries and illnesses in the database and those provided by park staff. This finding suggests that the park personnel surveyed have a very good understanding of the most significant contributors to visitor accidents and in which activities they occur for their specific park unit. We conclude that for each type of ranking made, the results show a high degree of correspondence between the rankings made by the park respondents and those derived from the risk analysis (i.e., park-specific comparisons).

When cumulative rankings for all activities are considered there is less agreement. Differences in ratings of the hazard associated with each activity performed by visitors in a park occurred in 40% of the rankings in the 22 parks responding to the questionnaire. Similar divergences were found in the cumulative ratings of risk conditions in the parks. For this factor, differences in ratings occurred 47% of the time. Although ratings might have differed between the two sources, the findings suggest that the visitor risk analysis database provides a good representation of the breadth of activities during which visitors are injured and the factors that contribute to those accidents.

4.5 Summary

Relatively few factors contribute substantially to visitor injuries and illnesses. The factors most often rated as very important were visitor characteristics. Environmental hazards were most often related to weather conditions. Peer pressures, visitor crowding, and recreational conflict were the social hazards most often cited as important. Interestingly, communication hazards were perceived to be very minor overall. These findings suggest that hazard management programs may have limited effects because the NPS cannot eliminate, limit, or control most visitor characteristics or weather conditions. On the other hand, the NPS may be able to eliminate, limit, or control the effects of such factors with targeted hazard management programs.

Finally, the absence of ratings for many of the hazards and risk conditions in the database indicates the absence of information rather than a lack of significance. Many of the hazards and risk conditions may play an important role in visitor accidents, but we lack readily available information to assign ratings. Park records contain relatively little information about many of the risk conditions identified in the literature. Generally, there is more information about the risk conditions associated with accidents involving motor vehicles because of the nature of the forms that have to be filed. Requiring similar levels of detail to be filed on other accidents, however, could be extremely burdensome for park personnel.

In spite of these gaps and limitations much important knowledge can be gained from an inventory of hazards and risk conditions at units within the National Park System. The knowledge can be useful for the NPS and park unit management efforts to better understand visitor safety and to improve visitor safety management programs.

5.0 Survey of visitor perceptions

The objective of the visitor survey conducted as Task 5 of the project was to gather information on visitor perceptions of risk, visitor perceptions of safety messages and other safety related management activities, and visitor risk behavior. In this section we summarize the methods and aggregated findings of the survey. More detailed descriptions of the findings for each individual park can be found in the report entitled *A Survey of Visitor Safety in the National Park System.*

5.1 Overview

The survey was conducted in two parts. Surveys were distributed at seven of the parks between January 27 and March 25, 2001 (the "winter survey").[5] Additional surveys were distributed at all 30 parks (including the seven surveyed in winter) between May 23 and August 15, 2001 (the "summer survey"). The data were analyzed between September and November 2001.

5.2 Methodology

The research and other literature were reviewed to identify the scope, content, and methods of implementation of visitor surveys conducted in parks and other areas. In addition, the project team solicited input from the NPS Social Science Program and other program and park managers regarding the scope, content, and implementation of the survey.

The survey was designed to address a variety of visitor safety topics, including:

- background information about the individual respondent and the nature of his/her activities in the park;
- visitor perceptions of the risks associated with various activities (e.g., hiking) and conditions (e.g., facilities and infrastructure)
- safety information and advice;
- responses to perceived risks and risk information and preparedness for chosen activities;
- the level of support for or opposition to various risk management activities (e.g., increased signage regarding risks, restrictions on activities);
- expectations and responsibilities of individuals engaged in different activities (i.e., to themselves, other park users, and park personnel).

The goal of the project was to distribute approximately 400 questionnaires at each of the 30 NPS units in the summer 2001, and 250 questionnaires at 7 of the 30 park units during the winter (2000/2001). These numbers were chosen to ensure that the final sample of completed questionnaires would be large enough to allow rigorous analysis. To ensure that the survey captured the likely differences between weekday and weekend visitors to the park units, questionnaires were distributed for approximately three hours in the morning and three hours in the afternoon on each of 4 weekdays and 2 weekend days during the summer and 2 weekdays and 2 weekend days in the winter. The surveys were administered by four students, who were trained in the survey protocols by senior project personnel.

[5] The seven parks selected for the winter survey included: Everglades NP, Lake Mead NRA, Mt. Rainier NP, Rocky Mountain NP, Saguaro NP, Statue of Liberty NM, Yosemite NP.

The same basic approach was used for the distribution of questionnaires in the summer and the winter surveys. This survey method closely follows the approach used in recent VSP surveys (e.g., Visitor Services Project 1997). These surveys use a modified version of the traditional mail-back questionnaire to enhance response rates.

Interviewers conducted a “front-end” interview with those visitors that agreed to participate, using an *Individual Information Form*. This interview took less than 2 minutes per group and was designed to help increase response rates.

Information collected during the “front-end” interview was also used to check for non-response bias. Following the Visitor Service Project example, the project team compared respondents and non-respondents on the key variables of age and group size. In some parks there was a significant difference in the ages of the respondents and non-respondents. The data from these parks were weighted by age in subsequent analyses.

After completing the *Individual Information Form* the individual was given a mail-back, postage-paid questionnaire. A protocol was developed to send postcard reminders and replacement surveys to those who did not return the questionnaire after four weeks. To ensure confidentiality, separate files for questionnaire responses and respondents’ names and addresses were kept in secure locations. No names or identifying information appear on the questionnaires or in any of the project reports or publications. The address file will be destroyed on completion of the project and all project personnel were made aware of these protocols and the need for confidentiality at all times.

International participants presented a particular problem for the survey because of the high cost of follow-up and replacement mailings, and because in many parks the number of international visitors is quite small. Alternatively, some parks have significant numbers of international visitors. To try to address this problem, the project team developed a set of protocols for the conduct of international mailings. In those parks where the proportion of international participants exceeded 25% (as indicated by the *Individual Information Forms*), the project team would carefully monitor the U.S. response rate *after* the follow-up mailings with the international response rate *before* a follow-up mailing. If the international response rate was lower by 15 percent or more than the U.S. response rate for a given park, the team would send replacement questionnaires to all of that park’s international non-respondents to close the gap as much as possible. In the end, the only park that exceeded 25% international visitors was the Statue of Liberty during the winter survey. However, the response rates differed by less than 15%, so no international mailings were conducted.

5.3 Survey response rates

In the winter survey, the survey team made initial contact with 1,740 visitors in total, for an average of 249 visitors/park (Table 5.1). Ninety-six percent of initial contacts agreed to participate, and 1,662 surveys were distributed. Nine hundred ninety-two participants returned completed surveys for an overall response rate of 60.1%. Response rates ranged from a high of 68.1% at Everglades National Park to a low of 50.8% at the Statue of Liberty/Ellis Island. Eighty-six percent of the refusals (67/78) were at the Statue of Liberty. Many initial contacts refused to participate because they believed their language skills were insufficient to allow them to complete the survey adequately, and this probably reflects the relatively large number of foreign visitors to this park.

Table 5.1 Winter Survey Response Rates

Park	Survey Dates	Initial Contacts	Refusals	Acceptance Rate (%)	Participants	Completed Surveys	Response Rate (%)
EVER	1/27-1/30/01	251	0	100.0%	251	171	68.1%
LAME	3/17-3/20/01	255	0	100.0%	255	143	56.1%
MORA	2/10-2/13/01	140	0	100.0%	140	94	67.1%
ROMO	2/22-2/24/01	253	3	98.8%	250	142	56.8%
SAGU	3/17-3/20/01	261	4	98.5%	257	155	60.3%
STLI	1/20-1/23; 2/28/01*	315	67	78.7%	248	126	50.8%
YOSE	2/16-2/18/01	265	4	98.5%	261	161	61.7%
	TOTAL	1740	78		1662	992	
	AVERAGE	249	11	96.36%	237	142	60.13%

* snow storm closed park and interrupted survey distribution

In the summer survey, the survey team made initial contact with 10,726 visitors in total, for an average of 358 visitors/park (Table 5.2). Eighty-eight percent of initial contacts agreed to participate, and 9,275 surveys were distributed. Five thousand three hundred twenty-five participants returned completed surveys for an overall response rate of 57.44%. Response rates ranged from a high of 73.7% at Natchez Trace Parkway to a low of 32.2% at the Delaware Water Gap National Recreation Area. The number of refusals varied substantially from park to park, but average 48/park overall. Of the 1,454 refusals, 654 (45%) were for lack of time, 254 (17%) were because visitors believed their language skills were inadequate, and 556 (38%) were for other reasons, such as not wishing to give out personal information.

Table 5.2 Summer Survey Response Rates

Park	Survey Dates	Initial Contacts	Refusals	Acceptance Rate (%)	Participants	Completed Surveys	Response Rate (%)
ASIS	7/12-7/17/01	272	0	100.0	272	127	46.7
BADL	7/12-7/17/01	456	56	87.7	400	257	64.3
BIBE	6/7-6/12/01	116	15	87.8	101	68	67.3
BLRI	6/28-7/3/01	318	0	100.0	318	211	65.9
CAVE	6/14-6/19/01	405	12	97.0	393	221	56.2
CAHA	7/5-7/10/01	411	45	89.1	366	183	50.0
CANY	6/21-6/26/01	469	69	85.3	400	273	68.3
CURE	6/7-6/12/01	204	0	100.0	204	129	63.2
CUVA	7/12-7/17/01	432	32	92.6	400	289	72.3
DENA	7/13-7/18/01	327	85	74.0	242	149	61.6
DEWA	8/2-8/7/01	240	66	73.8	177	57	32.2
EVER	6/14-6/19/01	271	22	91.9	249	137	55.0
FOSU	6/7-6/12/01	433	35	91.9	398	184	46.2
GETT	6/28-7/3/01	430	30	93.0	400	261	65.3
GRTE	8/2-8/7/01	501	101	79.8	400	216	54.0
LAME	6/28-7/3/01	296	137	53.7	159	71	44.7
LIBI	7/26-7/31/01	529	129	75.6	400	259	64.8
LOWE	5/23-5/28/01	122	114	88.5	108	72	66.7
MEVE	6/14-6/19/01	537	137	74.5	400	290	72.5
MORA	8/2-8/7/01	432	32	92.6	400	232	58.0
MORU	7/5-7/10/01	481	81	83.2	400	205	51.3
NATR	5/31-6/5/01	141	0	100.0	141	104	73.7
OLYM	8/9-8/14/01	427	27	93.7	400	213	53.3
OZAR	8/2-8/7/01	204	5	97.5	199	67	33.7
PAIS	5/31-6/5/01	386	20	94.8	366	160	43.7
PORE	7/26-7/31/01	305	49	83.9	256	143	55.9
ROMO	5/31-6/5/01	464	64	95.4	400	278	70.3
SAGU	6/21-6/26/01	133	7	94.7	126	90	71.4
STLI	7/25-7/30/01	528	128	75.8	400	196	49.0
YOSE	7/12-7/17/01	456	56	87.8	400	183	45.8
	TOTAL	10726	1554		9275	5325	
	AVERAGE	358	52	87.85	309	178	57.44

Lower than expected response rates in both the winter and summer surveys may be related to the nature of the survey and its length. They may also reflect the fact that we were using student interviewers rather than uniformed park personnel to distribute the surveys. Since we were using standardized methods, the variation in response rates between parks may reflect differences in the nature of the parks, the dominant activities therein, and the types of visitors. Several of the parks with relatively low response rates were recreation areas or coastal parks, and it may be that visitors to these parks are less amenable to completing surveys. Another factor that may influence both the lower than expected response rates and the variation among parks is timing. Many participants took a long time to return surveys, and substantial numbers of surveys were continuing to arrive after the analysis was complete. This may explain the low response rates at the Delaware Water Gap and the Ozark National Scenic Riverways, since these parks were two of the last parks to be surveyed. Finally, there was a notable drop in the flow of completed surveys in the weeks following the September 11 terrorist attack in New York. The scare about anthrax in the mail may also have affected return rates.

The findings from the survey are summarized here in two ways. Section 5.4 summarizes the findings from all 30 parks in aggregated form. Section 5.5 highlights some of the interesting comparisons and contrasts between and among the 30 parks. Detailed descriptions of the findings for individual parks are presented in the report entitled *A Survey of Visitor Safety in the National Park System.*

5.4 Aggregate findings from visitor survey

The summary of the aggregated data is described in three parts. The first part begins with a description of the sample, a description of the demographic composition of the respondents (including age, sex, education, and race), and a description of the visitation characteristics of respondents (including the frequency of visitation, whether or not the park was a primary destination, the expected duration of the visit, and the nature of the visiting group). The second part of the summary describes the activities that visitors engaged in during their visit, and their level of experience in and preparedness for their primary activity. This part also examines the level of concerns expressed about various hazards ranging from poisonous plants to motor vehicle accidents. Since driving is one of the biggest hazards in most of the park units, the third section examines safety issues of motor vehicles in more detail. The final part of the summary of the aggregated data presents data on visitor opinions about park management in general with regard to safety, including the locus of responsibility for safety and the appropriate levels of management intervention.

5.4.1 The sample

The summer survey included 30 parks. Overall, 10,726 visitor groups were contacted between May 23 and August 14, 2001, and 9,275 (87.9%) of these groups accepted questionnaires. Questionnaires were completed and returned by 5,325 visitor groups, resulting in a 57.4% response rate. We use the term “their park” below to indicate that the data refer to particular visitors at particular parks. The data summarized below were weighted to adjust for the slight difference in ages between the respondent and non-respondent groups. Because 118 respondents did not report their ages, their responses could not be appropriately weighted and are excluded from the analysis. This means that the sample size (N) is 5,207 or less.

5.4.2 Demographics

Figure 5.1 shows the distribution of respondents by age. (Since participation was solicited from only those visitors 16 and over, there are no respondents below the age of 16 years.). Fifty-three percent of respondents were female and 47% male. The overwhelming majority (93%)of respondents were white, with 2% Hispanic, 1% African-American, 1% Asian, and 2% of unknown race/ethnicity. Graduate school was the highest level of education attained by 24% of respondents, while an additional 34% classified themselves as college graduates. The majority (95%) of respondents were residents of the US, 4% were international visitors, and 1% were of unknown nationality.

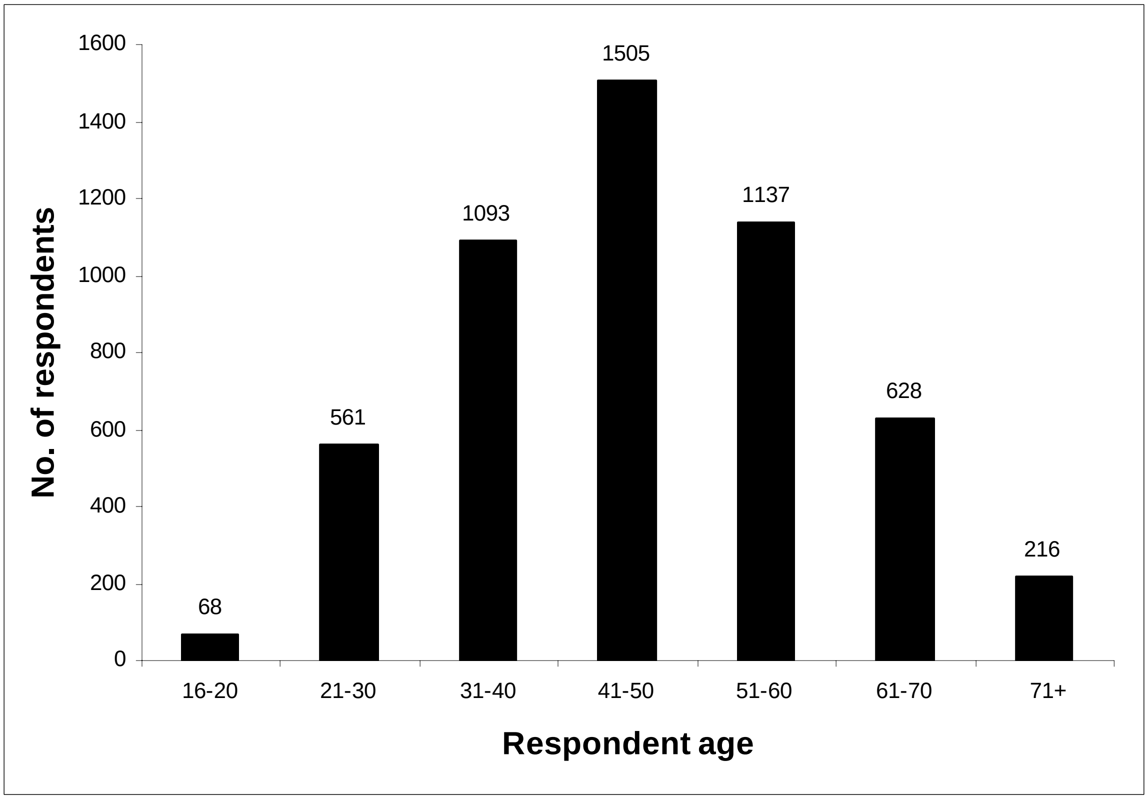

Figure 5.1: Distribution of respondents by age (N=5207)

5.4.3 Visitation

For 54% of respondents, this was their first visit to their park. Among those 2,560 respondents who indicated they were returning to their park, 33% had visited their park twice in the past 10 years (including the current visit), 22% 3-5 times, 13% 6-10 times, and 20% 11 or more times. This visit was the primary destination for 30% of respondents, but one of only several destinations for 61% of respondents. For 9% of respondents this visit was not a planned destination at all. Forty-eight percent of the respondents visited their park for a half day or less, 28% visited for up to one day, and 24% visited for more than one day. Five percent of respondents were visiting their park by themselves, 70% with family members, 12% with friends, and 10% with family members and friends.

5.4.4 Activities

Respondents were asked to identify every activity they pursued during their visit to their park from a list of 35 named activities (Figure 5.2). Figure 5.2 illustrates that many respondents visited the visitor center (76%) and viewed indoor exhibits (76%), but these are often only adjunct activities and not the primary purpose of many visitors. The questionnaire also asked respondents to identify the activity that engaged them for most of the time during their visit. Figure 5.3 illustrates that walking to outdoor attractions (33%), day hiking (16%), viewing indoor exhibits (10%), and various other activities (8%) were the most popular primary activities. Most respondents (85%) engaged in these activities with members of their own personal group (i.e., friends and family members), although 7% engaged in these activities alone, 6% with people aside from their own personal group, and 2% as members of organized groups.

Since level of experience has been identified as a significant determinant of personal safety, the questionnaire asked respondents to rate their own level of experience with regard to their primary activity in their park. On a scale of 1 (extremely experienced) to 7 (not at all experienced) most people considered themselves to be relatively experienced in their chosen activity and very few considered themselves to have little or no experience (Figure 5.4). Ratings of personal experience varied little between activities and between males and females.

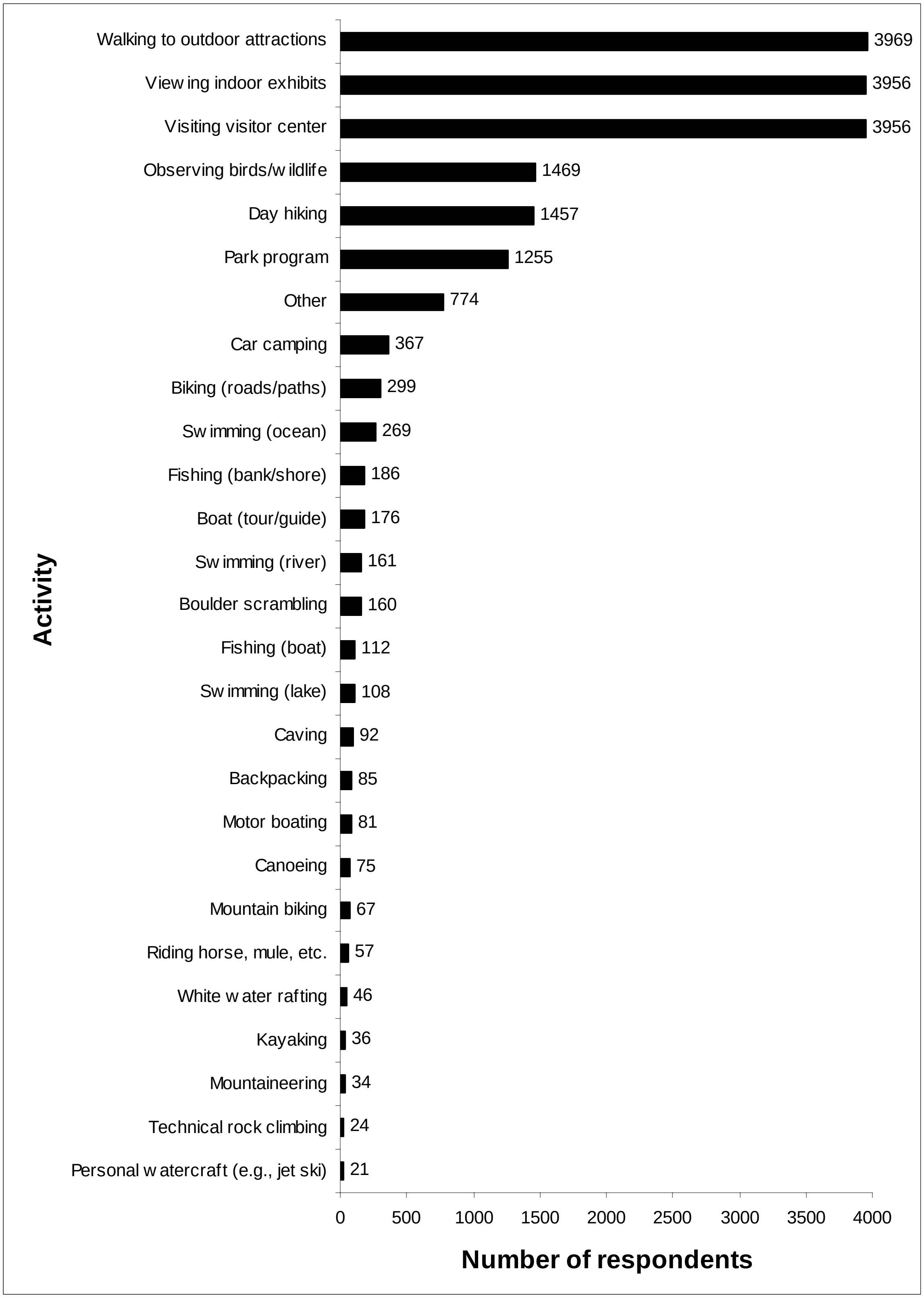

Figure 5.2: Visitor activities (N=5207)

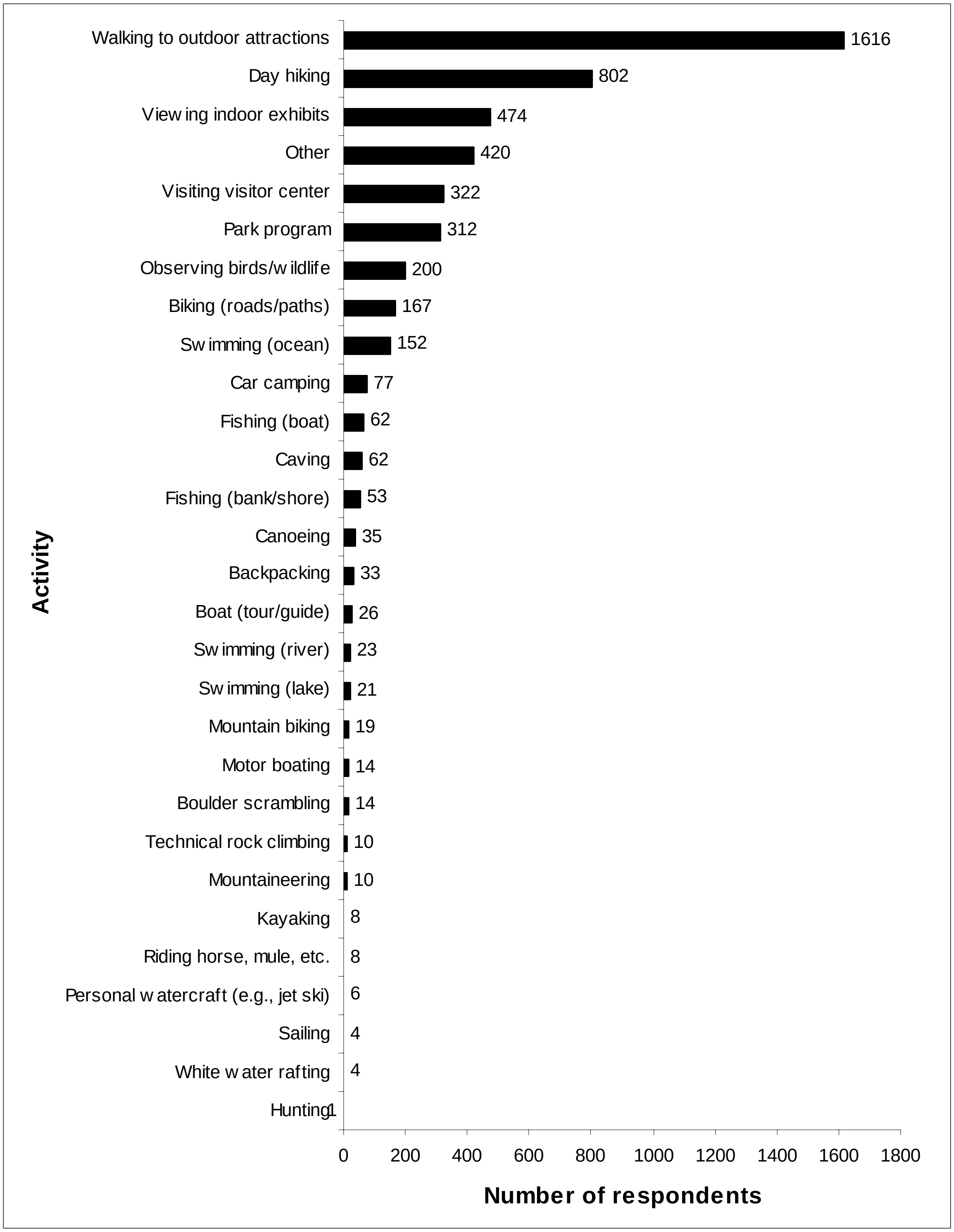

Figure 5.3: Primary visitor activities (N=4955)

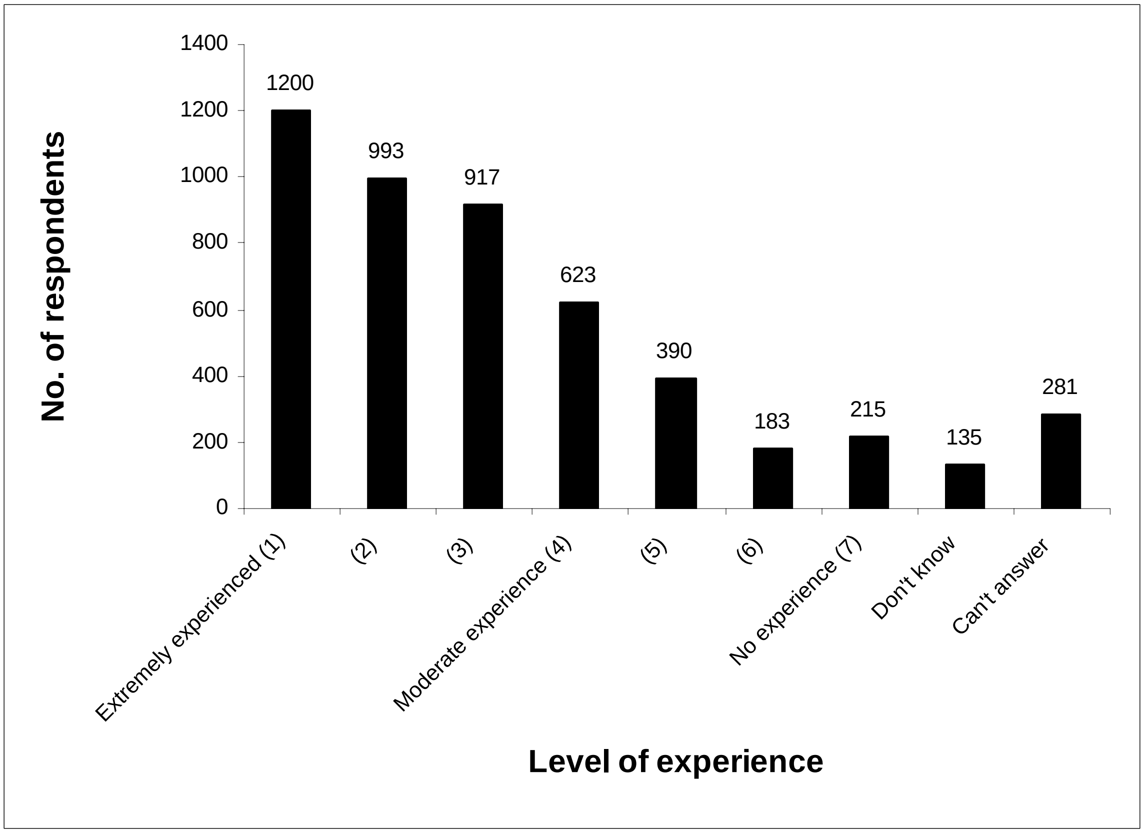

Figure 5.4: Personal level of experience (N=4937)

Preparedness is one aspect of experience, and Figure 5.5 shows how prepared respondents were based on the safety items that they had available during their visit.

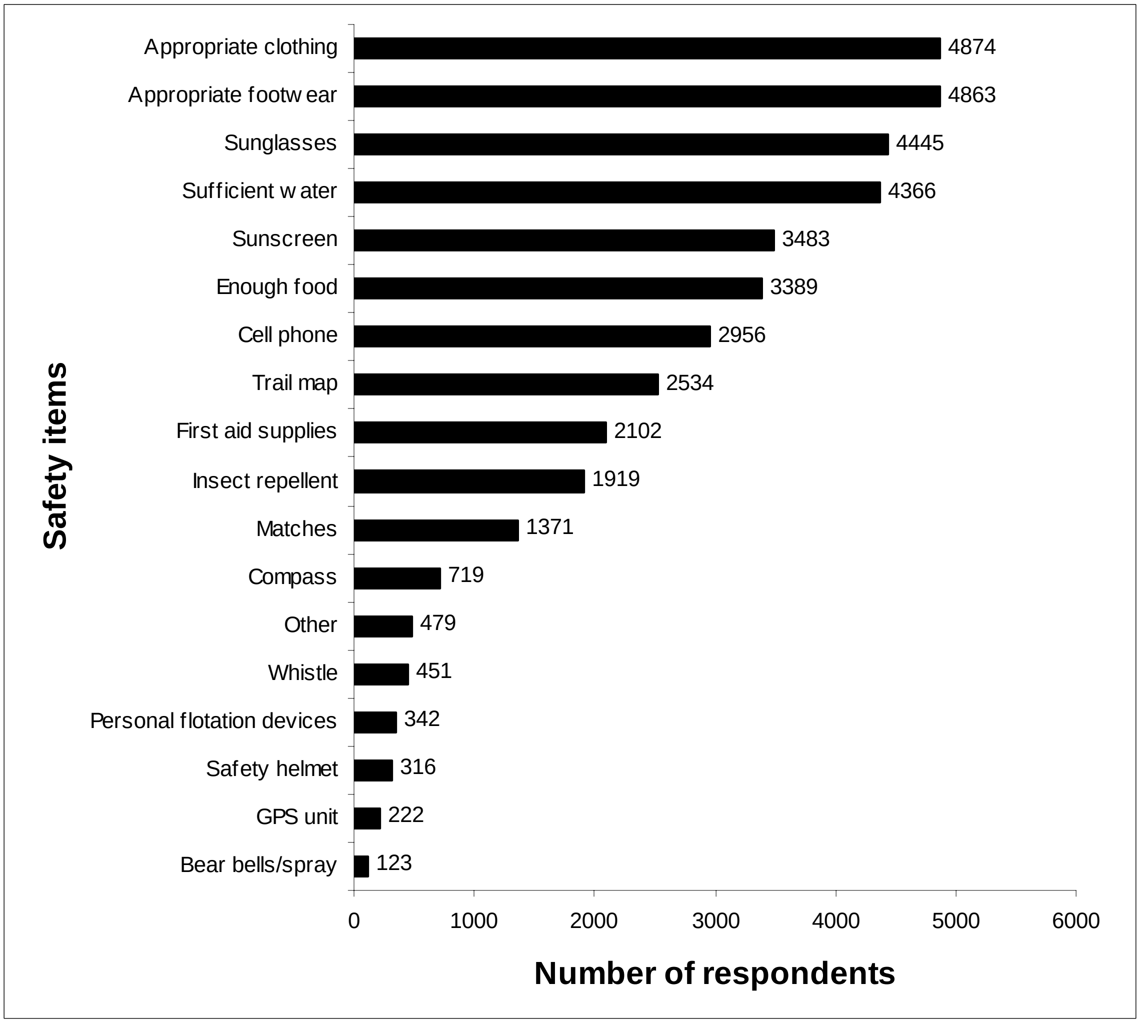

Figure 5.5: Personal safety items (N=5207)

Thirteen percent of respondents expressed concern about suffering an injury or illness while engaged in their primary activity. Without reference to a particular activity, however, Figure 5.6 shows how concerned respondents were about various hazards that might be encountered in their park. Between 5 and 8% of respondents expressed substantial concern, and between 36 and 38% of respondents were somewhat concerned about elemental exposure, motor vehicle accidents, falling, and insects. Evidently, most people had little or no concern about any of these hazards or believed they were not exposed.

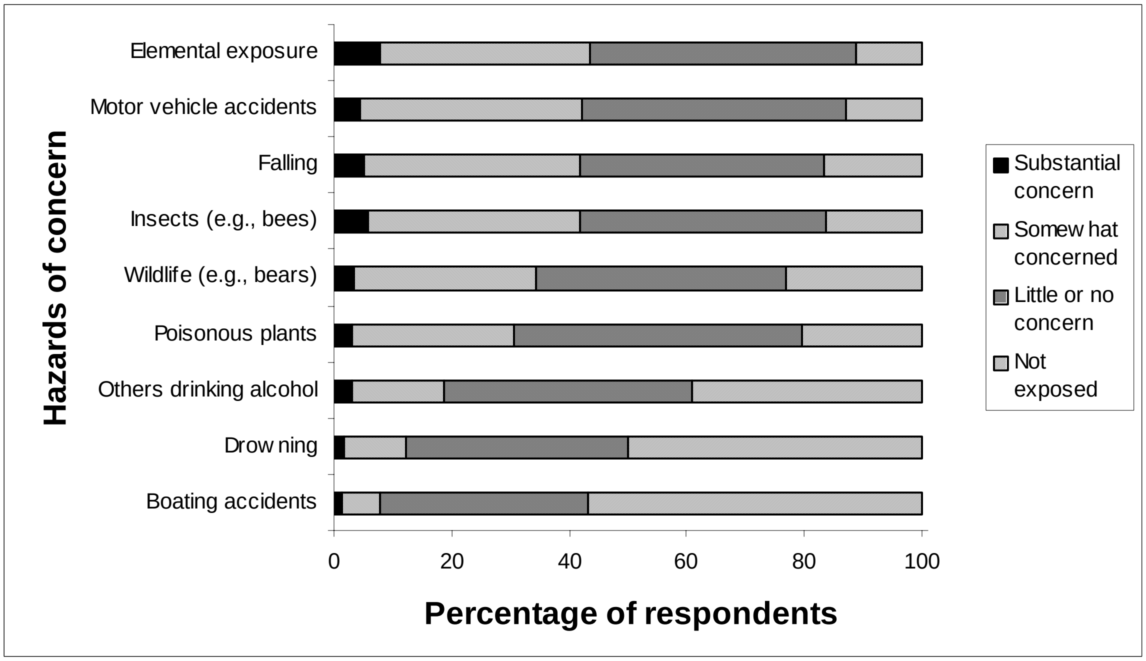

Figure 5.6: Level of concern about various hazards (N=5069-5089)

5.4.5 Motor vehicles

Looking at motor vehicles in more detail, we find that 89% of respondents were traveling in privately owned or rented vehicles. Eighty-four percent of respondents spent all of the time in the front seat, and 8% spent some of the time in the front seat. Of these individuals, 55% were driving for all or most of the time and 95% were wearing seatbelts most or all of the time. The majority (96%) of respondents thought that the speed limits in their park were appropriate all or most of the time. Forty-seven percent of respondents never encountered cars that were driving too fast, and 46% encountered speeding cars during some, most, or all of their visit. At some time during their visit, 44% of respondents encountered cars that were driving too slowly. Most (92%) respondents thought that the roads (pavement, plowing, etc.) were in good condition most or all of the time, and 92% thought that hazard-warning signs were adequate most or all of the time. Figure 5.7 indicates how often respondents believed certain conditions made driving on roads more hazardous. Between 3 and 7% of respondents believed that large recreational vehicles, bicycle riders, cars stopping to see the views or wildlife, and pedestrians presented driving hazards all or most of the time, and 29-38% of respondents thought these presented a hazard some of the time. Between 53 and 64% of respondents believed that these were hazards none of the time.

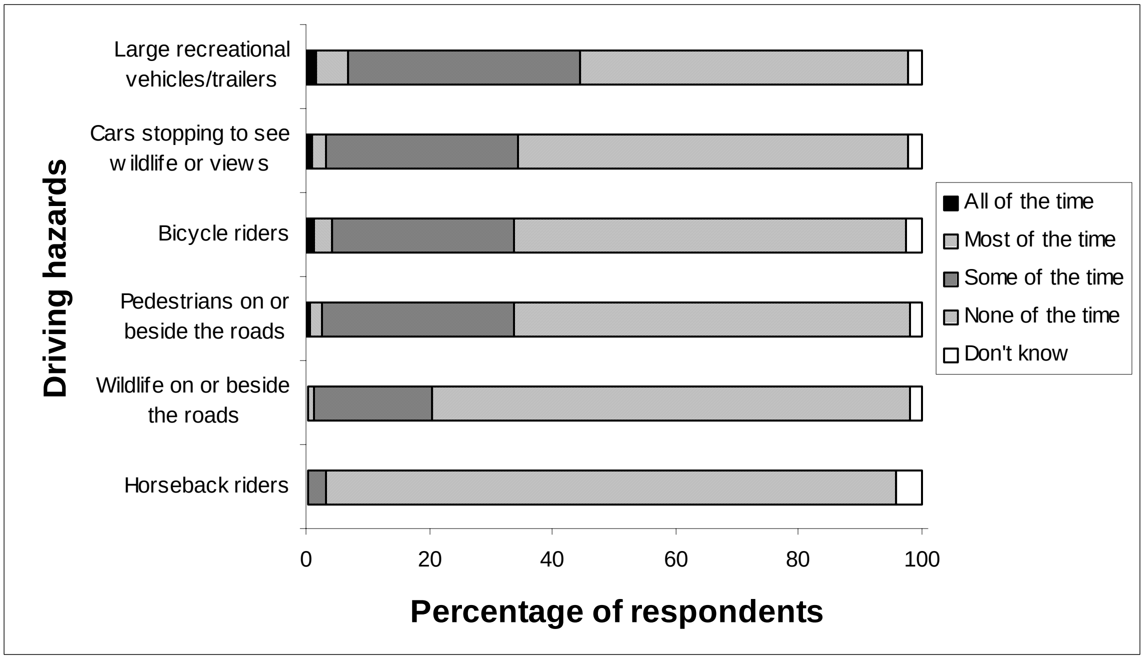

Figure 5.7: How often conditions contribute to perceptions that traveling on roads is hazardous

5.4.6 Management issues

With regard to the primary activity undertaken during their visit, 34% of respondents believed that safety was entirely the responsibility of the visitor, while 43% believed safety was the responsibility of both the visitor and the park staff (Figure 5.8).

The questionnaire also asked if any of their park's safety measures (such as warning signs, fences, regulations) detracted from the visitor's enjoyment of their chosen activity. Figure 5.9 shows that the overwhelming majority (72%) of respondents thought such measures definitely did not detract from their enjoyment of an activity.

Respondents were also asked about park management more generally, rather than with specific reference to a particular chosen activity. Forty-eight percent of respondents agree or agree strongly that most of the risks visitors face are beyond the control of the National Park Service, 9% disagree or disagree strongly, and 38% neither agree nor disagree. Twenty-four percent of respondents agree or agree strongly that it is the responsibility of the National Park Service to prevent visitors from undertaking activities that may pose a serious risk to them, 37% disagree or disagree strongly, and 36% neither agree nor disagree. Thirty-six percent of respondents disagree or disagree strongly that the National Park Service should not limit or prohibit activities that may pose a serious risk to participants, 27% agree or agree strongly, and 34% neither agree nor disagree.

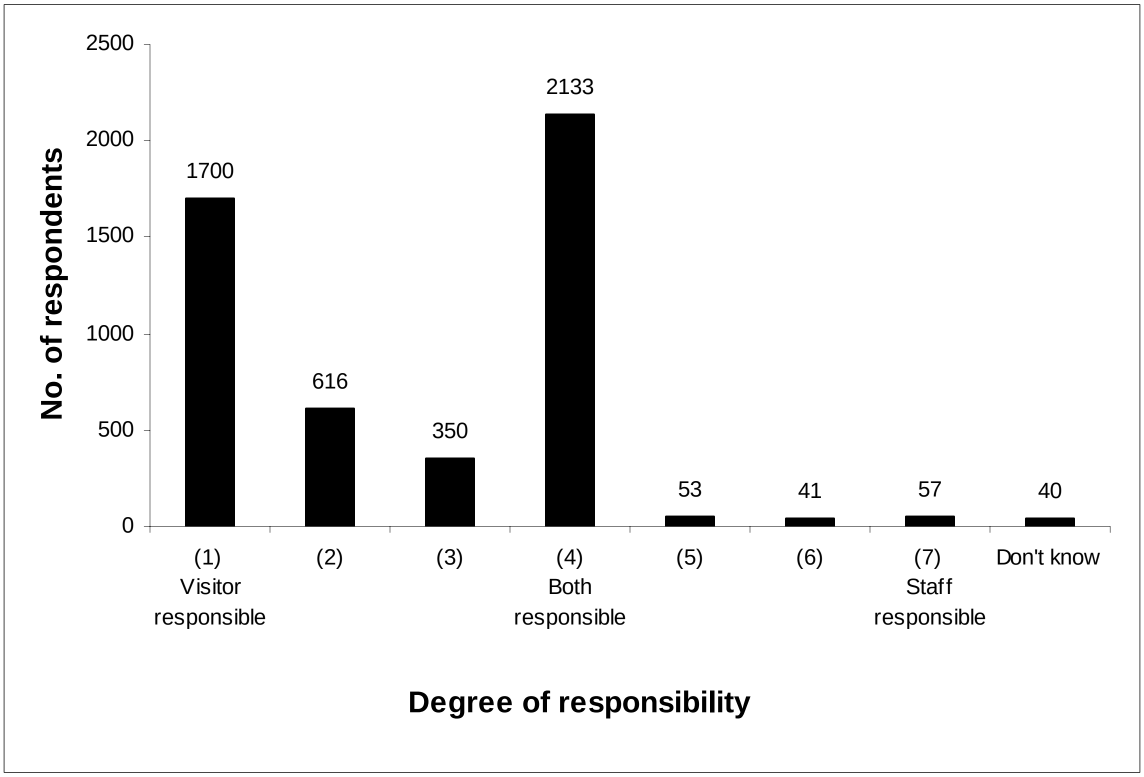

Figure 5.8: Responsibility for safety in chosen primary activity (N=4990)

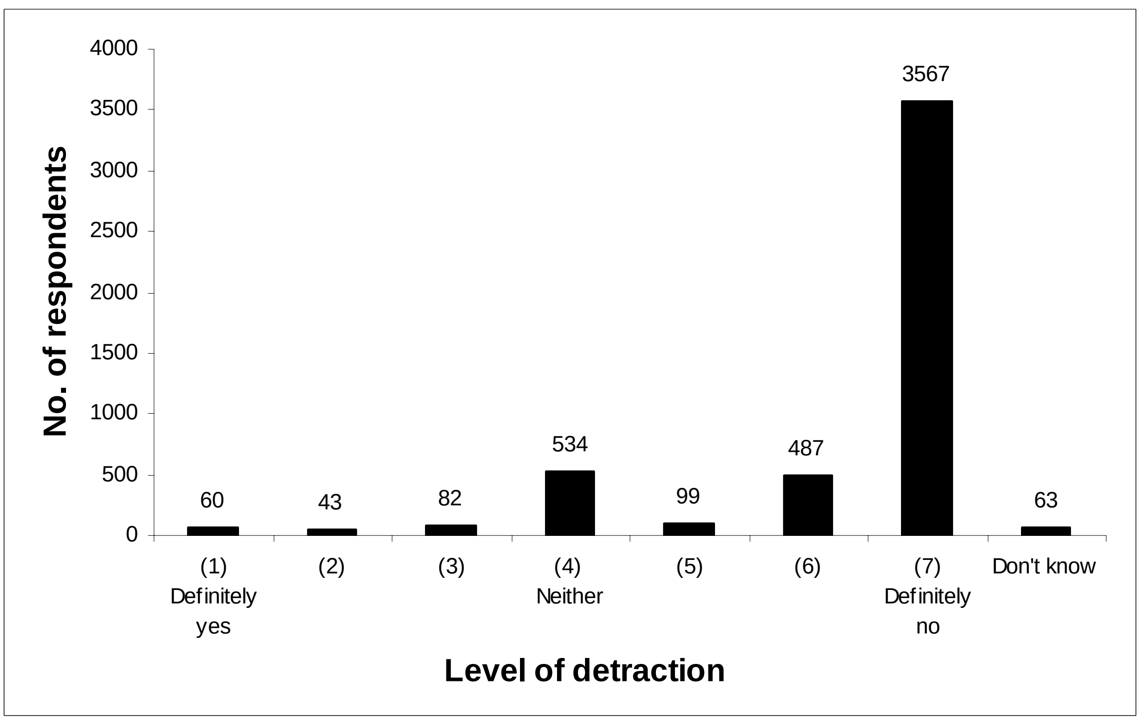

Figure 5.9: Do safety measures detract from visitor enjoyment? (N=4934)

The majority of respondents believe their park should have the present amount of:

- rules and regulations about what visitors should and should not do (84%);
- signs warning and advising about hazards (84%);
- brochures and other information warning about hazards (80%);
- restrictions on the number of persons/groups who undertake particular activities (71%);
- park rangers to enforce rules and regulations (70%);
- enforcement of alcoholic beverage restrictions (63%); and,
- safe surfaces on walkways and stairs (81%).

Substantial proportions of respondents, however, believe that there should be more or many more rangers to enforce rules and regulations (19%) and more or much more enforcement of alcoholic beverage prohibitions (14%). A substantial proportion of respondents were more ambivalent about a couple of items. For example, 19% did not know if there should be greater or fewer restrictions on the number of persons/groups who undertake particular activities while 21% did not know if there should be greater or lesser enforcement of alcoholic beverage restrictions.

Among those respondents who were aware of the various sources of information safety in their park, Figure 5.10 indicates the level of helpfulness provided by each source of information. Evidently, respondents find that uniformed park personnel (58%) and directional (67%) and warning (58%) signs are very helpful sources of safety information.

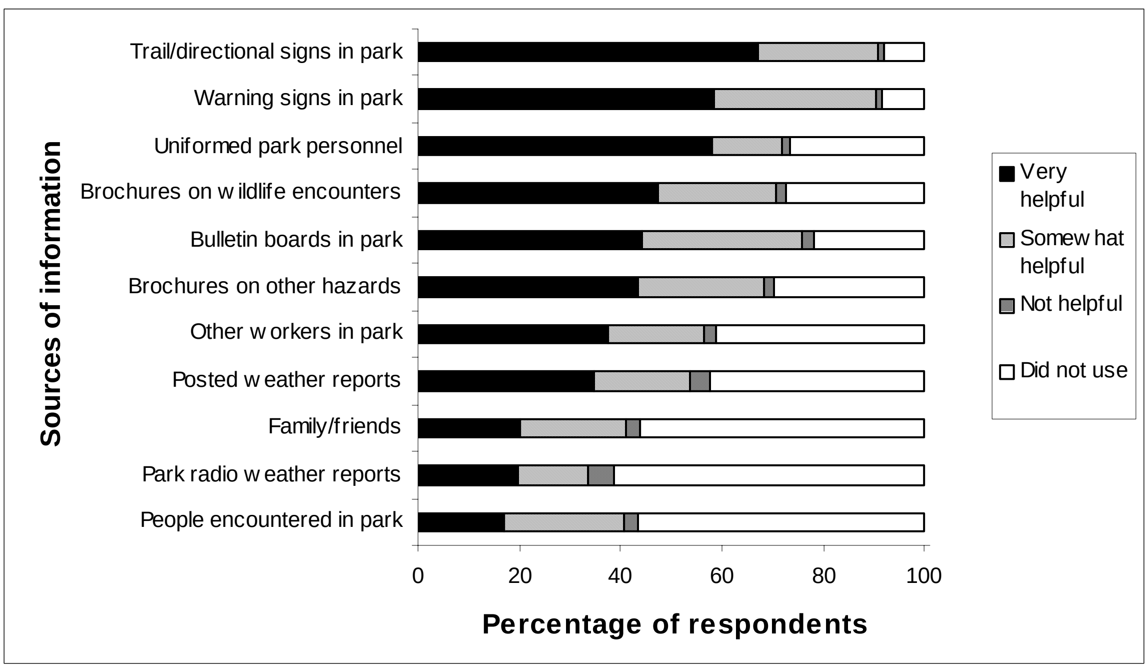

Figure 5.10: How helpful are various sources of safety information (N=2853-4501)

5.5 Comparative analysis of the parks

This section highlights some of the interesting similarities and differences among the 30 parks, in terms of visitor activities, levels of experience, visitor preparedness, visitor concerns, hazards of concern, motor vehicle use, locus of responsibility for park safety, management issues, sources of safety information, and differences between the summer and winter surveys. It should be emphasized again that parks differ substantially in terms of the nature of activities, conditions, and types of visitors, so that the comparisons must be carefully drawn.

5.5.1 Activities

Comparing the 30 parks in our sample, we can find many similarities and many differences. The three activities that dominate at most parks include visiting the visitor center, viewing indoor exhibits, and walking to outdoor attractions. These activities, however, are often only adjunct activities and not the primary purpose for many visits. The mix of activities that visitors pursue for most of the time during their visits varies substantially from park to park.

In the analysis of accident data (Section 3 above) the project team used a cluster analysis to group parks with similar accident characteristics. The analysis identified five groups of parks according to the clusters of activities that dominate in terms of visitor accidents: frontcountry activities, backcountry activities, motoring activities, water-related activities, and mixed activities. These five clusters can also be used to organize the survey responses regarding the most popular activities at each park. Accordingly, we found (Table 5.3) that:

- Walking to outdoor attractions and day hiking dominate in “backcountry parks.” These activities are either the most or second most popular activities at all of the backcountry parks, except Denali. The third most popular activities include observing wildlife, visiting the visitor center, and various other unspecified activities.
- Within the mixed activity cluster, biking is rated as the most popular activity at Cuyahoga Valley, with visiting the visitor center and walking to outdoor attractions as the second and third most popular activities.
- The most popular activities at the “frontcountry parks” are viewing indoor exhibits and walking to outdoor attractions. Attending a park program is the second or third most popular activity at 6 of the 9 parks
- As expected, swimming, boating, and fishing dominate at the five water-related parks. Swimming in lakes, rivers, or the ocean is one of the three most popular activities at all five water-related parks. Other popular activities include visiting the visitor center, viewing indoor exhibits, and walking to outdoor attractions.
- The motor vehicle cluster matches the survey response data the least well of any of the clusters, and this is because the survey did not include driving or riding in a motor vehicle as one of the 35 listed activities. Thus, we see a mix of visiting the visitor center, viewing indoor exhibits, walking to outdoor attractions, and day hiking among the five parks in this cluster.

Table 5.3: Popularity of activities by park cluster

Park	Most Popular Activity	Second Most Popular Activity	Third Most Popular Activity	Activity Clusters
ROMO	Walk to o/d attractions	Day hiking	Observing wildlife	Backcountry
BADL	Walk to o/d attractions	Day hiking	Visiting visitor center	Backcountry
CANY	Walk to o/d attractions	Day hiking	Other	Backcountry
YOSE	Walk to o/d attractions	Day hiking	Other	Backcountry
PORE	Walk to o/d attractions	Day hiking	Other	Backcountry
GRTE	Day hiking	Walk to o/d attractions	Observing wildlife	Backcountry
BIBE	Day hiking	Walk to o/d attractions	Other	Backcountry
MORA	Day hiking	Walk to o/d attractions	Visiting visitor center	Backcountry
OLYM	Day hiking	Walk to o/d attractions	Car camping	Backcountry
DENA	Other	Park programs	Observing wildlife	Backcountry
STLI	Viewing indoor exhibits	Walk to o/d attractions	Visiting visitor center	Frontcountry
LOWE	Viewing indoor exhibits	Walk to o/d attractions	Park programs	Frontcountry
MORU	Walk to o/d attractions	Viewing indoor exhibits	Visiting visitor center	Frontcountry
FOSU	Walk to o/d attractions	Viewing indoor exhibits	Park programs	Frontcountry
LIBI	Walk to o/d attractions	Park programs	Viewing indoor exhibits	Frontcountry
GETT	Walk to o/d attractions	Park programs	Other	Frontcountry
CAVE	Caving	Viewing indoor exhibits	Park programs	Frontcountry
CUVA	Biking (roads/paths)	Visiting visitor center	Walk to o/d attractions	Mixed
MEVE	Walk to o/d attractions	Park programs	Day hiking	Mixed
EVER	Walk to o/d attractions	Observing wildlife	Day hiking	Mixed
NATR	Walk to o/d attractions	Visiting visitor center	Viewing indoor exhibits	Motor vehicle
SAGU	Walk to o/d attractions	Visiting visitor center	Other	Motor vehicle
BLRI	Day hiking	Walk to o/d attractions	Viewing indoor exhibits	Motor vehicle
DEWA	Day hiking	Walk to o/d attractions	Visiting visitor center	Motor vehicle
CURE	Fishing (boat)	Fishing (bank/shore)	Motor boating	Motor vehicle
LAME	Visiting visitor center	Swimming (lake)	Walk to o/d attractions	Water
CAHA	Walk to o/d attractions	Swimming (ocean)	Viewing indoor exhibits	Water
ASIS	Swimming (ocean)	Walk to o/d attractions	Visiting visitor center	Water
PAIS	Swimming (ocean)	Other	Walk to o/d attractions	Water
OZAR	Canoeing	Other	Swimming (river)	Water

5.5.2 Level of experience

Since level of experience has been identified as a significant determinant of personal safety, the questionnaire asked respondents to rate their own level of experience with regard to their primary activity in the park. Most people considered themselves to be relatively experienced in their chosen activity and very few considered themselves to have little or no experience. In some parks, and the "frontcountry parks" in particular (e.g., Gettysburg, Mesa Verde, and Carlsbad Caverns), more respondents tended to indicate that they had less experience, and "didn't know" or "couldn't answer." This may be related to the fact that it is more difficult to rate one's experience in typical frontcountry activities such as viewing indoor exhibits, walking to outdoor attractions, and participating in park programs. While it may seem irrelevant to ask respondents about their level of experience in activities such as "walking to outdoor attractions" we believe this is valid information. For example, one of the most common causes of accidents in the parks is tripping and falling, which is often a result of uneven surfaces and inappropriate footwear. Experienced visitors would know to wear appropriate footwear for the kind of terrain they expect to encounter. Similarly, heat exhaustion is a common problem at many parks, and one would expect that the more experienced visitors would realize this and wear appropriate clothing and bring adequate supplies of water. We know from the research literature, however, that people tend to be overconfident in their own abilities and may well exaggerate their reported level of experience.

5.5.3 Visitor preparedness

As discussed above, there are many ways that visitors can be prepared for the common kinds of problems or hazards that may be encountered in the parks. The survey included a list of 18 items (see Table 5.4) that may be important for the safety of visitors and asked respondents to indicate every item that they had available during their visit. The 30 parks fall into two groups with respect to these data. In one group, respondents consistently checked off sufficient water, trail map, matches, GPS unit, compass, and other safety items. Bear bells/spray was an item that was often but not always checked off in this group. In the other group, respondents checked off all or most of the items on the list. In the first group, sufficient water, trail maps, and matches were checked off by the largest numbers of people, with relatively few identifying GPS units, compasses, and bear bells/sprays. In the second group, the items checked of by the largest numbers of people include sufficient water, appropriate clothing, and appropriate footwear, with smaller numbers of people checking off the other items.

This bifurcation in the sample of parks is curious, and does not seem to relate to any obvious characteristics of the parks. The pattern seems to be unrelated to the clusters identified above, the most popular activities at the park, or the nature of the park (such as urban vs. rural).

Table 5.4: Safety items by park

Park name	Sufficient water	Appropriate clothing	Appropriate footwear	Enough food	Trail map	Matches	Insect repellent	Cell phone	GPS unit	Compass	Sunglasses	Sunscreen	Safety helmet	First aid supplies	Personal flotation devices	Bear bells/spray	Whistle	Other
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
ASIS	x				x	x			x	x								x
BADL	x				x	x			x	x						x		x
BIBE	x				x	x			x	x						x		x
BLRI	x				x	x			x	x						x		x
CAVE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
CAHA	x				x	x			x	x								x
CANY	x				x	x			x	x						x		x
CURE	x				x	x			x	x						x		x
CUVA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
DENA	x				x	x			x	x						x		x
DEWA	x				x	x			x	x						x		x
EVER	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
FOSU	x				x	x			x	x						x		x
GETT	x				x	x			x	x								x
GRTE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
LAME	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x
LIBI	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
LOWE	x	x	x	x	x	x	x	x			x	x	x	x	x			x
MEVE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MORA	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
MORU	x				x	x			x							x		x
NATR	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
OLYM	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
OZAR	x				x	x				x								x
PAIS	x		x			x			x	x						x		x
PORE	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ROMO	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
SAGU	x				x	x			x	x						x		x
STLI	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
YOSE	x				x	x			x	x						x		x

5.5.4 Visitor concerns

The proportion of respondents expressing some concern that they or a member of their personal group might suffer an injury or become ill as are result of their activity ranges from 1% at Lowell to 48% at Big Bend, with an average of 13%. Broadly, it appears that levels of concern are lower in frontcountry parks and higher in backcountry parks. This is as might be expected given the nature of activities pursued in these parks. Given the large number of accidents associated with motor vehicles, one might expect to see higher levels of concern at parks such as the Natchez Trace and Blue Ridge Parkways. The research literature, however, demonstrates that members of the public consistently underestimate the toll taken by motor vehicle accidents and are consistently overconfident about their driving abilities.

5.5.5 Hazards of concern

The survey asked respondents to indicate how concerned they were about nine listed hazards regarding the safety of themselves and those in their group. The rankings of the hazards of concern vary substantially from park to park (Table 5.5). In addition, apparent anomalies were found in these data. For example, significant numbers of respondents at the Statue of Liberty were concerned about boating accidents, even though boating is not allowed in the park. Of course, the boating accidents of concern here refer to the possibility of accidents on the ferries to the islands. However, we also found that the patterns of concerns expressed by respondents seem broadly consistent with the kinds of accidents encountered in the parks. At the same time, concern about some hazards, such as wildlife attacks, may be exaggerated in comparison with the actual number of deaths or injuries associated with them. The research literature on perception of risks, however, tells us that the public often overestimates the likelihood of rare, dramatic kinds of risk events that are often given considerable media coverage.

We also compared the primary concerns with safety items carried by visitors. While we find that insects were are primary concern at Cape Hatteras and Assateague Island none of our respondents indicated that they had insect repellants with them. Exposure to the elements was a primary concern at Gettysburg, Canyonlands, and Big Bend, but none of our respondents indicated that they had sunscreen with them or that they were wearing appropriate clothing. Falling was a primary concern at Yosemite, Badlands and Fort Sumter but no respondents indicated that they were wearing appropriate footwear for their visit. Although boating was a primary concern at the Ozark Scenic Riverway, no one indicated that they had personal flotation devices.

Table 5.5: Hazard concerns by park

Hazards	Primary Concern	Secondary Concern	Tertiary Concern
Motor vehicle accidents	LOWE ROMO OLYM NATR BLRI MORU	YOSE MORA GRTE DENA CAHA LIBI GETT LAME	BADL MEVE CURE ASIS
Boating accidents	OZAR	CUVA CURE	STLI
Falling	YOSE MORA BADL MEVE CAVE FOSU	LOWE ROMO PORE STLI CANY BIBE	OLYM BLRI MORU CUVA GRTE DEWA
Drowning	CUVA	OZAR	PAIS
Others drinking alcohol	CURE		OZAR
Wildlife (e.g., bears)	GRTE DENA PAIS	ASIS	YOSE EVER LIBI
Insects (e.g., bees)	CAHA ASIS EVER	OLYM NATR DEWA	MORA CAVE DENA SAGU GETT LAME CANY BIBE
Poisonous plants	PORE DEWA SAGU	BLRI	NATR FOSU
Elemental exposure	LIBI GETT LAME STLI CANY BIBE	MORU BADL MEVE CAVE FOSU PAIS EVER SAGU	LOWE ROMO CAHA PORE

5.5.6 Motor vehicles

Motor vehicles present a significant hazard in many of the parks, but the numbers of motor vehicles and the extent to which visitors drive within the park boundaries varies from park to park. Our sample of 30 parks included two parkways (the Blue Ridge Parkway and the Natchez Trace Parkway) where driving dominates, and two other parks where driving is not permitted (i.e., Statue of Liberty/Ellis Island and Fort Sumter). Aside from the latter two parks, over 90% of respondents at all the other parks were traveling in privately owned or rented vehicles. Respondents who were sitting in the front seat of their vehicle as passengers or drivers, were asked a battery of questions about visitor driving habits and concerns. These questions were asked only of those in the front seat of a vehicle because those in the rear seats would likely be less likely and less able to evaluate driving conditions. In general, it appears that visitors are very satisfied with the speed limits, road conditions, and hazard warnings in these 30 parks.

An average of 94% of respondents said they were wearing their seatbelts most or all of the time while driving in the park. Reported seatbelt usage varied from 81% in Denali to 100% in the Delaware Water Gap. Seatbelt laws vary from state to state, but these numbers are far above the rates of compliance cited in the literature – of course it is likely that self-reported usage rates exceed actual rates. An average of 96% of respondents, with a range of 91% at Big Bend to 99% at Little Bighorn, indicated that speed limits in the parks were appropriate most or all of the time. The proportions of respondents who thought the roads in the parks were in good condition (i.e., pavement condition, etc.) most or all of the time ranged from 69% at Badlands to 99% at Natchez Trace, with an average of 92% over all 30 parks. The proportions of respondents who thought that the hazard warning signs were adequate all or most of the time ranged from 76% at Lowell to 98% at Denali, with an average of 92% overall.

5.5.7 Locus of responsibility for park safety

Assignation of responsibility for safety in the respondent’s primary activity varied substantially from park to park (Table 5.6). At the Statue of Liberty 10% of respondents believed that the visitor is primarily responsible for safety, while 71% believed that both the visitor and park staff are responsible. By contrast, 58% of respondents at Curecanti believed that the visitor is primarily responsible for safety, while 25% believed that both the visitor and the park staff are responsible. We found that the proportion of respondents believing that visitors are primarily responsible for safety is approximately inversely related to the proportion of respondents who believe that both visitors and park staff are responsible. Generally, as the proportion of respondents who believe the visitor is primarily responsible increases, the proportion of respondents who believe both visitors and staff are responsible decreases. Very few respondents at any of the parks felt that the park staff was entirely responsible for ensuring visitors’ safety.

It would also appear that more respondents place responsibility for safety on visitors in backcountry parks, whereas more respondents at frontcountry parks place responsibility on both park staff and visitors. This may result from the perception that the risks in frontcountry parks are more “controllable,” since visitor activities tend to be less physically rigorous and the venues tend to be more “benign,” with many paved walkways, regular stairs, and buildings. Alternatively, it may reflect a real difference in the types of people who visit frontcountry parks, their perceptions, and their expectations.

Table 5.6: Responsibility for safety by park

Park	Percent of respondents who believe that the visitor is responsible for safety	Percent of respondents who believe that the visitor and park staff are responsible for safety	Activity Clusters
STLI	10	71	Frontcountry
LOWE	13	78	Frontcountry
CAVE	15	68	Frontcountry
FOSU	22	57	Frontcountry
MORU	22	61	Frontcountry
DENA	23	54	Backcountry
EVER	24	49	Mixed
BLRI	27	45	Motor vehicle
MEVE	27	54	Mixed
GETT	29	51	Frontcountry
PORE	30	41	Backcountry
SAGU	31	49	Motor vehicle
CUVA	34	37	Mixed
LIBI	34	48	Frontcountry
CAHA	35	45	Water
OLYM	37	34	Backcountry
ASIS	38	37	Water
MORA	38	36	Backcountry
LAME	40	45	Water
CANY	43	31	Backcountry
DEWA	43	30	Motor vehicle
GRTE	43	27	Backcountry
ROMO	44	30	Backcountry
BADL	45	29	Backcountry
NATR	45	47	Motor vehicle
OZAR	45	40	Water
YOSE	45	29	Backcountry
PAIS	49	34	Water
BIBE	50	22	Backcountry
CURE	58	25	Motor vehicle

5.5.8 Safety measures as detractors

The survey reveals that most people believe that safety measures such as warning signs, fences, and regulations do not detract from their enjoyment of the parks. In contrast with the responses regarding the locus of responsibility, there is a remarkable level of consistency across the parks with regard to this item. The proportion of people who said such measures definitely did *not* detract from their enjoyment ranged from 64% at the Delaware Water Gap to 80% at Lowell, with an overall average of 72%.

5.5.9 Management issues

The questionnaire included three general questions regarding the management of risk by the National Park Service, irrespective of the primary activity in which the respondent was engaged. Respondents were asked to indicate how much they agreed with the following statements:

- *Most of the risk visitors face in the National Parks are beyond the control of the National Park Service*
- *It is the responsibility of the National Park Service to prevent visitors from undertaking activities that may pose a serious risk to themselves, no matter how popular the activity may be.*
- *Besides providing appropriate safety information and warnings, the National Park Service should not limit or prohibit activities that may pose serious risks to the participants.*

A large proportion of respondents, although rarely a majority, agree or agree strongly that most of the risk visitors face in the National Parks are beyond the control of the National Park Service. The proportion of respondents that agree ranges from 31% at the Statue of Liberty to 72% at Big Bend, with an average of 48% overall (Table 5.7). Generally, it would appear that the proportions of respondents agreeing with this statement are lower in the frontcountry parks, where risks may indeed be more controllable because of the nature of the park and the activities therein. The proportions of respondents agreeing with this statement are higher in the backcountry parks, where the risks may be less easily controlled by the Park Service.

We also gathered data about the proportion of respondents who agreed and disagreed that it is the responsibility of the National Park Service to prevent visitors from undertaking activities that may pose a serious risk to themselves. The proportion of respondents that agree with this statement ranges from 13% at Big Bend to 40% at the Statue of Liberty, with an average of 25% overall (Table 5.8). Conversely the percent of respondents who disagree with this statement ranges from 16% at the Statue of Liberty to 60% at Big Bend, with an average of 37% overall. Generally, it would appear that there is more support for restricting risky activities among respondents at the frontcountry parks than there is among respondents at the backcountry parks, although in no park is there the support of the majority for such actions. This may also reflect risk-seeking attitudes or a desire for no management intervention in those engaging in backcountry activities.

Table 5.7 Risks are beyond the control of the National Park Service

Park	Percent of respondents who agree or agree strongly that risks are beyond control of NPS	Percent of respondents who disagree or disagree strongly that risks are beyond control of NPS	Activity Clusters
STLI	31	16	Frontcountry
LOWE	38	15	Frontcountry
GETT	41	9	Frontcountry
LAME	41	5	Water
PAIS	41	10	Water
EVER	43	7	Mixed
OZAR	43	12	Water
PORE	43	11	Backcountry
BLRI	44	9	Motor vehicle
CAVE	44	10	Frontcountry
CUVA	44	9	Mixed
FOSU	45	9	Frontcountry
LIBI	45	15	Frontcountry
MEVE	46	8	Mixed
MORU	47	8	Frontcountry
SAGU	47	7	Motor vehicle
ASIS	49	10	Water
CAHA	49	6	Water
NATR	49	8	Motor vehicle
CURE	50	10	Motor vehicle
DENA	50	8	Backcountry
ROMO	50	7	Backcountry
BADL	53	7	Backcountry
OLYM	53	10	Backcountry
DEWA	54	7	Motor vehicle
MORA	54	9	Backcountry
CANY	55	9	Backcountry
GRTE	57	7	Backcountry
YOSE	59	9	Backcountry
BIBE	72	6	Backcountry

Table 5.8 The NPS should prevent risky activities

Park	Percent of respondents who agree or agree strongly that NPS should prevent visitors from activities that pose serious risk	Percent of respondents who disagree or disagree strongly that NPS should prevent visitors from activities that pose serious risk	Activity Clusters
BIBE	13	60	Backcountry
GRTE	17	47	Backcountry
YOSE	17	46	Backcountry
DEWA	18	48	Motor vehicle
PORE	18	39	Backcountry
BADL	20	40	Backcountry
CUVA	20	35	Mixed
MEVE	20	35	Mixed
MORA	20	44	Backcountry
SAGU	20	36	Motor vehicle
ROMO	22	43	Backcountry
CANY	23	44	Backcountry
CURE	23	37	Motor vehicle
OLYM	23	38	Backcountry
DENA	24	40	Backcountry
LOWE	24	31	Frontcountry
OZAR	24	38	Water
EVER	25	32	Mixed
LAME	25	33	Water
BLRI	26	36	Motor vehicle
GETT	27	31	Frontcountry
PAIS	27	32	Water
CAHA	28	33	Water
LIBI	28	32	Frontcountry
MORU	29	30	Frontcountry
CAVE	31	30	Frontcountry
ASIS	34	26	Water
FOSU	35	29	Frontcountry
NATR	36	36	Motor vehicle
STLI	40	16	Frontcountry

Finally, we identified the proportion of respondents who agree or agree strongly that besides providing appropriate safety information and warnings, the National Park Service should not limit or prohibit activities that may pose serious risks to the participants. The proportion of respondents that agree with this statement ranges from 16% at Lowell to 43% at the Delaware Water Gap, with an average of 27%. Conversely, the percent of respondents who disagree with this statement ranges from 18% at Big Bend to 54% at Fort Sumter, with an average of 36% overall. Generally, it would appear that there is greater support for restrictions on risky activities at frontcountry parks, although seldom a majority, and substantial opposition to restrictions at backcountry parks. This may also reflect risk-seeking attitudes or a desire for no management intervention in those engaging in backcountry activities.

The survey also asked if respondents thought the parks should have more, less, or the present amount of each of the following:

- rules and regulations about what visitors should and should not do;
- signs warning and advising about hazards;
- brochures and other information warning about hazards;
- restrictions on the number of persons/groups who undertake particular activities;
- park rangers to enforce rules and regulations; and
- enforcement of alcoholic beverage restrictions.

Overall, we found that there is strong support across all parks for the present level of management effort in these six areas. However, there is strong support for increased efforts on each of these items in some parks. Across the board, there is substantial public support for more rangers, more brochures warning about hazards, and greater enforcement of alcoholic beverage restrictions. There is less support for increases in the restrictions placed on the number of persons/groups who undertake particular activities, and it is on this item that we see the greatest degree of equivocation as evident in the larger proportion of respondents expressing “don’t know” as a response.

5.5.10 Sources of safety information

The sources of safety information that most people consistently rated as the most helpful include trail/directional signs, warning signs, and uniformed park personnel (Table 5.9). These three sources of information were rated together as the top three in 21 of the 30 (i.e., 70%) of the parks. Trail/directional signs were rated as “very helpful” by most people in 22/30 parks, and appeared as one of the top three sources in 27/30 parks. Uniformed park personnel were rated as “very helpful” by most people at 5/30 parks, and as the second most helpful source at 13/30 additional parks. Uniformed park personnel were among the top three sources at 25/30 parks. Warning signs were rated as the top source of safety information at Padre Island, as the second most cited source at 11 other parks, and the third most cited source at 16 remaining parks.

There were also some notable exceptions to these patterns. Brochures on wildlife encounters were cited as “very helpful” by most people at Assateague Island and Denali; they were the second most popular source of safety information atYosemite and the Grand Tetons, and the third most popular source at Rocky Mountain and the Delaware Water Gap. Other workers in the parks were rated as the second most popular source of safety information at Lowell and Curecanti.

Table 5.9 Respondent ratings of sources of safety information:

Park	Most Popular Source	Second Most Popular Source	Third Most Popular Source	Activity Clusters
ASIS	Brochures on wildlife risks	Bulletin boards in park	Warning signs in park	Water
DENA	Brochures on wildlife risks	Uniformed park personnel	Warning signs in park	Backcountry
DEWA	Trail/directional signs	Uniformed park personnel	Brochures on wildlife risks	Motor vehicle
ROMO	Trail/directional signs	Warning signs in park	Brochures on wildlife risks	Backcountry
CUVA	Trail/directional signs	Warning signs in park	Bulletin boards in park	Mixed
BADL	Trail/directional signs	Warning signs in park	Uniformed park personnel	Backcountry
BLRI	Trail/directional signs	Warning signs in park	Uniformed park personnel	Motor vehicle
CAHA	Trail/directional signs	Warning signs in park	Uniformed park personnel	Water
CANY	Trail/directional signs	Warning signs in park	Uniformed park personnel	Backcountry
LIBI	Trail/directional signs	Warning signs in park	Uniformed park personnel	Frontcountry
MORU	Trail/directional signs	Warning signs in park	Uniformed park personnel	Frontcountry
NATR	Trail/directional signs	Warning signs in park	Uniformed park personnel	Motor vehicle
BIBE	Trail/directional signs	Uniformed park personnel	Warning signs in park	Backcountry
CAVE	Trail/directional signs	Uniformed park personnel	Warning signs in park	Frontcountry
EVER	Trail/directional signs	Uniformed park personnel	Warning signs in park	Mixed
GETT	Trail/directional signs	Uniformed park personnel	Warning signs in park	Frontcountry
GRTE	Trail/directional signs	Brochures on wildlife risks	Warning signs in park	Backcountry
MEVE	Trail/directional signs	Uniformed park personnel	Warning signs in park	Mixed
MORA	Trail/directional signs	Uniformed park personnel	Warning signs in park	Backcountry
OLYM	Trail/directional signs	Uniformed park personnel	Warning signs in park	Backcountry
OZAR	Trail/directional signs	Uniformed park personnel	Warning signs in park	Water
PORE	Trail/directional signs	Uniformed park personnel	Warning signs in park	Backcountry
STLI	Trail/directional signs	Uniformed park personnel	Warning signs in park	Frontcountry
YOSE	Trail/directional signs	Brochures on wildlife risks	Warning signs in park	Backcountry
FOSU	Uniformed park personnel	Warning signs in park	Trail/directional signs	Frontcountry
LAME	Uniformed park personnel	Warning signs in park	Trail/directional signs	Water
LOWE	Uniformed park personnel	Other workers in park	Trail/directional signs	Frontcountry
CURE	Uniformed park personnel	Other workers in park	Warning signs in park	Motor vehicle
SAGU	Uniformed park personnel	Trail/directional signs	Warning signs in park	Motor vehicle
PAIS	Warning signs in park	Uniformed park personnel	Trail/directional signs	Water

5.5.11 Comparison of winter and summer survey results

Overall, the results of the winter and summer surveys are quite similar. Generally, the most popular activities are the same, although the rank order may change, and in the winter we see the addition of snowshoeing, cross-country skiing, and downhill skiing at Mount Rainier, Rocky Mountain, and Yosemite. There is a noticeable difference in levels of experience in the winter at Rocky Mountain and Mount Rainier, with fewer respondents rating themselves as extremely experienced and somewhat more rating themselves as having no experience. This results from the dominance of snowshoeing as a primary activity at these parks in the winter, and we can infer that many of our respondents are novice snowshoers with little or no experience.

The other major difference between the summer and winter surveys concerns the locus of responsibility for safety. In particular, there is a general shift in the locus of responsibility from the visitor in the winter towards both the visitor and the park staff in the summer.

6.0 Major findings and recommendations

In conclusion, we identify 15 key findings and make 17 recommendations. The findings are divided into three topical areas relating to causes and contributory factors in visitor accidents (6.1.1), risk management for visitor safety (6.1.2), and gaps in data and knowledge (6.1.3). The recommendations are divided into four sections regarding data collection and information management (6.2.1), risk management interventions (6.2.2), technology and information transfer (6.2.3), and future research (6.2.4).

6.1 Major findings

In this section we present general findings that are based on the key findings from the various tasks completed. While the reports completed for each task summarize findings specific to the data collected and analyzed as part of that task, here we focus on findings that are broadly based on the risk analysis, visitor survey, inventory of risk conditions, and literature review.

6.1.1 Causes and contributory factors in visitor accidents

1. Many of the accidents that involve visitors are relatively mundane. They include bee stings, cuts, abrasions, bruises, and the like. A measure of their relatively minor severity is that 44% of all injured or ill visitors were treated and released by park personnel. A substantial fraction (41%) of injured or ill visitors, however, required transportation to medical facilities for further assessment and/or treatment. Falls of various kinds result in about 24% of all injuries and illnesses and motor vehicle accidents result in about 19% additional injuries and illnesses.

2. The broad pattern of risks in the parks can be summarized in the form of risk ratios. We provide risk ratios in the form of the number of accidents per 100,000 visitors and per 1,000,000 visitor-hours. We note, however, that such measures do not allow for the enormous variations among parks in terms of visitor activities and risk conditions. Better measures of risk would incorporate measures of the degree of exposure, such as the amount of time people are engaged in a given activity (such as hiking, rock climbing, wilderness camping), the number of person-miles walked on trails, or the total vehicle miles driven in a given park. Unfortunately, these kinds of data on the degree of exposure are not available. Consequently, we are forced to use the alternate measures.

3. Visitor activities, risks, and risk conditions and visitor opinions about risk and safety vary considerably from park to park so that aggregating data across all parks may be misleading.

4. Visitors concerns about hazards are broadly consistent with the accident data for individual parks, although there are notable exceptions. For example, respondents at Lake Mead, Assateague Island, Cape Hatteras, Point Reyes, and the Delaware Water Gap expressed little concern for drowning or boating hazards, even though these are significant contributors to visitor injuries. This lack of concern may be related to visitor over-confidence in their personal level of experience. At Yosemite and Grand Teton

wildlife hazards are rated high by many visitors, even though wildlife attacks are quite rare. The research literature on risk perception, however, tells us that the public often overestimates the likelihood of rare, dramatic kinds of risk events that are often given considerable media coverage, and tend to underestimate more common, less feared risks. Cognitive biases may lead visitors to overestimate the control they have in risky situations and their ability to recognize hazards.

5. There is general consistency between ratings of the most hazardous activities associated with visitor injuries and illnesses in the database and those provided by park staff. This finding suggests that the park personnel surveyed have a very good understanding of the activities associated with most visitor accidents in their park.

6. A variety of individual characteristics can influence the risk to visitors at national park units. Many studies have shown that harsh environments, attitudes toward recreational risk, physical stress and fatigue, and a variety of other factors can limit preparedness, capabilities, and response to accidents. The ways that individuals react to such risk factors can also vary widely. The risk analysis database and the inventory of risk conditions further support this finding. Age, performance, levels of experience, and levels of preparedness were all identified as important contributory factors to visitor accidents. However, gaps in research occur because certain behaviors or situations have not been studied in full detail.

7. Park staff responding to the inventory questionnaire often identified visitor characteristics as significant risk conditions. Staff rarely rated communication or infrastructural hazards as important conditions contributing to visitor accidents. Some factors perceived as problems related to visitor judgments and behaviors, however, could also be understood as failures in communicating relevant information successfully to visitors. The ways that responsibilities are assigned to the causes of visitor accidents can have important implications for the types of visitor risk management strategies that are viewed as appropriate or possible.

8. Park staff and visitors have different perspectives on conditions that influence accident rates. For example, park staff members believe that visitor preparedness and level of experience in a given activity are important contributors to visitor accidents. Most visitors, however, considered themselves experienced in their chosen activity and many indicated that they were well prepared with appropriate shoes, clothing, water, etc. Also, park staff considered visitor center/indoor conditions of low importance as a contributor to visitor accidents. Most falls, however, occur on prepared surfaces. Finally, staff responding to the inventory questionnaire indicated that failure to use safety equipment was an important contributor to visitor accidents. On the other hand, the visitor survey shows that high a large percentage of visitors claim to use seatbelts most of time. Seatbelts are only one form of safety equipment, however. Furthermore, research demonstrates that there is a wide gulf between reported and actual behavior.

6.1.2 Risk management for visitor safety

9. The 30 parks may be grouped into six clusters according to the types of activities associated with the largest numbers of visitor accidents. These clusters are: frontcountry activities, motor vehicle operation, backcountry activities, water-related activities, and a mix of activities. These groupings also prove useful for analyzing the differences among the responses of visitors to the survey at different park units.

10. Visitor opinions about the locus of responsibility for safety varied substantially from park to park. In general, larger numbers of people in backcountry parks believe the visitor is responsible for safety. More respondents at frontcountry parks place the burden of responsibility on both the visitor and the park staff. Opinions varied about whether most of the risks visitors face in the National Parks are beyond the control of the National Park Service and whether it is the responsibility of the National Park Service to prevent visitors from undertaking activities that may pose a serious risk to themselves, no matter how popular the activity may be.

11. Across the board, there is substantial public support for more rangers, more brochures warning about hazards, and greater enforcement of alcoholic beverage restrictions as means for improving visitor safety in the sample of visitors we surveyed. There is less support for increases in the restrictions placed on the number of persons/groups who undertake particular activities as a means for reducing visitor fatalities, injuries, and illnesses.

12. The sources of safety information that most people consistently rate as the most helpful include trail/directional signs, warning signs, and uniformed park personnel. There were also some notable exceptions to these patterns. Brochures on wildlife encounters were cited as “very helpful” by most people at Assateague Island and Denali; they were the second most popular source of safety information at Yosemite and Grand Teton, and the third most popular source at Rocky Mountain and the Delaware Water Gap. “Other workers” in the parks were rated as the second most popular source of safety information at Lowell and Curecanti.

6.1.3 Gaps in data and knowledge

13. We found little evidence that the Park Service is *systematically* accumulating knowledge about visitor risk and safety nationwide. A small number of studies have been conducted that provide useful information for understanding visitor risks in specific activities (e.g., day hiking in the Grand Canyon National Park (Manning et al. 2000); visitor perceptions of volcano threat at Mt. St. Helens National Park (Greene et al. 1981); and visitor preparedness at Arches and Canyonlands National Volcanic Monument (Rentz and Schreyer 1977)). This knowledge, however, appears to be shared rarely outside the park studied and with managers in Washington, DC.

14. Much of the data that would be useful for assessing visitor risk and safety in the National Park System are either not collected or are missing from park accident records. For

example, data about ethnicity are missing in more than 40% of all records in our database and data on contributing factors are rarely noted except in a few activities. The quality of information in park specific databases varies from park to park. Such limitations affect the lessons that can be learned from visitor accident data.

15. Data about visitor "exposure" to risk are limited. While there are data about visitation rates to the park units, there are no baseline data about how many visitors engage in specific activities, when, and for how long. The survey results do not give us precise estimates for the number of people participating in and the length of time that they engage in particular activities. Without more precise estimates of the numbers of people engaged in a particular activity, the length of time that they are "exposed, " and the number of people injured, it will not be possible to derive more precise risk estimates.

6.2 Recommendations

This section presents a set of policy, risk management, and research recommendations to NPS managers. Recommendations are related to practical risk management activities that can be implemented to improve visitor safety, identifying needs for further data collection to document current conditions, opportunities for technology transfer and application of existing research, opportunities and methods of technical assistance to park units and NPS managers, and future research. The recommendations are based on the findings from the tasks completed, and summarized above, but it should be emphasized that all the recommendations should be adapted to local and regional conditions, as necessary. They are not listed in any order of priority.

6.2.1 Data collection and information management

1. Improving the accuracy and reliability of information will require the establishment and maintenance of an accident reporting system that is both useful and user friendly. Many NPS staff that we encountered expressed frustration with the current CIR system, and complained that it was cumbersome to use and did not allow for easy retrieval of information in ways that would be most useful to the users. This also means that data are not entered fully or accurately. Our database reveals that many types of information are not routinely entered for visitor accidents. Whatever reporting system is developed in the future, it should be adaptable to local and regional needs and conditions.

2. While good records are kept within the National Park Service about visitation rates to the various units, these are gross numbers. Consequently, they limit the kinds of risk estimates that can be made. Ideally, the NPS should collect more detailed data about the numbers and socio-demographic characteristics of visitors and the nature of the activities they pursue. If system-wide data collection is not possible, the Park Service should endeavor to collect such data at a smaller set of representative parks so that some baseline risk data are available. The kinds of data to be collected should be determined in close consultation with park staff, and should reflect local and regional needs and conditions.

3. The NPS should develop better mechanisms for systematically sharing information among parks and with managers in Washington, DC. Currently, studies conducted at one park may not be known to individuals from other parks or divisions. Such mechanisms

could include, for example, dissemination of study summaries via email, within current NPS publications (e.g., *Park Science*), and postings on the web.

4. The NPS should develop mechanisms for on-going systematic analysis and evaluation of visitor accident data. Currently, data are collected in a relatively haphazard fashion that differs between parks. Rarely are the data analyzed systematically, if at all. While safety officers often have a good understanding of the risks in a particular park unit, these perspectives are based on years of experience and "seat-of-the-pants" analyses. New staff will not have this knowledge, and preconceived notions and assumptions may go untested. Supporting data necessary for effective management actions are often minimal or absent. In addition, each park should collect and monitor data on the most salient visitor risk problems in that park, in order to evaluate and justify risk management decisions.

5. Interdisciplinary teams of park staff should be established to conduct inventories of risk conditions at each park. The inventories should include assessments of infrastructural and other characteristics that may lead to visitor accidents, and should be keyed to past accident data.

6. Appropriate staff from park units within the studies' sample of 30 should review carefully the results of the survey and risk analysis to identify park-specific problems and opportunities (e.g., the May spike of accidents at Lowell that is associated with the large number of school fieldtrips; and the spike of fatalities and injuries among young adult males in May and June in Denali National Park). Practical risk management activities may be derived from the findings specific to each park unit.

6.2.2 Risk management interventions

7. The NPS should develop a method for categorizing parks that is specifically related to visitor risk and safety. We found that the 30 parks in our sample can be grouped into several clusters according to the nature of visitor activities. While other ways of grouping park units are possible, the effective design and implementation of visitor risk management strategies can benefit by a consistent and clear method. Existing park classifications (e.g., national monument, national battlefield, etc.) may not be helpful in the analysis of visitor safety. Prior research on hazard management illustrates that targeted efforts can reap the largest benefits.

8. The NPS should focus effort on developing and testing innovative methods for educating visitors about risks and encouraging changes in behaviors to improve safety. These efforts should be adapted to regional and park-specific conditions and the characteristics of activities and visitors in each park. In general, most people responding to the visitor survey considered themselves to be relatively experienced in and well prepared for their chosen activity. Many visitors also reported using safety equipment (e.g., safety belts in vehicles). By contrast, many park personnel responding to the inventory questionnaire felt that many accidents were the result of visitor inexperience, lack or preparedness, and failure to use appropriate safety equipment. Prior research indicates that people often

overestimate their capabilities and safety in risky activities. Communication and education programs provide an important means for focusing people's attention on the need to be more vigilant about safety. Effective programs are not easy to design, however, and they are often not evaluated for their effectiveness.

6.2.3 Technology and information transfer

9. Mechanisms should be established to ensure better translation of research into practice and guidelines for park management and staff. Workshops can be held to provide guidance to safety officers about, for example, the design and evaluation of effective visitor risk communication programs. Similarly, workshops or written guidance documents should be provided to park interpretive staff about visitor risk communication, as the visitor survey revealed that they are often the actual or desired source of information for visitors. These workshops and guidance manuals should be adapted to regional and park-specific conditions.

10. The NPS should use existing risk management frameworks to identify management options whose effectiveness has been validated by prior research. While most of the research literature is not specific to parks or recreational activities, it remains very relevant. The causal model of hazards provides one potential framework that can be usefully applied by park managers. Visitor characteristics are often cited, in the literature review, database, and inventory, as important factors contributing to accidents. Their effects can be influenced by carefully crafted risk reduction strategies. These strategies should be adapted to regional and park-specific conditions.

6.2.4 Future research

11. Most accidents occur while visitors engage in seemingly "low risk/high volume" activities, such as visiting the visitor center, viewing indoor exhibits, and walking to outdoor attractions. Most accidents occur during these activities, because these are the activities that most visitors pursue in the parks. Relatively few accidents occur in "high risk/low volume" activities, such as mountain climbing and caving, because relatively few visitors participate in these activities. The National Park Service in general and each park in particular needs to conduct further analysis to determine how to set risk management priorities. In some cases, the problems associated with the "high risk/low volume" activities may be more tractable. In other cases, it may be more effective to focus on the "low risk/high volume" activities. In most cases, however, it is likely that strategies to deal with a "mixed portfolio" of risks may be most appropriate.

12. The National Park Service in general and each park in particular should conduct further research on strategies to handle "high profile" risk events (such as wildlife attacks), because such events will necessarily attract disproportionate media and public attention. Research should also be conducted to assess risk management strategies for a range of high-risk visitor activities, seasons, and visitor profiles. The research should strive to take a broad view of the risky activities by studying the people and situations that reflect the reality of NPS-related contexts, including environmental, infrastructural, informational,

personal, and social factors. Such research can benefit by better data on how many people engage in the high-risk activities and for how long (i.e., exposure to risk). With such information, better understandings of activity-specific risks can be achieved (e.g., risk comparisons).

13. Visitor characteristics are often significant contributors to accidents, but are difficult to modify. Consequently, the National Park Service should closely examine management strategies designed to make activities “goof proof” so that serious consequences do not occur from inevitable accidents.

14. Research is necessary to determine the association between visitor preparedness and visitor accidents. The visitor survey findings suggest that most visitors feel they are well prepared for their chosen activity. On the other hand, both the literature review and the inventory of risk conditions suggest that the visitors who are most likely to get hurt may be those who are ill prepared (i.e., lack experience or equipment, or failure to use safety equipment).

15. The collective knowledge of park staff about accident causes and contributing factors should be used to supplement the information available in park records and sampled in the accident database. Any effort to gather such qualitative data for analyses, however, must be done carefully and systematically. Research targeted to the collection of data about selected hazards may be the most efficient and effective strategy.

16. The NPS should consider sponsoring research on key factors that may contribute to accidents. Many factors were identified in the literature review, such as the impact of visitor crowding and the role of new technologies. Visitor crowding may result in increased recreational conflicts that can, in turn, make accidents more frequent. New technologies, such as cell phones and GPS devices, can inappropriately increase feelings of safety and cause visitors to engage in activities for which they are ill prepared. Alternatively, such devices may help search and rescue efforts. It is evident from the survey that substantial numbers of visitors carry cell phones and GPS units.

17. The inventory, literature review, and visitor survey demonstrate the need for improved safety-related communication programs. For example, in the inventory of risk conditions, park respondents often mentioned lack of visitor preparedness, visitor ignorance, and other characteristics that may be amenable to risk communication activities. While much research has been conducted on the design and implementation of risk communication programs, good information about NPS-specific contexts is lacking. Good risk communication is no guarantee of success, but poor risk communication will certainly make things worse. Generally, more warnings via multiple channels are better, but sometimes better warnings are needed. Whatever risk communication strategies are pursued, they need to be adapted to regional and park-specific conditions.

6.3 Final thoughts

The results of this project provide information to NPS managers that support on-going efforts and requirements to improve visitor safety throughout all the units of the Park System. The Organic Act of 1916 (16 U.S.C. sec. 1) and Director's Order Number 50B and its accompanying *Safety And Occupational Health Reference Manual* (NPS 1999b) provide the rationale for an NPS effort to improve visitor safety and risk management, including social science research. "Usable knowledge," as defined by the NPS Social Science Program (Machlis 1996) that supports the mission of the NPS and risk management guidelines, are provided by the results of this research on visitor safety.

Several forms of "usable knowledge" have been generated through this project:

- A set of policy, risk management, and research recommendations are being provided to NPS managers. The recommendations are related to risk management activities that can be implemented to improve visitor safety.
- NPS managers have received a detailed examination of visitor accident data available in 30 park units for the years 1993 – 1998. Most of the 30 park units have done little systematic evaluation of the available data on visitor accidents or of their visitor safety programs. In some parks, limited studies have been completed (e.g., Grand Canyon National Park). Thus, this project is the first systematic evaluation of available data on visitor safety in a representative sample of parks. The analysis provides a better understanding of how visitor risk differs among park unit types, and among different visitor populations, activities, and environments.
- NPS managers have been provided detailed information about visitor perceptions of risk and safety, of the effectiveness and suitability of safety programs, and of visitor risk-related behaviors in the sample of 30 park units.
- NPS managers will be able to learn how their own perceptions compare with those of visitors to the parks in the sample of 30 units. By understanding differences in perceptions about, for example, the effectiveness of safety messages and important contributory causes to visitor risk, NPS managers will be better able to develop and implement effective visitor risk management.
- The data analysis and survey methods provide models that NPS managers might use to extend the study of visitor safety to other units in the National Park System.
- NPS managers have received an extensive review of literature relevant to managing visitor safety and risk communication. Such information will enable NPS managers to make informed choices about risk management strategies for improving visitor safety and risk communication.
- Armed with information from the literature review, accident analysis, inventory, and visitor survey, NPS managers will be in a better position to evaluate existing safety programs and to develop new management strategies.

7.0 References

Bick, T., Hohenemser, C., and Kates, R.W. 1985. Regulating automobile safety. In R.W. Kates, C. Hohenemser, and J.X. Kasperson (eds.), *Perilous progress*, 311-344. Boulder, CO: Westview Press.

Bowonder, B., Kasperson, J.X., and Kasperson, R.E. 1985. Avoiding future Bhopals, *Environment* 27(7): 6-13, 31-37.

Canadian Park Service (now Parks Canada). 1995. *Situational analysis to guide production and delivery of national self-reliance communication products.* Ottawa, Canada: Parks Canada.

Canadian Park Service (now Parks Canada) 1996. *Parks Canada Visitor Risk Management Handbook.* Ottawa, Canada: Parks Canada.

Capper, P. 1996. Systems safety in the wake of the Cave Creek Disaster. Paper delivered to the Conference of the Australasian Evaluation Society, 29 August, 1996. Wellington, New Zealand. Available on the web at www.webresearch.co.nz/Public/Publications/CaveCreekPaper.pdf

Covello, V.T., von Winterfeldt, D., and Slovic, P. 1986. Risk communication: A review of the literature, *Risk Abstracts* 3(4):171-182.

Greene, M., Perry, R., and Lindell, M. 1981. The March 1980 eruptions of Mt. St. Helens: Citizen perceptions of volcano threat, *Disasters* 5(1):49-66.

Hoffman, D.A., Jacobs, R., and Landy, F. 1995. High reliability process industries: Individual, micro, and macro organizational influences on safety performance, *Journal of Safety Research* 26(3): 131-149.

Holmes, J. 1987. A lethal ingredient: Human error, *Insight* (9 March):52-53.

Kasperson, R.E., Kates, R.W., and Hohenemser, C. 1985. Hazard management. In R.W. Kates, C. Hohenemser, and J.X. Kasperson (eds.), *Perilous progress*, 43-66. Boulder, CO: Westview Press.

Kates, R.W. 1970. Natural hazard in human ecological perspective: Hypothesis and models, *Economic Geography* 47:438-451.

Machlis, G.E. 1996. *Usable Knowledge: A Plan for Furthering Social Science and the National Parks.* Washington, DC: National Park Service.

Manning, R., Cole, D., Stewart, W., Taylor, J., and Lee, M. 2000. *Day use hiking in Grand Canyon National Park.* Arizona: Grand Canyon National Park.

National Research Council. 1988. *Human factors research and nuclear safety*. Washington, DC: National Academy Press.

National Research Council. 1989. *Improving risk communication.* Washington, DC: National Academy Press.

National Park Service (NPS). 1997. *1997 National Park Service Strategic Plan.* NPS.

National Park Service (NPS). 1999a. *National Park Service Director's Order #83: Public Health.* Washington, DC: NPS.

National Park Service (NPS). 1999b. *National Park Service Safety and Occupational Health Reference Manual, #50B.* Washington, DC: NPS.

Perrow, C. 1984. *Normal accidents*. New York: Basic Books, Inc.

Pitz, G. 1993. Risk-taking, design, and training. In F. Yates (ed.), *Risk-taking behavior*, 283-320. New York: John Wiley and Sons.

Reason, J., Manstead, A., Stradling, S., Baxter, J., and Campbell, K. 1990. Errors and violations on the roads: A real distinction?, *Ergonomics* 33(10/11):1315-1332.

Rentz, L., and Schreyer, R. 1977. *Park visitor responses to low risk natural hazards.* Washington, DC: National Park Service.

Robinson, G H. 1982. Accidents and sociotechnical systems: Principles for design, *Accident Analysis and Prevention* 14(2):121-130.

Rasmussen, J. 1982. Human errors: A taxonomy for describing human malfunction in industrial installation, *Journal of Occupational Accidents* 4:311-333.

Sandman, P.M. 1987. Risk communication: Facing public outrage, *EPA Journal* 13(9):21-22.

Sherwonit, B. 2000. Too close for comfort, *National Parks* (September/October):32-37.

Slappendel, C., Laird, I., Kawachi, I., Marshall, S., and Cryer, C. 1993. Factors affecting work-related injury among forestry workers: A review, *Journal of Safety Research* 24:19-32.

TriData. 1996. *Wildland Firefighter Safety Awareness Study. Phase 1: Identifying the organizational culture, leadership, human factors, and other issues impacting firefighter safety*. BLM Contract # 1422-N-651-C5-3070. Arlington, VA: TriData Corporation.

Tuler, S., Machlis, G.E., and Kasperson, R.E. 1993. *A social risk assessment of the 1991 Winter Snow Removal Program at Mt. Rainier National Park.* Report prepared for Mt. Rainier

National Park, WA by the Cooperative Park Studies Unit, University of Idaho, Moscow, Idaho. National Park Service Technical Report NPS/PNRUI/NRTR-92/05. 80 pgs.

Visitor Services Project 1997. Lowell National Historic Park: Visitor Study, Summer 1997. VSP Report #100. Moscow, ID: Cooperative Park Studies Unit, University of Idaho.

Wadlington, Carol. Personal communication. 1/6/2000.

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