Employee Safety in the National Park Service

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Abstract

Many factors can contribute to safe and unsafe work practices in National Park Service (NPS) activities. Prior research is reviewed to highlight how factors influencing employee safety occur at multiple levels. Individual characteristics contributing to employee safety include stress and fatigue, and how they influence decision making, judgments, and behaviors. Group characteristics include how employees and team members share information and reach joint decisions. The potential for safety cultures and effective training programs are factors influencing employee safety at the organizational level. Special attention is placed on prior research which specifically addresses NPS employee safety. How lessons from prior research can be useful to NPS managers is emphasized throughout the report.

Introduction

Employee safety is essential to the mission of the National Park Service (NPS); a primary responsibility of all organizations is to protect its employees from harm. However, NPS employees are injured and killed in a variety of ways (J. Baylosis, personal communication, April 15, 1997; B. Halainen, personal communication, April 15, 1997; E. Rozas, personal communication, April 18, 1997).

Since the mid-1970s, studies of risky activities and technologies have been performed by psychologists, geographers, engineers, sociologists, and anthropologists. Risks from natural disasters, occupational accidents, household accidents, and large system failures have been examined. While much research still needs to be done, a substantial base of prior studies and experience exists for analyzing any given risk problem, including occupational safety. A broad view of safety that includes the relationships among individuals, institutions, and social and environmental features has proven useful in the design, evaluation, and management of safety in a variety of large-scale technological systems.

This paper reviews social science research relevant to employee safety in the NPS. The review is based on a representative sample of social science work generally relevant to employee safety. The goal of the paper is to summarize what is known and can be of assistance to managers concerned with employee safety. The paper also highlights where findings from prior research are ambiguous. Specifically, key issues related to individual, group, and organizational characteristics are discussed in the following sections. Information about management strategies for employee safety is presented. Literature that has explicitly addressed employee safety in the National Park Service is also included. [Terms that may be unfamiliar to the reader are highlighted in **bold face** and defined in a glossary at the end of the paper.]

Individual Characteristics

The way an individual behaves in a specific situation is related to many factors that influence the physiological and/or psychological characteristics of the individual. These characteristics can influence the safety and reliability of decisions, judgments, and actions. **Physiological characteristics** are related to such aspects of a person as strength, hearing, and visual perception. **Psychological characteristics** are related to a person's comprehension, judgment, communication, and decision-making skills.

The ways that people make judgments and decisions in a variety of situations have been extensively studied (Keinan et al. 1987; Slovic et al. 1988). The primary generalizations from this research are that:

- People often have difficulties making decisions, inferences, and judgments in complex situations (Slovic et al. 1988). For example, in complex situations there is often one simple and obvious solution that is selected. It is, however, s o m e -times incorrect or inefficient.

- Different decision strategies may greatly affect outcomes. Poor decisions can lead to the addition of small errors that can cause a future accident (Telfer 1989).

- People do not always use all the information available to them (Fischhoff 1986; van der Colk 1988). For example, information quality can be inadequate to fulfill requirements for appropriate decisions and judgments or decisions may be required in situations that allow only limited attention to any particular item or issue.

Research on human decision making indicates that predictable mistakes often occur because individuals develop biases and rules of thumb to simplify a complex world and guide judgments (Fischhoff 1986; Tuler 1988). While there is some debate over how strongly biases influence behaviors in non-experimental settings, patterns which are often observed include:

- overconfidence in estimations, plans, and skills,

- underestimation of time constraints and risks,

- attempts to verify previously held beliefs,

- exaggeration of personal immunity from threats,

- difficulties assessing probabilities and exponential processes,

- ignorance of subtleties or side effects,

- tendency toward conservatism,

- previous experiences often used as basis for future choices,

- options which are not readily observable may not be considered, and

- complacency in familiar situations.

Because biases and rules of thumb serve the important function of allowing people to operate with limited information in different situations, they cannot be dismissed as dangerous or useless. For example, during NPS emergency search and rescue operations, such strategies can help save time that can make a difference between life and death. However, in unfamiliar situations, they may lead to inappropriate choices or actions. For example, search and rescue personnel may respond to a unique situation using prior experience and rules of thumb that can result in increased risk of harm because they are not applicable to the current situation.

The ability of individuals to detect, comprehend, judge, decide, and act may be influenced by a variety of **stress factors** associated with a work task. Stress factors can compound difficulties of performing routine, familiar, and unfamiliar actions. Stress factors result from differences between task demands and a person's ability to respond. The importance of stress factors results from their ability to:

- increase workload and decrease coping ability,

- impair the perception of hazards,

- impair decision making and judgments,

- lead to inappropriate avoidance behavior, and

- lead to fatalities or injuries.

Stress factors have been documented and studied in a large number of contexts and include physical, physiological, psychological, and social factors (Anderson et al. 1995; Faff and Tutak 1989; Hockey 1983). Examples that have been observed in many types of work are listed in Table 1. A variety of stress factors can affect NPS employees on a regular basis, ranging from characteristics of the tasks they must perform, physical conditions in which they work, and the social environment in which they work. An understanding of these effects and how to mitigate them is important to ensuring employee safety in the NPS.

Table 1. Factors contributing to employee stress during work

Physical/physiological factors	Psychological/social factors
- noise - vibration - internal hot or cold (e.g., protective clothing worn during firefighting) - external temperature - comfort (e.g., backache) - visual illusions (e.g., "flicker") - disorientation - inadequate nutrition - dehydration, heat exhaustion - caffeine, alcohol, nicotine - muscle fatigue - sleep cycle disruption, inadequate rest - mental workload, mental fatigue	- boredom - anxiety, concern for safety - anger, frustration - sensory overload, sensory deprivation - time pressure - previous errors - domestic social problems - marital/family problems, separation from family - financial problems - legal problems - paperwork, irksome tasks, reporting requirements - liaison with supervisors - safety/organizational culture

However, current research is inconclusive on the role of stress as a contributor to employee accidents. People respond to stress in a variety of ways (Klein 1996; Mann 1993). For example, dangerous situations can cause personal anxiety (Idzikowski and Baddeley 1983), though it has also been reported that experience with stressful situations/activities can reduce stress in activities that occur at a later time (Ursin et al. 1978). In some cases, stress factors have been observed to positively influence behaviors and decision making (Klein 1996). In addition, stress levels can differ among individuals in the same situation (Luczak 1991). For example, one person may be afraid of heights, while others are not. Moreover, multiple stress factors are often present simultaneously in a situation. NPS employees are frequently exposed to multiple stress factors, such as dangerous working conditions, time pressures, fatigue, and unfamiliar situations.

Closely related to stress are **mental workload** and feelings of fatigue. Mental workload of employees has been extensively studied (Gopher and Donchin 1986; Kirk and Parker 1994; National Research Council 1993). Researchers have found that individuals can maintain high levels of performance (e.g., detection, comprehension, problem solving) while working on tasks even as demands and mental effort increase. However, as effort continues to increase, a point will be reached where the individual cannot continue to maintain the same level of performance. The result can be an abrupt deterioration in performance. Mental workload can be an issue for NPS personnel who must, for example, work long hours during peak seasons or during emergency situations.

Prior research on fatigue has found that subjective feelings of fatigue can be contributory causes to accidents and failures in a variety of mental and physical activities (Holding 1983; National Research Council 1993). While most people associate fatigue with feeling physically tired or not enough sleep, fatigue can also be associated with mental activity. Consequences of fatigue on work performance include performance deterioration and increases in risk-taking behavior. However, in some cases, the effects of fatigue on performance have been ambiguous (Borowsky and Wall 1983). In addition, the impact of individual differences with respect to sensitivity to fatigue is not well documented or studied (Chidester 1990). In spite of the conflicting results of studies, fatigue is thought to be an important factor in the safe performance of many tasks. Fatigue can be an issue for NPS employees in

many situations when much physical exertion is necessary or long hours of work are demanded.

Research has also considered the role of motivations and attitudes in maintaining employee safety. Human factors and occupational safety researchers have extensively studied the ways that personalities and attitudes contribute to accidents by influencing the ways that people make judgments and decisions, carry out actions, and react to stress (Dedobbeleer and German 1987; Geller et al. 1996; Lester and Bombaci 1984). For example, researchers have observed attitudes of workers which can contribute to dangerous behaviors or decisions, such as anti-authoritarian attitudes ("don't tell me what to do!"), impulsiveness ("do something now!"), beliefs of invulnerability ("nothing can happen to me"), macho attitudes ("I can do this"), feelings of resignation ("what's the point of trying?"), and deference ("I will do what you suggest"). However, few validation studies have been completed on the prevalence and impacts of these six attitudes (Lester and Bombaci 1984; Telfer 1989; Telfer and Ashman 1986). At the same time, these kinds of attitudes have been observed in many work situations, including the NPS (Tuler et al. 1992).

In some cases, motivations and attitudes are linked to risk-taking orientations of individuals (Machlis and Rosa 1990; Tuler et al. 1992; Yates 1993). Safe choices may actually be of secondary importance relative to other goals. Other motivating factors may be equally or more important—such as speed of performance, financial cost, fulfilling role expectations, and emotions. For example, NPS employees may believe it is necessary to conduct potentially dangerous activities because they improve visitor experiences or protect resources.

Group Characteristics

In many systems, groups of people must interact to perform a task. In the NPS, groups and teams of employees play a role in the performance of many activities, including trail and building maintenance, visitor services, search and rescue operations, firefighting, and law enforcement. While necessary, interactions of people in groups can also create conditions that lead to accidents or mishaps. For example, group interactions can lead to risk taking or incorrect decisions in different situations (Hare et al. 1996; Hirokawa and Scheerhorn 1986). These results can occur during the planning, operational, maintenance, and emergency response phases of work tasks.

Researchers have suggested several factors that may lead to faulty decisions in a group or team. They include:

- improper assessment of a situation,
- establishment of inappropriate goals and procedures,
- improper assessment of alternative decisions,
- establishment of faulty information on which to base a decision, and
- faulty reasoning.

Researchers have observed that pressures for group consensus may be very strong in some cases. One example is **groupthink**, in which a group arrives at a consensus decision without adequately evaluating all alternatives (Hare et al. 1996). Such pressures result from the characteristics of the group and the social environment in which they interact (Swap 1984). The characteristics fall into several categories:

- composition (e.g., group size, individual personalities, isolation of a group),
- leadership characteristics (e.g., centralization of authority, leadership style),
- task characteristics (e.g., demands and requirements of task, timing of task demands, interdependencies among different tasks), and
- decision rules (e.g., ability to reverse decisions, criteria used for making decisions, social context of group decision making).

Individual members of a group can enable or prevent faulty decisions in group decision making (Hare et al. 1996). In particular, faulty group decision making can often be traced to the influences of specific group members on communication and social factors such as deferment to peers. However, individuals also can prevent faulty decisions by counteracting negative influences, such as by convincing others to reject flawed beliefs, perceptions, and inferences. Research suggests that familiarity is important in group behavior because it can decrease misunderstandings between individuals and improve the reliability of communications. Such a view has contributed to recent research on crews and teams (Guzzo and Dickson 1996). However, familiar-

ity among members of a group may result in negative consequences, such as groupthink.

Organizational Characteristics

Much research has focused on the ways that organizational characteristics can influence individual behavior (Mitroff et al. 1989; Roberts 1989; Wilpert 1995). Incorrect perceptions and poor choices may result from:

- rigid organizational beliefs and practices,
- restrictions of the social and cultural environment,
- political interests,
- supervisor-subordinate relations and responsibilities,
- institutional constraints, and
- communication constraints.

In turn, such incorrect perceptions or poor choices may influence the behavior and effectiveness of an organization's individual members, and ultimately employee safety.

The dynamics of individual interactions in organizations depend partly on the organizational culture, work situation (e.g., management-employee relations, job requirements), and organizational structure. Researchers have addressed issues of incentives, disciplinary actions, information and education, and behavior modeling to encourage safe work practices and to avoid risk taking (DeJoy 1996; Peters 1991; Stetzer and Hofmann 1996). Factors that appear in the research literature include:

- pressure (e.g., authority, peer, heavy responsibility),
- job requirements (e.g., ill-defined job requirements, lack of resources, expectations too high or impossible, multiple tasks, selective attention by workers and management),
- conflicts among personnel (e.g., personality, procedural, substantive),
- conflicting assumptions related to tasks or roles (e.g., management vs. designer, management vs. operating personnel),
- rigid organizational beliefs, assumptions, and rules,

- rules and procedures not maintained,
- communication systems not adequate or unavailable,
- quality of work environment (e.g., lack of job satisfaction),
- industrial actions (e.g., slow-downs, strikes),
- system (or co-workers) considered unreliable or untrustworthy,
- mindsets (e.g., attitudes toward safety, professionalism, productivity), and
- lack of coordination, trust, and understandings among organizations.

The concepts of **organizational culture** and **safety culture** are receiving much attention (Schein 1990; Weick 1987). Interactions among individuals within an organization are partly a result of how the individuals believe the organization functions. These beliefs arise through an organizational culture. Organizations may create specific standards, rules, traditions, and roles to which employees must adhere. Recent research has focused on the institutionalization of safety cultures to establish standards for safety and high reliability (Dedobbeleer and Beland 1991; Roberts 1989; Weick 1987).

In addition, studies suggest that organizational culture can play an important role in motivation, commitment, and performance of risky activities (Mitroff et al. 1989; Tuler et al. 1992). Organizational culture may alter employee attitudes and perceptions of activities and the way that potential costs and benefits are weighed. Organizational culture may lead to performance of an activity even when workers may feel their personal risks are high. Moreover, personnel may voluntarily increase their risks in order to perform the activity according to institutionally established standards and expectations. Wilpert (1995) notes that a basic tenet of high-reliability organizations is a strong organizational culture—but this can actually increase risk taking and encourage cover-ups when official safety rules are violated.

Managing Employee Safety

In many instances, organizations must manage hazards. **Hazard management** is concerned with the prevention, mitigation, and recovery of accidents and natural disasters through the management of social risk factors. This is an area of research that can provide planning, training, and accident evaluation methods to the NPS. Such activities are intended to:

- improve situational awareness,
- improve knowledge of rules, alternative actions, and possible consequences,
- enhance coordination,
- improve correspondence between plans and implementation,
- ensure that individuals and organizations are capable of coping with time constraints and unexpected situations, and
- identify gaps and inadequacies in existing procedures and plans.

Possible strategies for hazard management include eliminating exposure to the risk, limiting exposure to the risk, and mitigating or controlling the consequences of the risk (Kasperson et al. 1985). For example, in road maintenance tasks, safety can be increased by:

- reducing the times or distances to which operators are exposed to dangers,
- establishing administrative limits on the roadway mileage to be maintained or the lengths of work shifts, and
- installing additional safety equipment, such as airbags.

Risks are reduced because drivers' exposure to dangers is decreased and the potential consequences of an accident are reduced.

A critical observation from prior research is that activities should only be undertaken when operational capabilities for people and their equipment are not to be exceeded. Such lessons can be as simple as having enough drinking water to avoid dehydration or suitable protective clothing to prevent hypothermia. In fact, a growing body of research suggests that **human errors** are a result of many interacting elements. Errors may be characterized as mismatches between humans and their tasks or machines (Rasmussen 1982). Yet, while mismatches are often the result of many factors, it is also possible to control factors that may contribute to accidents. Because mismatches may occur at any time, the best way to decrease their effects is to design systems that remove the opportunities for weaknesses to matter. Such systems provide a buffer zone for human variability in performance (Pitz 1993; Rasmussen and Goodstein 1987). These controls can be achieved by removing the contributing factor, by making the total system less sensitive to errors, and by providing opportunities to correct errors before they result in an accident. Effective hazard management requires that accidents and failures in plans be evaluated and lessons learned (England 1981; Malaterre 1990). However, organizations often fail to learn from prior mistakes and accidents.

The propensity for employees to adopt self-protective behaviors has been a long-standing area of research (Cohen 1993; Geller et al. 1996; Weinstein 1987). An understanding of when and why individuals adopt self-protective behaviors is important to improving safety in NPS work. Cohen (1993) has proposed several categories of self-protective behaviors, all of which are relevant to NPS employee behaviors. They are affected by employee motivation and attitudes, and include:

- proper use and operation of the hazard control systems (e.g., helmets, ventilators),
- good work habits in performing job tasks (e.g., using seat belts),
- increased awareness and recognition of workplace hazards,
- acceptance and use of personal protective equipment,
- observance of housekeeping and maintenance measures to keep work areas safe,
- proper response to emergency situations, and
- self-monitoring and early recognition of any signs or symptoms of hazardous exposures or activities.

One widely discussed approach to encouraging safety-related behaviors is **performance-based feedback** (Geller et al. 1996). A performance-based feedback approach uses observation and measurement techniques to monitor behaviors and to provide feedback for modi-

fying unsafe work practices. This approach to training for safety has been widely applied, including driving and industrial settings. It is also being applied to manage employee safety in several NPS units (N. Siler, personal communication, May 9, 1997). However, researchers have noted that there are limits to behavioral approaches to controlling work place hazards (Cohen and Jensen 1984; Geller et al. 1996).

Personnel training in teams has been observed to be important preparation for any hazardous activity (Pitz 1993; Tannenbaum and Yukl 1992; Vojtecky and Schmitz 1986). Training may reduce the potential for decision and action failures by:

- improving awareness of the work environment,
- improving knowledge of rules, alternative actions, and possible consequences,
- enhancing coordination and group interactions,
- improving correspondence between plans and implementation, and
- ensuring that organizations are capable of coping with time constraints.

However, research suggests that, in general, training may be of limited utility in improving performance in complex and unfamiliar situations (Pitz 1993; Vojtecky and Schmitz 1986). For example:

- unconscious use of rules of thumb and skills learned over time may create problems where they suddenly become irrelevant or even detrimental in new situations (Svenson 1979)—this has been referred to as *over-training*,
- short decision times have been shown to cause individuals to revert to decision rules used before training (Zakay and Wooler 1984), and
- training has been observed to have only short-term and limited effects.

One solution proposed is for training to occur repeatedly. Another is to provide extensive training for unfamiliar or emergency situations (National Research Council 1993; Tuler 1988).

Employee Safety in the National Park Service

This section focuses on literature that has explicitly addressed employee safety in the National Park Service. This literature is limited.

Olympic National Park Mountain Goat Removal Project

Mountain goats were introduced by people to the Olympic Peninsula in the 1920s and have been causing damage to portions of the unique ecology of the Olympic National Park (Olympic National Park 1987, 1995). To prevent further damage to the sensitive high country of the national park, Olympic National Park personnel began an experimental program to rid the park of the mountain goats in the early 1980s. In 1988, a live capture and removal program was initiated. The Olympic National Park Mountain Goat Removal Project was based on a set of unique requirements and activities. The effort required innovative and difficult activities in some of the most remote and rugged backcountry areas of Olympic National Park. Task requirements of complex helicopter flights, difficult capture of goats from the air, and handling of goats on rugged terrain combined with social factors that influenced the capabilities of personnel to operate safely and reliably for intensive periods during the summer months. The combination of these specific factors created physical and social hazards to personnel.

Research reviewed the risks that were related to the social context of the project and provided recommendations for their mitigation (Machlis et al. 1990; Tuler et al. 1992). Risks were involved in the nature of equipment used, characteristics of the animals, method of capture and removal, and drugs used to sedate the animals. Social factors created and contributed to a variety of safety risks to both personnel and mountain goats. Such social factors included overlapping organizational planning authority, decision and judgment errors due to fatigue and stress, and National Park Service employee values, attitudes, and behaviors.

In particular, the researchers found organizational culture to be an important mediating factor in determining both individual risk decisions of the team members as well as the level of their performance of risky

activities (Tuler et al. 1992). The organizational culture of the NPS enabled the extraordinary performance of risky activities beyond what traditional approaches to risk-taking behavior would suggest. Although organizational culture may not have been the only factor that mediated the outcomes, it was observed to be critical in the Olympic National Park Mountain Goat Removal Project.

The analysis concluded that specific changes to the program could enhance safety, reliability, and performance. Because improvements in some areas could be made prior to the following summer's operations, immediate short-term suggestions as well as suggestions that could be useful in long-term planning were provided. Recommendations were related to:

- altering the project to reduce social risk factors,

- altering the social environment to reduce social risk factors,

- monitoring social risk factors associated with the project, and

- additional options, such as the role of training.

The research did not evaluate specific risks associated with mechanical failure or provide a quantitative risk assessment of the project. While safety to the mountain goats was of much import and concern, it was not examined in the research. The research findings were part of the evidence used in the Draft Environmental Impact Statement for Mountain Goat Management (Olympic National Park 1995).

Mount Rainier National Park
Winter Snow Removal Program

Maintaining access to the Paradise Visitor Center of Mount Rainier National Park during the winter season requires a continuous and sophisticated program of snow removal. A program to maintain an open and safe road requires innovative skills and difficult activities in often unpredictable and harsh winter weather. The Mount Rainier National Park Winter Snow Removal Program is based on the use of several snow removal vehicles to remove snow between the Nisqually Entrance and Paradise Visitor Center. Performance of the needed activities results in the exposure of park personnel and visitors to a number of safety hazards. At several stages of the program, they could be injured or

involved in accidents causing property damage. A study to assess the social risks in the Snow Removal Program was conducted (Tuler et al. 1993).

In general, the authors found that program activities were performed safely and efficiently. However, there was room for additional safety improvements. The analysis concluded that:

- Catastrophic accidents that resulted in multiple fatalities or severe injuries were relatively rare.

- Accidents that resulted in minor or moderate injuries to park personnel or visitors or property damage were more common. In many cases, the combination of changing weather and difficult working conditions with little room for error created accident situations despite the best efforts of equipment operators. The characteristics of activities required to remove snow may change everyday because weather, road surface, and equipment may be different every day.

- Visitors were a main source of risk. Unexpected encounters with snow removal equipment, combined with frequently insufficient experience in winter driving, has led to a relatively large percentage of prior accidents.

- Sources of management-employee tensions were found in the organization of the program. Opportunities were available to reduce tensions with monitoring and evaluation activities.

- Vehicles used for the winter snow removal program were not always suitable for the required tasks. Frequent equipment breakdown often required operators to use vehicles inappropriate for the specific conditions.

- Inadequate attention to problems that did exist may have contributed to safety hazards. Adequate data were not always available for accurate risk analysis and program evaluation.

The authors identified specific changes that might be useful to enhance safety, reliability, and performance. Recommendations for improving safety, reliability, and performance were based on:

- altering tasks to reduce social risk factors,

- altering the social environment to reduce social risk factors,

- monitoring social risk factors associated with program activities, and

- additional options, such as the role of training and providing information to visitors.

Wildland Firefighting Safety

A study of wildland firefighting safety has been sponsored by the National Interagency Fire Center (NIFC), which includes the National Park Service, U.S. Forest Service, Bureau of Land Management, Bureau of Indian Affairs, and U.S. Fish and Wildlife Service. It is being conducted in close collaboration with the NIFC, the five federal agencies, and TriData (a private contractor). The study is being conducted in four phases; phases 1 and 2 have been completed (TriData 1996, 1997). The four phases are to:

- identify the existing organizational culture and its contribution to safety problems,

- identify the elements of the desired organizational culture of the future to enhance safety,

- develop an implementation plan to create the desired organizational culture, and

- assist, monitor, and evaluate implementation of the plan.

The information for Phase 1 was generated through a literature review, one-on-one interviews with federal and state wildland firefighters, and a national survey of a sample of federal wildland firefighters. Over 1,000 people were contacted as part of the study.

A long list of approximately 250 issues were identified as affecting firefighter safety. They fall into five general categories: organizational culture, leadership, accountability, human factors, and external influences that affect wildland firefighter safety. At the same time, there was general agreement about the most pressing problems across agencies, ranks, gender, and ethnic groups. The high priority needs related to firefighter safety were identified as:

- improving the experience level, training, and physical fitness of individual firefighters,

- improving attitudes toward safety, particularly in the minority of firefighters who do not seem adequately concerned about safety,

- ensuring that crew and division supervisors have the required characteristics, training, and experience to supervise during emergencies, and

- holding all ranks accountable for unsafe performance decisions.

The report states:

> The lack of adequate accountability in the current culture was especially stressed. While all levels of management came in for various criticisms, and many outside influences (from local political pressures to budget shortfalls to forest health considerations) were identified as important influences on safety, the firefighters focused most on the need to make improvements at the firefighting level rather than blame others, even though the survey was anonymous (TriData 1996:viii).

A general conclusion of the Phase 1 report is that:

> Virtually every problem raised by firefighters had one or more solutions offered by firefighters to solve it. There is no need for a massive change in the approach to wildland firefighting. Rather, attention must be given to making the current approaches work better. The one big caveat to this is the availability of resources relative to expectations and the condition of the wildlands (TriData 1996:202).

The completion of Phase 2 of the study has resulted in the ranking of proposed solutions to the identified safety-related problems. The general approach to identifying solutions was based on a concern for the entire wildland firefighter system, including: (1) reducing exposure to fires, (2) increasing safety behavior at fires, and (3) escaping when necessary.

Law Enforcement and Threats to NPS Employees

In 1993, two employees of the NPS Southwest Region began a research project to assess the violence-related hazards to non-commissioned employees (Sikoryak and Dec 1994). The authors wrote:

Acts of aggression and violence toward uniformed National Park Service personnel in the performance of their duties is increasing. These acts range from verbal abuse to threats to physical attacks, some of which have resulted in death. This violence is not gender specific...(Sikoryak and Dec 1994:1).

The evidence for these conclusions is based on a survey administered to Southwest Regional non-commissioned employees during 1994. At that time, there were 7,351 rangers employed by the NPS; 1,520 were permanent commissions and about 900 were seasonal commissions. The authors estimated that approximately half of the non-commissioned rangers reported being harassed, threatened, or attacked during their work. The results of the survey regarding the number of employees experiencing different threat situations is shown in Table 2.

In spite of these statistics, the authors observed that little focus had been placed on training of non-commissioned personnel. Situational awareness; stress management; threat, personal, and risk assessment; fear management and response; and other strategies were not part of law enforcement training programs. Respondents to the survey also collected information about the kinds of skill training that would be beneficial to help cope with threatening and violent situations, such as:

- how to assess a situation and determine when an unusual or uncomfortable situation is becoming dangerous,
- how to minimize or avoid risk, including how to defuse hostile situations or prevent them from escalating,
- how to converse without being argumentative,
- how to escape a dangerous situation and buy time, and
- how to identify individuals and groups that may present problems.

Current Research Needs on Employee Safety

What is known about employee safety? What further research is needed? The current research literature offers an extensive body of findings, but has many important gaps. In spite of these gaps, however, the social sciences provide a useful perspective from which to assess and improve employee safety in the NPS. The NPS can benefit from information about the characteristics of individuals, groups, and organizations that can influence employee safety. Understanding these issues can improve employee safety and hazard management

Table 2. Survey results about acts of aggression to Southwest Region NPS employees

% of Respondents experiencing situation	Situation
77%	been verbally attacked
75%	dealt with those under the influence of drugs or alcohol
61%	felt threatened
57%	felt unable to handle interpersonal situations due to lack of training
50%	dealt with groups such as gangs, political activists, etc.
44%	felt threatened or in danger by someone they knew
19%	been touched or grabbed in an inappropriate manner
14%	been threatened or physically attacked going to or from work

Source: Sikoryak and Dec 1994

in the NPS. An important lesson from prior research is that work tasks must be analyzed in terms of the *total system*. Individuals interact within the context of equipment, other personnel, organizational cultures, social and economic factors, and the environment. Mismatches between any of these elements can create conditions that lead to, or contribute to, accidents.

Research on individuals can benefit the NPS by showing how fatigue and mental workload can change and impair NPS employee behavior. This information can contribute to the design of safer work procedures, task characteristics, and work environments by reducing or eliminating their contribution to risk. An understanding of how groups and teams make decisions and behave is also of critical importance to NPS employee safety. Problems can be prevented by appropriate training and management. NPS employees can learn how their behaviors can influence group actions, in both positive and negative ways. Finally, in order to design and implement effective employee safety programs, the NPS must have a clear understanding of how organizational characteristics influence individuals and groups. Research on organizational characteristics can provide information about strengths and weaknesses of different hazard management options to ensure that the best strategies are used to implement NPS employee safety programs.

Much of what is unknown is related to the many variables that influence the reactions of individuals and groups in specific situations. Limitations in research occur because certain behaviors or situations have not been studied in detail. Limited research has addressed the unique combinations of work requirements, social and physical work environments, management commitment, organizational culture, and individual and group behaviors that occur in many of the tasks performed by NPS employees.

Thus, studies on human errors and their causes are not capable of explaining exactly why or when mismatches may occur, or how the effects of stress, fatigue, and workload influence particular individuals or groups. Nor can it fully explain why the reactions of individuals and groups can vary when exposed to similar factors.

Knowledge of effective hazard management strategies has much to contribute to employee safety. It is known that organizational cultures can be created and maintained that do enhance safety and reliability. Furthermore, management commitment, training, and formal evaluation and monitoring programs have been found to improve hazard management, and thus, safety. While they cannot guarantee employee safety, such management activities can establish conditions that maintain and improve employee safety within the NPS.

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Glossary

groupthink: Refers to pressures for group consensus, in which a group arrives at a consensus decision without adequately evaluating all alternatives.

hazard management: Actions concerned with the prevention, mitigation, and recovery of accidents and natural disasters.

human error: A catch-all term for all unexplained causes of accidents. A result of many interacting elements that are characterized as mismatches between humans and their tasks or between humans and machines they use.

mental workload: The amount of mental tasks or unresolved issues and responsibilities on an employee's mind.

organizational culture: Refers to the beliefs and norms held by members of an organization about how the organization functions (including its structure, formal and informal rules, standards, and employee roles). Organizational culture can influence the interactions, motivations, safety-related behaviors, and risk perceptions of individuals within an organization.

performance-based feedback: An approach that uses observation and measurement techniques to monitor behaviors and provide information to modify unsafe work practices.

physiological characteristics: Physical and biological characteristics that can influence safety and reliability of decisions, judgements, and actions. These are related to a person's strength, hearing, and visual perception.

psychological characteristics: Mental and emotional characteristics that can influence safety and reliability of decisions, judgements, and actions. These are related to a person's comprehension, judgement, communication, and decision-making skills.

safety culture: Refers to the specific norms, rules, traditions, and roles created within an organization to which employees must adhere.

stress factors: A result of the difference between task demands and a person's ability to respond, these include a range of physical, physiological, psychological, and social factors.

Additional Resources

Journals

Applied Ergonomics, published by Elsevier Science, http://ww1.elsevier.nl/

Ergonomics, published by The Ergonomics Society, http://www.ergonomics.org.uk/

Journal of Occupational Accidents, published by Elsevier Science, http://ww1.elsevier.nl/

Journal of Safety Research, published by Elsevier Science, http://ww1.elsevier.nl/

Professional Safety, published by the American Society of Safety Engineers, http://www.asse.org/

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