

ABSTRACT

CAPPS, KATHERINE BRECKHEIMER. Factors Related to the Occurrence of Incidents in Adventure Recreation Programs. (Under the direction of Dr. Aram Attarian)

This study examines accident data generated over a five-year period from a nationally recognized outdoor adventure program located in the United States using a combination of Hale's Accident Model (1983) and Nicolazzo's Site Management Theory (2004). The study specifically explores the potential for incident trends through stationary or moving sites.

Results for the primary research question, do more outdoor program accidents occur at moving or stationary sites, showed that there is a significant difference between stationary, moving, and combination sites ($p < .001$). However, findings also indicated that there was not a significant difference when comparing just stationary to moving sites ($p > .05$), so the results for the primary research question were inconclusive. Secondary research questions were: does the type of activity affect where accidents occur, does the type of incident affect where accidents occur, does individual status affect where accidents occur, and does the type of site determine the type of injury that occurs? All secondary research questions were found to be significant ($p < .002$ or less), concluding type of site is an important environmental factor when examining why accidents occur.

Implications recommend actions for administrators and field staff to explore reasons why frequency of incidents is similar at moving and stationary sites. Additional research is also needed to examine the role demographics play in incident occurrence as well as the seriousness of the injury. More research is needed from additional programs, for longer periods of time and testing more accident theories.

FACTORS RELATED TO THE OCCURRENCE OF INCIDENTS IN ADVENTURE RECREATION PROGRAMS

by

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DEDICATION

This thesis is dedicated first to my husband, Kevin Capps, without whose support this whole graduate school endeavor would not have been possible. This thesis is also dedicated to our son, Connor, who is looking forward to being able to spend a lot more time with Mommy when it is finished and to all of the grandparents that helped at many points along the way.

BIOGRAPHY

Katherine Breckheimer Capps (Kathy) was born in Ithaca, New York on December 6, 1977. Childhood years were spent cultivating a love for the outdoors and family through summer camp experiences, family vacations and various work experiences. She moved to Wilmington, North Carolina to attend the University of North Carolina at Wilmington (UNCW) where she graduated in 2000 with a B.A. in Parks and Recreation Management. While at UNCW, Kathy worked for The Outdoor Center, where she gained valuable experience as a trip leader, challenge course facilitator and program administrator. Her internship was spent at Fort Carson, Colorado working for the Adventure Program of the US Army's MWR program.

After undergraduate school, Kathy moved to Raleigh, NC and began her professional career as the Adventure Program Manager for Raleigh Parks and Recreation Department. She also enjoyed volunteering as an EMT for a local area EMS squad. In 2003, she was married and started her graduate studies on a part-time basis. Her professional interests include wilderness medicine, emergency response, and risk management methods.

Kathy lives in Youngsville, NC with her husband Kevin, son Connor and dog Aspen.

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Chapter 1: Introduction

Risk management has been a key responsibility of programs offering outdoor adventure pursuits since the 1970's. Risk management in the outdoor adventure industry is "the process of reducing the potential for incidents to an acceptable level and minimizing the consequences to the people and the organization in the event an accident occurs" (p. 1, Ajango, 2000). Risk management is a dynamic, ongoing process that allows programs to continually evaluate their potential for risk and the best methods to address those risks (van der Smitten, 1990). Examination of accident data as part of the risk management process allows administrators and field staff to make better-informed decisions about actual program risks. Trend data can justify policy changes, changes in the level of training or experience for staff as well as change program location or activity. Accident data when shared as an industry can help identify industry wide or localized trends, add to the collective body of knowledge and shape industry standards.

The concept of risk management began in the 1970's as a result of several factors. For public programs, the Tort Claims Acts were revised so that they no longer provided governmental immunity against court judgments. Increased litigation related to leisure activities and subsequent settlements and judgments created a fear of financial loss among both private and public programs. Insurance premiums also increased so that it became difficult and expensive to obtain insurance coverage (van der Smitten, 1990). Risk management became a standard prevention strategy in the outdoor adventure industry and a means for securing lower insurance premiums. A sustained focus is placed on risk management for outdoor adventure programs as litigation and concerns with insurance coverage are still ongoing issues in the new millennium.

Over the decades, risk management has also diversified in purpose. Risk management, according to van der Smissen (1990), is a means for programs to provide the programming that they desire, fulfill a moral and ethical responsibility to their clients to keep them reasonably free from harm, protect program assets and employees and protect the program's professional image. Attarian (2006) states similar purposes for risk management: reduce the frequency of fatalities, decrease the number of injuries, lessen property damage and create a safe work environment.

Collection and review of accident data is an important area of risk management as administrators can create an accident database for analysis, observe trends, evaluate efficacy of safety and management measures and predict potential future trouble areas (Erickson and Leemon, 2000). Large organizations like the National Outdoor Leadership School (NOLS), Outward Bound USA and the American Alpine Club (AAC) have well-documented and published histories of accident profiles. These programs and others' willingness to share accident information have encouraged smaller programs to follow suit and as a result have opened the doors for added research in this area.

STATEMENT OF THE PROBLEM

St. Paul Companies, an insurance conglomerate, and Outward Bound USA conducted a nationwide study of three hundred outdoor adventure programs (2001). Two of the primary conclusions of the study were:

- 1) Outdoor adventure programs have a clear need for better training resources and risk assessment tools.
- 2) The outdoor adventure industry as a whole, as well as its consumers and evaluators, need a clear and consistent way to assess risk and safety management systems. In particular, the industry needs a system in place to track and report

accidents and injuries to get a clear picture of the risks inherent in the industry and how to mitigate these risks. (p. 3)

Though some programs have started to share information, accident data is still “guarded information” by many. Many programs fear that by making this information available, it may expose the program to litigation. Information about accidents can also detract from a program’s public image. Greater emphasis on the benefits of accident analysis industry wide should be emphasized in order for more programs to actively take part in the learning process. Additionally, programs analyze their own accident information to meet their own internal goals. However, this practice has resulted in very little information published about accidents across programs or accident data addressing an industry trend or question. Finally, accident research tends to be limited, showing only the types and frequency of accidents and other similar summaries of data. Lacking is research testing accident models or how accident analysis affects current and future accident trends.

This study addresses two identified problems concerning accident analysis. First, the study emphasizes the benefits of accident analysis industry wide to encourage more programs to actively take part in this learning process. Second, it will be inaugural research in the outdoor adventure recreation field that tests accident models using accident data.

STUDY PURPOSE AND HYPOTHESES

This study examines accident data generated over a five-year period from an outdoor adventure program located in the United States using a combination of Hale’s

Accident Model (1983) and Nicolazzo's Site Management Theory (2004). The study specifically explores the potential for accident trends through stationary or moving sites.

The following primary research question and secondary research questions were posed:

Primary Question

Do more outdoor adventure program accidents occur at moving or stationary sites?

H0: There is no difference in the number of accidents that occur in moving versus stationary sites.

H1: Accidents are more likely to occur at stationary sites opposed to moving sites.

H2: Accidents are more likely to occur at moving sites opposed to stationary sites.

H3: Accidents occur in a combination of both moving and stationary sites.

Secondary Questions

Does the type of activity affect where accidents occur?

H0: There is no difference comparing type of activity and where accidents occur.

H1: There is a difference comparing type of activity and where accidents occur.

Does the type of incident affect where accidents occur?

H0: There is no difference comparing type of incident and where accidents occur.

H1: There is a difference comparing type of incident and where accidents occur.

Does individual status affect where accidents occur?

H0: There is no difference comparing staff/student status and where accidents occur.

H1: There is a difference comparing staff/student status and where accidents occur.

Is the type of injury affected by where accidents occur?

H0: There is no difference comparing type of injury and where accidents occur.

H1: There is a difference comparing type of injury and where accidents occur.

DELIMITATIONS OF THE STUDY

Some of the delimitations of this study were self-imposed while the program that provided the accident data dictated others. The study was limited to a single program with a standardized accident and incident reporting system. Data over a five-year period was utilized, as the data were available in paper format (hard copy). The program chose to limit the type of demographic information available for this study. The only ‘demographic’ information made available was whether a staff member or student was involved in an incident. The program also chose to remain anonymous so that no identifying historical information about the program could be presented as part of the study.

LIMITATIONS OF THE STUDY

There is significant potential for inconsistency in the accuracy and level of incident reporting because of the five-year time frame of the study and turnover of field staff and administrators within a program.

Programs offer many different adventure activities for varying lengths of time and at various levels of risk. Programs are also spread over geographic areas that span the globe and have very different missions and purposes for providing leisure pursuits.

Therefore, it is difficult to generalize the results of this study to the outdoor adventure industry as a whole.

DEFINITION OF TERMS

The definitions listed below will be used in this study:

Program – An entity that provides outdoor adventure recreation activities to a group of clients. The activities are facilitated and supervised by the program's instructors. A program can be public, private, non-profit or government sponsored. Examples of outdoor adventure programs include municipal parks and recreation departments, the National Park Service, the National Outdoor Leadership School, the Student Conservation Association, Outward Bound and all types of private guiding services including rafting, sea kayaking, rock climbing, etc.

Incident – Similar to an accident, it is a potentially dangerous occurrence that results in injury, property damage or a near miss. As in the case of motivational or behavioral incidents, an incident may not be unplanned. Because all incidents examined for the purpose of this study were indeed unplanned (as are accidents), the terms incident and accident are used synonymously throughout the text.

Accident – An unplanned, potentially dangerous occurrence that results in injury, property damage or a near miss (Leemon, Schmelpfenig, Gray, Tarter, and Williamson, 1998).

Near Miss (Close Call) – A potentially dangerous situation where safety was

compromised but that did not result in reportable injury. An unplanned and

unforeseen event (Leemon, et. al., 1998).

Motivation or Behavioral Incident – Intentional incidents resulting from a participant's

unwillingness to participate or cooperate with program regulations. Examples are

refusal to participate, running away, alcohol or drug use or an emotional or

psychological situation that compromises the students' ability to participate in the

program (Leemon, et. al., 1998).

Risk – “Our field is very unique in the sense that we are one of a few fields in the world

to intentionally use risk as part of our services. And as a result, we need to interact

with it in a fundamentally different way” (P. Cline, January 22, 2007, personal

communication). Instead of a value negative definition (the potential to lose

something of value), the definition of risk for this study is value neutral: human

interaction with uncertainty (Cline, 2004).

Human Factors – Subjective hazards due to personality, attitude, or state of mind.

Examples include fatigue, distraction or lack of experience (Leemon, et. al.,

1998).

Environmental Factors – Objective hazards that are usually quantifiable and represent the

overall condition of the environment. Examples include weather, water conditions

and wild animals (Leemon, et. al., 1998).

Reduction of Risk – Reduction of the potential for program loss through removal or

minimization of hazards (Cuskelly and Auld, 1989).

Retention of Risk – Programmatic assumption of a certain amount of loss (Cuskelly and Auld, 1989).

Transfer of Risk – Assumption of risks by other parties, either by agreements or insurance (Cuskelly and Auld, 1989).

Avoidance of Risk – Elimination of risk through cancellation of the activity or event (Cuskelly and Auld, 1989).

Moving Site – A moving site is characterized by changing boundaries, unknown hazards and safe zones, and increased actual risk (Nicolazzo, 2004). Examples of moving sites include backpacking on a trail, river running or lead climbing. Typical characterization of a moving site is Point A to Point B travel.

Stationary Site – A stationary site is defined by fixed boundaries, known hazards and safe zones, and participation in an activity that does not take the participant outside of the boundaries (Nicolazzo, 2004). Examples of stationary sites include a top-rope climbing site, playboating in a single point on a river, a ropes course experience or a camp kitchen.

Both Site – An incident that occurred over two or more sites. This is the result of an incident that developed over a longer period of time, or an unplanned transition from a stationary to moving site or vice versa. Examples of both sites include an infection or illness that developed over several days, a student getting lost in the middle of the night after leaving the tent to use the bathroom (stationary to moving), a vehicle breakdown resulting in the group being stranded at the vehicle for an extended time (moving to stationary), etc.

Chapter II: Review of Literature

Examination of accident data as part of the risk management process allows outdoor adventure recreation program administrators and field staff to make better-informed decisions about actual program risks. This study examines accident data generated over a five-year period from an outdoor adventure program located in the United States using a combination of Hale's Accident Model (1983) and Nicolazzo's Site Management Theory (2004). The study specifically explores the potential for accident trends through stationary or moving sites. The research from this study addresses two identified problems concerning accident analysis. First, the study emphasizes the benefits of accident analysis industry wide to encourage more programs to actively take part in this learning process. Second, it will be inaugural research in the outdoor adventure recreation field that tests accident models using accident data.

This chapter explores the literature related to accident research and is divided into two categories: the use of models and theories and reviews of accident data. The models and theories presented in the first section focus primarily on the causal factors of accidents, the relationship between causal factors and implications for risk management. The second section explores how accident data has been reviewed, in what fields and for what purpose.

RISK MANAGEMENT AND ACCIDENT MODELS AND THEORIES

The use of models and theories to aid decision-making in risk management and understand how accidents happen in outdoor adventure programs has occurred since the

early 1970s. One of the earliest, The Dynamics of Accidents Theory (Hale, 1983), divides the causal factors for accidents into two categories: objective and subjective (Figure 1). The objective category defines environmental factors such as weather and terrain while the subjective category defines human factors including skill level and

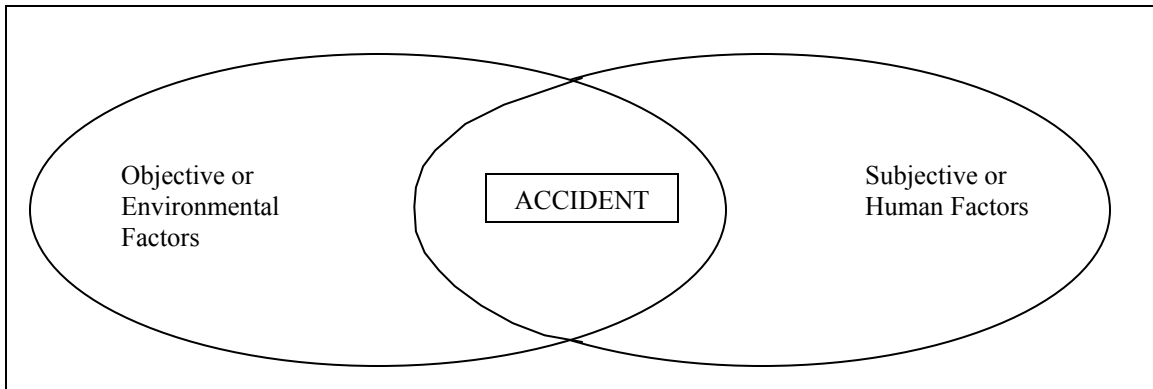


Figure 1 – Hale’s 1983 Dynamics of Accidents Theory with modifications by Erickson and Leemon (2000)

judgment (Erickson and Leemon, 2000). The area in which the two categories interact creates the highest potential for accidents.

Potential Causes of Accidents in Outdoor Pursuits		
Potentially Unsafe Conditions Due To:	Potentially Unsafe Acts Due To:	Potential Errors in Judgment Due To:
Falling Objects (Rocks, etc)	Inadequate Protection	Desire to Please Others
Inadequate Area Security	Inadequate Instruction	Trying to Adhere to a Schedule
Weather	Inadequate Supervision	Misperception
Equipment/Clothing	Unsafe Speed (Fast/Slow)	New or Unexpected Situation
Swift/Cold Water	Inadequate Food/Drink/Medications	Fatigue
Animals/Plants	Poor position	Distraction
Physical/Psychological Profile	Unauthorized/Improper Procedure	Miscommunication of Participants and/or Staff
		Disregarding Instincts

Figure 2 - A Matrix Designed and Revised by Dan Meyer and Jed Williamson (1979-2003)

The accident matrix by Meyer and Williamson first introduced in 1979 has undergone several revisions (Figure 2). The categories of environmental and human factors are common to Hale's model, however the category - human factors is divided into two categories. Each of the three categories is detailed into subcategories. The chief use of this matrix has been to investigate primary and secondary causes following an accident.

The Potential Frequency and Severity of Loss Model defines appropriate action to mitigate risk depending on the likelihood of and seriousness of injury. The model developed by van der Smitten (1990) contained an extra five quadrants, all with duplicate information. Cuskelly and Auld (1989) and Gregg (1998) refined the model to include four quadrants and no duplications (Figure 3). When the potential for frequency of an accident and the severity of an accident is low, it is acceptable practice to retain the risk within the organization. When severity is low but potential frequency is high, the program should make attempts to reduce the risk. Risk reduction can occur through activity modification, alternate location, change in policy and procedure or other

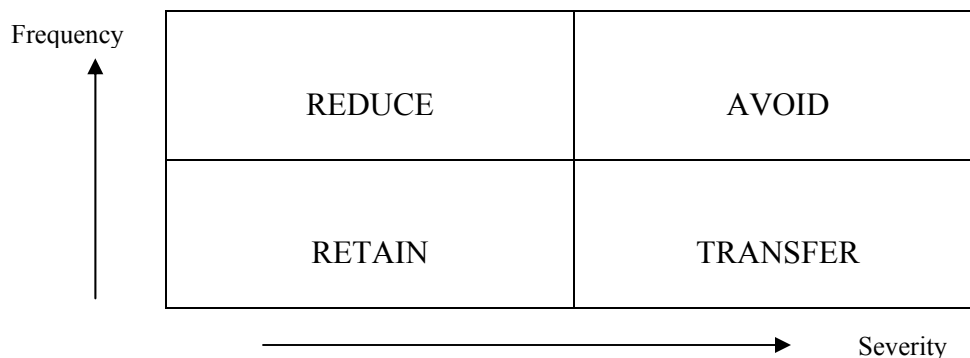


Figure 3 – Potential Frequency and Severity of Loss Model – Cuskelly and Auld (1989)

methods. When severity is high and frequency is low, the preferred method for management is to transfer the risk through insurance policies and exculpatory clauses like the assumption of risk and release of liability. When both severity and frequency are high, the best practice is to avoid the activity entirely. Gregg's model descriptors in each quadrant were simple yes and no's so that the model had use by both field staff and administrators while the Cuskelly and Auld model descriptors are the same as above for use by administrators. This model is also known as the risk matrix and was first used by insurers to manage risk.

Perrow (1984) developed the Normal Accident Theory which purports that risk factors in complex systems interact in multiple and unpredictable ways. Factors can link together in a chain of events leading up to an accident. Factors can be loosely coupled, meaning that they have an indirect relationship, or tightly coupled and a direct relationship (Erickson and Leemon, 2000). The theory suggests that since factors interact with such complexity in random and irregular patterns, accidents will occur regardless of program structure or management.

The High Reliability Theory (Sagan, 1993) presents an alternative discussion of the relationship between organizational structure and accidents. The theory states that safety can be attained by applying the proper program structure and management consisting of four components:

- 1) Leadership Safety Objectives: the program creates and emphasizes safety priorities.

- 2) The Need for Redundancy: the program realizes that mistakes can happen and employs back-up systems.
- 3) Decentralization, Culture, and Continuity: the program empowers all employees to be responsible for safety, creates a culture where safety is common practice and keeps the safety message consistent across all operations.
- 4) Program Learning: the program analyzes and learns from mistakes, near misses and accidents.

High Reliability Theory emphasizes the importance of accident and near miss reporting for the greater understanding of the program and the industry as a whole. A near miss can be a warning sign of an impending accident if corrective measures are not taken.

Nicolazzo (2004) developed Site Management Theory as a technique for leaders to assess risks and manage a group in the backcountry based on site type, as either stationary or moving. A stationary site is defined by fixed boundaries, known hazards and safe zones and participation in an activity that does not take the participant outside of the boundaries. Examples of stationary sites include a top-rope climbing site, playboating in a single point on a river or a camp kitchen. A moving site is characterized by changing boundaries, unknown hazards and safe zones and increased actual risk. Examples of moving sites include backpacking on a trail, river running, or lead climbing. Site Management Theory also defines two zones: the safe zone and the transition zone. A safe zone can be located within a stationary or a moving site and is a hazard free zone where participants can gather unsupervised. A transition zone is the location where a group

changes from a moving site to a stationary site or vice versa. Planned transition zones that occur simultaneously with safe zones are preferred. Accidents or incidents can occur when the transition zone is not anticipated, for example the unplanned swim at a stationary river feature that leads to a downstream chase.

Most of the theories in this section suggest that multiple factors interact in order for an accident to take place. By examining how factors interact, the theories imply that understanding how accidents occur can help manage accident potential.

REVIEWS OF ACCIDENT DATA

There have been numerous papers, reports and studies focusing on accident data from various outdoor adventure pursuits. For example, The National Outdoor Leadership School (NOLS) has published overviews of its incident profiles because “an organization that understands its risk management history is better able to identify if and when changes in risk management methods are necessary” (p. 174, Leemon and Schimelpfenig, 2003). The report identifies the most common types of injuries and illnesses among NOLS course participants, rates for injury, illness, evacuation and fatalities. Athletic and soft tissue injuries continue to be the most common type of injury, while gastrointestinal problems the most commonly reported illness (Leemon and Schimelpfenig, 2003). Ela (2004) examined wilderness search and rescue in New Hampshire, focusing on demographics, type of injury, environmental factors and fatalities. Results indicated that middle-aged men who had become lost or had lower extremity musculoskeletal injuries, caused the most search and rescue incidents in New Hampshire to be initiated.

An Austrian study of helicopter rescues in the Alps compared two three-year periods from 1998-2003 to look for trends in injury data (Kaufmann, Moser, and Lederer, 2006). The study found an increase in incidents due to greater participation in mountain sports, but a significant decrease in the number of life-threatening incidents, with two-thirds of the incidents involving tourists.

Other studies have focused on a specific demographic factor. Demographics present an interesting way to look at subgroups of incidents. Twombly and Schussman (1995) surveyed participants of an Outward Bound backpacking course to examine the role of gender with injury and illness. Findings indicated that women experienced a higher rate of injury than men. The study also found that injury reporting by men was somewhat dependent on the gender make up of the leader pair. A study looking at risk factors for incidents taking place at summer camp found that campers reported more injuries than did staff and those campers participating in advanced backpacking and advanced canoeing trips were most prone to injury (Elliot, Elliot, and Bixby, 2003).

Type of Activity has been a common study factor. The American Alpine Club (2002) has kept and published accident data annually in *Accidents in North American Mountaineering* since 1951. Tables compare accident factors including terrain, immediate and contributory causes, age, experience level, time of year, ascent or descent and type of injury. Contributions to the annual report include significant injury or rescue only, and as a result, fatalities account for over 20 percent of incidents reported (American Alpine Club, 2002). The American Alpine Club's accident analyses also show that contrary to other areas of the world known for mountaineering, more accidents occur

during the ascent than the descent in North America. American Whitewater (2007) keeps a similar accident database to the American Alpine Club's database. The database dates back to 1974 with accident reports compiled by year for all whitewater related incidents including kayaking, canoeing and rafting. The American Whitewater database contains significant injury or fatality reports only; resulting in the majority of reports filed involving a fatality. Common causes of death included foot entrapment and drowning due to undercut rocks. Fiore's (2003) review of rafting and kayaking compared injuries between the two activities. The paper included injury and fatality rates, as well as acute and chronic injury types. The study reported that kayakers had higher injury and fatality rates than rafters and were more likely to sustain chronic injury as a result of participation. A telemark skiing study obtained information on injury frequency and type, participant habits, demographics and equipment (Tuggy, 1996). Injury rates showed women and less experienced skiers to be more prone to injury and that telemark skiers had less severe injuries than alpine skiers. Equipment also played a factor in injury rates. Hiking lava fields in Hawaii was the focus of an injury study looking at the roles of experience, behavior, preparedness and demographics (Heggie and Heggie, 2004). The study found soft tissue injuries to the lower extremities and dehydration were common and that inexperience was the most significant contributing factor responsible for injury.

An in-line skater study focused almost entirely on equipment used by skaters and how that impacted injury data (Osberg and Stiles, 2001). The study found men had a higher injury rate than women and that in general not enough skaters wore protective equipment, especially helmets.

Fatalities data also draw interest and are the focus of several studies. An examination of deaths on challenge courses over a 14-year period found two main causes; falls from height (5 fatalities) and sudden cardiac arrest (10 fatalities) (Welch and Ryan, 2002). All but one of the fatalities from falls involved a staff member. All of the sudden cardiac arrests were in men; age 33 to 60 years old. A California wilderness area study also found that men accounted for 78 percent of the deaths in the study, with cause of death: heart disease, drowning, or a fall from height (Montalvo, Wingard, Bracker, and Davidson, 1998). Researchers in Arizona found that fifty percent of 100 wilderness mortalities in the Pima County study involved alcohol as a contributing factor in the incident (usually resulting in drowning or a fall from height) (Goodman, Iserson, and Strich, 2001).

These studies all present descriptive data about the sample examined as part of the study. This information presents a useful overview of accidents, however the ability to generalize the information to other areas or populations is limited because studies are scattered and inconsistent. The two areas of adventure recreation with the most research completed are climbing and boating (canoeing, kayaking, and rafting). The studies would be more useful if additional model and theory testing was completed as part of the study or if results were compared with results of similar studies.

Chapter III: Methods

Examination of accident data as part of the risk management process allows outdoor adventure recreation program administrators and field staff to make better-informed decisions about actual program risks. This study examines accident data generated over a five-year period from an outdoor adventure program located in the United States, using a combination of Hale's Accident Model (1983) and Nicolazzo's Site Management Theory (2004). The study specifically explores the potential for accident trends through stationary or moving sites. The research from this study addresses two identified problems concerning accident analysis. First, the study emphasizes the benefits of accident analysis industry wide to encourage more programs to actively take part in this learning process. Second, it will be inaugural research in the outdoor adventure recreation field that tests accident models using accident data.

This chapter describes the research methods used in this study. The first section describes the program from which accident data were collected. The second section explains the accident report form. The dependent and independent variables used for the study are discussed in the third section. For use in this study, the dependent variable was type of site and the independent variables included type of incident, type of activity, type of injury and individual status. The third section also includes the coding category used for each variable and other procedures. The final section describes how data were analyzed.

THE PROGRAM

The program from which the accident data were collected has a well-established history and reputation within the outdoor adventure recreation industry. It offers programs varying from one day to 72 days in length for both youth and adults. Participants and staff are a mix of males and females. Commonly programmed activities include: whitewater canoeing, sea kayaking, backpacking, rock climbing and a challenge course experience. The annual participant numbers, participant days, staff numbers and staff days are found in Table 1. The program has established criteria for incident reporting and a centralized process for incident data collection and processing. The program requested anonymity for the study due to the sensitive nature of the data collected. It also requested that no demographic information be collected about the individuals, except for status as staff or participant.

Table 1 – The Program’s Annual Participant and Staff Numbers and Program Days

Year	Total # of Participants	Total Participant Program Days*	Total # of Staff	Total Staff Program Days
2002	2528	26554	211	13161
2003	2877	26239	195	10533
2004	2602	24093	154	9885
2005	3276	26265	167	10996
2006	3045	25805	175	11078
Total	14328	128956	902	55653

*Total participant program days = number of program days in length x number of participants in program

Therefore, no demographic information was collected such as male or female, age, education level, etc.

THE INCIDENT REPORT FORM AND DATA COLLECTION

The incident report form is a standardized form to be completed whenever incident criteria are met. The form underwent little change in the period 2001-2006, allowing consistent data for the study. Criteria for reporting an incident are found in Table 2.

Table 2 – Criteria for Completing an Incident Report Form

Criteria for Completing an Incident Report Form
• Requires more than simple first aid. (e.g., more than a band aid or blister dressing) • Requires more than cursory staff attention. • Requires follow-up by staff in the field. • Requires follow-up care by a medical professional. • Requires follow-up by a therapist, psychologist, or social worker. • Requires use of prescription medications • Interferes with the subject's active participation. • Requires evacuation from the field. • Results in the loss of at least one calendar day of participation in program activities following the day an injury or illness occurs. (Lost Day Case) • Results in a Near Miss. (serious injury was narrowly avoided.) • A Behavioral or Motivational Incident that significantly affects the subject's or patrol's experience. • Any Incident that has potential to involve an insurance claim, lawsuit or public relations concern. • Vehicle Accidents • Early Departures for behavioral, motivational, psychological, or medical reasons. • Evacuations from the field that require non-OB outside resources (helicopter, fixed wing, horse, private vehicles, etc.) • Any incidents requiring the use of field communication devices.

The reporting process begins by collecting objective information about the patient, environment and conditions. The next section describes the type of incident, followed by the type of communication device / method used and evacuation method. Following were type and location of injury and the activity occurring at the time of the

incident. Remaining sections comprise more subjective information including primary and secondary causes of the incident, specifics on behavior, incident narrative and analysis. The majority of the variables for the study were category headings in the incident report form (Appendix A).

Data were collected by visiting the organization on site and reviewing every individual incident report and coding each variable for each report. Data reviewed were fairly consistent considering number and types of incidents reported. The thoroughness of reporting depended somewhat on the instructor completing the report and the seriousness of the incident. Many reports also had supporting documents such as doctor's reports and witness or patient statements. All variables except type of site were identified on the incident report. The only variable determined by the researcher was type of site. Type of site was determined primarily by the activity type and reviewing the report narrative. For an incident to be coded as occurring at a stationary site, the entire group had to be stationary, and the boundaries clearly established. For example, a burn from a stove set up in the camp kitchen was categorized as a cooking incident that occurred at a stationary site. A moving site involved the entire group moving or a temporary stop where no boundaries had been established. A laceration on the hand from cutting an apple while backpacking on a trail would be considered a cooking incident that occurred at a moving site (cooking refers to all food preparation, consumption and clean-up). However, if the same laceration occurred but the group that was backpacking had officially stopped for a lunch break on the trail, the incident was identified as a stationary site instead of moving. An incident was coded as a both site if there was an unplanned transition between

stationary and moving sites, if the group was split between sites, or if the incident spanned over at least two sites. If bug bites developed on day one of a sea kayaking trip, followed by redness and soreness on day two and swelling and drainage from the bite sites on day three, it was coded as a sea kayaking incident at a both site. If a bear wandered into a student's solo camp and caused that student to abandon camp in search of his instructors, it was coded as a solo incident occurring at a both site.

The study was a combination of Nicolazzo's Site Management Theory (2004) and Hale's Accident (1983) model as it examined stationary and moving sites through the environmental factor of type of activity and the human factor of individual status. The additional factors of type of incident and type of injury were also examined.

STUDY VARIABLES

The dependent variable for this study was type of site. Type of site was coded into one of three categories: stationary, moving or both. A stationary site has fixed boundaries and known safe zones and hazards. A moving site has no fixed boundaries, no known safe zones and unknown hazards. A site that was coded as both involved an incident that occurred in two or more sites.

The independent variables were type of incident, type of activity, type of injury and individual status (student or staff). There were seven incident type categories on the report form: injury, illness, motivational, behavioral, near miss, vehicle and other. For the study, only four of these categories were used. Motivational and behavioral incidents were omitted since the study was examining accident trends. Motivational incidents

involved participants who wanted to be removed from the program and behavioral incidents involved participants who were asked to leave the program. Examples would be unwillingness to participate, running away, alcohol or drug use, or an emotional or psychological situation that compromises the students' ability to participate in the program (Leemon, et. al., 1998). The primary definition of accident is "an event that is unforeseen". Motivational and behavioral incidents are deliberate actions therefore eliminating their value to the study. The vehicle category by itself did not have enough incidents for analysis purposes so it was collapsed into the "other" category. The final four types of incident categories for the study were: injury, illness, near miss and other. The other category describes incidents that do not fit in any other category, for example a lost participant, altercation with person outside the group, wildlife encounter, etc.

Type of activity was the second independent variable. The study started with 31 categories for this variable however for analysis purposes were collapsed into 11 categories. Table 3 describes the original and collapsed categories for the study. There were six categories that had no incident data over the five-year period (catarafting, caving, cycling, kayaking – inflatable, kayaking – river and portaging). The remaining categories were combined by like attributes or moved to the category other until all categories had counts sufficient to be analyzed. For example, base camp and camping were combined into a single activity because both activities are primarily fixed boundary activities with similar features including sleeping areas, bathroom areas and a kitchen. Rock climbing and rappelling activities were combined because they both typically take place on a rock face, use ropes, harnesses and other technical equipment and require the

same type of training and experience. Best judgment was used to combine categories, and categories without any logical combination were grouped with other. Any category in the right column with additional activities indented underneath indicates that category is inclusive of those additional activities.

Table 3 – Original and collapsed categories for type of activity

Original Activity Categories	Final Activity Categories
Backpacking	Backpacking
Base Camp	River Crossing
Camping	Base Camp
Canoeing	Camping
Cata rafting *	Canoeing
Caving *	Challenge Course
Challenge Course	Initiative
Cooking	Cooking
Cycling *	Kayaking – Sea/Lake
Glacier Travel	Rock Climbing
Hiking	Rappelling
Horseback Riding	Running
Initiative	Hiking
Kayaking – Inflatable *	Solo
Kayaking – River *	Unaccompanied Travel
Kayaking – Sea/Lake	Urban activity
Mountaineering	Vehicle
Mountain Biking	Service
Portaging *	Other
Rafting	Glacier Travel
Rappelling	Mountaineering
River Crossing	Horseback Riding
Rock Climbing	Mountain Biking
Running	Swimming
Service	
Solo	
Swimming	
Unaccompanied Travel	
Urban Activity	
Vehicle	
Other	

* This category contained no incidents and was omitted for the final categories

Type of injury also required that the 38 injury categories be collapsed. Categories were collapsed in a similar manner to type of activity so that the final 15 categories were all large enough for analysis. Table 4 describes the category collapsing for type of injury.

Table 4 - Original and collapsed categories for type of injury

Original Injury Categories	Final Injury Categories
Abrasion	Allergy
Anaphylaxis	Anaphylaxis
Allergy, other	Burn
AMS (Acute Mountain Sickness)	Blister
Asthma	Dehydration
Blister	Hypothermia
Burn	Hyperthermia
Cardiac	Exhaustion
Concussion	Frostbite
Contusion	Fever
Dehydration	Flu
Dental	Cold Symptoms
Dislocation	Fracture
Exhaustion	Dislocation
Fever	Head Injury – LOC and No LOC (Loss of Consciousness)
Flu/Cold Symptoms	Gastrointestinal
Fracture	Gynecological
Frostbite	Urinary Tract
Gastrointestinal	Infection
Gynecological	Skin Problem
Head Injury – No LOC (Loss Of Consciousness)	Laceration
Head Injury – LOC (Loss of Consciousness)	Abrasion
Hyperthermia	Puncture
Hypothermia	Contusion
Infection	Pre-existing
Laceration	Respiratory
Pre-existing	Asthma
Psychological	Sprain
Puncture	Strain
Respiratory	Tendonitis
Skin Problem	Tick
Sprain	Insect Bite
Strain	Other
Tendonitis	AMS (Acute Mountain Sickness)
Tick/Insect Bite	Cardiac
Urinary Tract	Dental
Other	Psychological
No Injury Occurred	No Injury Occurred

The final independent variable is the individual status, either as student or staff.

DATA ANALYSIS

Every incident for years 2001-2006 was coded, resulting in 875 useable incidents for analysis.

Descriptive statistics were used to describe the characteristics of the data for each variable and the distribution of data among categories.

The primary research question, do more outdoor adventure program accidents occur at moving sites or stationary sites and hypothesis was tested using Chi-square tests: Likelihood Ratio and Pearson, followed by pair-wise comparisons.

Chi-square tests (Likelihood Ratio and Pearson) were also used to test the secondary research questions: does the type of activity affect where accidents occur, does the type of incident affect where accidents occur, does individual status affect where accidents occur, and is the type of injury affected by where accidents occur?

In Table 14 and Table 17, 24 percent of the cells had data counts less than 5. Therefore, Cramer's V tests were computed for these two tables to provide an extra measure of reliability.

Version 6.0.0 of JMP software (Copyright 2005, SAS Institute Inc.) was used to perform the Chi-square tests and pairwise comparisons. Version 9.1.3 of SAS software (Copyright 2006, SAS Institute Inc.) was used to perform the Cramer's V test. SAS software was also used to run the Chi-square tests for Table 14 and Table 17 a second time to ensure the output from both types of software yielded the exact same results.

Chapter IV: Results

Examination of accident data as part of the risk management process allows outdoor adventure recreation program administrators and field staff to make better-informed decisions about actual program risks. This study examines accident data generated over a five-year period from an outdoor adventure program located in the United States using a combination of Hale's Accident Model (1983) and Nicolazzo's Site Management Theory (2004). The study specifically explores the potential for accident trends through stationary or moving sites. The research from this study addresses two identified problems concerning accident analysis. First, the study emphasizes the benefits of accident analysis industry wide to encourage more programs to actively take part in this learning process. Second, it will be inaugural research in the outdoor adventure recreation field that tests accident models using accident data.

This chapter is divided into three sections. The first section describes the characteristics of the data for each variable and the distribution of data among categories. The second section addresses the primary research question: Do more outdoor adventure program accidents occur at moving sites or stationary sites? The third section addresses the four secondary research questions of the study: does the type of activity affect where accidents occur, does the type of incident affect where accidents occur, does individual status affect where accidents occur and is the type of injury affected by where accidents occur?

DESCRIPTIVE STATISTICS

This section describes the distribution of incidents by site type. Almost half of

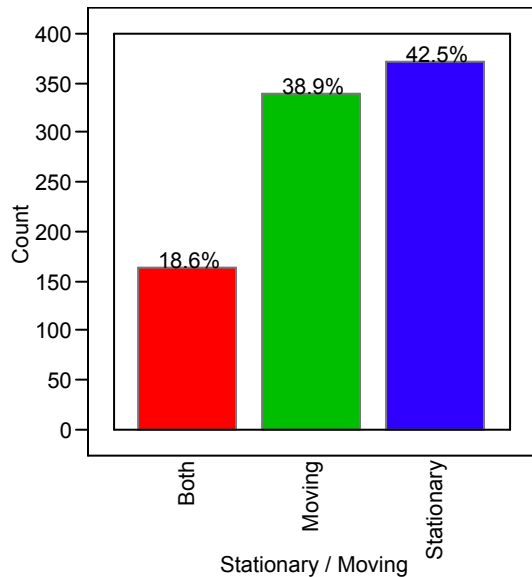


Figure 4 – Frequency of Incident by Type of Site (n=875)

incidents occurred at stationary sites (n=372), while over one-third occurred at moving sites (n=340). The remaining 18.6 percent of incidents occurred at both (n=163). The type of site variable is illustrated in Figure 4.

Figure 5 illustrates the type of incident variable. Injuries (n=340) make up over one-third of the incidents followed by illness (n=248) and near misses (n=152). The remaining 15.4 percent was vehicle/other (n=135).

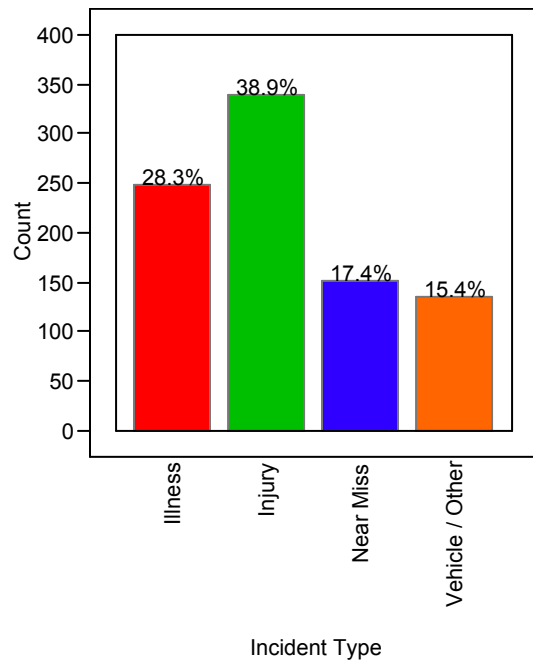


Figure 5 – Frequency of Incident by Type of Incident (n=875)

The type of activity variable is described in Figure 6. Over one fourth of all incidents were backpacking / river crossing (26.4 percent). This was followed by base camp / camping (17.3 percent) and rock climbing (13.1 percent). Canoeing was fourth at 9.8 percent. The remaining activities all ranged from 3 to 6 percent. The activity with the fewest number of incidents was kayaking – sea/lake (3.1 percent).

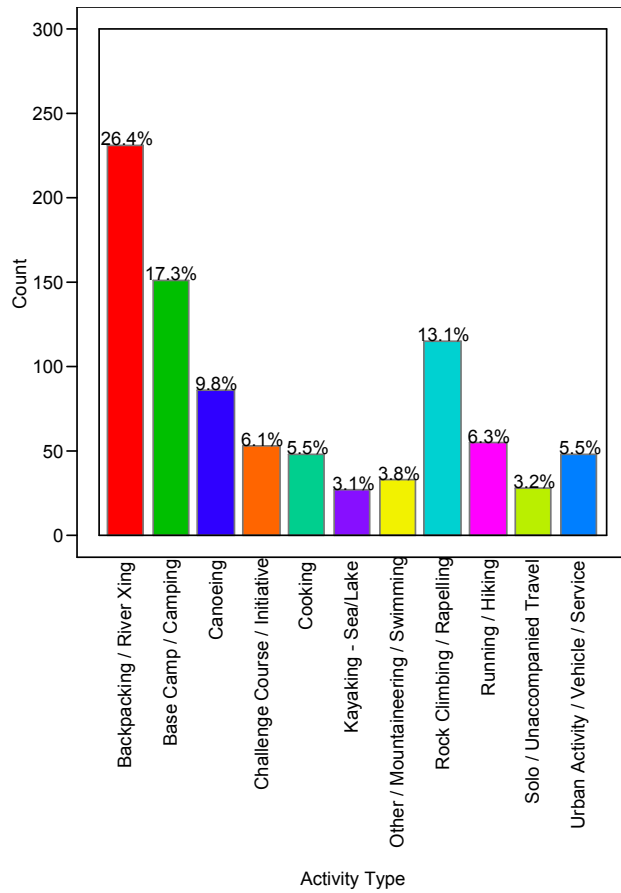


Figure 6 – Frequency of Incident by Type of Activity (n=875)

The type of injury variable is illustrated in Figure 7. The “no injury occurred” category was the largest (31.7 percent) due to a combination of near miss incidents and other incidents resulting in no injury. For incidents that did result in injury, the most common was strains / sprains and tendonitis category (13.9 percent) of total incidents. This was followed by the laceration / puncture / abrasion and contusion (12.3 percent) and infection / skin problem (7.0 percent). All other injury categories were less than 5 percent.

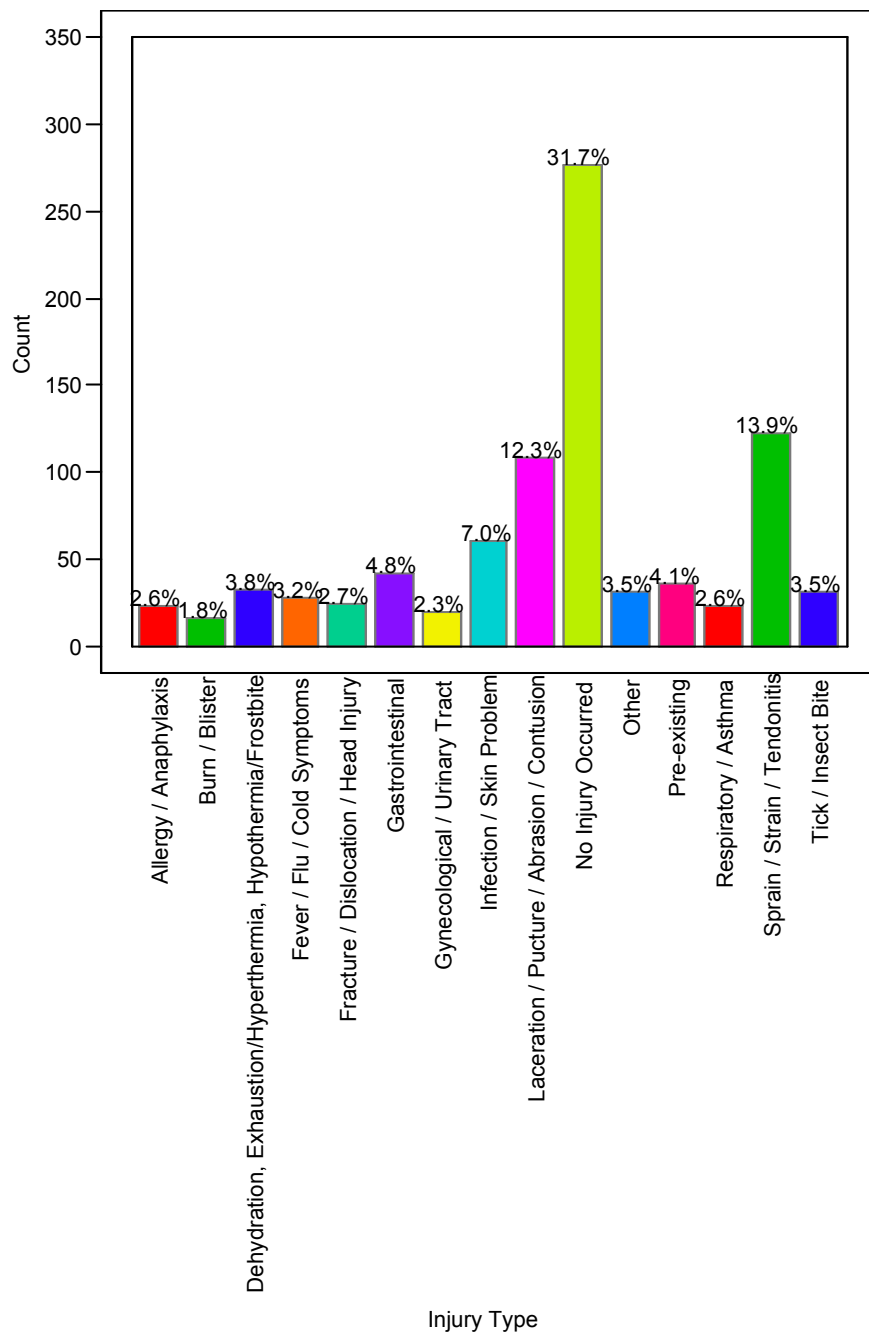


Figure 7 – Frequency of Incident by Type of Injury (n=875)

Figure 8 describes the individual status variable. Students accounted for nine out of every ten incidents (89.1 percent).

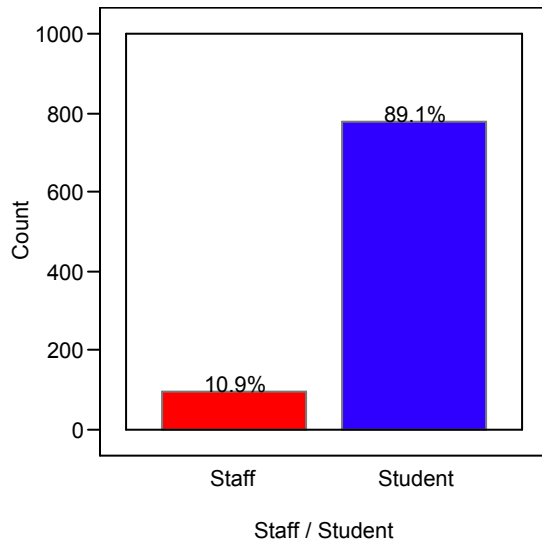


Figure 8 – Frequency of Incident by Individual Status (n=875)

PRIMARY RESEARCH QUESTION AND HYPOTHESIS

This section addresses the primary research question: Do more outdoor adventure program accidents occur at moving sites or stationary sites? The hypothesis examined in this study:

H0: There is no difference in the number of accidents that occur in stationary versus moving sites.

H1: Accidents are more likely to occur at stationary sites opposed to moving sites.

H2: Accidents are more likely to occur at moving sites opposed to stationary sites.

H3: Accidents occur in a combination of both moving and stationary sites.

Data were analyzed utilizing Pearson and Likelihood Ratio Chi-square tests, followed by pair-wise comparisons. The full data set was analyzed, followed by a subset of data using injury and illness and a second subset of data using only injury.

The full data set (n=875) was divided into three categories: stationary site (n=372), moving site (n=340), and both site (n=163). Tables 5 and 6 describe the probabilities and Chi-square test results. The small p-value (<0.05) suggests that the three sites were significantly different with regard to accident occurrence.

Table 5 – Test Probabilities for Entire Data Set

Level	Estimated Probability	Hypothesized Probability
Stationary	0.42514	0.33333
Moving	0.38857	0.33333
Both	0.18629	0.33333

Table 6 – Chi-square tests for Entire Data Set

Test	Chi-Square	DF	Probability>Chi-square
Likelihood Ratio	95.5823	2	p<.0001
Pearson	86.8960	2	p<.0001

Therefore, pair-wise comparisons were performed to compare each pair to the null hypothesis of equality among groups at the .05 significance level. Table 7 illustrates the results of the pair-wise comparison. The comparisons between stationary and both and moving and both were found to be statistically significant. However, the comparison between stationary and moving was not statistically significant, supporting the null hypothesis.

Table 7 – Pair-wise Comparison for Entire Data Set

Test Function	Z	Chi-Square Critical Value	Outcome
Moving - Stationary	1.85	3.84	Not Significant
Both - Stationary	104.15	3.84	Significant
Both - Moving	76.51	3.84	Significant

The second set of data analyzed was the subset: injury and illness. Total counts for categories were: stationary site (n=210), moving site (n=232), and both site (n=146) for a total count of 588 for the injury and illness subset. Tables 8 and 9 describe the probabilities and Chi-square tests results. The small p-value (<0.05) suggests that the three sites were significantly different with regard to accident occurrence.

Table 8 - Test Probabilities for Illness / Injury Subset

Category	Estimated Probability	Hypothesized Probability
Stationary	0.35714	0.33333
Moving	0.39456	0.33333
Both	0.24830	0.33333

Table 9 – Chi-square tests for Illness / Injury Subset

Test	Chi-square	DF	Probability>Chi-square
Likelihood Ratio	21.2216	2	$p<.0001$
Pearson	20.3673	2	$p<.0001$

Therefore, pair-wise comparisons were performed to compare each pair to the null hypothesis of equality among groups at the .05 significance level. Table 10 illustrates the results of the pair-wise comparison for the injury and illness subset of data. The comparisons between stationary and both and moving and both were both statistically significant. However, the comparison between stationary and moving was not statistically significant, thus supporting the null hypothesis.

Table 10 – Pair-wise Comparison for Illness / Injury Subset

Test Function	Z	Chi-Square Critical Value	Outcome
Moving - Stationary	1.39	3.84	Not Significant
Both - Stationary	13.85	3.84	Significant
Both - Moving	24.27	3.84	Significant

The second subset of data to be analyzed was the injury only subset. The total numbers in each category were: stationary site (n=137), moving site (n=167) and both site (n=36) for n=340 for the injury only subset. Table 11 and table 12 describe the probabilities and Chi-square tests results. The small p-value (<0.05) suggests that the three sites are significantly different with regard to accident occurrence.

Table 11 - Test Probabilities for Injury Only Subset

Category	Estimated Probability	Hypothesized Probability
Stationary	0.40294	0.33333
Moving	0.49118	0.33333
Both	0.10588	0.33333

Table 12 – Chi-square tests for Injury Only Subset

Test	Chi-square	DF	Probability>Chi-square
Likelihood Ratio	98.8714	2	p<.0001
Pearson	83.1235	2	p<.0001

Therefore, pair-wise comparisons were performed to compare each pair to the null hypothesis of equality among groups at the .05 significance level. Table 13 illustrates the results of the pair-wise comparison for the injury only subset of data. The comparisons between stationary and both and moving and both were statistically significant. Even though the Chi-square value for the stationary and moving comparison for injury only

was closer to the critical value than the illness and injury data subset, it was not significant, thus supporting the null hypothesis.

Table 13 – Pair-wise Comparison for Injury Only Subset

Test Function	Z	Chi-Square Critical Value	Outcome
Moving - Stationary	2.96	3.84	Not Significant
Both - Stationary	71.2	3.84	Significant
Both - Moving	112.57	3.84	Significant

SECONDARY RESEARCH QUESTIONS AND HYPOTHESES

This section addresses the secondary research questions and each of the corresponding hypotheses:

Does the type of activity affect where accidents occur?

H0: There is no difference comparing type of activity and where accidents occur.

H1: There is a difference comparing type of activity and where accidents occur.

Does the type of incident affect where accidents occur?

H0: There is no difference comparing type of incident and where accidents occur.

H1: There is a difference comparing type of incident and where accidents occur.

Does individual status affect where accidents occur?

H0: There is no difference comparing staff/student status and where accidents occur.

H1: There is a difference comparing staff/student status and where accidents occur.

Is the type of injury affected by where accidents occur?

H0: There is no difference comparing type of injury and where accidents occur.

H1: There is a difference comparing type of injury and where accidents occur.

The Pearson and Likelihood Ratio Chi-square tests were conducted to test each hypothesis.

Does the type of activity affect where accidents occur? The first null hypothesis stated that there is no difference comparing type of activity and where accidents occur. The Chi-square tests examined the relationship between the dependent variable (type of site) and the independent variable (type of activity). Chi-square values were 608 and 492 respectively, and the p value for both was less than .0001, therefore the null hypothesis was rejected (Table 14). For example, the table illustrates that for backpacking and river crossing, the majority of incidents occurred at moving sites (67.1 percent), followed by both sites at 28.57 percent. Very few backpacking and river crossing incidents occurred at stationary sites (4.33 percent). Cramer's V examined the association between type of activity and type of site as an additional test since 24% of the cells in Table 14 had a count of less than five. The Cramer's V was .5305 with a critical value of .1 indicating a strong association between the two variables.

Table 14 – Contingency Table for Type of Activity by Type of Site

Count	Stationary	Moving	Both	
Total %				
Col %				
Row %				
Backpacking / River Crossing	10	155	66	231
	1.14	17.71	7.54	26.40
	2.69	45.45	40.74	
	4.33	67.10	28.57	
Kayaking – Sea/Lake	5	9	13	27
	0.57	1.03	1.49	3.09
	1.34	2.64	8.02	
	18.52	33.33	48.15	
Base Camp / Camping	107	2	43	152
	12.23	0.23	4.91	17.37
	28.76	0.59	26.54	
	70.39	1.32	28.29	
Rock Climbing / Rappelling	85	24	6	115
	9.71	2.74	0.69	13.14
	22.85	7.04	3.70	
	73.91	20.87	5.22	
Running / Hiking	4	43	8	55
	0.46	4.91	0.91	6.29
	1.08	12.61	4.94	
	7.27	78.18	14.55	
Solo / Unaccompanied Travel	16	10	2	28
	1.83	1.14	0.23	3.20
	4.30	2.93	1.23	
	57.14	35.71	7.14	
Urban Activity / Vehicle / Service	20	27	1	48
	2.29	3.09	0.11	5.49
	5.38	7.92	0.62	
	41.67	56.25	2.08	
Other	17	13	3	33
	1.94	1.49	0.34	3.77
	4.57	3.81	1.85	
	51.52	39.39	9.09	
Canoeing	13	57	15	85
	1.49	6.51	1.71	9.71
	3.49	16.72	9.26	
	15.29	67.06	17.65	
Challenge Course / Initiatives	48	0	5	53
	5.49	0.00	0.57	6.06
	12.90	0.00	3.09	
	90.57	0.00	9.43	
Cooking	47	1	0	48
	5.37	0.11	0.00	5.49
	12.63	0.29	0.00	
	97.92	2.08	0.00	
	372	341	162	n=875
	42.51	38.97	18.51	
Test	Value	Probability>Chi-Square	Critical Value	
Likelihood Ratio Chi-Square	608.660	p<.0001		
Pearson Chi-square	492.415	p<.0001		
Cramer's V	.5305		.1 (Outcome Significant)	

Does the type of incident affect where accidents occur? The second null hypothesis stated that there is no difference comparing type of incident and where

accidents occur. The Chi-square tests were conducted to examine the relationship between the dependent variable (type of site) and the independent variable (type of incident). Chi-square values were 174 and 179 respectively, and the p value for both was less than .0001, therefore the null hypothesis was rejected (Table 15). For example, the table shows that roughly 50 percent of all incidents occurring at moving site involved injury, followed by illness (19.12 percent), and vehicle/ other (16.47 percent). Near misses only accounted for 15 percent of all incidents occurring at moving sites.

Table 15 – Contingency Table for Type of Incident by Type of Site

Count	Stationary	Moving	Both	
Total %				
Col %				
Row %				
Injury	136	168	36	340
	15.54	19.20	4.11	38.86
	36.56	49.41	22.09	
	40.00	49.41	10.59	
Illness	73	65	110	248
	8.34	7.43	12.57	28.34
	19.62	19.12	67.48	
	29.44	26.21	44.35	
Near Miss	99	51	2	152
	11.31	5.83	0.23	17.37
	26.61	15.00	1.23	
	65.13	33.55	1.32	
Vehicle / Other	64	56	15	135
	7.31	6.40	1.71	15.43
	17.20	16.47	9.20	
	47.41	41.48	11.11	
	372	340	163	875
	42.51	38.86	18.63	
Test	Chi-Square		Probability>Chi-Square	
Likelihood Ratio	174.123		p<.0001	
Pearson	179.291		p<.0001	

Does individual status affect where accidents occur? The third null hypothesis for the secondary questions stated that there is no difference comparing staff/student status

and where accidents occur. The Chi-square tests were conducted to examine the relationship between the dependent variable (type of site) and the independent variable (individual status). Chi-square values were 14 and 12 respectively, and the corresponding p values were .0006 and .002, therefore the null hypothesis was rejected (Table 16). For example, the table shows that staff are more likely to be involved in an incident at a moving site (50.53 percent), than a stationary site (43.16). Staff are least likely to have an incident occur at a both site (6.32 percent).

Table 16 – Contingency Table for Individual Status by Type of Site

Count	Stationary	Moving	Both	
Total %				
Col %				
Row %				
Staff	41	48	6	95
	4.69	5.49	0.69	10.86
	11.02	14.12	3.68	
	43.16	50.53	6.32	
Student	331	292	157	780
	37.83	33.37	17.94	89.14
	88.98	85.88	96.32	
	42.44	37.44	20.13	
	372	340	163	875
	42.51	38.86	18.63	
Test	Chi-Square		Probability>Chi-Square	
Likelihood Ratio	14.791		p<0.0006	
Pearson	12.418		p<0.0020	

Does the type of site determine the type of injury that occurs? The fourth null hypothesis for the secondary questions stated that there is no difference comparing type of injury and where accidents occur. Chi-square tests were conducted to examine the relationship between the dependent variable (type of site) and the independent variable (type of injury). Chi-square values were 364 and 393 respectively, and the p value for

both was less than .0001, therefore the null hypothesis was rejected (Table 17). For example, in the fracture/dislocation/head injury category, two-thirds of the incidents occurred at a moving site and one-third occurred at a stationary site. There were no incidents occurring at the both site for this category. Cramer's V examined the association between type of activity and type of site as an additional test since 24% of the cells in Table 17 had a count of less than five. The Cramer's V was .4744 with a critical value of .1 indicating a strong association between the two variables.

Table 17 – Contingency Table for Type of Injury by Type of Site

Count	Stationary	Moving	Both	
Total %				
Col %				
Row %				
Dehydration / Hyperthermia / Hypothermia	9	22	2	33
	1.03	2.51	0.23	3.77
	2.42	6.47	1.23	
	27.27	66.67	6.06	
Fever / Flu / Cold	9	1	18	28
	1.03	0.11	2.06	3.20
	2.42	0.29	11.04	
	32.14	3.57	64.29	
Fracture / Dislocation / Head Injury	8	16	0	24
	0.91	1.83	0.00	2.74
	2.15	4.71	0.00	
	33.33	66.67	0.00	
Gastrointestinal	14	3	25	42
	1.60	0.34	2.86	4.80
	3.76	0.88	15.34	
	33.33	7.14	59.52	
Gynecological / Urinary Tract	3	1	16	20
	0.34	0.11	1.83	2.29
	0.81	0.29	9.82	
	15.00	5.00	80.00	
Infection / Skin Problem	11	8	42	61
	1.26	0.91	4.80	6.97
	2.96	2.35	25.77	
	18.03	13.11	68.85	
Laceration / Puncture / Abrasion / Contusion	59	48	1	108
	6.74	5.49	0.11	12.34
	15.86	14.12	0.61	
	54.63	44.44	0.93	
Pre-existing	11	14	11	36
	1.26	1.60	1.26	4.11
	2.96	4.12	6.75	
	30.56	38.89	30.56	
Allergy / Anaphylaxis	10	9	4	23
	1.14	1.03	0.46	2.63
	2.69	2.65	2.45	
	43.48	39.13	17.39	
Respiratory / Asthma	6	16	1	23
	0.69	1.83	0.11	2.63
	1.61	4.71	0.61	
	26.09	69.57	4.35	
Sprains / Strains / Tendonitis	30	81	11	122
	3.43	9.26	1.26	13.94
	8.06	23.82	6.75	
	24.59	66.39	9.02	
Tick / Insect Bite	12	11	8	31
	1.37	1.26	0.91	3.54
	3.23	3.24	4.91	
	38.71	35.48	25.81	
Other	18	5	8	31
	2.06	0.57	0.91	3.54
	4.84	1.47	4.91	
	58.06	16.13	25.81	
No Injury Occurred	160	101	16	277
	18.29	11.54	1.83	31.66
	43.01	29.71	9.82	
	57.76	36.46	5.78	

Table 17 Continued

Burn / Blister	12	4	0	16
	1.37	0.46	0.00	1.83
	3.23	1.18	0.00	
	75.00	25.00	0.00	
	372	340	163	875
	42.51	38.86	18.63	
Test	Value	Probability>Chi-Square	Critical Value	
Likelihood Ratio Chi-Square	364.835	p<.0001		
Pearson Chi-Square	393.859	p<.0001		
Cramer's V	.4744		.1 (Outcome Significant)	

Chapter V: Discussion and Conclusions

Examination of accident data as part of the risk management process allows outdoor adventure recreation program administrators and field staff to make better-informed decisions about actual program risks. This study examines accident data generated over a five-year period from an outdoor adventure program located in the United States using a combination of Hale's Accident Model (1983) and Nicolazzo's Site Management Theory (2004). The study specifically explores the potential for accident trends through stationary or moving sites. The research from this study addresses two identified problems concerning accident analysis. First, the study emphasizes the benefits of accident analysis industry wide to encourage more programs to actively take part in this learning process. Second, it will be inaugural research in the outdoor adventure recreation field that tests accident models using accident data.

This chapter contains four sections. The first section summarizes the study methods. The second section presents a summary of results and conclusions. Section three presents the discussion and implications of the study. Recommendations for further study are explored in section four.

SUMMARY OF METHODS

The study was conducted by collecting categorical data on five variables from 875 accident reports. The accident reports came from a large outdoor adventure program in the United States. Categories were totaled and collapsed to create a manageable data set for analysis. Analysis was completed on the primary research question using Chi-square

tests and pair-wise comparisons. Secondary research questions were analyzed utilizing Chi-square tests. Cramer's V tests were also conducted on two contingency tables with 24% of cell counts less than 5.

SUMMARY OF RESULTS

Results were explained in Chapter IV using descriptive statistics and analyses of the research questions and hypotheses. Results indicated that for the type of site variable, most incidents occurred at stationary sites followed closely by moving sites. Categories for most common incidents (from most to least) were: injury, illness, near miss, and vehicle/other. The three most common activities for an incident to occur during were: backpacking and river crossing, base camp and camping activities, and rock climbing and rappelling. The largest category for type of injury was in fact "no injury occurred", due to the high number of near miss and vehicle/other incidents that resulted in no injury. Of the remaining categories, the top three injury types were: (1) sprains, strains, and tendonitis, (2) lacerations, punctures, abrasions, and contusions, and (3) infection and skin problems. Students were more likely to be involved in an incident than staff at a ratio of 9 to 1.

The null hypothesis for the primary research question, "There is no difference in the number of accidents that occur in stationary versus moving sites", was tested using two Chi-square tests. Results were found to be significant suggesting the three sites are significantly different with regard to accident occurrence. Pair-wise comparisons were then conducted to examine stationary vs. moving, moving vs. both, and both vs. stationary sites. The number of incidents at stationary sites vs. moving sites was not

found to be significant. However, the number of incidents at moving sites vs. both sites and both sites vs. stationary sites were significant. The same procedures were conducted on two subsets of data with similar findings. Based upon the findings and within the limitations of the study, the Chi-square tests support rejection of the null hypothesis. However, results from the pair-wise comparisons do not support rejection of the null hypothesis, so the results from the primary research question and hypothesis are inconclusive.

The secondary research questions and null hypotheses are as follows:

Does the type of activity affect where accidents occur?

H0: There is no difference comparing type of activity and where accidents occur.

Does the type of incident affect where accidents occur?

H0: There is no difference comparing type of incident and where accidents occur.

Does individual status affect where accidents occur?

H0: There is no difference comparing staff/student status and where accidents occur.

Is the type of injury affected by where accidents occur?

H0: There is no difference comparing type of injury and where accidents occur.

Chi-square tests were performed and found to be significant for each hypothesis, indicating a high interaction factor between the two variables being tested. Based upon the findings and within the limitations of this study, there is evidence to support the rejection of all of the null hypotheses for the secondary research questions. Cramer's V

tests for Tables 14 and 17 showed strong associations between type of site and type of activity, and type of site and type of injury.

DISCUSSION AND IMPLICATIONS

The categorical distribution of data among the variables is consistent with the accident research described in Chapter II. The common types of injuries in the study were consistent with the research that presented musculoskeletal and minor trauma injuries as most common (Leemon and Schimelpfenig, 2003, Ela, 2004, Heggie and Heggie, 2004). Findings also supported the premise that students were more likely to be injured than staff (Elliot, Elliot, and Bixby, 2003). Two areas of data that were unable to be compared to previous research were gender and fatalities. Gender was not an available demographic for the study, and there were no fatalities for the program during the 2001-2006 data frame.

The incident report form for the purpose of this study was easy to follow and collect data from. The form is a typical incident report form with the majority of main categories standard for the industry. However, if this form were to be modified for use by the outdoor adventure recreation industry as a whole for incident data collection, a few modifications would be needed. The categories activity at the time of the incident, contributing objective factors and contributing subjective factors would need to be expanded to be inclusive of all outdoor adventure recreation activities and factors, not just those that the specific program operated with. If staff were properly instructed with the definitions of site type, it would be useful to have site type listed on the form. It

would also be helpful to have a defined scale of seriousness of injury from 1 to 10 and have the incident rated on each form. A standardized reporting system for all incidents would remove one barrier from programs sharing incident data industry-wide.

Findings for the primary research question were inconclusive. While statistical analysis supported the idea that all three sites were significantly different with regard to accident occurrence, the analysis also showed that the comparison between stationary and moving sites was not significant. Findings suggest an accident is more likely to occur at either a stationary or moving site rather than at both site. The both site is unique in that an incident has to cross sites in order to be considered in this category. Because of this, it is not surprising that more incidents occur at a single site (moving site or stationary site) rather than a both site.

It has been a long-standing assumption in the adventure recreation industry that moving sites are more dangerous than stationary sites due to non-established boundaries and unknown hazards. However, findings from this study do not support this assumption with regard to frequency of accidents. In order to test this assumption further, the severity of accidents must also be analyzed to see if perhaps the number of accidents are the same at moving and stationary sites but severity is higher at moving sites.

Not enough data were collected to conduct an analysis on type of site for each activity; however, data suggests a series of trends examining site type by individual activities. Data in Table 14 suggests that activities tend to have more accidents in one location vs. another. Cooking, camping, ropes course, and rock climbing were more likely to have accidents at stationary sites. This is due to the fact that the majority of these

activities typically take place at a stationary site for this program. However, a company that programmed more traditional or lead climbing, a moving site, would expect to have a different outcome for the rock climbing activity category. Backpacking, canoeing and hiking were more likely to have incidents at a moving site. These results are logical since the majority of time spent backpacking or canoeing or hiking would be spent at a moving site rather than a stationary site (snack break, bathroom break, etc.). The single activity with the largest number of incidents in the “both” category was sea or lake kayaking. Data suggests that the reason for this is the majority of sea and lake kayaking injuries were infection injuries which developed over time and over several different sites.

The findings of this study are valuable for practitioners. Since there is no significant difference between moving and stationary sites with respect to frequency of accidents, it raises the question why? Perhaps stationary sites despite boundaries and established safe zones are not really “safer”. Perhaps instructors are less structured with supervision at a stationary site, since a stationary site is viewed as “safer”. Perhaps students have more unsupervised time and decision-making at stationary sites, leaving more opportunity for incidents. Perhaps if moving sites are more dangerous, this fact is masked by lower staff to student ratios or higher level of training for staff working in activities traditionally programmed at moving sites. Administrators who can answer this question have the ability to modify procedure and protocol to address potential safety concerns. Field staff can modify supervision practices. This information could be useful for insurers who may incorrectly have more concern for moving sites.

The rejection of all of the secondary questions' null hypotheses suggest strong relationships between type of site and the other accident variables. Near miss and "other" incidents were most likely to occur at stationary sites, injuries at moving sites and illness at both sites. Activity incidents and types of injuries had a tendency to occur at one site over another. This information can help administrators to allocate staff and resources, and provide appropriate staff training. Field staff can more adequately prepare students for programs and more effectively evaluate accident potential.

These findings suggest support for Nicolazzo's Site Management Theory; concluding that type of site is an environmental factor of importance when examining why incidents occur. The significance of type of site has implications for theoretical models like the Meyer and Williamson's Potential Causes of Accidents in Outdoor Pursuits (1979-2003). It could be appropriate to add site as a category for environmental factors for the model.

RECOMMENDATIONS FOR FURTHER STUDY

There are two areas of recommendation for future research: procedural recommendations and substantive recommendations. To maximize the use of data collected, a procedural recommendation would be to collect as much demographic information about each incident as possible. It would be useful to examine whether gender or age played a role in accident occurrence. Other demographic information of interest includes fitness and skill level or experience. Also of procedural significance would be the seriousness of the injury. It has been suggested that moving sites, because

of undefined boundaries and hazards, have higher risk than stationary sites (Nicolazzo, 2004). It was not possible with this research to support this idea with the data concerning the frequency of accidents at these sites, but perhaps that information is evident in the seriousness of injuries that occur in each site.

The substantive findings of this study simply call for more research from additional programs and for longer periods of time. More data would allow for comparisons across programs, collecting industry trend information, and additional analysis examining closer the relationship between type of site and activity. The research in this study suggests relationships between type of site and other accident variables. Future research should seek to explain these relationships. There should be additional research testing Site Management Theory (Nicolazzo, 2004) and other theories to confirm or dispel assumptions that the outdoor adventure industry has about how accidents happen. Additional research should also be conducted on theories developed outside of the outdoor adventure industry such as the High Reliability Theory (Sagan, 1993) for application within the outdoor and adventure recreation field.

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Appendix

Appendix A – Incident Report Form

Incident # _____ Entered by _____ Date _____

Subject Name _____ Age _____		☐ Male ☐ Female ☐ Participant ☐ Staff	
Region _____	Base _____	Course# _____	Type _____
Date of Incident _____	Day of Course _____	#Days in Course _____	Time of Incident _____ AM PM

Incident Type (check Only One) ☐ Injury ☐ Illness ☐ Motivational – (Motivational incident or subject chose to leave the course) ☐ Behavioral – (Behavioral incident or subject was asked to leave the course) ☐ Near Miss – (Serious injury or significant consequences were narrowly avoided) ☐ Vehicle – (Land vehicle - circle vehicle type: truck, van, trailer and # of passengers ____) ☐ Other – (Lost, Public, Boat capsized, etc. Please describe in narrative section)	Incident Outcomes (check All that apply) <u>Date</u> _____ ☐ Subject did not leave the field _____ ☐ Subject left the field _____ ☐ Subject went to a medical facility _____ ☐ Subject returned to the field _____ ☐ Subject left the course _____ (Early Departure for any reason)
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Did the Subject miss a full day of course activity following the date of the incident due to injury or illness? ☐ Yes ☐ No	
How many program days, following the date of the incident, did the Subject miss due to <u>any incident type</u> ? # Days _____	

Behavioral / Motivational Incidents only: (number the Primary Behavior #1, number the secondary behaviors #2,3,4, etc.) <u>or</u> NA	
☐ Physical Harm/ Self ☐ Physical Harm / Others ☐ Other- Please Describe:	☐ Bias Behavior ☐ Fail to Follow Instructions ☐ Drug / Alcohol Use ☐ Verbal Abuse ☐ Sexual Behavior ☐ Refused to Participate ☐ Runaway ☐ Suicide Ideation

Field / Base Communications (check All that apply) <u>or</u> NA ☐ Medical Consultation ☐ Evacuation Support ☐ Management Support ☐ Satellite Phone ☐ Cell Phone ☐ Radio ☐ Land Line	Evacuation Method (check All that apply) <u>or</u> NA ☐ Ambulatory ☐ Assisted / Litter ☐ Helicopter ☐ Fixed Wing ☐ Boat ☐ Other:
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Type of Environment (check All that apply) ☐ River ☐ Lake ☐ Ocean ☐ Forest ☐ Desert ☐ Mountain ☐ Cliff ☐ Glacier ☐ Snow / Ice ☐ Cold Environment ☐ Road ☐ Base ☐ Urban	Surface Condition (check All that apply) <u>or</u> NA ☐ Wet ☐ Dry ☐ Snow ☐ Loose ☐ Ice ☐ Trail ☐ Rock ☐ Flat ☐ Sloped ☐ Other
Temp (°F) _____	Precipitation Type _____
Wind (mph) _____	Visibility (mi) _____ <u>or</u> NA

Type of Injury or Illness (number the Primary Injury or Illness #1, number the secondary factors #2,3,4, etc.) <u>or</u> NA	
☐ Abrasion ☐ Anaphylaxis ☐ Allergy, other ☐ AMS (altitude) ☐ Blister ☐ Burn ☐ Cardiac ☐ Concussion	☐ Contusion ☐ Dehydration ☐ Dental ☐ Dislocation ☐ Exhaustion ☐ Fever ☐ Flu symptoms (cold) ☐ Fracture ☐ Frostbite ☐ Gastrointestinal ☐ Gynecological ☐ Head Injury- No LOC ☐ Head Injury- LOC ☐ Hyperthermia ☐ Hypothermia ☐ Immersion Foot
☐ Infection ☐ Laceration ☐ Pre-existing ☐ Psychological (diagnosed) ☐ Puncture ☐ Respiratory ☐ Skin problem ☐ Sprain	☐ Strain ☐ Tendonitis ☐ Tick / Insect Bite ☐ Urinary Tract ☐ Other:

Location of Injury (number the Primary Location #1, number the secondary locations #2,3,4, etc.) <u>or</u> NA	
☐ Head ☐ Face ☐ Eyes ☐ Mouth ☐ Neck ☐ Shoulder	☐ Chest ☐ Upper Back ☐ Lower Back ☐ Pelvis ☐ Abdomen ☐ Buttock ☐ Genitalia ☐ Upper Arm ☐ Elbow ☐ Forearm ☐ Wrist ☐ Hand ☐ Finger ☐ Upper Leg ☐ Knee ☐ Lower Leg ☐ Ankle ☐ Foot ☐ Toe ☐ Other:

Activity at the Time of the Incident (number the Primary Activity #1, number the secondary activities #2,3,4, etc.) <u>or</u> NA	
☐ Backpacking ☐ Base ☐ Camping ☐ Canoeing-Whitewater ☐ Canoeing-Flatwater ☐ Cataracting ☐ Caving ☐ Challenge Course	☐ Cooking ☐ Cycling ☐ Dog Sledding ☐ Glacier Travel ☐ Hiking ☐ Horseback Riding ☐ Initiative ☐ Kayaking-Inflatable ☐ Kayaking-River ☐ Kayaking-Sea / Lake ☐ Mountaineering ☐ Mountain Biking ☐ Portaging ☐ Rafting ☐ Rappelling ☐ River Crossing
☐ Rock Climbing ☐ Running ☐ Sailing ☐ Service ☐ Skiing ☐ Snowboarding ☐ Snow / Ice Climbing ☐ Snowshoeing	☐ Solo ☐ Surfing ☐ Swimming / Dipping ☐ Unaccompanied Trav. ☐ Urban Activity ☐ Vehicle / Van ☐ Other:

Page 2 Subject Name _____ Course Number _____ Incident Date _____

Contributing Objective Factors (number the Primary Factor #1, number the secondary factors 2,3,4, etc.) or NA			
☐ Altitude	☐ Fall on Snow	☐ Infection	☐ Psychological (diagnosed)
☐ Avalanche	☐ Falling Rock	☐ Lightning	☐ Screening, Improper or Not Reported
☐ Clothing	☐ Loose Rock (not rockfall)	☐ Medication	☐ Technical Systems Failure
☐ Darkness	☐ Fast Water	☐ Missing / Lost	☐ Improper Technique
☐ Dehydration	☐ Hazardous Animal / Insect	☐ Overuse Injury	☐ Unclipping
☐ Drugs / Alcohol	☐ Hostile Bystander	☐ Person Overboard	☐ Unidentified Hazard
☐ Equipment	☐ Hygiene	☐ Poor Visibility	☐ Weather
☐ Fall / Slip	☐ Immersion	☐ Pre-Existing Illness / Injury	☐ Other: (specify)

Contributing Subjective Factors (number the Primary Factor #1, number the secondary factors 2,3,4, etc.) or NA			
☐ Administrative Support	☐ Hazard and Risk Assessment	☐ Motivation	☐ Staff Positioning
☐ Exceeded Ability / Unfit	☐ Inattention	☐ Participant Assessment	☐ Staff Training
☐ Exhaustion / Fatigue	☐ Instruction	☐ Safety Policy Violation	☐ Supervision
☐ Failure to Follow Inst.	☐ Logistical Support	☐ Schedule / Itinerary	☐ Other (specify)
☐ Group Dynamics	☐ Misbehavior	☐ Site reconnaissance	

How many staff were assigned to the patrol for the activity?	☐ One	☐ Two or More	☐ None
How many staff were present at the time of the incident?	☐ One	☐ Two or More	☐ None

Were Body Fluids Spilled?	☐ Yes	☐ No	If YES, were universal precautions followed?	☐ Yes	☐ No
Were Medications Administered?	☐ Yes	☐ No			
Date	Drug Name / Quantity	Problem	Administered By		
_____	_____	_____	_____		
_____	_____	_____	_____		
_____	_____	_____	_____		

NARRATIVE Concisely summarize the incident in 2 or 3 sentences. Be sure to summarize the entire incident in this section, including the outcome. Attach additional documentation to this report, including SOAP notes, Physician's Visit Forms, Early Departure documentation, notes of conversations with parents, etc., as required.

FIELD STAFF ANALYSIS How could this incident have been prevented? What lessons have been learned?

NAME _____ POSITION _____ DATE _____

STAFF INVOLVED _____

PROGRAM MANAGER (CD/ PM/ PD) ANALYSIS

COURSE DIRECTOR _____ DATE _____

PROGRAM DIRECTOR _____ DATE _____