

BRIEF REPORT

## Epidemiology of Search and Rescue in Baxter State Park: Dangers of Descent and Fatigue

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**Objective.**—The purpose of this study was to determine the epidemiology of injury in Baxter State Park, Maine, and to better tailor search and rescue (SAR) resources, personnel, and training to acute needs in the park.

**Methods.**—We conducted a retrospective review of all SAR incident reports in Baxter State Park from July 1992 through June 2014. For each event, demographics, location, time, activity before the incident, incident details, and evacuation means were recorded and analyzed.

**Results.**—In all, 754 incidents of SAR or medical need were identified. Mean age was 38.9 years; mean age for subjects with fatigue as the primary complaint was 48.7 years. A majority (60.5%) of victims were male. Nineteen fatalities occurred during the study. Traumatic injuries precipitated 51% of SAR incidents, and an additional 30% were initiated for late or lost parties. Slips or falls while hiking were the most common causes of injury (67%), with the lower extremity being the most common injury site (31%). When applicable, 84.4% of acute need occurred while descending, as opposed to ascending, a mountain. Fatigue was the most commonly reported medical emergency, causative in 66% of medical SAR events.

**Conclusions.**—Fatigue is a major factor in SAR events, both as a discreet cause and as a contributor to other injuries. Search and rescue need is more likely to occur during mountain descent, and lower extremity injuries are the most common etiology. Efforts should be focused on training rescuers in lower extremity and fatigue treatment, and more rescuers should be available when many are descending.

*Key words:* wilderness medicine, epidemiology, recreation

### Introduction

Outdoor recreational activities continue to gain popularity across the United States, and although these sites attract visitors with a wide range of health statuses, many of the recreational activities that park visitors engage in are risky.<sup>1–10</sup> Previous research has focused on determining the epidemiology of wilderness search and rescue (SAR) events in national park settings<sup>8,9</sup> and in individual states,<sup>2,6,7</sup> as well as emergency medical services responses to wilderness emergencies.<sup>3,5</sup> Scant data regarding SAR events in wilderness locations in the eastern United States exist. To our knowledge, no

published data evaluating SAR incidents in Maine's unique and remote wilderness are available.

Many visitors to Baxter State Park, home of Maine's highest peak, aspire to summit the mountain, often underestimating the physical conditioning and supplies necessary for navigating the rugged terrain (personal communication, Ben Woodard, July 2014). Located in northern Piscataquis County, Baxter State Park averages 128,504 visitor-days per year. The demographic characteristics of park visitors follow those of the state, the country's most aged, with the 51- to 55-year-old age group representing the highest proportion of park visitors (personal communication, Ben Woodard, July 2014). Little is known about the influence of older age on wilderness SAR events, as previously published works typically describe a younger population.<sup>1,2</sup> In addition, although existing literature has identified exhaustion or fatigue as a potential cause of injury, the wilderness SAR

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literature has not described fatigue as it relates to the need for SAR response.<sup>1-8</sup> It is possible that fatigue plays an important role in precipitating SAR events for Baxter's unique cohort of older hikers.

In addition, the role of hiking phase (ascending/descending a mountain) is not discussed in currently available wilderness medicine literature. Understanding when park visitors are most vulnerable to hiking-related injuries may assist in planning for potential rescue situations and resource distribution. Therefore, the primary objective of this study was to describe the epidemiology of wilderness SAR events in Baxter State Park's unique wilderness setting so park rangers and administrators can more efficiently distribute and train personnel within limited educational and operational budgets.

## Methods

### STUDY DESIGN

This was a retrospective analysis of Baxter State Park incident report records generated from the inception of record-keeping in July 1992 through study initiation in June 2014. Baxter State Park granted permission for data use, and our Institutional Review Board exempted the study and waived the requirement for written informed consent.

### SETTING AND SUBJECTS

Baxter State Park is a 209,501-acre wilderness area located in Millinocket, Maine. The park is home to Mount Katahdin, with Katahdin's highest point, Baxter Peak, also being the northern terminus of the Appalachian Trail. The park's terrain is rugged, consisting of mountainous clusters, multiple bodies of water, hiking and snowmobile trails, hunting and fishing areas, as well as camp sites. There is no electricity or running water in the park and weather conditions are often harsh, with an average temperature of 38.6°F (3.7°C), average annual precipitation of 37 inches, and snowfall possible in any month.

Subjects were park visitors who either required a SAR response from park rangers or directly approached a ranger for medical or evacuation-type support. Incidents of search and rescue for false alarms were excluded.

### STUDY DATA

Baxter SAR personnel are required to fill out a report for each incident in which they are involved. Although report format has changed over time, all reports included a prose narrative that provided data for the study. Park rangers logged incidents in several ways. Individual

reports were logged when responses for individual hikers were required. When support for parties of hikers was needed, rangers usually logged an individual report for each injured party member. However, when a party required assistance owing to extreme fatigue or being lost, 1 report was logged for the entire group. In our analysis, each person with medical need was logged separately, whereas lost parties were encompassed in a single point. In exhausted-party reports, the event was logged using the demographics of the visitor described as slowing the group down, unless multiple members were explicitly and independently described as fatigued, at which point they were analyzed as individual events.

### DATA ANALYSIS

Data were analyzed using both Microsoft Excel (Microsoft, Redmond, WA) and IBM SPSS Statistics version 22 (IBM Corp, Armonk, NY) statistical software. Statistical significance was set at an alpha of <0.05. Descriptive statistics were used to describe the characteristics of the population. Frequencies are described using numbers and percentages. Group comparisons were made using the independent samples *t* test,  $\chi^2$  analysis, or Fisher's exact test.

### Results

Baxter State Park conducted 750 SAR missions between July 1992 and July 2014. Of these missions, 7 reports described 2 injured persons and 3 were false alarms, yielding data from 754 incidents for analysis. There were 27.4 SAR incidents per 100,000 visitor days during the study period. June through September were the most common months for SAR need (Figure 1). Saturday, the busiest park day, was the most common day of the week for rescue events (Figure 2). The mean age of study subjects was 38.9 years, with more than 1.5 males per 1 female (60.4% male, *n* = 429). Demographic characteristics are presented in Table 1.

A specific primary cause of the incident was reported for 100% of cases. These are detailed in Table 2. Fifty-one percent (*n* = 386) of events were precipitated by a traumatic injury. Traumatic injury cause was recorded for 84% (*n* = 290 of 386) of cases. Of those, injuries resulting from falls or slips represented 66.6% (*n* = 193), rolled or twisted ankles comprised 16.9% (*n* = 49), and other mechanisms accounted for 16.6% (*n* = 48).

Fatigue was the most common medical emergency, with ranger response for extreme fatigue required in 149 cases (19.8% of total cases, 65.9% of medical cases). The mean age of fatigued visitors was significantly

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