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## ORIGINAL RESEARCH

# Unique Occupational Hazards of Alaska: Animal-Related Injuries

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**Objective.**—During 1992–2000, an average of 40 fatal occupational injuries and 12 400 nonfatal occupational injuries and illnesses related to animals were recorded each year in the United States, most involving domestic farm animals. Although Alaska has a relatively small farming industry, it supports several industries that require workers to regularly be in contact with animals. This study examines the pattern and characteristics of animal-related occupational injuries in Alaska.

**Methods.**—Two data sources were accessed: the Alaska Trauma Registry for nonfatal injuries requiring hospitalization and the Alaska Occupational Injury Surveillance System for fatal injuries. The case definition included events in which the source of the injury was an animal or animal product (*Occupational Injury and Illness Classification Manual* source code 51).

**Results.**—In Alaska during 1991–2000, there were 43 animal-related occupational injuries requiring hospitalization and 25 animal-related fatalities. There were only 2 fatal events: 1 bird-strike aircraft accident killing 24 military personnel and 1 bear attack. The majority of the nonfatal injury events were related to marine wildlife ( $n = 20$ ), with the rest related to either domesticated ( $n = 11$ ) or nondomesticated ( $n = 12$ ) mammals. Of events reporting a hospital charge (23 of 43), the average cost was over \$9700 per person.

**Conclusions.**—The catastrophic aircraft crash increased bird-control efforts near airports around the state. The nonfatal animal-related injuries have received less notice, although they result in thousands of dollars in hospital costs and lost workdays. Fishing-industry workers in particular should be made aware of potential injuries and educated on how to treat them when away from definitive medical care.

*Key words:* animal, fatality, occupational injury or illness, Alaska, workplace

## Introduction

Animal-related occupational injuries affect workers across the United States. During 1992–2000, the Bureau of Labor Statistics recorded 366 fatal occupational injuries whose primary source was an animal, comprising 0.6% of all fatal occupational injuries (Census for Fatal Occupational Injuries).<sup>1</sup> If fatal injuries in which an animal was a secondary source are included, the number

rises to approximately 1% of all fatal occupational injuries,<sup>1,2</sup> indicating that 1 of 100 occupational fatalities is attributed to an animal-related event. The Bureau of Labor Statistics estimated more than 111 000 nonfatal animal-related injuries and illnesses, requiring 1 or more days away from work, during the same period (Survey of Occupational Injuries and Illnesses),<sup>1</sup> comprising 0.6% of all nonfatal occupational injuries resulting in missed workdays. The most common animals involved in occupational fatalities in the United States are domestic farm animals, specifically cattle and horses.<sup>2–4</sup> Large animals such as these can inflict injuries to a number of regions of the body that result in multiple days in a hospital<sup>5</sup> and missed work.

Alaska is a unique place within the United States in many ways. It is the largest state in the nation, with twice the land of Texas.<sup>6</sup> Forty percent of the state's

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population lives outside large cities (Anchorage, Juneau, Fairbanks; 2000 US Census),<sup>6</sup> and many workers often work in or travel through rugged and remote terrain away from definitive medical care. Although Alaska has a relatively small farming industry, employing less than 1% of the workforce,<sup>7</sup> it has other large animals and supports several industries that require workers to regularly be in contact with animals. Two relatively common large wild animals that live in or near residential and commercial areas are moose and bears. The risk of a daily commuter having a motor vehicle crash with a moose on one of Alaska's highways is the same as the risk of being involved in an alcohol-related traffic accident.<sup>8</sup> In the southern coastal areas of Alaska, where the state's large cities are located, densities of brown bear reach over 175 bears per 1000 km<sup>2</sup>.<sup>9</sup> The wildlife and rugged terrain of Alaska are linked to several industries in which workers regularly interact with animals. In 2003, over 25 000 commercial fishing permits were issued in Alaska (Commercial Fisheries Entry Commission).<sup>10</sup> Fishery workers are exposed to several kinds of animal-related injuries, including lacerations or punctures, blunt injuries from large fish, and toxins from sea urchins and rockfish. Traumatic injuries can be complicated by infection, often leading to hospitalization and time away from work. Service industries including tourism, such as bear viewing, dog sledding, fishing, and hunting services, cater to visitors' fascination with wildlife and put these workers in direct contact with animals.

This study examines the pattern and characteristics of occupational injuries related to animals in Alaska and compares them with nationwide patterns in order to identify areas where worker safety could be improved.

## Methods

Two data sources were queried for animal-related injuries: the Alaska Trauma Registry for nonfatal injuries requiring hospitalization and the Alaska Occupational Injury Surveillance System for fatal injuries. The Alaska Trauma Registry is a population-based trauma registry that collects information from all 24 acute-care hospitals in Alaska. It includes data from 1991 onward on patients who, because of injuries, have been admitted to a hospital as inpatients or for observation, transferred to a hospital with a higher level of care, or declared dead in the emergency department. Patients who have not been treated within 30 days after injury are excluded, and those with preexisting chronic injuries are counted just once if the injuries are reoccurring.<sup>11</sup> Only data on patients' first admissions after injury are included in this analysis, and this data source was used only for nonfatal injuries. The Alaska Trauma Registry is maintained by

the Alaska Department of Health and Social Services, Division of Public Health, Section of Community Health and Emergency Medical Services, with financial, technical, and analytic support by the National Institute for Occupational Safety and Health. The Alaska Occupational Injury Surveillance System is maintained by the National Institute for Occupational Safety and Health Alaska Field Office and includes data from 1990 onward on all traumatic occupational fatalities that occurred within Alaska. Deaths due to disease, such as coronary heart disease, that occurred during work hours are not included in the database. For consistency across the 2 databases, injuries occurring only during the 10-year period 1991–2000 were included.

The case definition for inclusion in this study was that the injury occurred while the person was working and that the injury was related directly or indirectly to an animal. Injuries that occurred during work follow the Operational Guidelines for Determination of Injury at Work<sup>12</sup> originally distributed by the Association for Vital Records and Health Statistics. Both paid and volunteer activities are included, but commuting to or from the worksite is not. Only injuries to workers aged 16 years or older were reviewed. An occupational animal-related injury included all events in which the primary or secondary source of the injury was an animal or animal product (*Occupational Injury and Illness Classification Manual*<sup>13</sup> source code 51). This includes all living animals except humans and all animal products except food. For example, injuries from fish when first brought on board a boat and during initial processing are included, whereas injuries from boxes of frozen fish are not. An animal may be a secondary source if it was involved in the event but not the direct source of the injury (eg, a motor vehicle crash immediately after the driver swerved to avoid a moose).

For comparison purposes, nonfatal nonoccupational injuries to people aged 16 years or older that occurred in Alaska during the study period were examined from the Alaska Trauma Registry. This included all hospitalized injuries in which the primary or secondary source of the injury was an animal.

Data were analyzed by the SAS 9.0 (SAS Institute, Cary, NC) program. Differences between groups were compared by using chi-squared tests of independence, likelihood ratio test, and *t* test for independent means, with a significance level of .05.

## Results

### FATAL INJURIES

During the 10-year period 1991–2000, 2 events resulted in 25 fatal animal-related injuries in Alaska (Table 1).

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**Table 1.** Number of people injured at work in an animal-related event by type of animal

<i>Animal group/ animal</i>	<i>Fatal injuries</i>	<i>Nonfatal injuries</i>
<b>Marine wildlife</b>		
Total	0	20
Fish		13
Sea urchin		3
Crab		2
Jellyfish		2
<b>Nondomesticated mammal</b>		
Total	1	12
Bear	1	7
Moose		3
Muskrat		1
Reindeer		1
<b>Domesticated mammal</b>		
Total	0	11
Cat		3
Cattle		3
Horse		3
Dog		2
Bird	24*	0
Total	25	43

\*Deaths from a single aircraft accident caused by bird strike.

In 1995, a military plane carrying 24 personnel hit a flock of geese during take-off, stalling both port engines because of bird ingestion, and then crashed. The other event was a brown bear attack on a seismic exploration worker in 1998. The bear attacked and killed the worker as he unknowingly walked within 40 feet of the bear's winter den.

The animals involved in the Alaska occupational deaths were different from those involved in occupational deaths in the United States overall during 1992–1997. The most common animals involved in occupational fatalities in the United States are domesticated mammals, specifically cattle and horses,<sup>2–4</sup> whereas the few fatalities in Alaska were caused by wild birds and a bear (Table 2). Fatal injuries resulting from insects (eg, bees, wasps) and arachnids (eg, spiders, scorpions, ticks) accounted for 11% of the animal-related occupational deaths in the United States overall but none in Alaska.

## NONFATAL INJURIES

During the same time period there were 43 animal-related nonfatal occupational injuries in Alaska requiring inpatient hospitalization (Table 1). The majority of the nonfatal injury events were related to marine wildlife ( $n = 20$ ), with the remaining related to either domesticated ( $n = 11$ ) or nondomesticated ( $n = 12$ ) mammals. Most marine wildlife-related events involved fish ( $n = 13$ ) and most mammal-related events involved bears ( $n = 7$ ).

Available nonfatal injury data for the United States overall from the Survey of Occupational Injuries and Illnesses includes injuries and illnesses that resulted in

**Table 2.** Percentage of people injured at work in an animal-related event by type of animal\*

<i>Animal group</i>	<i>Alaska† fatal injuries</i>	<i>US‡ fatal injuries</i>	<i>Alaska§ nonfatal injuries</i>	<i>US   nonfatal injuries and illnesses</i>
Marine wildlife	...	...	47	3
<b>Mammal</b>				
Total	4	81	53	43
Domesticated¶	...	68	26	41
Nondomesticated	4	13	28	2
Insects/arachnids	...	11	...	48
Bird	96	...	...	2
Other	...	...	...	3

\*Percentages may not sum because of rounding or the application of publication criteria for the United States data. Ellipses represent either no documented injuries or values not meeting publication criteria for the national data.

†Alaska Occupational Injury Surveillance System data 1991–2000, does not include fatal work illnesses.

‡Census of Fatal Occupational Injuries data 1992–1997,<sup>2</sup> does not include fatal work illnesses.

§Alaska Trauma Registry data 1991–2000, injury requiring hospital admission.

||Survey of Occupational Injuries and Illnesses data 1992–1997,<sup>2</sup> illness or injury requiring 1 or more days away from work.

¶Domesticated includes cats, dogs, cattle, horses, mules, sheep, pigs; nondomesticated includes all other mammals.

1 or more days off work to recover. Thus, they are not strictly comparable with Alaska Trauma Registry data that include injuries requiring 1 or more days in the hospital. Both data sets are presented together (Table 1) because they indicate the types of animals implicated in injuries resulting in lost work. For the entire country, insects and arachnids are most often the source of non-fatal occupational injuries and illnesses. Nondomesticated mammals are rarely involved in injuries and illnesses in the United States overall, comprising only 2% of all animal-related nonfatal occupational injuries and illnesses. Although marine wildlife are involved in 47% of animal-related nonfatal injuries requiring hospitalization in Alaska, they are involved in only 3% of injuries and illnesses resulting in missed work in the United States overall.

Most of the workers with animal-related injuries were in service-industry occupations ( $n = 15$ ) that regularly come in contact with animals, such as fishing and hunting guides, animal researchers, handlers, and groomers. The next 2 industries with the most animal-related worker injuries were seafood processing ( $n = 9$ ) and fishing ( $n = 8$ ). Nine of the 43 people with animal-related injuries were from out of state, and 5 of those worked in the fishing or seafood-processing industries.

The injuries sustained were determined to be non-life threatening (Abbreviated Injury Scale [AIS]<sup>14</sup>: 7 minor, 32 moderate, and 4 serious) because most injuries were external, affecting only skin and muscles. The 4 serious injuries were caused by bears ( $n = 2$ ), a reindeer, and a horse. These 4 injuries also had the highest Injury Severity Scores<sup>15</sup> (ISS between 13 and 17), indicating that there may have been injury to multiple regions of the body. Thirteen of the 20 marine wildlife-related injuries were open (ICD9-CM Codes 870–897) or infected superficial wounds (ICD9-CM Codes 914.9, 919.7), and 9 of these occurred in the hand or fingers.

Most victims were Alaska residents (77%), male (79%), and white (79%), with Alaska Natives comprising the next most numerous other racial or ethnic group (12%). Of all Alaskan workers, an estimated 82% are residents.<sup>16</sup> Most are white (77%), with Alaska Natives comprising 11% of all Alaskan workers, and about half are male (53%) (2000 Census of Population & Housing, from Alaska Department of Labor & Workforce Development).<sup>17</sup>

The majority of workers were admitted to a hospital 1 or more days after their injury events (56%). Delay of medical care was related to the type of animal involved in the injury; more people with injuries related to nondomesticated mammals obtained care the day of the event compared with people with injuries related to marine or domesticated animals ( $\chi^2 = 6.53$ ,  $df = 2$ ,  $P =$

.04). Delay of medical care was unrelated to injury severity as measured by AIS (likelihood ratio test = 0.87,  $df = 2$ ,  $P = .65$ ), the number of days spent in the hospital ( $t$  test = 1.34,  $df = 41$ ,  $P = .19$ ), or the hospital charge ( $t$  test =  $-0.59$ ,  $df = 37$ ,  $P = .56$ ). Workers who were hospitalized 1 or more days after their injuries were more likely to have an open wound or infected superficial wound as their primary diagnosis, although the test was only marginally significant ( $\chi^2 = 3.20$ ,  $df = 1$ ,  $P = .07$ ).

Injured workers spent an average of 2.8 days in the hospital (range 0–10). Of those reporting a hospital charge (23 of 43), the average cost was over \$9700 per person. When examining only those who were admitted for more than 24 hours ( $n = 22$ ; excludes those immediately transferred to other hospitals or admitted for brief observation), the average cost was over \$10,000 per person. The average number of days spent in the hospital for cases reporting a charge (2.9 days) was very similar to those without charge information (2.8 days), indicating that the charges reported are probably representative of all 43 cases. The majority of people were discharged home ( $n = 37$ ), with 4 transferred to another acute-care hospital (2 unknown). The 4 people who were transferred to another acute-care hospital had injuries from bears ( $n = 2$ ), a rockfish, and a horse.

Injury events related to marine wildlife occurred mostly in the Aleutian Islands ( $n = 6$ ) and southeast Alaska ( $n = 8$ ), whereas the nondomesticated animal injuries occurred primarily in Fairbanks ( $n = 3$ ), elsewhere in the interior ( $n = 2$ ), and Kodiak ( $n = 2$ ). The highest number of domesticated animal injuries occurred in the Mat-Su Valley ( $n = 3$ ), although such injuries occurred all over the state.

Alcohol was documented in only 1 injured worker, who had a blood alcohol level of 0.17 mg %.

Nonoccupational animal-related injuries to people in Alaska were much more numerous than occupational injuries, with 610 occurring during the study period. The majority of these were related to domesticated mammals ( $n = 415$ , 68%), specifically dogs ( $n = 209$ ) and horses ( $n = 130$ ). Nondomesticated mammals were the next most common source of nonfatal animal-related injuries ( $n = 173$ , 28%), with almost all involving moose ( $n = 142$ ) usually in motor vehicle incidents. Fewer than 1% of the injuries involved marine wildlife. The vast majority of the people involved in these nonfatal injury events were Alaska residents (92%) and white (70%).

## Discussion

Animal-related occupational fatalities and nonfatal serious injuries in Alaska show a different pattern of animals

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involved and types of injuries sustained than those in the rest of the United States. These differences are likely because of the unique, rural habitat of Alaska. The lack of roads and low density of people mean that many types of workers come in contact with potentially dangerous wildlife such as moose and bears. There are also many occupations in Alaska where contact with wildlife is part of the job, such as fishing and hunting guides, dog-sled handlers, deckhands, and fish processors, among others. The occupations with the highest number of animal-related injuries in Alaska were service industry and fishing or seafood-processing industry positions. This pattern is different from other studies examining animal-related occupational fatal<sup>3,4</sup> and nonfatal<sup>2</sup> injuries in the United States overall, where occupations on farms had the highest number of injuries.

Although the overall number of fatal and nonfatal events presented in this study is small, the costs associated with these events were not trivial. The fatal plane crash from a bird strike represents the single most expensive event both in the number of lives lost and in associated costs. Twenty-four people died in that crash; the average age of the personnel was 31 years old. The aircraft involved was an E-3 Sentry (Airborne Warning and Control System) plane worth approximately \$180 million dollars.<sup>18</sup> Costs associated with nonfatal animal-related occupational injuries include direct hospital expenses, outpatient follow-up care, and lost workdays. The direct hospital charges for the injured individuals were substantial, averaging over \$9700 per person. Previous studies examining animal-related occupational injuries using Census of Fatal Occupational Injuries<sup>3,4</sup> and Survey of Occupational Injuries and Illnesses<sup>2</sup> data were unable to assess the associated costs.

Many interventions have been put in place both in response to animal-related injuries and as general prevention measures. The incident involving the military aircraft in 1995 spurred the reevaluation of many goose-control measures at Elmendorf Air Force Base near Anchorage. Current measures include the elimination of small ponds and water sources, monitoring insect levels (potential food source), and habitat modifications near the runway (Major W. Browne, Elmendorf Air Force Base, oral communication August 2004). Birds are also a hazard for nonmilitary aviation. Of the 60 aviation accidents involving birds in the United States during 1990–2000, Alaska had the most of any state ( $n = 15$ , 25%). Eight of the 15 accidents in Alaska involved commercial aircraft flying as air taxis (NTSB Aviation Accident Database).<sup>19</sup> Since the fatal bird strike of the military plane in 1995, a combination of lethal (shooting, egg collecting) and nonlethal (habitat modification, haz-

ing, gosling translocations) activities have resulted in a decline in the number of Canada geese in Anchorage.<sup>20</sup>

All three bear species that inhabit North America live in Alaska: the black bear (*Ursus americanus*), the brown or grizzly bear (*Ursus arctos*), and the polar bear (*Ursus maritimus*). Bear attacks are frightening to consider but remain extremely uncommon.<sup>21–23</sup> This study found 7 occupational injuries requiring hospitalization related to bear attacks and 1 worker fatality. In comparison, during the study period there were 11 nonoccupational fatal bear attacks on people in Alaska (Tom S. Smith, oral communication regarding previously published data,<sup>24</sup> May 2005). Many employers recognize the potential danger of bears and therefore train and equip their employees appropriately. An example program is the United States Fish and Wildlife Service Bear Safety Policy as implemented in Region 7 (revised March 27, 2003). Personnel working in bear habitat are required to complete and pass a 4-hour course on bear safety. All parties are required to have at least 1 designated shooter with a firearm who has completed and passed the firearm safety course. This and similar measures by other employers are probably responsible for the low number of occupational injuries related to bears. The nonfatal injuries that did occur were costly; the 3 most expensive reported hospital stays were injuries related to bears.

In 1995, Alaska had the highest known moose-vehicle accident rate in the world,<sup>8</sup> with accidents occurring both in rural areas and within the state's largest city, Anchorage.<sup>25</sup> The vast majority of moose-vehicle crashes do not result in fatalities.<sup>26</sup> There were over 1200 moose-vehicle crashes in Anchorage during 1990–2000, about 300 people injured, and 2 fatalities (T. Neri, unpublished data using Alaska Department of Transportation data). There were only 3 moose-related occupational injuries requiring hospitalization in Alaska during 1991–2000, and 2 of those were vehicle related. In the non-occupational nonfatal injury data, moose accounted for a much larger proportion (23%) of all animal-related injuries. Again, the case definition of 'at work' does not include commuting to and from the worksite.<sup>12</sup> In 2001, a \$1.3 million state project was undertaken to illuminate a 3-mile section of the Glenn Highway so motorists might see moose in the Palmer hay flats before the animals enter the roadway. The effectiveness of this project is still under review.

The majority of nonfatal occupational animal-related injuries had marine wildlife as the source and consisted of open or infected wounds. These wounds were more likely to occur on the hand, which is a uniquely vulnerable site because of its anatomy and functional importance. Tendon sheaths of the hand are poorly vascularized and the fascial spaces communicate with each other,

spreading any infection internally.<sup>27</sup> Wounds from fish spines, bones, or teeth have a high risk of infection. Irrigating such penetrating wounds can result in edema from the infused saline, which can, in turn, further trap bacteria and foreign material inside the wound.<sup>27</sup> Previous work has identified *Staphylococcus* and *Streptococcus* species as the most common source of infections acquired in the marine environment.<sup>28</sup> Proper treatment in the field can reduce the risk of complications.<sup>29,30</sup>

Toxins produced by marine animals can also complicate injuries. These toxins cause local inflammation, which slows wound healing and increases the risk for infection. A toxin isolated from sea urchins has been shown to cause histamine release from mast cells.<sup>31</sup> The resulting swelling can contribute to poor wound irrigation and retention of bacteria. Rockfish, members of the family *Scorpaenidae*, have venomous spines that release a mixture of proteins that have inflammatory properties.<sup>32</sup>

Although jellyfish have stinging cells on their tentacles that can produce painful welts or rashes at the site of contact, the 2 jellyfish-related injuries in this study resulted not from stings but from slipping on jellyfish on fishing vessels. Falls were the second most common event leading to hospitalized nonfatal injuries in the commercial fishing industry in Alaska during 1991–1998.<sup>33</sup>

This study replicates previous findings that many victims of wild-animal injuries do not seek medical attention until infection or complications occur.<sup>27</sup> Two possible scenarios can explain why most nonfatal animal-related occupational injuries in Alaska were not treated the day of the event. The first is that many of the injuries may have occurred a substantial distance from any hospital, including injuries that occurred on a fishing vessel at sea. Alaska has only 24 acute-care hospitals serving a state twice the size of Texas. The other possibility is that the victims did not understand that the injuries required medical attention, as in the case of a seemingly small puncture wound harboring a potentially dangerous infection. Data in this study showed that workers who had injuries involving marine or domesticated animals were more likely to have delayed seeking hospital care than were workers who received injuries related to non-domesticated animals. These data could support either scenario. In either case, whether the delay is due to logistics or to complications involving infection, added training and supplies for on-site wound cleaning and care may reduce the degree of medical care needed and number of days off work.

## Conclusions

Workers in Alaska face unique animal hazards different from those posed by animals in the rest of the nation

and different from those faced by Alaskan adults when not at work. Results showing that most workers with nonfatal animal-related injuries were employed in either the seafood-processing or fishing industry at the time of the event and that the majority of injuries were related to fish are indicative of a specific and addressable problem. Future worker injury-prevention measures in Alaska should include information on training and supplies for proper field treatment of animal-related injuries.

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