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Conflicts between Man and Grizzly Bears in the National Parks of North America

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INTRODUCTION

Few Canadians or Americans have ever seen a grizzly bear (*Ursus arctos* L.). Far fewer have been injured by this massive, powerful and potentially dangerous carnivore. Despite a very low probability of injury the possible presence of the bear crowds most people's thoughts when travelling on foot or horseback through grizzly habitat. It does not matter if you fail to encounter a grizzly. A partial foot track set in mud showing claw marks well beyond the toes, or a massive scat full of partially digested huckleberries, is enough to make most backcountry travellers feel the presence of the bear. Where grizzlies exist, they set the mood for many backcountry excursions.

But in National Parks, the grizzly has had another major interaction with man. For example, in Yellowstone as recently as 1967, it was commonplace to be able to see as many as seventy grizzlies standing shoulder to shoulder, foraging amongst garbage at the Trout Creek Dump. In public campgrounds in Yellowstone, grizzlies gradually became accustomed to feed on man's garbage and food became highly dangerous nuisances. Here too people thought of and feared the grizzly, but in response they demanded better management to end the unfortunate mixture of garbage and bears. Similar situations have occurred in other national parks because the omnivorous feeding habits of the grizzly have brought him into contact with omnivorous man.

It is because the influence of the grizzly on the behaviour of human beings extends well beyond its few sightings and statistically insignificant attacks on man that study of conflicts with man is justified. I began this type of research by analyzing the causes and character of grizzly bear attacks on man in the National Parks of North America from 1872-1969 (Herrero 1970a; b). Since then further information has been collected mostly on a standardized form available to wildlife managers in National Parks having grizzly bear populations. In this paper I analyze these data for the period 1970-73 and compare them to my pre-1970 data and to analyses carried out by others. Martinka (1971; 1974) has made the most detailed analysis of grizzly bear and human interactions in a single national park.

ATTACKS- How many? Where? Preceding circumstances? What type of bear?

Table 1 shows that during the period 1970-73 there were 23 persons injured in 18 separate incidents which occurred in 5 of the 13 national parks in Canada and the United States which have grizzly bear populations. One person was injured in each of 13 incidents and 2 persons in each of 5 incidents. A single grizzly bear inflicted all of the injuries in each case, although frequently a female grizzly was accompanied by cubs prior to attack. Crude estimates of the frequency of injury are summarized in Table 1.

TABLE 1. GRIZZLY BEAR INCIDENTS AND INJURIES 1872-1969 AND 1970-73, SHOWING THE NATIONAL PARK IN WHICH THEY OCCURRED.

North American National Parks which have Grizzly Bear Populations	1970-1973 Number of Incidents	Injuries	1872-1969 Number of Incidents	Injuries
U. S. A.				
Yellowstone	4	5	45	45*
Glacier	0	0	10	14
Mt. McKinley	4	5	2	2
Grand Teton	0	0	0	0
Canada				
Banff	4	5	2	4
Jasper	4	5	4	8
Waterton	0	0	0	0
Yoho	0	0	2	3
Kootenay	0	0	0	0
Glacier-Revelstoke	2	3	1	1
Kluane	0	0	-	-
Nahanni	0	0	-	-
Totals	18	23†	66	77

* In 1970, when the first analysis was conducted, there were 18 more incidents resulting in 18 injuries listed as 'possibly' due to grizzly bears in Yellowstone. Cole (1972) referred to these 18 cases as 'probable' grizzly attacks. Cole (1974b), after further investigation, refers to these incidents as 12 probable and 6 known. All took place in developed areas and were preceded by camping; none have been included in my analysis.

† Includes 3 incidents and injuries not directly inflicted by grizzly bear.

Table 3 indicates that of the 23 persons injured 10 received major injury and 13 minor injury. Two deaths were included as major injuries, one death being inflicted by an adult female and the other by an adult male. Except for these two incidents the remainder of major injuries and most minor injuries were inflicted by female grizzlies with cubs.

Table 4 categorizes the injured person's activity prior to attack and the age/sex class of the bear involved in each injury. Females with cubs were responsible for a minimum of 74% of all the injuries inflicted during the 1970-73 period. In my analysis of injuries 1872-1969, this age/sex class of bear was responsible for a minimum of 48% of all injuries. This difference is statistically significant because the data describe the entire population of injuries and not a sample, but it is important to note that during 1872-1969 in 42%, or 32 of 77 incidents, the age/sex class of the bear was unknown. During 1970-73 the age/sex class of the bear was unknown in 13%, or 3 of 23 incidents. The 'unknown' age/sex class represent possible major sources of error which could significantly change the percentage of all incidents for which females

TABLE 2. CRUDE ESTIMATES OF THE FREQUENCY OF INJURY INFLICTED BY GRIZZLY BEARS*.

	Total Visitation (No. of visitors/injury)		Back Country Use (No. of backcountry man days/injury)
	1960-1969	1970-73	1970-73
Banff	17, 170, 465 : 1	2, 019, 753 : 1	53, 200 : 1
Jasper	872, 839 : 1	1, 176, 714 : 1	38, 175 : 1
Waterton	4, 742, 100 : 0	2, 149, 372 : 0	15, 187 : 0
Yoho	6, 136, 125 : 0	4, 032, 260 : 0	78, 700 : 0
Kootenay	6, 571, 778 : 0	4, 972, 459 : 0	25, 050 : 0
Glacier/Revelstoke	12, 487, 444 : 1	2, 610, 511 : 1	2, 620 : 1
Yellowstone	510, 000 : 1	1, 745, 142 : 1	59, 300 : 1
Glacier(USA)	500, 000 : 1	4, 403, 000 : 0	85, 469 : 0
Mt. McKinley	131, 750 : 1	153, 340 : 1	5, 054 : 1

*These figures are only crude estimates of frequency of injury. Data on total visitation in some parts includes persons driving through as well as persons stopping. Data from which backcountry man days were calculated are *very* tentative, especially for the Canadian Parks where errors could be in magnitudes of two or three. More precise data quantifying human use of grizzly bear habitat is needed.

TABLE 3. EXTENT AND NUMBER OF HUMAN INJURIES AND AGE/SEX CLASS OF GRIZZLY BEARS INVOLVED WITH THE INJURY 1970-1973.

	Age/Sex Class of Grizzly Bear				
Extent of Human Injury	Female with cubs	Adult female	Adult male	Unknown	Totals
No. of persons receiving major* injury	8	1	1		10
No. of persons receiving minor† injury	9		1	3	13

*MAJOR injury included those injuries which resulted in greater than overnight hospitalization or death.
†MINOR injury included those injuries which resulted in overnight or less hospitalization.

TABLE 4. PERSON'S ACTIVITY PRECEDING ATTACK AND AGE/SEX CLASS OF GRIZZLY BEAR INVOLVED WITH THE INJURY.

	Activity of Person				
		Camping			
Age/Sex Class of Grizzly Bear	Hiking or Riding Back-Country Area	Backcountry Undeveloped Area	Developed Area	Provoking Bear	Total
Females with cubs					
Of year	5√		2		7
Older		1			1
Age unknown or unstated	6	2†		1	9
Total all females with cubs	(11)	(3)	(2)	(1)	(17)
Adult female (no cubs)			1		1
Adult male			1*	1	2
Unknown	3				3
Totals	14#	3	4	2	23

√Two of the injuries were inflicted in one incident by a female with cubs of the year who had a history of garbage foraging.

Two of these persons were injured when thrown from horses.

†These two injuries were inflicted by a female with cubs in what appeared to be a sudden surprise incident in camp. The bears had no known or suspected history of garbage foraging.

*An old male grizzly tried to enter a cabin. A park employee was injured when he jumped through a window.

with cubs were responsible during each period. Despite this, the most probable explanation for the apparent increase in percentage of incidents attributed to females with cubs is that circumstances preceding attacks have changed quantitatively since 1872-1969 (Table 5). During 1970-73 a significantly larger percentage of incidents (61%) were preceded by backcountry hiking-riding than during 1872-1969 (31%) (Herrero 1970a). Conversely, during 1970-73 a significantly smaller percentage of incidents (30%) were preceded by camping as compared to 1872-1969 (61%). During 1872-1969, females with cubs were not found to be disproportionately involved in incidents preceded by camping in developed areas, although the data were incomplete. The percentage decrease in incidents preceded by camping generally reflects better garbage and food management in many of the national parks. Poor management of garbage and human food, especially in campgrounds and developed areas, were tentatively held responsible for 44 out of 47 incidents

TABLE 5. PERCENTAGE OF INJURIES DURING 1872-1969 AND 1970-1973 PRECEDED BY DIFFERENT ACTIVITIES

	1872-1969 %	1970-1973 %
Camping:		
Backcountry		
Undeveloped Area	5	13
Developed Area	56	17
Total	61	30
Hiking or Riding Backcountry Area	31	61
Provoking Bear	6	9
Other	1	-

preceded by camping during 1872-1969 and for 5 out of 7 such incidents 1970-73. In these areas grizzlies seemed to learn to associate food or garbage foraging with human odour and thus lost some of their avoidance behaviour toward man. After habitually foraging on food or garbage near people, some grizzlies became directly aggressive toward people while others attacked people after they were surprised at close range.

Females with cubs accounted for a much larger percentage of incidents preceded by backcountry hiking/riding (minimum 71%, 1872-1969; minimum 79%, 1970-73) than their typical percentage fraction (17%)* within a population would predict if all age/sex classes were equally likely to be involved in attacks preceded by backcountry hiking/riding.

In summary females with cubs account for most backcountry incidents preceded by hiking/riding. Additionally, the data available do not demonstrate that females with cubs are more likely to be involved in campground foraging incidents than is any other age/sex class. This information, therefore, tentatively accounts for the percentage change in incidents attributed to females with cubs—a minimum of 48%, 1872-1969, and a minimum of 74%, 1970-73.

It is also probable that females with cubs of the year are more dangerous to the backcountry hiking/rider than are females with older cubs. The 1970-73 data show that females with cubs of the year were positively identified as being responsible for five out of eleven backcountry-hiking/riding incidents attributed to grizzly bear females with cubs. In the remaining six incidents the age of the cubs was not determined or was not reported. I advance the hypothesis that, despite individual differences in aggression, there is overall a decrease in aggression by females as their cubs grow older. The hypothesis is tentatively supported by the data trend showing more injuries inflicted

*This figure was calculated using data for the Yellowstone population available in Craighead *et al.* 1969, and Craighead *et al.* 1974.

by females with cubs of the year than by females with older cubs. The data are crude, however. Pearson's (in press) detailed field observations on aggressive behaviour of grizzly bear females with cubs also suggest a decrease in aggression as cubs grow older. This hypothesis is also logically supported by the cubs' increasing ability with age to defend themselves. The evolution and expression of aggressive behaviour in grizzlies is discussed elsewhere (Herrero 1972).

As was found previously (Herrero 1970a; b), sudden surprise at close range was an important variable preceding backcountry-hiking/riding incidents (Tables 4 and 5) which involved females with cubs. In each of 11 injuries inflicted under these circumstances, the attacked did not sight the bear at a distance greater than 100 m (328 ft.). Often the distance was less than 30 m (89.5 ft.). Under these circumstances females with cubs appear to be acting almost reflexively in response to an intrusion into their 'individual distance', Martinka (1968) labelled this type of incident a 'defence reaction'. It is very important to realize that other age/sex classes of grizzly bears are seldom involved in this type of incident. Additional observations suggest that this behaviour is rare even for females with young cubs. They will usually flee in response to an intrusion if sufficient escape space and time are available.

Females with cubs were also involved in six injuries in which backcountry hiking/riding was not a preceding variable (Table 4). Of these, two injuries were inflicted in one incident by a female with cubs assumed (from the presence of fresh scats) to have been living in an area chosen as a backcountry campsite. In this incident the female with cubs apparently came upon two men in their sleeping bags without being aware that the men were there. There was no reason to suspect that this female was foraging for human food or garbage. Sudden surprise at close range was probably the important preceding circumstance. Of the remaining four injuries inflicted by females with cubs, three involved probable foraging for human food or garbage in camping areas, and one involved a photographer up a tree who made a squeaking noise like a rabbit to attract the female with cubs. The bear climbed 3.0-4.6 m (10-15 ft.) up the tree, pulled the man to the ground and inflicted major injury. This incident was classified as involving provocation.

The three incidents involving identified age/sex classes other than females with cubs were unique. They are important and merit detailed description because they resulted in one minor injury and two deaths, the sixth and seventh human fatalities inflicted by grizzly bear in the National Parks since 1872.

The sixth fatality occurred on June 25, 1972, at about one o'clock in the morning. Two young men returned to a technically illegal campsite in the Upper Geyser basin of Yellowstone National Park. In the dark they unexpectedly came upon an old female grizzly (the park's report estimated the age as about 20 years) who was foraging on their inadequately stored groceries. Both men ran and the bear charged, quickly catching and killing one man. Park's records show that the bear had been previously captured and transplanted from the Old Faithful developed area because of nuisance behaviour in 1970. After the attack the bear was killed and appeared reasonably healthy for an older bear. There were no parasites and the kidney fat index was normal. One possible indication of difficulty for the bear was that all canine teeth were broken and worn smooth to the level of the incisors. Several pieces of important data are disputed in this incident. A key issue is whether or not the abrupt closure of Yellowstone's dumps was a proper management strategy to restore and perpetuate natural grizzly populations. This issue has been debated in the literature (Cole 1972; 1974; Craighead and Craighead 1972; Craighead *et al.* 1974).

The National Academy of Sciences, U.S.A., has investigated this issue [National Academy of Sciences (NAS), 1974]. In brief the Craigheads have claimed that abrupt dump closure *increased* (at least for a period) the probability of injury in developed areas, and because of the large number of grizzlies killed, plus natural mortality to grizzlies, has given rise to a situation which, if it continues, will endanger the Yellowstone grizzly population. Conversely, Cole hypothesizes that abrupt dump closure *decreased* the cumulative probability of human injury because habitual campground foraging grizzlies were killed and young bears had less chance to learn this behaviour. Cole further claims that compensatory responses in the population have now restored the population to near carrying capacity. For the purposes of my present analysis the relevant data are clear—a very old bear with a history of some campground involvement killed and partially consumed a young man. My data suggest that very old grizzlies may be over-represented in aggressive encounters and attacks. I will discuss this later.

Sudden surprise of a grizzly bear on ungulate kills or carrion has been the cause of several aggressive encounters with grizzly bears in national parks. Outside national parks, hunters have been severely injured when returning to find cached game which, during the hunter's absence, has been claimed by a grizzly. Superficially the bear involved in the fatal Yellowstone incident behaved as if it were defending food. What is unknown is the extent to which the campground foraging history of the bear, or the abrupt phasing out and closure of dumps, influenced its behaviour.

The seventh fatality occurred in a backcountry area of Banff National Park and involved significant provocation of the bear and poor judgement on the part of the men involved. In late September 1973, a large adult male grizzly, with a well-documented history of numerous aggressive, garbage/human food foraging incidents, was being transplanted by helicopter. A Canadian Wildlife Service (C.W.S.) employee, a professional photographer and the helicopter pilot, accompanied the drugged bear to the transplant site. The C.W.S. employee and the photographer waited to photograph the bear as it came out of the drug. Photographing proceeded for several hours. Despite several clear signs of aggression, the two men continued to film and to move within 28 m (92 ft.) of the bear. The bear finally charged the men, both of whom ran. The bear caught and killed the C.W.S. employee despite attempts by the photographer throwing rocks to scare the bear away. The helicopter pilot flying his helicopter finally scared the bear off the body.

Bears recovering from the influence of drugs may behave strangely. John Craighead (pers. comm.) reported an instance where a female grizzly just recovering from drugging was charged and killed by an adult male. I interpret this to mean that the female's normal signal and defence system was altered, thus predisposing her death. These two incidents serve to suggest that drugged bears can be either dangerous to man or in danger themselves. Grizzlies under these circumstances should be regarded with utmost care.

The third incident involving an identified age/sex class of grizzly other than a female with cubs allows further comment on incidents involving very old bears. In Mt. McKinley National Park, near Wonder Lake Ranger Station, a grizzly 'in excess of 20 years' was involved in repeated break-ins into campers, garbage trucks and finally the ranger's cabin (Mt. McKinley National Park, pers. comm., 1975). At the cabin the bear seemed to be breaking down the front door so a park's employee jumped through the rear window, cutting himself on the broken glass. This is one of several incidents which suggest that very old bears may be particularly dangerous to man. The death and

partial devouring in Yellowstone in 1972 of a young man by a grizzly about 20 years old has been discussed. The August 1967 incident at Trout Lake in Glacier National Park, U.S.A., where a young girl was killed and partially devoured also involved an old female with worn canines and no cubs. This bear had aggressively sought food near humans many times before (Glacier National Park, 1967; Russell 1968). Generally, park wildlife managers often have unusual trouble with this age class. Martinka (1974) reported that 'selective disposal of five bears during 1968-69 involved sub-adult or old-age individuals in each instance'. Similarly in Waterton Lakes National Park, Canada, in October 1972, near Chief Mountain Customs station, a grizzly was reported to be 'obsessed' with breaking into every building nearby. The bear was killed and examination revealed worn teeth characteristic of an old bear. In an incident which occurred outside a National Park near Fort St. John, British Columbia, (Bryan and Jansson 1973), a guide was partially eaten, and presumably killed, by a very old grizzly.

Among the most bizarre of all aggressive encounters with grizzly bears was one which took place in the backcountry of Kluane National Park in August 1973, and involved a very old female accompanied by a 3-5 year-old sub-adult. Autopsy later showed the female to be 'thin' (79.5 kg, 175 lb), and 'in poor shape'. She had broken nasal bones and long claws indicative that she had not been digging very much. A park warden out on patrol first saw these two bears at 137 m (450 ft.). The female charged, followed by the sub-adult. The warden dodged and warded off attack with his rain slicker and a poncho. Ten to twenty charges were endured, each beginning from a distance of 1.5-9.1 m (3-30 ft.). During several charges the old female leaped completely off the ground and launched herself into the air toward the warden. Finally after the bear had grabbed and worried both slicker and poncho, the warden dropped his hat, which was also grabbed and flipped about. At this point the warden was able to separate himself from the bears. He later returned with a companion and they were tracked when the bears apparently got their scent and discovered their camp. While the bears were in the wardens' camp a shout and thrown rock triggered a charge. The bears were shot and later autopsied.

These incidents collectively, while often lacking precision of detail, strongly suggest the potential danger of some very old grizzlies to man. It appears that difficulties in securing adequate food to maintain a healthy body weight may increase foraging motivation so that human food or garbage may be aggressively sought. The possibility that some old grizzly bears under special circumstances may be potential predators of man is also suggested by the data. Bryan and Jansson (1973) report that Corbett in his studies of man-eating leopards and tigers in India found that the only animals which became man-eaters were those prevented from normal hunting by age or injury.

The data should not be interpreted as sanctioning the widespread disposal of very old grizzlies from national park populations. Old females can produce offspring (Craighead and Craighead 1972), and for this reason alone are valuable. The analysis does suggest that old-aged grizzlies may form a difficult management challenge and that specific individuals require careful evaluation if involved in aggressive incidents.

ADDITIONAL CIRCUMSTANCES RELATED TO ATTACKS

The data suggest that sleeping in the open without a tent may be particularly dangerous in grizzly bear habitat, but especially when garbage foraging griz-

zlies exist which are habituated to human odour. During 1872-1969, records show that nine persons were injured while in sleeping bags on the ground without a tent, whereas ten were injured in sleeping bags while in tents. From 1970-73, five of seven persons injured in incidents preceded by camping were in sleeping bags on the ground without tent or other protection. During the same period, no one was injured while in a tent. I do not know what percentage of persons camp without tents, though I suspect that it is only small compared with those who camp using tents. If this assumption is correct, then the data do suggest that 'sleeping under the stars' may increase the probability of injury as compared to using a tent. Martinka (1974) has recommended that in some areas protective sleeping accommodation might be considered.

I have found no records of persons in national parks who were on horseback prior to being directly injured by a grizzly bear. In two incidents which were included in my 1970-73 injury analysis, the persons were injured when thrown from a horse which was startled by aggressive behaviour from a grizzly bear. In these incidents the grizzly did not contact the person.

Making a noise to prevent sudden surprise of a grizzly, or climbing a tree if adequate time exists, are two frequently recommended techniques. These should not be inferred as giving absolute protection as the noise may be masked or the bear's attention focussed sharply on something such as feeding. Mature grizzlies do not commonly climb trees, but with strong motivation and proper spacing of limbs they can climb. During 1970-73, a party of two persons were both injured although they claimed to be making noise prior to attack. In another incident a grizzly climbed 3.0-4.6 m (10-15 ft.) into a tree and injured a man who had been provoking the bear. Grizzlies have previously been reported to climb trees above the level of their reach and then injure people (Herrero 1970a).

Data did not indicate that either menstruation or the use of cosmetics by women were related to any attacks as has been hypothesized (Glacier National Park, 1967). Because of the grizzly's acute sense of smell this hypothesis might merit experimental investigation.

INDIVIDUAL NATIONAL PARKS

Glacier National Park, U.S.A.

The most significant decline in grizzly bear inflicted injury rates from the 1960s to 1970-73 took place in Glacier National Park, U.S.A. (Table 2). Here the dramatic death of two girls in two separate incidents in 1967 sparked a very intensive management programme (Martinka 1968, 1971, 1974). Management actions there have included successful clean-up of garbage and other unnatural food sources both in developed and backcountry areas, an intensified research programme on both grizzly bear ecology and the grizzly's relationship to man, as well as management of human activities in certain backcountry areas. The latter point has included periodic trail closure in areas known to be frequented by female grizzlies with cubs or in areas where grizzlies seasonally congregate for food, or in areas where unnatural food sources attracted grizzlies. In Glacier in 1969-73, there were no grizzly-caused human injuries, despite an increase in number of visitors at a mean annual rate of 4.8 per cent. Also very important is the fact that few grizzlies were captured and transplanted or purposely killed by park personnel during the period, thus indicating that the causes of the grizzly problem were dealt with rather than the symptoms.

Yellowstone National Park, U.S.A.

Evaluating the situation in Yellowstone National Park is more difficult for reasons previously indicated. In Yellowstone the garbage management problem, especially in campgrounds, was far worse than in any other national park. The number of grizzly bear injuries inflicted in man during the 1960s and earlier reflected this (Table 2). Sanitation of campgrounds and successful bearproofing of sanitary landfill sites has improved the situation with regard to danger to the visitor although abrupt phasing out of dumps 1969-70 and abrupt closure of dumps 1970-71 may have temporarily increased the probability of human injury. Yellowstone still has several major campgrounds located in or near prime grizzly bear habitat and this will continue to create special management demands beyond those existing in Glacier National Park, U.S.A., where a comparable situation does not exist. Cole (1974) presents evidence that injuries to humans declined significantly in Yellowstone during 1970-73. He also argues that during this period the grizzly bear population suffered no serious decline despite removal of many grizzlies in management control actions. The Craigheads strongly dispute both points, arguing that after initial dump phase-out and closure the probability of human injury increased at least during 1968-71 (Craighead and Craighead 1972) and that the decline in numbers of grizzlies in the total Yellowstone ecosystem is serious (Craighead *et al.* 1974). The N.A.S. (1964) investigation of the grizzly in the Yellowstone ecosystem concluded that available data were inadequate to settle the controversy over whether or not abrupt closure of dumps increased the probability of human injury. They did conclude that there was no convincing evidence that the grizzly bears in the Yellowstone ecosystem were in immediate danger of extinction, although they reported that during 1968-1973 it was most probable that the grizzly population was reduced substantially. The question of current population status clearly requires further research. Compensatory responses with the Yellowstone grizzly bear population postulated by Cole to have occurred, and considered probable by the N.A.S. team, still require further documentation. Craighead *et al.* (1974) argue that compensatory responses to mortality known to take place in many mammalian populations may not occur within the Yellowstone grizzly population under its present condition. Consistent with this contention, field work done by Knight in 1974 found the average litter size for Yellowstone female grizzlies to be only 1.7 (J. Craighead, pers. comm.).

Banff and Glacier National Parks, Canada

The most serious increase in injury rates from the 1960s to 1970-73 took place in Banff and Glacier National Parks in Canada (Table 2). My understanding of injury data from these parks suggests different causes. In Glacier National Park, Canada, increased injury rates have reflected increases in park and backcountry use. Here there is no reason to suspect serious garbage or human food mismanagement. Rather, sudden surprise encounters at close range were the cause of all injuries. Glacier National Park, Canada, is experimenting with an interesting management strategy to decrease the probability of sudden encounters with grizzlies in backcountry areas. In grizzly habitat where trails pass through densely vegetated areas, and especially where fast-flowing streams create a masking sound, park wardens have made trail cuts up to 6.1 m (20 ft.) wide. The object is to allow hikers to see grizzly bears at a great enough distance to prevent sudden surprise. While such a technique may be effective in preventing injury it obviously should be a last resort after considering trail re-routing, periodic trail closure, and other environmentally and aesthetically less damaging techniques.

In Banff Park, Canada, increases in injury rates reflected both increased overall visitation and backcountry use as well as a continuing inability to solve serious garbage management problems, thus allowing grizzlies to forage unnaturally and become habituated to human odour. For instance in Banff Park 1970-73, four of five injuries were caused by grizzlies with known histories of garbage/campground feeding. In one incident already mentioned, a Canadian Wildlife Service employee was killed. In this incident the man would never have been handling the bear if it had not been necessary to transplant it because of garbage feeding in a developed area. The remaining three garbage-influenced incidents were all probably inflicted by one female grizzly with three cubs of the year with a long and well-documented history of garbage problems in developed and backcountry areas. Two women suffered minor injury from this female grizzly in a brief attack near a backcountry lodge. In the other incident a man was very seriously injured by this same female with cubs when she attacked him while he lay in his sleeping bag at a backcountry campsite. He and his companion's food was properly stored well away from the campsite. This incident, though not fatal, is similar in character to an incident which resulted in death in Glacier Park, U.S.A., in 1967. In Banff National Park serious and immediate effort is needed to improve management, especially with regard to garbage. The extent of the problem is documented by the fact that during 1972-73, wardens in one district alone (District 2, Lake Louise) handled grizzlies 56 times in control incidents, purposely destroying nine and one dying accidentally. During this same period in Glacier Park, U.S.A., only one family of bears was handled in a control incident and one bear was purposely destroyed. Glacier has both a higher population density and greater total population of grizzly bears. There is some indication that the situation may be improving in Banff, since in 1974 only 4 grizzlies were handled in the Lake Louise district, although grizzly bear problems continued in other park areas including a sanitary landfill site near Banff. Detailed scientific assessment of both the grizzly bear population status and the management problems is required to give accurate answers regarding Banff National Park.

Jasper National Park, Canada and Mt. McKinley National Park, U.S.A.

In both Jasper and Mt. McKinley National Parks there was little change in frequency of injury when total visitation during the 1960s is compared to 1970-73 (Table 2). Both parks had 5 injuries during 1970-73. These relatively high numbers of injuries reflect amongst other things significant backcountry human use of grizzly bear habitat in both parks. In Mt. McKinley a garbage problem is not obvious but injury rates are amongst the highest in North America (Table 2). Better trail planning and management of human backcountry use is indicated for both parks. In Jasper in addition to backcountry human use of grizzly habitat there is also a garbage problem needing immediate attention. Here grizzlies occasionally forage in some campgrounds and during the study period they frequently got into the sanitary landfill (Retfalvi, pers. comm., 1973).

Kluane and Nahanni National Park

A challenge is faced in the new national parks having grizzly bear populations. In Kluane and Nahanni of Canada the cumulative knowledge of grizzly bear ecology, and encounters and incidents with man is being used in initial park planning to avoid problems present in established parks.

HOW TO AVOID ATTACKS

There are many ways to reduce to a minimum the small probability of being attacked by a grizzly bear and yet still hike and camp in national parks inhabited by grizzlies. The simplest way is to plan trips into areas where grizzlies are not found or are uncommon. Park Service personnel should be able to provide this information to persons not familiar with seasonal grizzly bear habitat.

If a party chooses to cohabit an area where grizzlies are found, then they and the park service have a joint responsibility. Park officials are responsible for managing and maintaining grizzly bear populations in as near a natural state as is possible. With regard to human safety this means little or no human food or garbage feeding sources. Past failure to control this variable has allowed grizzly bears to become habituated enough to man to forage in developed and backcountry campsites and has thus predisposed grizzly bear attacks on campers. Prompt action and constant surveillance by park officials is required to identify and clean up such areas: their temporary closure may be required while they are cleaned up (Martinka 1974). A special problem is present in areas of good fishing where grizzlies also exist. Both dead fish and fish remains can attract grizzly bears and create danger. Special fishing regulations regarding both the keeping and cleaning of fish may sometimes be needed.

Trapping and transplanting, or 'control kills', of garbage-addicted grizzly bears are inadequate and symptomatic treatment of the garbage and human food problem. Transplants serve to move highly dangerous and human-habituated garbage-feeding bears way from areas of high human concentration into areas of low human concentration. Return rates from most transplants are high. The 'biological success' of transplants has not been studied but is probably low. Bear proof garbage management can nearly eliminate the need for trapping, transplanting and 'control kills'.

Proper garbage and food management cannot stop at park boundaries in areas where acceptable grizzly bear habitat is located adjacent to but outside national parks. Grizzly bears are known to travel long distances in search of food or other needs (Craighead *et al.* 1974; Pearson, in press).

To provide further for human safety, park officials need to know the seasonal distribution of grizzly bears, particularly the approximate location of individual females with cubs. Temporary trail closure or public warnings may need to be employed, or mode of access may need to be regulated. Trail re-routing away from prime grizzly bear habitat may be desirable in some instances. Where re-routing is not practical wide trail cuts may be a partial solution in areas where surprise encounters might take place. Campgrounds located in grizzly bear habitat either require special management or they should be closed. Special grizzly bear preserve areas may be necessary in some cases, with the public seasonally excluded.

The average park visitor is unfamiliar with the characteristics of grizzly bears. Adequate information should be provided to the visitor to alert him to potential dangers. Specific information should be available from park service personnel regarding probable grizzly bear activity in a given area. Park visitors unfamiliar with the bears' habitat and characteristics should be encouraged to make enough noise to warn bears of their approach (Mundy and Flook 1973). Ideally visitors should also learn enough about the grizzly so that their appreciation of the bear outweighs their fear.

Park managers have a broad responsibility to the public for human safety in

grizzly habitat. A thorough scientific research programme is needed to provide information on the bear's ecology and population characteristic in each park. This information is needed by the manager, both to protect the public and also to provide for the long-term survival of the bear populations. Not all biological data collected on one population applies throughout the grizzly bears' range because different ecotypes exist, each adapted to their own local conditions.

Glacier National Park, U.S.A., is a good example of a park which has employed most of these research and management techniques and has as a result greatly decreased both human injury and also handling and control kills of grizzly bears. Their work is well documented (Martinka 1968, 1971, 1974).

The park service cannot, however, guarantee complete safety to the visitor, nor does it have total control over visitors. Visitors can be strongly encouraged to store food and garbage properly, but despite regulations it is their decision whether or not to leave a clean camp. Ironically, refuse left by one of several groups may predispose injury by grizzly bear of some future visitors.

In addition to following rules and suggestions presented by park managers, there are other things that the backcountry park visitor can do to avoid injury in grizzly habitat. Learning about their seasonal habitat preferences, behavioural traits, movement capabilities, food preferences, track and scat characteristics, can assist the visitor in knowing where and when grizzlies might be encountered. Dirty campsites and areas to which garbage bears have been transplanted should be avoided, as should areas of high seasonal natural bear activity.

Knowledge of the grizzly by the visitor, and thorough management activities by parks, can allow the visitor to avoid in most cases the two main causes of human injury—garbage-influenced grizzlies and sudden surprise of grizzlies, especially females with cubs, at close range.

CHARACTERISTICS OF AGGRESSIVE ENCOUNTERS WITH GRIZZLY BEARS. WHAT TO DO IF A GRIZZLY IS ENCOUNTERED OR IF A GRIZZLY ATTACKS.

There are no absolute formulas. The characteristics of individual bears vary as much as do the characteristics of individual people. Nevertheless grizzlies have species-specific patterns of behaviour which are fairly regular. Defense of and care of cubs by a female is a good example of this. The agonistic behaviour signal system is another good example. The grizzlies language of aggression and appeasement has been described by Stonorov and Stokes (1972).

I examined reports of fifty aggressive encounters between people and grizzly bears in North America's National Parks. These incidents did not result in human injury but involved a grizzly (or grizzlies) acting in what was perceived to be an aggressive manner. These data come from park records, written reports (especially Mundy and Flook 1973) and individual responses to my questionnaire. They are only a partial sample of all aggressive encounters. Table 6 categorizes the actions of people prior to the fifty grizzly bear encounters which I studied. These are the actions either before the bear was sighted or before it acted in what was perceived to be an aggressive manner. These actions do not appear to be very different from those which led to attacks in other cases. More revealing are the actions of both people and bear during an aggressive encounter. Single and multiple charges by the bear were common, sometimes to within very close distances such as 1.2-1.5 m (4 or 5 ft.). Grunting, woofing, snapping jaws and laboured breathing were sounds reported

TABLE 6. PERSON'S ACTIVITY PRECEDING AGGRESSIVE ENCOUNTER AND AGE/SEX CLASS OF GRIZZLY BEAR INVOLVED IN THE AGGRESSIVE ENCOUNTER.

Age/Sex Class of Grizzly Bear	Activity of Person					
		Camping or Residing				
	Hiking or Riding Backcountry Area	Backcountry Undeveloped Area	Developed Area	Driving Car	Other	Total
Female with cubs						
Of year	2					2
Older	6	3	2	1	2√•	14
Age unknown or unstated	9		1	2		12
Total all females with cubs	(17)	(3)	(3)	(3)	(2)	(28)
Group	3		1			4
Adult						
Sex Unknown	3			1	1	5
Male	1#				1*	2
Sub-Adult						
Sex unknown	3	1				4
Female					1†	1
Unknown	5		1			6
Totals	32	4	5	4	5	50

Large male grizzly which had been previously shot.
√ Female grizzly with older cubs charged a crew working on train tracks.
• What was assumed to be a female grizzly with a 3 year old cub chased 4 fisherman at a backcountry lake.
* Adult male grizzly aggressively approached a fish cleaning table and then a boy.
† A three year old female grizzly aggressively approached 3 fishermen at a backcountry lake.

TABLE 7. PERSON'S PREDOMINANT ACTION(S) DURING AGGRESSIVE ENCOUNTER

Predominant Action	Number of Parties Doing Action
Stand still	6
Talk quietly	1
Shout, bang, clap, scream or growl	12
Run away	13
Walk slowly away	5
Climb tree	10
Slap or hit bear	1
Get into car	1
Fire shot	1
Total	50

in several instances. These sounds and close charges without contact are part of the normal species-specific agonistic display system of the grizzly. What is it then which turns a possible aggressive encounter into an actual attack? The characteristics of the individual bear which seem important are factors such as: has it a history of garbage feeding and habituation to human beings? is it a particularly reactive female with cubs of the year? has it previously been wounded outside the park? is it a very old bear with feeding difficulties? I have already hypothesized that most females with cubs of the year may be more dangerous than females with older cubs. In a given instance, characteristics of the individual bear will interact with the specific situation to produce flight, an aggressive encounter or an attack. Probably 95% of encounters are non-aggressive and result in the bear fleeing. This is an impression for which I do not have accurate data. How important are the actions of the person(s) involved in a confrontation? Certainly sudden surprise at close range should be avoided but if it is not, what then? Table 7 categorizes people's actions during the fifty aggressive encounters which I studied. Particular note should be taken that several behaviours not recommended in park's grizzly bear information pamphlets (Parks Canada, 1974) were common and did not in these instances lead to attacks. Twelve actions by persons involved shouting, screaming, banging, clapping or even growling. Thirteen actions involved running away. This documents that under certain circumstances, with certain bears, these actions by people do not necessarily lead to attack. Conversely my analysis of attacks during 1872-1969 revealed that 13 persons injured while hiking (54% of all persons were injured while hiking) were attacked while fleeing. Five were running away and eight were part way up a tree. I conclude that fleeing does not necessarily trigger an attack, although it certainly may. The documented ability of grizzlies to outrun human beings (Herrero 1970a) is an important variable in this context.

The commonly recommended course of action if actually charged by a grizzly

at close range is to stand one's ground or slowly withdraw while quietly talking to the bear. This action seems to be effective for those people calm enough to pursue it. I also tried to discover whether or not the dropping of an object, such as camera or pack, during the chase might help to distract a grizzly. In the reports which I examined approximately one out of two charging bears seemed to be distracted. Tree climbing was effective prevention if appropriate trees were available and the bear was spotted far enough away.

Clearly, no absolute recommendations can be made regarding human behaviour in close proximity to grizzly bears. Ultimately progress will be made as we begin to better understand grizzly bear behaviour in an evolutionary and ecological perspective. Why grizzly bears occasionally charge and sometimes attack human beings can be understood by knowing grizzly bear ethology. In incidents related to foraging for garbage or human food, specific grizzlies seem to have overcome a reluctance to associate with man and have become willing to forage aggressively near man in campsites. The danger comes either from this aggressive foraging or from sudden encounters with people while foraging. Occasionally it appears that a grizzly will 'explore' a person as a possible food source.

Sudden surprise of a grizzly at close range is the other major category of circumstances preceding encounters and attacks. My data demonstrate that for bears who have not become habituated to man through garbage feeding it is females with cubs which constitute the primary danger. They apparently charge in response to a perceived violation of their individual distance, i.e. they charge in response to a perceived threat. To alter this situation either a person needs to leave, i.e. retreat beyond the individual distance, or needs to allow the female and cubs opportunity to leave. Being sensitive to this situation can suggest different human actions in different specific situations. Age/sex classes of grizzlies other than females with cubs do charge people and will occasionally attack in response to sudden surprise, but these instances are very rare. For further understanding of grizzly bear behaviour the reader should consult Hornocker (1962); Stokes (1970); Stonorov and Stokes (1972); and Herrero (1972).

The final situation to be considered is that where actual attack occurs. What does analysis of actual attacks tell us concerning bear and human behaviour?

Grizzly bears, when attacking people, almost always do so from a position with the four legs on the ground. During 1970-73, only one attack took place while a bear was standing on its hind legs and only minor injury was inflicted to each of the two women involved. The hind-leg stance, however, often preceded attack, and appears to be a reaction whereby a bear is attempting to sense a situation through smell or sight. During attack both jaws and claws are used as weapons although in cases of death it is injuries inflicted by the jaws which are usually fatal. Cattle are also killed with the jaws (Murie 1948). Attacks are almost always of short duration, 30 seconds to several minutes, although in certain instances where major injury has been inflicted attacks have lasted in excess of ten minutes. In incidents preceded by backcountry hiking/riding and sudden surprise of non-garbage/human habituated bears the bear seems to have behaved as if it were responding to a threat. Generally, once the person (threat) is chased away or held still (playing dead, fainting), this category of attack ceases.

In 1970(a), I hypothesized that the extent of injury, once attacked, might in some cases be related to the behaviour of the person during the attack. I further suggested that incidents involving people attacked by garbage-influenced/man-habituated bears might be subject to different rules than incidents involving

non-garbage-influenced bears suddenly surprised at close range. I suggested then, and have further discussed in this paper, that the motivation of the bear was different in each instance. Table 8 presents data which relate to these questions. Here I attempted to analyze attack reports to see whether playing dead or fighting back increased or decreased the intensity of attack after it began. Because of the subjective interpretation necessary for these data, statistical analyses are not valid. The data do, however, suggest that playing dead may be a good strategy if involved in a sudden surprise incident while hiking. Further, in this type of incident, fighting back seemed to increase the intensity of attack. In a few cases the opposite effects were found, so once again absolute rules are not possible. In such sudden surprise hiking incidents the bears' attack wes sometimes diverted from one person to another by shouting or running, with the person doing the action receiving the fresh attack. In incidents preceded by camping and involving garbage/man habituated bears, neither fighting back nor playing dead seemed to influence the intensity of attack. Here also the number of instances was small.

TABLE 8. NUMBER OF THE INCREASES OR DECREASES IN INTENSITY OF ATTACK PER PERSON ONCE CONTACT MADE, TABULATED AGAINST ACTION OF PERSON DURING ATTACK, AND CIRCUMSTANCES PRECEDING ATTACK.

	Play Dead or at Least not Resist		Fight Back, (Yell, Kick, Struggle, Knife)		Preceding Circumstances
	1872-1969	1970-1973	1872-1969	1970-1973	
	7	7	2	0	
Decrease	14		2		All incidents preceded by hiking*, or involving sudden surprise in camp of a presumably non-garbage-conditioned grizzly bear.
	1	1	3	4	
Increase	2		7		
	2	0	2	1	
Decrease	2		3		All incidents preceded by camping and all bears presumably garbage-conditioned.
	0	1	3	0	
Increase	1		3		

*In incidents preceded by hiking the bear's attack was sometimes diverted from person to person by shouting or running, with the person doing the action receiving the fresh attack.

LEGAL IMPLICATIONS OF GRIZZLY BEAR ATTACKS

In some cases the question of blame for a grizzly bear attack becomes a legal one. Several persons have attempted to sue and prove negligence on the part of

park managers who are ultimately the Canadian and United States government. Few cases have come to trial and only in one instance have the courts supported the claimants. A 1974 decision in the United States awarded approximately $87,000 to the estate of the man killed in Yellowstone during 1972. As better information is developed concerning the proper management of grizzly bear populations for human safety (as well as for human enjoyment and local grizzly bear population survival) the issue of liability will become increasingly more clearly defined. This should force the management of every park population of grizzly bears to be of the highest known standards.

THE BIOLOGY OF REMNANT POPULATIONS AND REGIONAL PLANNING IMPLICATIONS

In North America, all National Parks have the statutory obligation to preserve natural ecosystems. The long-term fulfilment of this mandate will be particularly difficult with regard to grizzly bears in several national parks. At one time the grizzly's range in North America was large (Storer and Tevis 1955; Haynes and Haynes 1966; MacPherson 1965; N.A.S. 1974). Today in the contiguous United States and in southern Canada the grizzly exists in remnant populations. The question of what is a minimum population size for grizzlies for their survival is a complex one. Part of the answer depends upon the number of years into the future one wishes to have a high probability that grizzlies will survive in a given park or other area. Diamond's (1972) data on extinction rates in tropical ecosystems can tentatively be interpreted to suggest that, other things being equal, the smaller the population of any species the greater the probability of extinction over time. For species like the grizzly, national parks essentially become island refuges with gene flow to other populations prevented. If we are forced to choose and can only allow certain populations to survive, then the biology of remnant populations tells us to choose the largest populations in the largest areas.

In a genetically isolated remnant population of European brown bear (*U. a. marsicano*), which Franco Zunino and I studied in central Italy, the population was estimated to have numbered only 70-100 (Zunino and Herrero 1972). In a population of this size we can expect in any one year about 5-7 adult females with their cubs of the year. Unusual natural death in this population segment coupled with deaths inflicted by man could in one bad year seriously endanger this population. If further the population is fragmented and its habitat altered, the swing to extinction could be rapid.

Are any of the North American National Park populations endangered? Craighead *et al.* (1974) present evidence that, if present trends continue, this will be the case for the Yellowstone population. Good quality population data are not available for any southern Canadian national park population; however, I believe that three populations require careful study to document their characteristics and to generate long-term planning for protection: these exist in Waterton, Glacier and Revelstoke, and Banff, Yoho and Kootenay National Parks. Waterton is a small park (525 km^2 = 203 sq. mi.), intensively used. Surrounding land is significantly ulilized for cattle grazing and resource extraction. On the British Columbia border of the park a proposed road over the Akamina Pass could remove potentially valuable habitat, cause conflict with human users, and further fragment the population. A hopeful condition exists where the southern border of Waterton Park is continuous with Glacier Park, U.S.A.

A similar problem exists in Glacier and Revelstoke National Parks. Here small

park size, Glacier 1349 km^2 (521 sq. mi.) and Revelstoke 259 km^2 (100 sq. mi.), means small park grizzly bear populations, estimated to be 74 grizzly bears for the larger and more densely populated Glacier (Mundy and Flook 1973; Hamer 1974a). The two parks are surrounded largely by B. C. provincial lands. Historically the grizzly has been heavily hunted in these areas as well as being killed when in conflict with men logging, mining or farming (Hamer 1974a; b). In Banff, Yoho and Kootenay, similar conflicts exist in surrounding British Columbia and Alberta Provincial Lands. In parts of Banff Park, population declines have been tentatively attributed to hunting in surrounding British Columbia Provincial Lands (Noble 1972). The situation, no doubt, exists elsewhere but has not been studied. There is, however, evidence that both provinces, British Columbia and Alberta, are well aware of the potential impact of hunting on grizzlies and that their management plans reflect this. Further concern is necessary in Banff, where control kills and stress induced by transplantation are high. In addition Banff may soon see development of a new visitor service centre at Lake Louise, very near grizzly habitat. A very large (tentative permanent service population of up to 3700 persons) proposed development was withdrawn only after extreme protest (Herrero 1970c; Omstead *et al.* 1972).

Clearly the potential impact of all proposed developments within these parks must be carefully evaluated with regard to influence on grizzly bear populations. This cannot be done until proper scientific data exist regarding grizzly bear population characteristics and overall ecology. Often we have managed dynamic ecosystems as if they were static. From this view, development might be justified in closed coniferous forest. This habitat type is usually not important for grizzly bear feeding habitat. But if the forest is burned, successional stages can be very productive of food for the grizzly. Martinka (1973) reported a major grizzly bear concentration on huckleberries (*Vaccinium* spp.) in one area forty-four years after a burn. In addition to careful impact assessment for all developments, regional wildlife management plans should be developed with surrounding provincial and municipal jurisdictions. The best example of this regional management approach is in the Yellowstone ecosystem, where coordinated research and management exists for a 69, 930 km^2 (27, 000 sq. mi.) area, having the 8, 806 km^2 (3, 400 sq. mi.) of Yellowstone as its core (National Park Service, 1973). This integrated research and management unit is clearly valuable and necessary, but its initial success has been questioned (N. A. S. 1974). If rapid progress is not made in the direction of regional research and management in Canada, several grizzly bear populations could be lost within the 50-year future.

THE GRIZZLY BEAR IN THE MIND OF MAN

Scientific data on grizzly bear ecology and on the interactions between man and grizzly are necessary for management programmes. However, these data are not sufficient to ensure the future of the grizzly in the various North American national parks where it is found. For survival the grizzly needs to become a valued resource to a significant percentage of North Americans. The challenge is to reach, educate, and relate grizzly bears to, the average North American whose life is normally far removed from them. There is hope. For those who appreciate the grizzly it is one of the finest living components and symbols of natural ecosystems. Because it requires large tracts of relatively undisturbed land for survival it is a type of wilderness indicator species where it is found. Monitoring the status of grizzly bears and maintaining their population status usually ensures the integrity of many other ecosystem components (Herrero *et al.* in press).

Ecologically the grizzly bear usually has minor influences. The ecosystem effects of grizzly bears are greatest in the infrequent situation where they function as significant predators, especially if other more specialized predators such as wolves are absent or reduced in numbers. Such a situation exists periodically in Yellowstone Park where Cole (1972) believes that grizzlies through predation help to dampen elk population fluctuations by culling vulnerable animals. The grizzly in this specific circumstance could also influence local elk evolution because predation becomes a selection factor. Further, Cole demonstrated how a grizzly population, through predation and scavenging upon elk, could influence secondary consumers such as coyotes. The same types of relationships would exist where grizzly predation upon salmon is significant (Shuman 1950; Gard 1971). More typically, however, the omnivorous food habits of the grizzly mean that its energy intake sources overlap with many other species. It functions as a browser, grazer, scavenger and predator. Remove a grizzly population from an area and there is no ecosystem collapse. But the grizzly does demonstrate what spectacular beings biological evolution can produce to fill an open niche. The grizzly is a massive and powerful statement of the evolutionary history of circumpolar northern environments. The grizzly symbolizes the power, dynamism and productivity of the ice ages. Grizzly bears are a well-tuned way of capturing and utilizing a broad range of available energy. But the omnivorous grizzly ultimately competes with omnivorous man, and human beings through their technology have what our primitive ancestors lacked—the power to exterminate the grizzly.

We should preserve grizzly bear populations, not because their ecological function is critical, but because of what they can do for human imagination, thought and experience. York Edwards (1970) describes two similar mountains, one which has lost its grizzlies and the other which still has them. On the mountain with the great bears there is suspense, caution, more of the unknown—in a word, mystery. The other mountain, having lost its grizzlies is tamer and somehow depauperate.

Travelling through grizzly country can provide human visitors with a rare opportunity to establish relationships with the natural world. Fernandez (1972) discusses the manner by which human experience with animals was essential for definition of the self in aboriginal human beings. We still have the genotype of our ancestors. Travel in grizzly country can help us to define, understand and appreciate ourselves through appropriate responses to this species which shared Pleistocene evolution with man. In grizzly habitat caution, care and occasional fear and awe, are key elements. These are significant components of the wilderness experience and are elements for which our own genetic heritage is preadapted. But a wilderness experience cannot be had with a grizzly bear tamed and warped by garbage feeding.

I have discussed what the grizzly bear in national parks can become to fortunate and understanding visitors. It should be clear that this is the hopeful and biased opinion of one who appreciates grizzlies.

Public opinion concerning grizzlies is another important source to consider. Mahalic (1974) did a detailed study of the attitudes toward grizzlies of 158 visitors to Glacier National Park, U. S. A. Approximately 65% of all persons surveyed had positive attitudes, 20% were neutral and 15% had negative attitudes. Mahalic had little success in understanding the genesis of their attitudes. An attitude survey done by the Christian Science Monitor of its readers (Cahn 1968), just after two girls were killed by grizzlies in 1967 in Glacier National Park, U. S. A., revealed that only 104 out of 3420 persons (3%) favoured elimination of grizzlies from national parks. Bryan and Jansson (1973) surveyed human

attitudes toward grizzlies, and knowledge about grizzlies, in three Canadian communities in Alberta: they concluded that substantial inaccuracies exist with regard to people's understanding of grizzly bear behaviour, but that improvements in understanding are correlated with familiarity or contact with wildlife. They also predicted that increased injuries would create strong public pressure to destroy potentially dangerous wildlife species such as the grizzly. At least one scientist (Moment 1968, 1969, 1970) has called for the elimination of grizzly bears from the national parks of North America.

Also relevant are the views of those individuals who have actually been injured by grizzly bears in the national parks. Some opinion has been against the grizzly. 'They shouldn't be allowed to exist anywhere near civilization' and 'I can see no reason why grizzlies should be preserved in the national parks' or 'guns should be carried so that aggressive grizzlies can be shot'. But even amongst the group of individuals actually injured by grizzlies the majority of opinions favour the bear. 'We are in complete agreement concerning the preservation of the grizzly' was one comment. 'There is no reason in the name of civilized progress to kill an animal for doing what is natural. I feel no malice toward the bear.' This statement came from a man seriously mauled by a female with cubs.

What influences these different perceptions of the grizzly? How can the grizzly bear become more of a valued resource and less of a liability to North Americans? The formation of our perceptions seems to be imbedded in our lifestyle, education system and attitudes toward nature.

The grizzly bear is worth the strong focus and disproportionate interest which I have suggested, because of its unique place in the mind of man. It alone is the 'beast which walks like a man'. It is similar in some ways to man, yet awesomely more physically powerful and clearly more at home in natural environments. In learning to share some of our national parks with the grizzly we can begin to rediscover and redefine our place in nature.

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SUMMARY

During the period 1970-73, twenty-three persons were injured by grizzly bears in the national parks of North America. Persons were hiking or riding in backcountry prior to 14 (61%) injuries; were camping in backcountry prior to 3 (13%) injuries, and were camping in a developed area prior to 4 (17%) injuries. Two (9%) injuries were preceded by provocation of the attacking bear.

Female bears with cubs were the most dangerous age/sex class of grizzly and responsible for a minimum of 17 (74.9%) of all injuries. Most injuries involved sudden surprise of the female at close range.

Very old grizzlies were another age class disproportionately involved in incidents with man. Careful monitoring is recommended for difficult bears from this age segment.

Examination of the current management programme in Glacier National Park, U. S. A., suggests that management strategies exist which can both encourage the long-term survival of free-ranging grizzly populations and also provide park visitors with a high degree of safety regarding females with cubs, as well as other age/sex classes.

Ways of avoiding attack by grizzly bear point to a joint responsibility of park managers and park visitors. Circumstances which preceded aggressive encounters which did not result in human injury are discussed. In the event of actual attack, especially after sudden surprise of a female with cubs, data suggest that playing dead can help to decrease the intensity of attack.

Garbage and human food disposal continues to be a problem, though in most parks the situation was improved. Grizzlies who forage on human food or garbage in close proximity to people become habituated to man and also more dangerous to visitors.

The effectiveness of management programmes is assessed with respect to human safety and grizzly bear preservation for relevant North American national parks. Human safety is being adequately provided for in many and the remaining problem areas which can be made safer by improved management are identified. However, several park grizzly bear populations appear to be headed for elimination during the next 50 years unless effective regional management plans are adopted soon.

The grizzly bear is worth disproportionate study emphasis compared to other animal species in national parks because it uniquely stimulates human imagination and thought, and can help man relate meaningfully to his own genetic heritage and to natural environments. The grizzly is a wilderness indicator species whose protection encourages survival of many other species and their wild habitat.

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