

Appendix O. Publication on Denali National Park and Preserve Bear Program

BEAR-HUMAN CONFLICT MANAGEMENT IN DENALI NATIONAL PARK AND PRESERVE, 1982-94

DAVID W. SCHIROKAUER,¹ National Park Service, P.O. Box 9, Denali National Park, AK 99755, USA
HILARY M. BOYD,² National Park Service, P.O. Box 9, Denali National Park, AK 99755, USA

Abstract: In response to a dramatic increase in visitation and in problems with grizzly and black bears (*Ursus arctos*, *U. americanus*) during the 1970s, Denali National Park and Preserve implemented a comprehensive bear-human conflict management plan in 1982. The components of Denali's bear-human conflict management plan include visitor education, food-storage regulations, backcountry closures, and experimental aversive conditioning. Prior to the opening of a paved highway to the National Park in 1972, reports of bear-inflicted injuries, property damage, and bears obtaining anthropogenic food averaged <1/year. In 1982, 40 such incidents occurred. After implementation of the bear-human conflict management plan, incidents decreased steadily until 1988 when 9 occurred, a decrease of 77%. Incidents in which bears obtained anthropogenic food decreased from 23 in 1982 to 1 in 1989, a decrease of 96%. A recent slight increase in incidents (all types) may reflect the activities of either a few bears before they were removed or aversively conditioned, or bears which were never subjected to management actions. Since 1984, aversive conditioning was conducted on 2 black bears and 9 grizzly bears. In 8 of these cases, the bears avoided test camps and did not cause further problems during the season aversive conditioning occurred. Four of the bears aversively conditioned in the backcountry stayed away from camps for at least 2 years. Bears successfully broke into bear-resistant food containers in 12 of 55 attempts since 1979, due to improperly latched or defective lids and overfilled containers. There have been no reports of bears breaking into the newest model of bear-resistant food container. This work updates previous analyses of bear-human conflict in Denali National Park and Preserve.

Ursus 10:395-403

Key words: Alaska, aversive conditioning, bear-human interaction, bear-resistant food container, black bear, Denali National Park and Preserve, grizzly bear, *Ursus americanus*, *Ursus arctos*.

Bear management has likely been a part of Denali National Park and Preserve's (formerly Mount McKinley National Park) operations since its creation in 1917, although the first records of such actions are from 1946. Less than 6,000 people annually visited the park when it was accessible only by railroad prior to 1957. The 1958 completion of the Denali Highway increased visitation, but it was the 1972 opening of a paved highway linking the park to Alaska's population centers that increased visitation 5-fold and doubled overnight backcountry use in a year. Concerns about traffic safety and effects on wildlife prompted the National Park Service to restrict private vehicle use on the 154-km road accessing the park's interior and to establish a shuttle bus system. A permit and quota system limiting overnight backcountry use were also implemented.

As visitation and backcountry use increased, so did reports of bear-human conflicts. The Bear-Human Conflict Management Action Program was implemented in 1982 in response to an increase in injuries, property damage, bears charging hikers, and bears obtaining anthropogenic food from <1/year prior to 1972 to 40/year in 1982 (numbers revised in 1994). Between 1917 and 1982

at least 48 bears were destroyed or relocated (0.75 bears/year; Dalle-Molle and Van Horn 1989). Between 1982, when the program was implemented, and 1994 only 2 bears have been removed by management (0.17 bears/year), and the rate of bears damaging property or obtaining anthropogenic food dropped dramatically. Dalle-Molle and Van Horn (1989) described the elements of the program, its implementation, and evaluated its success through 1987. We describe the current elements of the program and evaluate its effectiveness through 1994.

We thank the employees of Denali National Park and Preserve for their contributions to bear management. We also thank J. Dalle-Molle, who designed and implemented this model bear management program, for his dedication. We thank J. Van Horn, G. Olson, K. Stahlnecker, S. Carwile, and J. Keay for their helpful ideas and reviews of early drafts of this manuscript and D. Gianturco for developing the Bear Information Management System database used at Denali. We also thank B. McLellan, M. Gibeau, S. Sharpe, and M. Munson-McGee for their thoughtful reviews of this paper.

STUDY AREA

Denali covers approximately 24,000 km² in interior Alaska. Elevations range from approximately 100 m above sea level to over 6,000 m at the summit of Mount McKinley. Elevation of approximately one third of the park is >1,500 m, where ice and rock predominate. Below the perennial snow line, alpine tundra, dwarf birch (*Betula nana*), and willows (*Salix* spp.) dominate the landscape. Braided rivers drain broad glacial valleys from the alpine regions down to the forested lowlands. For a more detailed description of the vegetation see Murie (1981), Stelmock (1981), Dean and Heebner (1982), and Heebner (1982).

On the north side of the Alaska Range, grizzly bears are abundant in the mountainous areas of alpine tundra and open glacial river valleys. Dean (1987) reported grizzly bear densities as high as 3.2 bears/100 km². Black bears generally inhabit the lowland forests but are also found in alpine regions on the south side of the Alaska Range. Both species eat salmon (*Oncorhynchus* spp.) on the south side of the Alaska Range.

Near the eastern boundary, both inside and outside the park, are tourist services including hotels and restaurants. At the west end of the park road are 4 small lodges on private inholdings, an historic mining district, and several patented and unpatented mining claims. Of the 7 campgrounds located along the park road, 3 accommodate private vehicles. Most visitors get into the park via shuttle and tour buses. A 1988 survey indicated that 95% of bus passengers saw at least 1 grizzly bear during their trip in the park (Machlis and Dolsen 1989).

Day hiking and backpacking from the park road are popular, and hikers generally follow river drainages and ridgelines. The backcountry in the core portion of the park is divided into 43 units which contain no maintained trails or campsites.

Elements of the Bear-Human Conflict Management Program

Special Staff.—A seasonal Wildlife Management Technician was hired in 1982, and 2 have been hired each summer since then to monitor bear-human interactions, investigate bear problems, and conduct bear management activities according to the Bear-Human Conflict Management Action Plan. They also trained park and local employees in bear safety, worked with local businesses and inholders to help them safely coexist with bears, and patrolled front and backcountry areas to monitor compliance with food and garbage handling regulations.

Visitor Education.—All visitors stopped at the Denali Visitor Center to obtain shuttle bus coupons, campground and backcountry permits, *Bicycle Rules of the Road* brochures, and the park newspaper, which included information on food storage and behavior in bear country. A detailed bear encounter brochure was distributed to visitors inquiring about day hikes. Backcountry users viewed an interactive video program on safe backpacking, including a module on camping and hiking in bear habitat. Information specific to Denali was presented, followed by various scenarios and choices about how to act during bear encounters. After choosing an action, viewers were presented with the consequences of their decision. For non-English speaking visitors, there were slide programs narrated in French and German and a Japanese transcript of the slide program. Before permits were issued, backpackers received verbal warnings on traveling and camping in bear country from a uniformed ranger. Compliance with the backcountry permit system approaches 100% because backpackers were not permitted to board shuttle buses without a backcountry permit.

Bear information was presented at all interpretive programs, guests of the Park Hotel received park newspapers, and weather-resistant plastic signs explaining appropriate food storage were posted in campground bathrooms, on bulletin boards, and on every picnic table. Park staff and volunteers patrolled campgrounds at least 4 times daily to ensure compliance with food storage regulations.

Food and Garbage Storage and Handling.—Prior to 1975, most bears killed or relocated by management had been attracted by improperly stored food and garbage (Dalle-Molle and Van Horn 1989). Frontcountry bear problems decreased after bear-resistant garbage cans and dumps were installed. Beginning in 1982, backpackers camping in areas with a history of bear problems were issued bear-resistant food containers (BRFCs), a 20 x 40 cm hard PVC cylinder. By 1987, bears obtaining anthropogenic food in the backcountry decreased by 95% (Dalle-Molle and Van Horn 1989). BRFC use became mandatory for all backcountry users except mountaineers in 1992. The \$150 fine for non-compliance was enforced.

Dalle-Molle and Van Horn (1989) noted that bears occasionally obtained anthropogenic food while a BRFC was open, and the containers occasionally failed due to improperly latched lids (Dalle-Molle et al. 1986). Since 1991, Denali National Park has replaced many of the older (model 812a) BRFCs with a new model (812c)

BRFCs marketed by Garcia Machine (14097 Ave. 272, Visalia, CA 93292, USA). The new containers were designed to prevent overfilling, had interchangeable lids, carried a lifetime guarantee, and weighed approximately 1.3 kg.

Bear Management Actions.—Front and backcountry areas were sometimes temporarily closed to minimize opportunities for adverse bear-human interactions (i.e., around a large animal carcass). When bears obtained anthropogenic food, the area was closed while the wildlife technicians attempted to observe the bear's behavior and conduct management actions. Depending on their assessment, the area reopened immediately, remained closed for additional observation and management actions, or remained closed until the end of the season. These reactive closures temporarily removed the elements (people and campsites) a bear may have associated with obtaining human food; they also allowed the wildlife technicians to conduct aversive conditioning without endangering park visitors.

Hazing and aversive conditioning were alternatives conducted prior to relocating or killing bears that frequented developed areas or had obtained anthropogenic food. Hazing involved using deterrents such as noise, throwing rocks, shooting cracker shells, or spraying capicum to chase uncollared or untagged bears away from developed areas before they became habituated to the site or obtained human food. If a bear obtained anthropogenic food or continued to investigate developed areas despite repeated hazing, it was radiocollared and subjected to aversive conditioning trials. If radiocollaring and aversive conditioning were logistically impossible, hazing continued.

Aversive conditioning was used to alter the behavior of radiocollared or tagged, food-conditioned bears. After a bear obtained anthropogenic food, the wildlife technicians immediately searched for a bear exhibiting food-conditioned behavior. If the incident occurred in the backcountry, they camped near the incident. After the bear was located, it was radiocollared so it could be located throughout the season and sometimes in subsequent years for aversive conditioning trials. Whenever the radiocollared bear was observed approaching within 30 m of the camp or developed area, it was aversively conditioned with plastic slugs, or cracker shells fired from a 12-gauge shotgun (Dalle-Molle and Van Horn 1989).

Every effort was made to continuously monitor areas with problem bears so hazing or aversive conditioning could occur immediately after these bears exhibited problem behaviors. Altering the behavior of a food-conditioned bear is difficult (McCullough 1982), but there have been some successes (Stenhouse and Cattet 1984, Derocher and Miller 1986, Dalle-Molle and Van Horn 1989). Since Dalle-Molle and Van Horn (1989) completed their report in 1987, 6 bears have been aversively conditioned and at least 9 bears were hazed in Denali National Park and Preserve. Two of the 9 hazed bears had obtained anthropogenic food, but radiocollaring was not logistically possible.

Travel Restrictions.—The road restrictions and bus system generally kept bears and humans apart. All tour and most shuttle bus passengers disembark at designated rest stops only. Shuttle bus drivers would not let hikers disembark within 1 km of a visible bear. Only a limited number of permits to drive private vehicles in the park interior were provided to people with mobility impairments, professional photographers, and people accessing businesses and inholdings in Kantishna.

METHODS

Various methods were used to report bear-human interactions throughout Denali's history. Data from the park's Bear Information Management System (BIMS), case-incident reports, annual bear management reports, management action forms, and field notes from 1979 to 1994 were collected and compiled for this analysis. Bear-human interactions and bear management actions have been recorded using the BIMS since 1978 (Smith 1983). Prior to 1982, most BIMS records documented only interactions during which anthropogenic food was obtained or property was damaged.

The quality and number of reports varied among years due to staff turnover and changing priorities. Bear interactions with overnight backcountry users were reported more consistently than those involving day hikers or frontcountry users because most backpackers were specifically asked about bear encounters when they returned their BRFCs to the visitor center. Based on a comparison between historical and modern records and comments from long-term park and concessionaire employees, we believe many frontcountry interactions were unreported because visitors were not aware of the BIMS reporting system or they believed the interaction was not serious enough to report. Beginning in 1989, a greater effort was made to obtain BIMS reports for less serious bear-human interactions and for interactions that occurred in the frontcountry, on private inholdings, and on mining claims.

In 1993, the standard BIMS form was revised to make it more specific to Denali and a database was developed to store, access, and analyze data. Date, location, bear behavior (Dalle-Molle and Van Horn 1989), habitat type, visitor's activity, visitor's source of bear information, and the type of interaction were included. Interactions were classified as encounters or incidents following Singer (Problem analysis—grizzly bear management, Natl. Park Serv., Anchorage, Alaska, 1982). Because reporting of bear-human interactions was inconsistent during the sampling period, we believe the only interactions reported consistently among years were those in which bears obtained anthropogenic food, caused property damage, or injured people. Therefore, our analysis only considered these incidents. As defined below, BIMS records are classified as encounters, incidents, injuries, management actions, and container tests (Bear-human conflict management action plan, Denali Park, Alaska, 1992).

When evidence suggested that a bear perceived a human presence, it was classified as an *encounter*. Sufficient evidence included a behavioral response or when a human was very close (<20 m) even if the bear showed little reaction.

An *incident* occurred when a bear (1) made physical contact with a human resulting in no physical injury (walked on a human in a tent, touched a human with a paw), (2) obtained anthropogenic food, (3) damaged property, (4) charged a human or approached closely (ran to within 10 m, walked slowly but directly to within 5 m, or approached noise-making humans multiple times within 25 m), or (5) caused a human to take extreme evasive action (climbed a tree, played dead, fired capsicum spray, etc.), whether or not such action was justified. Incidents were divided into cases in which bears obtained anthropogenic food or property damage occurred.

Injuries were all cases in which a bear contacted a human resulting in injury. This included cases in which a human was injured escaping from a bear.

Use of physical force on a bear by park employees including hazing, aversive conditioning, relocation, and destruction were classified as *management actions*. Bears killed in defense of life and property by inholders and visitors were included in this category although these incidents were not always reported.

When a bear attempted to break into a BRFCs, it was classified as *container test*. This did not include instances when bears merely sniffed or lightly bat-

ted BRFCs; nor did it include cases when bears obtained anthropogenic food that was stored outside of a BRFC.

For our purposes, the number of visitors riding shuttle buses was used to index park visitation. Trends in park visitation and bear incidents from 1979 through 1994 were analyzed using linear regression (Sokal and Rohlf 1981). We evaluated the park's bear education program based on where people involved in bear-human interactions learned of appropriate behavior in bear habitat. Hazing was evaluated by monitoring the area where the problem occurred. If there were no additional problems, the management action was considered successful. Aversive conditioning was considered successful if the radio-collared bear stopped approaching camps or developed areas. Container tests were evaluated by comparing the frequency of successes and failures of bears attempting to break into BRFCs.

RESULTS AND DISCUSSION

Education

Of the 329 groups that reported bear-human interactions in 1993 and 1994, 154 (44%) reported no previous knowledge of bears before entering the park and 3 (0.9%) reported that they had received no information on bears. These data suggest in-park distribution of bear information was important because many of the people that interacted with bears learned how to behave during

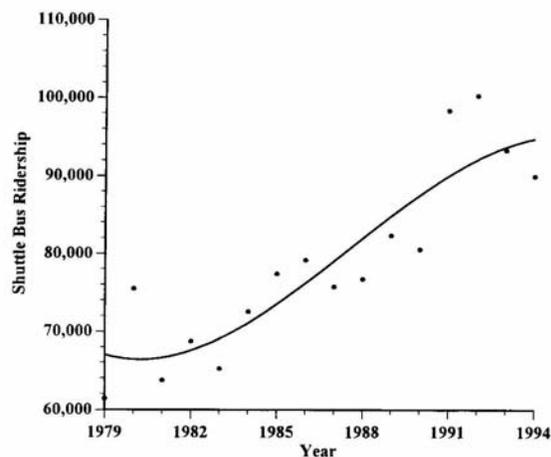


Fig. 1. Shuttle bus use in Denali National Park and Preserve, Alaska, 1979-94. $r^2 = 0.80$, $P < 0.0002$.

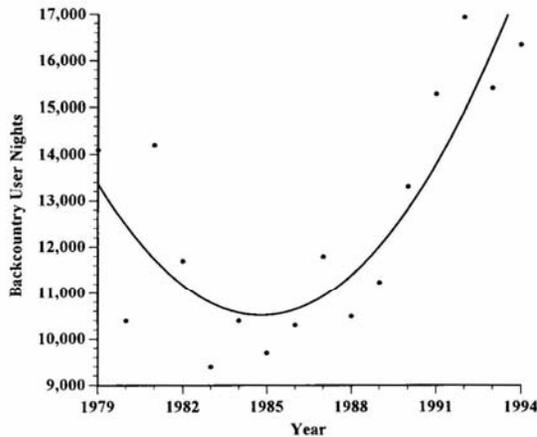


Fig. 2. Backcountry use in Denali National Park and Preserve, Alaska, 1979–94. $r^2 = 0.76$, $P < 0.005$.

a bear encounter from information they received upon entering the park.

All backcountry campers within this group had received information from at least 1 source. Of the people involved in interactions, 65% had viewed the backcountry simulator and 48% had read printed materials on bears. These data indicated it is important to provide multiple sources and formats of information to reach all visitors.

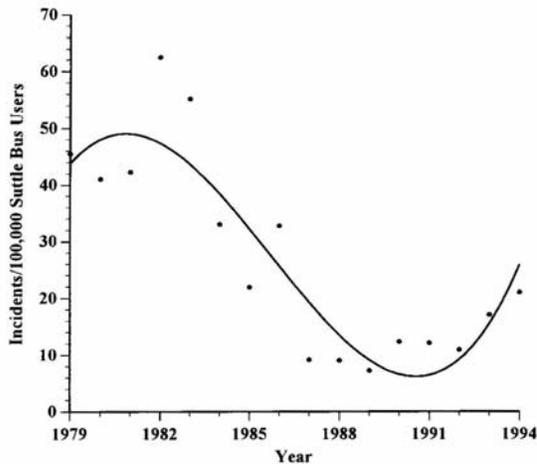


Fig. 3. Total incidents in which bears damaged property or obtained anthropogenic food/100,000 shuttle bus users, Denali National Park and Preserve, Alaska, 1979–94. $r^2 = 0.86$, $P < 0.00001$.

It was also important to have information available in different languages. Among people reporting bear-human interactions in 1993 and 1994, 9.6% were not native speakers of English. Of all overnight backcountry users, 10.1% were not native speakers of English. The victim of 1 of the most serious bear-inflicted injuries in Denali did not speak English.

Incidents

Total park visitation rose from 1979, peaked in 1992, and leveled off through 1994 (Figs. 1, 2). Although the initial increase in Denali visitation after 1979 was accompanied by increased bear incidents (Dalle-Molle and Van Horn 1989), the number of times bears obtained anthropogenic food or caused property damage per 100,000 park visitors declined significantly from 1979 to 1994 (Fig. 3). This general trend indicated that Denali's bear management program effectively reduced bear-human conflict even as visitation levels rose.

Between 1989 and 1994, the number of incidents in which bears obtained anthropogenic food fluctuated from a low of 1 in 1989 to a high of 5 in 1993. These incidents resulted from improperly stored food and garbage on private inholdings, improperly stored food in the backcountry, an open BRFC that was abandoned as a bear approached, improperly stored food in a frontcountry campground, food left on the park road, and an unusual situation in which a black bear obtained food from a mountaineering party camped on

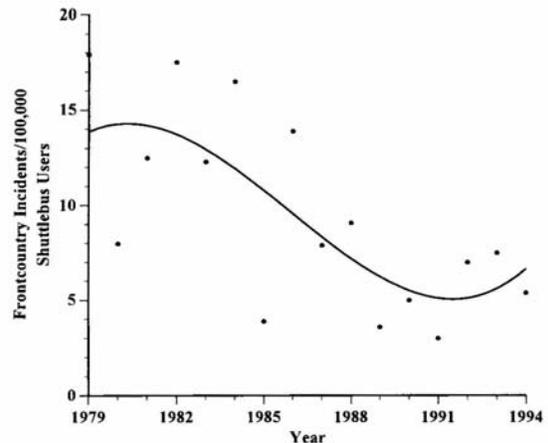


Fig. 4. Frontcountry incidents in which bears damaged property or obtained anthropogenic food/100,000 shuttle bus users, Denali National Park and Preserve, Alaska, 1979–94. $r^2 = 0.52$, $P < 0.01$.

a glacier above an impassable ice fall (the mountaineers were flown in).

Dalle-Molle and Van Horn (1989) attribute the decline in incidents to efforts to educate park users, use of BRFCs, and aversive conditioning. We attribute the recent increase in bear incidents to a few bears that damaged property or obtained anthropogenic food. These bears were not subjected to management actions due to logistical constraints including the inability to find the bear or its close proximity to developments.

Although the proactive components of the Bear-Human Conflict Management Action Plan were primarily responsible for the reduction in incidents, they did not eliminate the need for reactive management actions. The increase in incidents from 1989 to 1993 demonstrated the importance of immediate management actions in response to bear incidents.

Frontcountry.—The rate of frontcountry incidents followed the same general pattern as total incidents (Fig. 4). Among the bear incidents in which bears obtained anthropogenic food in the frontcountry between 1980 (the year The Kantishna Mining District became part of Denali National Park and Preserve) and 1994, 48% (15) occurred on private land or unpatented mining claims in the Kantishna area. Of the management actions in which bears were killed, removed, or killed in defense of life and property, 50% (8) occurred in the Kantishna area.

The concentration of bear incidents in the Kantishna area is due to open garbage dumps, accessible human food, and a propensity for residents to own and use firearms. Denali does not have jurisdiction on private land within the park boundary, and enforcement of the State of Alaska's food and garbage handling regulations was sporadic. Although the majority of landowners in the Kantishna area consistently comply with Denali National Park's food and garbage handling standards, the few that were inconsistent caused most of the bear problems. If more businesses and residences are constructed in the Kantishna area, bear problems may increase. However, Denali National Park has acquired funds to purchase much of the private land in the Kantishna area as it becomes available.

Bears obtained anthropogenic food and were killed in defense of life and property in nearby squatters' camps and towns just outside the park boundary. Since 1992, at least 3 bears were killed in defense of life and property a few miles from the park's eastern border. Other frontcountry incidents and management actions were not concentrated in any single location.

Backcountry.—Trends in backcountry incidents (Fig. 5) showed a pattern similar to the park-wide incidents.

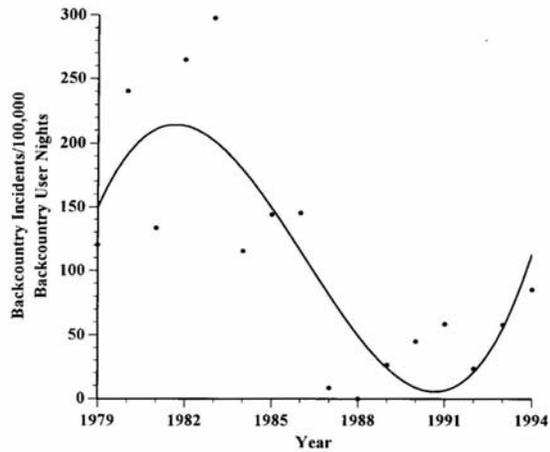


Fig. 5. Backcountry incidents in which bears damaged property or obtained anthropogenic food/100,000 backcountry users, Denali National Park and Preserve, Alaska, 1979–94. $r^2 = 0.69$, $P < 0.002$.

From 1982 to 1988, backcountry incidents declined significantly but increased slightly after 1991. This pattern indicated that the Bear-Human Conflict Management Action Plan was successful, even as overnight backcountry use increased (Fig. 2). Most backcountry

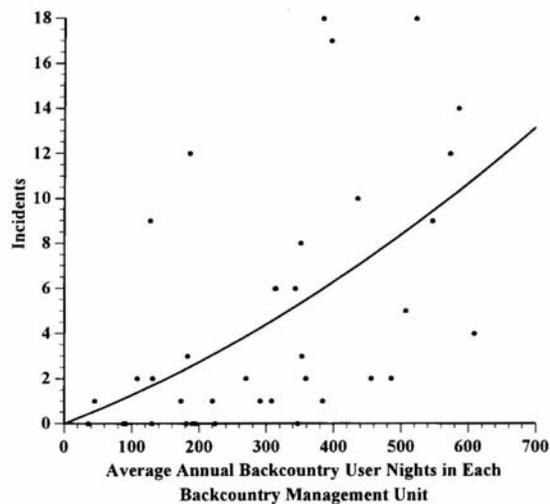


Fig. 6. Average annual backcountry user nights in each backcountry unit plotted against the number of incidents in the backcountry unit, Denali National Park and Preserve, Alaska, 1982–94. $r^2 = 0.29$, $P < 0.005$.

incidents were concentrated in a few units. When 3 outliers were removed from the analysis, a weak but significant correlation existed between the number of incidents in a backcountry unit and the average annual number of user nights in the backcountry unit (Fig. 6). These points were outliers because the management of these 3 backcountry units was different. Two backcountry units that did not have a quota limiting overnight use until 1993 and therefore had high use levels were not included in the analysis. The third outlier was a backcountry unit that was closed for most of the study. Some backcountry units deviated from the pattern displayed in Fig. 6 because they had low overnight use quotas (2–4 people/night) but occurred in an area where bear-human interactions were common. Habitat type and human and bear travel patterns may have affected the rates of bear incidents. It is also plausible that the rate of backcountry incidents was correlated with bear density in each unit. No data exist to support or refute this hypothesis.

Bicycles.—The number of bicyclists using the park road increased from 124 in 1990 to 327 in 1994, as recorded at the Savage River Entrance Station. Many bicyclists entered the park on shuttle buses, traveled the park road at night, or cycled during the spring and fall to avoid traffic, and were not counted; thus we believe this figure is low. To date, 4 BIMS records document bear incidents with cyclists. We also believe this number is low due to under-reporting. One bicyclist was chased “at high speed for 30 m” (Denali Natl. Park and Preserve, unpubl. data) by a female grizzly he had been photographing. Another bicyclist believed that 2 bears feeding near the road were attracted to the sound of his squeaking brakes. One of these bears approached within 2 m. In 2 incidents, bicyclists abandoned their bicycles as a bear approached. In both cases the bears investigated the bicycles and left unrewarded, but 1 left only after being nudged by a vehicle. Shuttle buses occasionally pick up bicyclists when bears are nearby, preventing potential incidents.

Due to the increasing number of bicyclists on the park road and the silent nature of bicycles, the potential for serious bear incidents may be high. Jasper National Park in Alberta, Canada, reported that a cyclist was injured by a grizzly bear during a surprise encounter (History of bear-human conflict management in Jasper National Park, Jasper, Alberta, 1995). Because many cyclists use the road through Denali at off-peak hours, we suggest that a way-side exhibit be installed in a conspicuous location to notify cyclists of appropriate behavior should they encounter a bear. The importance of making noise in areas with low visibility, stopping and slowly retreating, or walking past a bear near the road, and traveling in groups should be stressed.

We recommend cyclists keep their bicycles with them as they retreat from a bear because bears could obtain anthropogenic food from panniers.

Bear-Human Conflict in Other Areas.—Other national parks in North America have experienced similar trends in visitation and bear-human interactions and similar success with bear management programs. In Yellowstone National Park, the number of people injured by bears decreased from an average of 48/year to an average of 1/year and property damage decreased from an average of 98 incidents/year to 14/year between 1931 and 1993 (Gunther 1994). During this period, bear management changed from a hands-off policy of allowing visitors to feed bears, to public education and a strict policy of keeping all human food secure from bears. Glacier National Park implemented a bear management program in 1968 that emphasized visitor education and reducing the availability of anthropogenic food. Due to Glacier’s program, black bear removals declined from an average 10.3/year during the 1960s to 2.6/year between 1990 and 1994; grizzly bear removals declined from 2.0/year to 0.6/year during the same period (Gniadek and Kendall 1998). The bear management program at Yosemite National Park included education, improved food storage, and moderate levels of law enforcement; it resulted in a decrease of black bear incidents in most frontcountry areas (Keay and Webb 1989). Bear removals in Jasper National Park declined from an average of 13.9 black bears and 2.8 grizzlies/year from 1960 to 1969 to 0.8 black bears and 0.4 grizzlies/year between 1990–95 due to garbage becoming inaccessible to bears during the 1970s and 1980s (Ralf 1995). Bear incidents in Shenandoah National Park declined from a high of 257 in 1976 to 13 in 1986 due in part to garbage dump closures and a drop in overnight backcountry use (Garner and Vaughan 1989).

Bear Resistant Food Container Tests

Bears have been documented at campsites with BRFCs over 450 times since 1979 and have attempted to break into BRFCs 55 times. Bears successfully obtained anthropogenic food in 12 of these incidents due to improperly latched or defective lids and overfilled containers. These instances all occurred with the older BRFC model (812a). There have been no reports of bears successfully breaking into the newer model BRFC (812c).

Bear Management Actions

Aversive Conditioning.—Since 1984, 2 black bears and 9 grizzlies were subjected to aversive conditioning (Table 1). In 8 of 11 cases, the bears avoided test camps and did not cause further problems during the season the aversive conditioning occurred. However, 2 bears caused problems

Table 1. Results of aversive conditioning of bears in Denali National Park, Alaska, between 1984–94.

Bear ^a number	Species ^b /Sex	Number of treatments	Longest conditioned period	Location ^c
1	GB/F	4	5 years	BC
2	GB/F	2	2 years	BC
3	GB/F	2	2 years	FC
4	GB/F	1	3 years	BC
5	BB/M	2	3 days	FC
6	BB	2	3 years	FC
7	GB/M	6	2 days	FC
8 ^d	GB	Unknown	2 years	FC,BC
9 ^d	GB	Unknown	3 years	FC,BC
10	GB/F	Unknown	2 years	BC
11	GB/M	7	7 weeks	FC

^a Bears 1–5 appear in a similar table in Dalle-Molle and Van Horn (1989).

^b Species: GB, grizzly bear; BB, black bear.

^c Location: BC, backcountry; FC, frontcountry.

^d Bears 8 and 9 were the offspring of bear 10 and did not obtain any anthropogenic food.

again; 1 bear was killed in defense of life and property 3 days after radiocollaring, and another died of complications during recapture.

Among the frontcountry cases where bears obtained anthropogenic food, 2 of 5 bears subjected to aversive conditioning stayed away from camps and developments during the season the aversive conditioning was conducted. Of the 7 bears subjected to aversive conditioning in the backcountry, 4 avoided camps for at least 2 years. The higher success rate for backcountry aversive conditioning may be due to the ephemeral nature of backpackers' campsites, the low number of people permitted in the backcountry at any given time, and the high compliance with the BRFC program resulting in a low level of food conditioning.

Hazing.—Since 1984, hazing has been documented for 12 bears. In 11 (92%) of these cases, no additional nuisance bear activity was reported in the area during the season the hazing occurred. The bear that continued to display nuisance behavior had obtained anthropogenic food in the backcountry. It stopped approaching test camps, but property damage in the same area was attributed to that bear. Another bear that obtained anthropogenic food from a frontcountry campground was hazed 4 times within 24 hours of its food reward. No additional bear sightings occurred in that campground that season.

These results support Denali National Park and Preserve's guidelines on deterring bears from developed areas. However, the long-term effects of hazing are difficult to evaluate because unmarked bears cannot be identified and a variety of factors can cause a bear to

discontinue using a particular area. However, there are short-term benefits. Hazing can remove a bear from an area where it might obtain anthropogenic food if it were to linger, preventing a curious bear from learning to associate humans and their facilities with food.

MANAGEMENT IMPLICATIONS

Inconsistencies in BIMS limited our ability to analyze data. Future analyses will be improved if the more consistent reporting efforts begun in 1989 are continued. We suggest additional data on the location and number of day hikers using the backcountry be gathered to clarify actual backcountry use. We support a collaboration of bear managers in designing BIMS databases to facilitate inter-area comparisons of bear-human interactions and effects of different bear management programs.

Denali's transportation system offers a broad-scale model for managing large numbers of visitors in an area where the potential for bear-human conflict and resource degradation is high. In 1993, over 204,000 people rode shuttle and tour buses into the park and another 10,000–14,000 rode private buses to lodges in Kantishna. Had the travel restrictions not been in place and all these visitors driven their private vehicles on the park road, it is likely that bear-human interactions would have been much more common. Denali's road restrictions and bus system provide a system for managing a large number of visitors over a large area accessed by a 154-km road in an area with a high concentration of grizzly bears. Many of these bears are habituated to traffic but are not food conditioned (Albert and Bowyer 1991, Schirokauer and Boyd pers. observ.). These restrictions on human activities along with the other components of Denali National Park and Preserve's bear management program continue to keep rates of bear-human conflict low.

LITERATURE CITED

- ALBERT, D.M., AND R.T. BOWYER. 1991. Factors related to bear-human conflict in Denali National Park. *Wild. Soc. Bull.* 19:339–349.
- DALLE-MOLLE, J.L., M.A. COFFEY, AND H.W. WERNER. 1986. Evaluation of bear-resistant food containers for backpackers. Pages 209–214 in R.C. Lucas, ed. *Proc. Natl. Wilderness Res. Conf. U.S. Dep. Agric. For. Serv. Gen. Tech. Rep. INT-212.*
- , AND J.C. VAN HORN. 1989. Bear-people conflict management in Denali National Park, Alaska. Pages 121–128 in M. Bromley, ed. *Bear-people conflicts: Proc. of a Symp. on Manage. Strategies.* Northwest Territ. Dep. Renewable Resour., Yellowknife.

- DEAN, F.C. 1987. Brown bear density in Denali National Park, Alaska, and sighting efficiency adjustment. *Int. Conf. Bear Res. and Manage.* 7:37-43.
- , AND D.K. HEEBNER. 1982. Landsat-based vegetation mapping of Mount McKinley National Park region, Alaska. *Natl. Park Serv. Contract No. CX-9000-6-E084*, Anchorage, Alaska. 198pp.
- DEROCHER, A.E., AND S. MILLER. 1986. Twelve gauge ferret shell test on polar bears, Cape Churchill, Manitoba, 1984. *Northwest Territ. Dep. Renewable Resour.*, Yellowknife. *File Rep.* 54:1-40.
- GARNER, N.P., AND M.R. VAUGHAN. 1989. Black bear-human interactions in Shenandoah National Park, Virginia. Pages 155-161 in M. Bromley, ed. *Bear-people conflicts: Proc. of a Symp. on Manage. Strategies*. Northwest Territ. Dep. Renewable Resources., Yellowknife.
- GNIADK, S.J., AND K.C. KENDALL. 1998. A summary of bear management in Glacier National Park, 1960-94. *Ursus* 10:155-159.
- GUNTHER, K.A. 1994. Bear management in Yellowstone National Park, 1960-93. *Int. Conf. Bear. Res. and Manage.* 9(1):549-560.
- HEEBNER, D.K. 1982. The numerical analysis of vegetation plots in Denali National Park and Preserve. M.S. Thesis, Univ. Alaska, Fairbanks. 243pp.
- , AND M.G. WEBB. 1989. Effectiveness of human-bear management at protecting visitors and property in Yosemite National Park. Pages 145-154 in M. Bromley, ed. *Bear-people conflicts: Proc. of a Symp. on Manage. Strategies*. Northwest Territ. Dep. Renewable Resour., Yellowknife.
- MACHLIS, G.E., AND D.E. DOLSEN. 1989. Denali National Park visitor service project. *Visitor Serv. Proj. Rep.* 18. *Natl. Park Service*, Washington D.C.
- MCCULLOUGH, D.R. 1982. Behavior, bears, and humans. *Wild. Soc. Bull.* 10:27-33.
- MURIE, A. 1981. *The grizzlies of Mount McKinley*. Univ. Washington Press, Seattle. 251pp.
- RALF, R. 1995. History of bear-human conflict management in Jasper National Park 1907 to 1995. *Parks Canada*, Jasper National Park, Alberta. 19pp.
- SMITH, J.K. 1983. BIMS—The bear reporting network for the National Park Service. *Int. Conf. Bear. Res. and Manage.* 5:299-303.
- SOKAL, R.R., AND F.J. ROHLF. 1981. *Biometry*. Second ed. W.H. Freeman and Company, New York, N.Y. 859pp.
- STELMOCK, J.J. 1981. Seasonal activities and habitat use patterns of brown bears in Denali National Park—1980. M.S. Thesis, Univ. Alaska, Fairbanks. 118pp.
- STENHOUSE, G., AND M. CATTET. 1984. Bear detection and deterrent study, Cape Churchill, Manitoba, 1984. *File Rep.* 44. *Northwest Territ. Dep. Renewable Resour.*, Yellowknife.

BEAR-PEOPLE CONFLICT MANAGEMENT IN DENALI NATIONAL PARK, ALASKA

JOHN L. DALLE-MOLLE, National Park Service, Box 9, Denali Park, AK 99755

JOSEPH C. VAN HORN, National Park Service, Box 9, Denali Park, AK 99755

Abstract: Bear-people conflicts in Denali National Park increased dramatically during the 1970's as visitation to the park rose 7-fold. Incidents of property damage, bears obtaining human foods, charges, and injuries increased from less than 1/year prior to 1972 to a high of 37 in 1982. In 1982 a comprehensive effort was begun to reduce incidents. The bear-people conflict management plan was substantially revised. Two seasonal wildlife technicians were added to the park staff to work exclusively on the problem. Portable bear-resistant food containers were distributed to backpackers. Aversive conditioning was used on bears that had obtained food from back-country camps. As a result of this emphasis on preventative actions, since 1982 no management relocations or killing of bears have been necessary. Incidents have decreased by 81% parkwide, 60% in developed areas and 92% in the back-country. The number of incidents involving property damage decreased 88%. Monetary losses from damages declined 93%. Incidents of bears obtaining human food or garbage have decreased 95%.

Bear-People Conflicts - Proc. of a Symposium on Management Strategies (1989). Northwest Territories Dept. of Renew. Res.

Rapidly increasing visitation in national parks in the 1970's was accompanied by increases in bear-people conflicts (Martinka 1982). Visitation to Denali National Park doubled in 1972 when a paved state highway reached the park. Incidents of property damage, charges, injuries, and bears obtaining human foods increased from less than 1 per year prior to 1972 to 36 by 1982. This paper describes the management actions taken to reduce the incidents and the results of those actions.

We thank Al Lovaas for obtaining funding to start this program and for his continuing encouragement, and Doug Waring and Brad Shults for field assistance.

BACKGROUND

Denali National Park and Preserve consists of about 24,000 km² in south-central Alaska. Elevations range from 122 - 6,194 m, culminating in North America's highest peak, Mount McKinley. The lower areas consist of taiga dominated by black spruce (*Picea mariana*), white spruce (*P. glauca*), paper birch (*Betula papyrifera*), and quaking aspen (*Populus tremuloides*), with numerous lakes, streams and bogs. The foothills of the Alaska Range are chiefly covered by shrub communities of willow (*Salix* spp.) and dwarf birch (*B. glandulosa* and *B. nana*), with moist areas of cottongrass (*Eriophorum* spp.). Tundra plants such as mountain avens (*Dryas* spp.) and sedges (*Carex* spp.) are found on the mountain slopes to about 1,500 m, above which rock and glaciers predominate.

Grizzly (*Ursus arctos*) and black bears (*U. americanus*) inhabit the park. Grizzlies are most abundant in the foothills and mountains, while black bears rarely leave the forested lower terrain.

Most visitor use of Denali occurs along the 154 km gravel road that traverses the foothills and lower slopes of the north side of the Alaska Range. Transportation is primarily by shuttle and tour buses (Singer and Beattie 1986). At the east end of the road there are hotels and other services both in and out of the park. At the west end of the road there are a few lodges and a mining district. Seven campgrounds are located along the road.

Easy accessibility and open country make hiking into the back-country popular. There are no designated trails or campsites and use is dispersed throughout the open terrain. Hikers follow the broad, glacial river valleys or tundra ridges and slopes of the mountains. The area accessible from the road has the best grizzly bear habitat in the park. Dean (1987) estimated the minimum grizzly bear density for this area as 1 bear/44 km².

THE PROBLEM

Prior to 1972, bear-people conflicts in the park were not considered a serious management problem. Many years no incidents were recorded. From its establishment in 1917 (as Mount McKinley National Park) through 1971, only 4 injuries to people were reported. Ranger reports seldom mentioned problems. Adolph Murie studied

121

wildlife in the park for many years between 1939 and 1970. Bear-people conflicts are rarely mentioned in his book on the park's grizzlies (Murie 1981).

In 1972 this situation changed with the opening of the state highway to the park. With the increase in recreational visits, bear-people conflicts increased (Table 1). By 1978 a bear incident reporting form was developed, rangers were equipped with immobilizing drugs, and a bear-human conflict management plan was prepared. In 1978, park staff reported 79 interactions.

Prior to 1982 a major management response to bear-people problems had been to remove the bears (Table 1). Open garbage dumps and poorly stored food attracted bears and led to most of the management relocations and removals prior to 1975. That year all dumps but 1 were closed. The 1 which stayed open was fenced, and in 1980 was replaced by a large holding tank from which garbage is trucked to a state landfill 100 km from the park.

Although bears were being denied garbage, problems continued to increase. Part of the problem was the sheer number of people in bear habitat. Unexpected encounters with bears resulted in defensive reactions by bears, such as charges. Bears were finding back-country campers' food caches, approaching campers who were cooking, or obtaining food from packs dropped by hikers during encounters (Table 2). Bears obtained poorly stored food or unprotected garbage on privately owned lands within or adjacent to the park, and then caused problems in the park. Some bears were killed by private landowners. Park regulations are not enforceable on private inholdings.

Efforts to educate campers about food storage and behaviour in bear country were made when people picked up their permits. As only 7% of back-country campers did not get a permit (Plager and Womble 1981), rangers were able to personally distributed written information and talk to most campers. Areas where conflicts had occurred were frequently closed to visitor use for weeks at a time. State regulations for food and garbage protection on private inholdings were not enforced until after a problem had occurred and a complaint had been lodged with state officials. Even then, the cause of the problems was rarely permanently corrected.

Despite dump closures, visitor education, area closures, and relocation or destruction of bears, overall problems did not decline. In 1982, the park began to evaluate its

Table 1. Annual visitation, injuries, incidents, and bear removals, Denali National Park, Alaska, 1917-1986.

Year	Visitors	Injuries	Incidents	Bears Removed ^a
1917-70	<40,000/yr	4	<1/yr	28
1971	45,000	0	0	2
1972	89,000	1	2	1
1973	137,000	3	4	1
1974	160,000	0	5	1
1975	161,000	1	10	1
1976	158,000	0	10	4
1977	170,000	1	21	2
1978	223,000	0	29	2
1979	287,000	0	28	4
1980	318,000	3	29	1
1981	262,000	0	25	1
1982	322,000	1	36	1
1983	346,000	0	31	0
1984	394,000	0	25	0
1985	436,000	2	21	0
1986	530,000	0	23	0
1987	575,000	2	7	0

^a Management relocations or kills.

Table 2. Back-country camper-nights, injuries, and incidents, Denali National Park, Alaska, 1971-1987.

Year	Camper-Nights	Injuries	Incidents
1971	2200	0	0
1972	3500	1	0
1973	4000	2	0
1974	4000	0	3
1975	5800	1	2
1976	6800	0	2
1977	8300	0	10
1978	10000	0	23
1979	14100	0	19
1980	10400	2	25
1981	14200	0	21
1982	11700	1	26
1983	9400	0	22
1984	10400	0	12
1985	9700	0	14
1986	10300	0	14
1987	11800	2	3

actions and establish a comprehensive program of problem analysis, planning, and field management actions.

PROBLEM ANALYSIS

Denali's Resource Management Plan, a basic planning, programming and budgeting document, identified the need for conducting a problem analysis. The analysis used bear incident records collected by park staff (F. J. Singer, unpubl. rep., National Park Service, Anchorage, 1982). Key findings from this analysis were:

1. Problems in the front-country (the area within 0.5 km of roads or developments) seemed to have stabilized as sanitation management improved.
2. Problems in the back-country (the area more than 0.5 km from front-country) were increasing very rapidly, and the incident rate of 90 per 100,000 visitor-nights was extremely high compared to other parks with grizzlies. This situation was primarily due to inability of campers to secure their food, as 58% of cases were related to a food incentive at the campsite.

The number of bear incidents was significantly correlated to total visitation within back-country units. Interactions increased rapidly after a unit exceed 500 - 800 visits/year.

Recommendations were made for improving data collection, establishing clear decision guidelines for management action, setting research priorities, and testing the effectiveness of various management actions.

PLANNING

Concurrent with the problem analysis, planning was undertaken to revise the Bear-Human Conflict Management Action Plan. Findings from the problem analysis were then incorporated in this plan. Action plans are the operational parts of the Resource Management Plan. Planning was based on these policies:

1. The causes, not just symptoms, of problems must be treated. Total elimination of unnatural food rewards and management of human use must be the first priorities.
2. If these fail, aversive conditioning of bears will be tried before bears are removed or destroyed.
3. Attempts must be made to determine a bear's behaviour during an incident. Bears acting

defensively or from natural curiosity while foraging will not be manipulated, unless conditioning to unnatural foods is likely to result.

The park's current plan contains a modification of the elements recommended by Taylor (1984) for bear management plans. The elements of our plan are objectives, organization structure, evaluation, monitoring, education, staff responsibilities, enforcement, regional management, budgeting, food and waste management, management actions in response to interactions, and research and training.

The plan also lists clear decision criteria to determine when action must be taken against a bear. These are used to determine the type of interaction that has occurred, the bear's behaviour, whether it is acceptable or not, and the appropriate response (Table 3).

A set of field guidelines further describes the specific management actions to be applied in a stepdown manner for 10 types of bear-human interactions that have often occurred in Denali. For example, if a bear is observed within ½ km of a developed area, extra warnings are made and patrols for sanitation problems are increased. If the bear starts to stay around facilities or people even though no food is obtained, a thorough review is first made of all reports to try to determine if the same bear is likely involved in each case. If so, the next step is to observe the bear's behaviour. We try to deter the bear from the area if it continues its pattern and appears likely to eventually become a conditioned bear. If that fails, and the bear becomes conditioned, the plan calls for radio-collaring the bear and trying aversive conditioning. Relocating the bear would be the next step, and finally if all else failed, destruction.

The plan has also assigned clear lines of responsibility, and annual evaluation, modification, budgeting and staffing are accomplished so the program receives consistent high priority.

The park's Wilderness Recreation Management Action Plan controls the extent and distribution of back-country visitor use. The park is divided into 44 units. Limited numbers of campers are allowed in each, with controls based on such factors as impact to vegetation, perceived crowding, disturbance to wildlife, and prevention of bear-human incidents. Only 2 - 8 people are permitted to camp in most units each night.

A study of the park's efforts to educate visitors in bear country was one element of our plan. Sundstrom (1984) found 74% of visitors knew the proper precautions for

Table 3. Criteria used in Denali National Park, Alaska to determine when a bear's behaviour in the presence of people requires management action towards the bear.

Behaviour Category	Human-Bear Interaction	Management Response
Foraging		
Curious	Bear shows inquisitiveness one time to identify a scent or object, then moves away.	None
Mistaken prey	Person acting like normal bear prey, or bear attacks in brush where it has been preying on moose calves, etc.	None
Defensive		
Dominance	Bear challenges intruder of its personal space by approaching, charging, or body language displays.	None
Surprise	Close, unexpected encounter; bear reacts, then leaves once person is no longer considered a threat.	None
Provoked	Person intentionally approaches close or harasses bear. Bear reacts, then leaves immediately.	None
Habituated		
Tolerant	Bears in areas also used by people; tolerates people nearby but ignores them and their facilities.	Monitor Deter
Conditioned	Repeat interest in people or their facilities; if allowed to continue, likely will result in obtaining unnatural food or will approach people or facilities.	Aversively condition Relocate Remove
Rewarded	Bear has obtained unnatural foods.	Aversively condition Relocate Remove
Aggressive		
Threat	Made repeated nondefensive charges or caused injury.	Destroy
Predation	Kills and consumes victim.	Destroy

avoiding conflicts with bears. The park's efforts significantly increased their knowledge; however, many visitors did not apply that knowledge. This indicated the park should make a major effort to convince visitors of the critical need to apply their knowledge. Park and concession employees had lower behaviour scores than visitors, pointing out the need for stronger attention to that group. As a result of this study, changes have been incorporated in the plan to increase the time spent with hikers explaining proper behaviour, and to increase training of employees. An experimental interactive computer system (Cuillard 1987) is being developed where hikers can place themselves in various simulated situations with bears, choose their behaviour and see the bears' reactions. If they choose wrong, they will see the consequences and be given the correct information.

Efforts to prevent problems on private lands within and adjacent to the park consist of monitoring garbage handling, offering assistance with designing appropriate bearproof facilities, and encouraging better state regulations and strong enforcement.

FIELD MANAGEMENT ACTIONS

Special Staff

In 1982 a biological technician was hired in the summer for bear-human conflict management. Since 1983 there have been 2 technicians. Their duties are to immediately respond to bear-human conflicts, investigate them, attempt to identify the bear involved, and take action according to the Bear-Human Conflict Management Action Plan. Because their time is dedicated solely to this work, they can stay with a situation continuously for days if needed. In the past when rangers had to deal with such problems they were often called away to perform other duties. The "bear techs" also patrol areas such as the park hotel, housing, campgrounds, and similar developed areas outside the park boundary for litter problems. They help train employees of the park and local businesses in safe practices in bear country. In the past we often could not investigate rumours of conflicts, but the bear techs now have the time to do this. This has resulted in greater knowledge of the actual number of problems and the details regarding them.

Bear-Resistant Food Containers

In 1982 we began a program aimed at reducing food-related problems with bears. Field tests were conducted to find a portable plastic food container for backpackers

that would be resistant to bears. There are no trees for hanging food in much of the park, so hikers cached food on the ground where bears easily found it. Bears learned to seek out such food and to damage packs and tents while searching for food. Containers have been loaned to backpackers going into areas which have historically had the most problems. Containers have proven very effective in reducing problems and visitor acceptance of them has been very high (Dalle-Molle et al. 1986).

During 1982 through 1987, bears were reported present at sites a minimum of 106 times when containers were in use. Bears obtained food 20 times due to: 5 failures of early models of containers, 5 lids not latched completely by users, and 10 instances of food left outside the container, usually while people were cooking when a bear approached.

Deterring and Aversively Conditioning Bears

Park policy is to remove bears only as a last resort. Therefore, efforts are made to deter bears from sites before they obtain unnatural food, and to modify behaviour of bears conditioned to such food. We recognize that it is difficult to change the behaviour of a bear whose efforts have gained it a food reward in the past (McCullough 1982), but some success has been reported (Stenhouse and Cattet 1984; Derocher and Miller 1986).

Our plan calls for deterring bears from developed areas, before they become conditioned to unnatural foods, by making noise, firing cracker shells, or shooting them with soft plastic slugs fired from a 12 gauge shotgun. The slugs cause discomfort to the bear but bounce off. They have caused only minor localized tissue damage to the 2 bears we have examined.

When a bear is conditioned to unnatural food, we try to aversively condition it to avoid sites which it has associated with unnatural food rewards. As soon as a bear is reported to have obtained unnatural food, we go to the site. If there is a bear at or near the site, we observe its behaviour to see if it acts like a food-conditioned bear, that is, if it approaches the camp or people directly, is not deterred by noise-making and arm-waving, and fits the description of the bear involved in the incident. If it meets these criteria, we assume it is the bear that obtained food. We immobilize it by darting, and radio-collar it. If the incident happened at a developed site and the bear returns to the site or other similar sites, we shoot it with soft slugs. If the incident happened to back-country campers, we locate

the bear about once a month throughout the summer and set up a tent simulating a backpacker's camp where the bear may notice it. If the bear approaches within 30 m of the camp, it is shot with a slug. We remain quiet inside the tent so the bear will hopefully associate the unpleasant experience with the camp rather than people, as bears have often raided camps at night or when hikers were away. We vary the model, colour and number of tents used. The behaviour of the bear is recorded from the time it notices the camp until it had moved 1 km away from the site.

Table 4. Aversive conditioning of bears in Denali National Park, Alaska 1984-1987.

Bear No.	Sex	No. of tests	Reaction ^b			No. times shot	Longest conditioned period ^c
			DA	ID	A		
1	F	17	2	7	8	4	3 years
2	F	5	3	0	2	2	1 year
3	F	10	1	3	6	2	1 year
4	F	3	1	0	2	1	3 years
5	M	3	2	0	1	2	3 days

^a Bears 1-4 are grizzlies; 5 was a black bear; 3 had cubs with her during her last season of tests.

^b Reaction to test. DA = Direct approach to test camp, essentially a straight line, no hesitation. ID = Indirect approach, circuitous, slow; A = Shows awareness of and avoids test camp.

^c Longest time bear avoided test camps after aversive conditioning.

Five collared bears have been subjected to this form of aversive conditioning (Table 4). Three of these grizzlies and the black bear are known to have obtained food from back-country campers, acted unafraid of people making noise, and approached camps directly without hesitation. The history of bear number 4 is unknown. When we first encountered her, she behaved like food-conditioned bears in her direct approach, which was not deterred by yelling and waving, so we concluded she too had been getting campers' food. It is possible her behaviour was related to her extreme old age, and not conditioning to unnatural food. These radio-collared bears now act much more wary when near a camp than when the aversive conditioning first began. When they have made subsequent approaches, they have done so more indirectly and slowly than previously. Two have not approached our test camps in the past 3 consecutive seasons, and 2 have not approached the test camps in the past season.

After being shot at a lodge, bear 5 moved to a mining camp 1 km away and ate a large amount of meat left overnight in an open truck. It was killed by residents, ending our brief attempts at aversive conditioning.

In addition to the radio-collared bears, a black bear sow and 2-year-old cub broke into a developed site and got food. They kept returning over a 3-day period and were shot 5 and 4 times respectively, after which they ceased returning. A noncollared grizzly got food from construction workers and was scared off by a car horn and siren. A week later it was back at the site. During 2 days it was shot twice with slugs, and cracker rounds were also fired. It did not return until the following summer, when it was seen at this site once but did not cause problems. However, a bear fitting its description did approach vehicles and people on foot along a stretch of the road 5 km away.

DISCUSSION

Since the current efforts started, there have been decreases in every category we use to monitor the program's success (Table 5). In addition we have not had to relocate or kill any bears (Table 1). The decreases are likely even greater than shown, as incidents prior to 1983 were probably under-reported given the smaller staff available to track down reports. The decrease in problems occurred despite continually increasing visitation (Table 1) and the initiation in 1983 of several maintenance and construction projects that have put additional people in bear habitat. The decrease may in part be due to a 17% decline in back-country use since 1981, although the decrease in problems continued even in the years when use went back up (Table 2). The trend indicates continued success, although more remains to be done to further reduce problems.

Table 5. Number and percent decrease in bear-people conflicts in Denali National Park between 1982-1987.

	1982	1987	Percent Decrease
Parkwide incidents	36	7	81
Back-country incidents	26	2	92
Front-country incidents	10	4	60
Closure days	176	38	78
Property damage incidents	24	3	88
Property damage costs (U.S.\$)	3030	220	93
Bears obtaining food/garbage	19	1	95

Although no bears obtained food from backpackers in 1987 for the first time in many years, additional containers are needed so that all backpackers can use them to prevent future food-conditioning of bears. Greater effort must be made to stress to users the importance of putting food in the containers and latching the lid correctly if they see a bear. Failure to do so has been a major cause of bears obtaining food. All injuries but 1 since 1980 have been due to surprise encounters or to photographers approaching too close to bears. Visitors must be better informed about the hazards of hiking in areas of restricted visibility, and education and enforcement of standards for photographers must increase. The value of deterrents and aversive conditioning, and their long-term implications to bear behavior and habitat use, must be evaluated further. The role of habituation of Denial's bears to humans must be studied to determine if problems will occur with bears that are not conditioned to unnatural foods. New state regulations for proper food storage on private land, and stronger enforcement of existing garbage disposal regulations, are needed to prevent unnecessary killing of bears.

LITERATURE CITED

- CUILLARD, J.D. 1987. Computers in the wilderness. *Courier* 32(2):15-16.
- DALLE-MOLLE, J., M. A. COFFEY, and H. W. WERNER. 1986. Evaluation of bear-resistant food containers for backpackers. Pages 209-214 in R. C. Lucas, compiler. *Proc. Natl. Wilderness Research Conf. Gen. Tech. Rep. INT-212*, Intermountain Res. Station, Ogden, UT.
- DEAN, F. C. 1987. Brown bear density in Denali National Park, Alaska and sighting efficiency adjustment. *Int. Conf. Bear Res. and Manage.* 7:37-43.
- DEROCHER, A. E., and J. S. MILLER. 1986. Bear deterrent study (twelve gauge Ferret shell tests) Cape Churchill, Manitoba 1984. File Rep. No. 54. NWT Dept. of Renewable Resources, Yellowknife.
- MARTINKA, C. J. 1982. Rationale and options for management in grizzly bear sanctuaries. *Trans. North Am. Wildl. and Nat. Resour. Conf.* 47:470-475.
- McCULLOUGH, D. R. 1982. Behavior, bears, and humans. *Wildl. Soc. Bull.* 10:27-33.
- MURIE, A. 1981. *The grizzlies of Mount McKinley*. Univ. Washington Press, Seattle. 251 pp.
- PLAGER, A, and P. WOMBLE. 1981. Compliance with backcountry permits in Mount McKinley National Park. *J. For.* 78:155-156.
- SINGER, F. J., and J. B. BEATTIE. 1986. The controlled traffic system and associated wildlife responses in Denali National Park. *Arctic* 39(3):195-203.
- STENHOUSE, G., and M. CATTET. 1984. Bear detection and deterrent study Cape Churchill, Manitoba, 1983. File Report No. 44. NWT Dept. of Renewable Resources, Yellowknife.
- SUNDSTROM, T. C. 1984. An analysis of Denali National Park and Preserve's management program to educate visitors regarding behavior while in bear country. M.S. Thesis, Univ. Wyoming, Laramie. 291 pp.
- TAYLOR, J. S. 1984. Bear management plans in Canadian National Parks: fifteen essential elements. M.S. Thesis, Univ. Calgary, Calgary, Alberta. 347 pp.