

MANAGEMENT OF BLACK BEARS AND HUMANS IN YOSEMITE NATIONAL PARK

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Abstract.

Black bears (Ursus americanus) and brown bears (U. Arctos) in U. S. National Parks have for many years been managed largely to reduce nuisance problems and to increase their entertainment values for park visitors. In Yosemite National Park, a recent sharp increase in human-bear conflicts, coincident with a growing sensitivity to scientific and aesthetic resource management, has resulted in a comprehensive human-bear management plan and a program to study and monitor the Yosemite black bear population. After four years of management and monitoring, data suggests that Yosemite bears are reducing their consumption of human foods and decreasing their interactions with park visitors. The population continues to be characterized by high mean weights, an equal sex ratio, and a large proportion of adult bears, but mortality in the sub-adult classes appears to be increasing. This probably is the result of the management program and of a severe 2-year drought. Bear incidents currently are increasing in the back-country, where reducing encounters and restoring a natural black bear population will require more management of people, and management of natural bear food resources.

INTRODUCTION

The history of human-bear interactions in Yosemite National Park is long. To the native Indians, bears were totems; the word "Yosemite" is itself derived from an Indian word for grizzly bear. The arrival of settlers and their livestock in the latter 19th century signaled the beginning of the end for the resident grizzly bears in Yosemite, as it did in most of the remainder of their range in the contiguous United States. Black bears, on the other hand, secretive, and much less dangerous to humans or stock, survived to prosper as one of the protected attractions of this National Park.

HISTORICAL SYNOPSIS

By the 1920's, black bears had become regular visitors to the garbage dumps of Yosemite Valley, and were taking refuse and unguarded food from camps (Grinnell and Storer 1924). In the years that followed, evening visits of bears to park dumps became a visitor attraction, which the Park Service facilitated by providing seating and staff. At the same time, dogs, as well as trapping and shooting, were used to keep bears

away from the hotels and concentrations of people (Wright et al. 1932). Despite these efforts, roadside begging and the resultant "bear jams" became a regular feature of Yosemite, as in Yellowstone National Park. Personal injuries caused by bears were common occurrences; in one season in the 1930's there were more than 60 hospital cases in Yosemite (Parker 1952). The bear shows were discontinued during World War II, but personal injuries and property damage continued.

From the 1930's through the 1960's, a standard management practice in the national parks where bears were numerous was live capture and removal to remote areas whenever "bear incidents" were considered excessive. Especially aggressive individuals, or those which were habitual nuisances, were killed in some cases.

During the years prior to 1960, scant scientific data were collected from bear populations in the parks; even records of management actions for those years are not always complete. Thus, changes which may have taken place in composition of populations as a result of human food supplies, intentional destruction of bears, or disturbance by increasing numbers of visitors, largely are a matter of speculation.

The basis for current bear management in the national parks is the report of the Special Advisory Board on Wildlife Management to Secretary of the Interior Stewart Udall (Leopold et al. 1963). This "Leopold Report" stressed management based upon research. In the opinion of the board, an objective of every national park was to achieve a reasonable approximation of pristine America as it appeared when settlers first arrived. The report also specifically condemned feeding of bears. This new and powerful concept of national parks was soon incorporated into official administrative policy (National Park Service 1967).

As a direct consequence of the new policy, open garbage dumps in Yosemite were closed in 1969 and 1970, as they were concurrently in Yellowstone. In Yosemite, the bears quickly compensated for this loss by entering campgrounds and residential areas, where they could utilize the open "dumpster" refuse containers. Property damage increased sharply; the 103 bear incidents in 1971 were nearly double the mean of the previous 5 years (Harms 1978). Control actions — bears trapped and removed or killed — likewise increased.

In the meantime, a bear management plan for Yellowstone had been developed by the National Science Advisory Committee of the National Park Service (Leopold et al. 1969). Its major recommendations included:

- (1) Elimination of garbage dumps from the park, and bear-proofing of refuse containers;
- (2) Public education through signs, handouts, and personal contact, and enforcement of campground regulations;
- (3) Plans for improved visitor safety by restricting bear or human access in some areas (a measure designed more for grizzlies than black bears);
- (4) Initiation of more research on black bear ecology and human-related behavior;
- (5) Management of problem bears by relocating them at acceptable habitats far enough away to prevent their return, and by destroying incorrigible or dangerous individuals. These 5 recommendations eventually became the basis for bear management plans in Yosemite and in other national parks with bear problems.

The number of bear incidents including property damage in Yosemite increased 154% in 1972 over the previous year. Control actions increased from 40 in 1970 to 81 in

1972 (Harms 1978), and 17 bears were killed in 1972.

In 1969, newspapers in the vicinity of the Great Smoky Mountains National Park expressed concern that bears in the park were becoming scarce, and articles questioned whether the Park Service was managing the resource correctly. That same year, the University of Tennessee began studies of black bear ecology and behavior which continue today. In 1973, Assistant Secretary of the Interior Nathaniel Reed received an anonymous letter from a seasonal employee at Sequoia National Park; it claimed that rangers were killing bears secretly and without proper cause; taking trophies; and bears were being transported beyond park boundaries in violation of official policy. It further suggested that these actions might be adversely affecting the Sequoia bear population. The letter resulted in an official investigation.

A concessioner in Yosemite National Park directed similar claims about that Park's management of bears to the California Department of Fish and Game. In 1973, these charges were made public by a small San Francisco area protectionist group. Also that year, a journalist with extensive knowledge of Yosemite discovered a bear carcass-dump below one of the park roads. In an article in the Sierra Club Bulletin (Rowell 1974), he described the discovery. Based upon discussions with Park Service officials, together with the rumors and anecdotes which abounded, Rowell concluded that secrecy; the absence of a clear bear management plan with defined responsibilities for carrying it out; poor communication within the Park and with the public; and the lack of scientific data about the bear population and the effects of control actions were providing inadequate management of this public resource.

Investigations by the Department of the Interior into charges brought against Yosemite and Sequoia illustrated consequences of the lack of a comprehensive written management plan and the lack of scientific data and carefully written records, all available to the public. In fact, by the end of 1973, Yosemite had produced a bear management plan, and had contracted with the University of California for research on black bear population ecology in the Park. This study, by the authors, is approaching completion. Sequoia-Kings Canyon followed suit the following year.

THE YOSEMITE HUMAN-BEAR MANAGEMENT PROGRAM

In 1974, a new bear management plan for Yosemite National Park specified that control actions would be taken only against those individual bears identified as causing property damage or personal injury, and in the former case only if food was stored properly, in accordance with the new food storage regulations. Given the lack of evidence to the contrary, the plan presumed that a small percentage of the bear population was responsible for most incidents. For that reason, and in deference to public concern with management of bears in the park, there were only 26 control actions in 1974, a 6-year low. However, damage incidents climbed to 613, up from 246 the previous year (Harms 1978). Experiments with bear-proofing of dumpsters, the chief attractants for bears in the campgrounds, were initiated. Research began in the summer of 1974, which included capture of bears in addition to those trapped in control actions, tagging and collection of data from all captured bears, observations of bear behavior and of human-bear interactions, and food habits evaluation using scat analysis.

By the fall of 1974, it was apparent that the management plan was not sufficient to achieve its stated aims, which were to provide for protection of visitors and their property, and to restore and maintain the natural distribution, abundance, and behavior of the black bear population. Rangers found it almost impossible to identify the

individual bears responsible for particular incidents, and complaints from visitors of property damage far outnumbered statements of concern for bear welfare. Moreover, 16 different bears were captured in the east end of Yosemite Valley, and we estimated that as many as 27 individuals included that small area in their home ranges (Graber and White 1975).

Under the direction of Yosemite National Park wildlife biologist Dale Harms, a more comprehensive "Human-Bear Management Program" was initiated in 1975, and has continued through 1977 with minor additions and alterations. It adds to the two previous objectives a third, to provide opportunities for visitors to understand, observe, and appreciate the black bear in its natural habitat. The basic methods employed are the Leopold Committee recommendations of 1969:

- (1) Public information and education. With progressive additions over the past 3 years, the program now includes brightly colored warning signs at entrances, campgrounds, trail heads, and restrooms; front-country and back-country brochures describing the best methods of food storage and describing park regulations concerning bears; articles in every summer issue of the park newspaper; interpretive talks and bear-oriented ranger patrols; and a taped radio broadcast to which visitors can tune as they enter the park.
- (2) Elimination of human food sources. Dumpsters were bear-proofed in 1975. Cables for hanging food out of reach of bears have been installed in front-country walk-in, and some back-country, campgrounds. Bear-proof metal food lockers were installed on an experimental basis in 1977 on every site in a drive-in campground which had been plagued by auto-related bear damage in the past, and by the concessioner in one camp where food storage had been especially difficult.
- (3) Law enforcement. Special regulations which include enforcement provisions were promulgated in 1976, requiring proper food storage methods. Arrest and/or impoundment of property are possible, although verbal warnings have been the usual mode of enforcement to date.
- (4) Control of problem bears. Captures are attempted whenever injuries occur in the front-country, or damage incidents rise above a flexible low level. Bears are captured with culvert traps, projectile syringes, or Aldrich snares; they are sedated, marked with cattle tags and vinyl flags, measurements and samples required by the research program are taken; and the bears then are relocated to selected sites 13 to 50 km from the point of capture. Bears which are recaptured repeatedly, or are responsible for injuries, may be destroyed.
- (5) Research and monitoring. The Division of Resource Management has developed a sophisticated central monitoring system that records injuries, damage incidents, and control actions on a daily basis. The research program initiated in 1974 feeds raw data into this system, and regularly exchanges processed information with Resource Management.

THE RESULTS OF THE HUMAN-BEAR MANAGEMENT PROGRAM

In 1975, 135 control actions were taken, 147 in 1976, and 103 in 1977. In 1975-1977, 50 bears were killed in the park. Of these, 30 were killed intentionally during control actions; the remainder died in vehicle and other accidents. There were 373 relocations of bears from 1974 through 1977. A total of 202 different individuals were relocated one or more times from 1974 through 1976 (Harms 1978).

In 1975, reported damage incidents rose to 975 (\$113,197) from the previous year's 613 (\$80,248). In 1976, incidents dropped to 688 (\$66,294). and in 1977 to 516 (\$30,820). Personal injuries declined from an 8-year high of 28 in 1974 to 15 in 1975, 12 in 1976, and finally to 6 in 1977. Reported back-country incidents climbed from 61 (\$2,145) in 1975 and 1,186 in 1976, indicating that most bear incidents in the back-country were not reported.

Harms (1978) found that the rate at which relocated bears in Yosemite returned to the area of capture, based on recapture data, has increased with each year of the management program. Returns of individual bears to the area of capture within 1 year have climbed from 8% for 1974 relocations to 38% for 1976 relocations. By the third year, 48% of bears relocated in 1974 had returned, and by the second year, 49% of those moved in 1975 had done so.

THE YOSEMITE BLACK BEAR POPULATION: 1974-1977

Research on the Yosemite black bear population, and the first comprehensive management program, both began in 1974. In 1976 and 1977, a serious drought occurred in the Sierra Nevada which appears to have markedly affected the production of plant foods used by bears in Yosemite. This drought was coincident with the reduction in availability of human foods for bears as a result of the Human-Bear Management Program. Both factors are likely to have contributed to observed changes in the black bear population.

Figure 1 shows the sex and age profiles of black bears examined in 345 captures from 1974 through 1977. Age of bears was estimated using tooth characteristics including irruption, wear, and annulation. The amount of sex and age bias in our capture procedures is unknown, and there is considerable variation from year to year, making interpretations difficult. The near lack of cubs in 1974 resulted in part from inadequate trapping procedures during the first year. In all 4 years, there was a high proportion of adult bears (4 years and older); 60% of the sample in 1974, 58% in 1975, 47% in 1976, and 56% in 1977. These percentages of adult bears are similar to those Jonkel and Cowan (1971) found in wild bear populations in Montana. Cubs were numerous in 1976, amounting to 24% of the trapping sample. There were fewer young bears, 2, 3, and 4 years old, than expected, particularly in 1976 and 1977. Our preliminary analyses indicate that bears of these ages are lost from the Yosemite population at high rates. We are uncertain of the causes of these losses.

The sex ratio of bears captured during all 4 years did not differ significantly from 1:1 (Fig. 1). Additionally, the age and sex ratios of 30 bears killed intentionally in management actions during 1975-1977, presumably representing bears that frequented the human food resources, were similar to those of all bears captured (Fig. 2). Interestingly, in Great Smoky Mountains National Park, Pelton (pers. comm.) found a sex ratio (M:F) among all captured bears of 1.4:1, and among bears termed "panhandlers," a ratio of 5.4:1. Similarly, Rogers et al. (1976) found a sex ratio of 2.1:1 among 126 bears captured at garbage dumps, campgrounds, and residential areas in the Upper Peninsula of Michigan.

Although total capture effort by management and research personnel was approximately equal for the years 1975-1977, capture success dropped from 112 individuals in the first 2 years to 79 in the third. This, together with the decline in reported damage incidents, suggests that there were fewer bears in the human-use areas in 1977. The

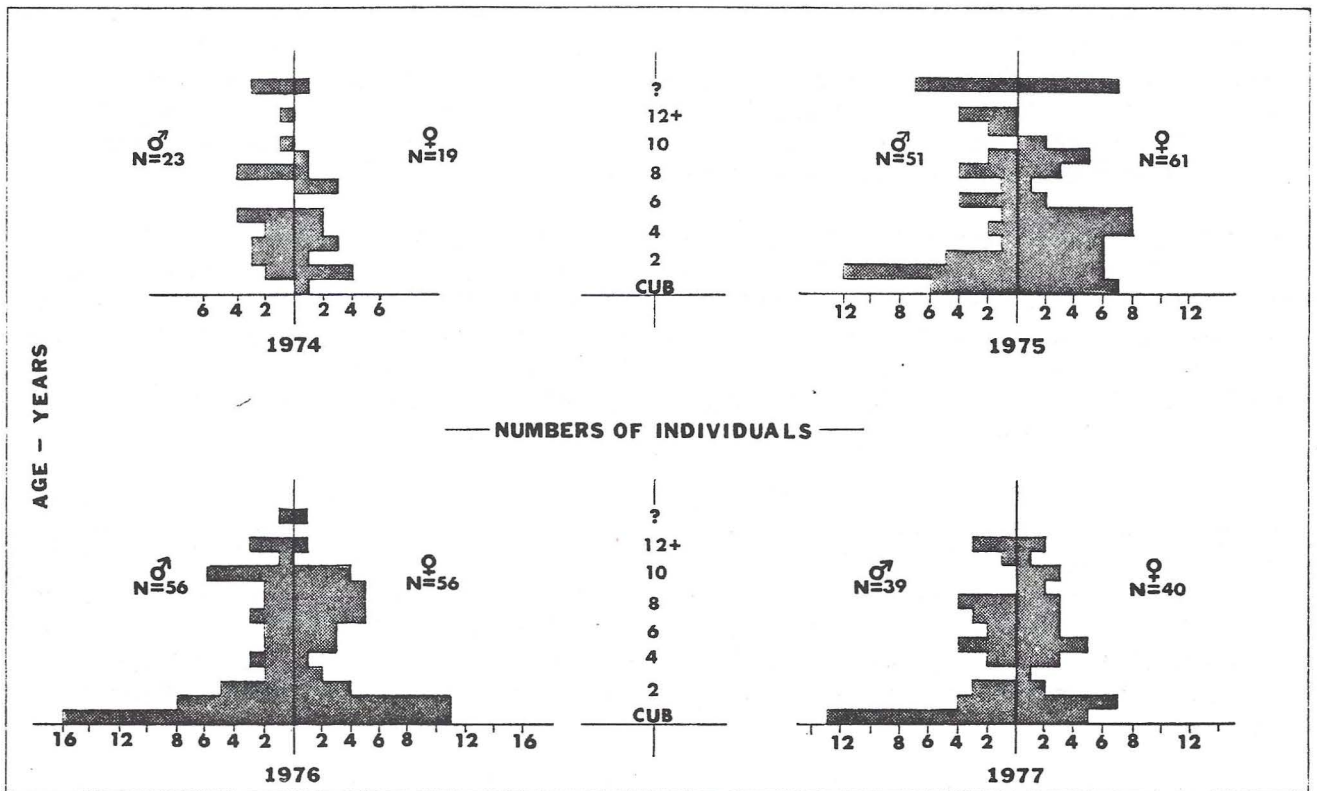


Figure 1. Sex and age profiles of black bears in 345 captures in Yosemite National Park from 1974 through 1977. ? category = adult bears of undetermined age.

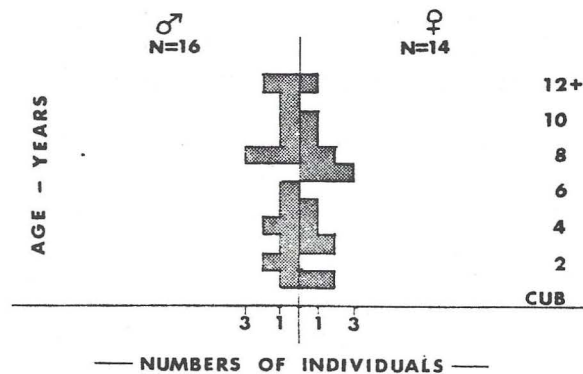


FIGURE 2. Sex and age profile of 30 black bears killed intentionally in management actions during 1975 through 1977.

marked decrease of yearlings and sub-adults from 1976 to 1977 (Fig. 1) indicates that increased mortality in these age classes was occurring. Another reason for the losses could have been dispersal to other areas of the park and beyond. Reported hunter kills of marked animals, however, dropped from 6 in 1975, to 5 in 1976, and to only 1 in 1977, despite an increase from year to year in the pool of marked animals. This does not indicate an increased emigration rate.

Figure 3 shows an estimate of black bear food habits for the 1 July - 30 September period of 1974 through 1976. The analysis is based upon % volume of material in 190 scats collected in Yosemite Valley (at \pm 1500 m) and at higher elevations (1800 m and above). The relative proportions of the major components of black bear diet fluctuated greatly from season to season and from year to year. There was a decline in occurrence of human foods both in Yosemite Valley and at higher elevations, corresponding to closure of dumpsters in 1975 and the reduction of bear incidents in 1976.

There are marked differences in the food resources used by bears in Yosemite Valley compared to those from the higher areas. Fruits, especially black oak (*Quercus kelloggii*) acorns, manzanita (*Arctostaphylos viscida*) berries, and apples (*Malus sylvestris*) from abandoned orchards were fed upon heavily in Yosemite Valley. At higher elevations, vegetative plant materials, especially grasses, predominated. Animal matter represented no more than 15% of any sample, and at least half of that was insects. Animal matter tends to be under-represented in scat samples because of its greater digestibility, however.

Observation, trapping, scat analysis, and radio-telemetry data indicate that the Yosemite Valley areas are used predominantly from fall through spring, while the higher elevations are mostly summer-use areas. Unfortunately, this pattern coincides not only with natural food availability, but with human-use patterns as well.

Despite progressive restrictions on availability of human foods, and a 2-year drought, there were no marked reductions in weight for adult bears from 1974-1977. Mean weights for adult males were generally above 300 pounds and about 200 pounds for females. These means are among the highest reported for black bears in North America. There is variability in the seasonal gain and loss patterns, depending especially upon fall mast production and time of spring snow melt. Cubs and yearlings, especially, show great individual variation in weight.

Although censusing the Yosemite bear population has been difficult, in part because of the management activities, our current estimate is of approximately 300 bears in the Park. Grinnell and Stoarer (1924) estimated the Yosemite population to be 125 more than 50 years ago. There are approximately 1,800 km² (700 mi²) of available bear habitat in Yosemite, of highly variable quality and seasonal utility. Thus, our population estimate indicates a crude density of 1 bear per 6 km² (1/2.3 mi²).

Given the important supplementation by human foods during the past 50 years, it is likely that the present bear population exceeds the present natural carrying capacity of the habitat. If this is so, then a reduction in numbers, as indicated by 1977 capture data, and future reductions through increased sub-adult and yearling mortality, emigration, and reduced productivity would be expected. However, fire suppression and the physical impact of millions of visitors have substantially reduced the grass, forb, and shrub components of the Yosemite vegetation in the past century, thus reducing the natural carrying capacity of the park for bears. Changes in resource management could, over time, at least partially reverse this trend, and partially compensate for the loss of human foods. At least so far, there is little evidence that bears in Yosemite

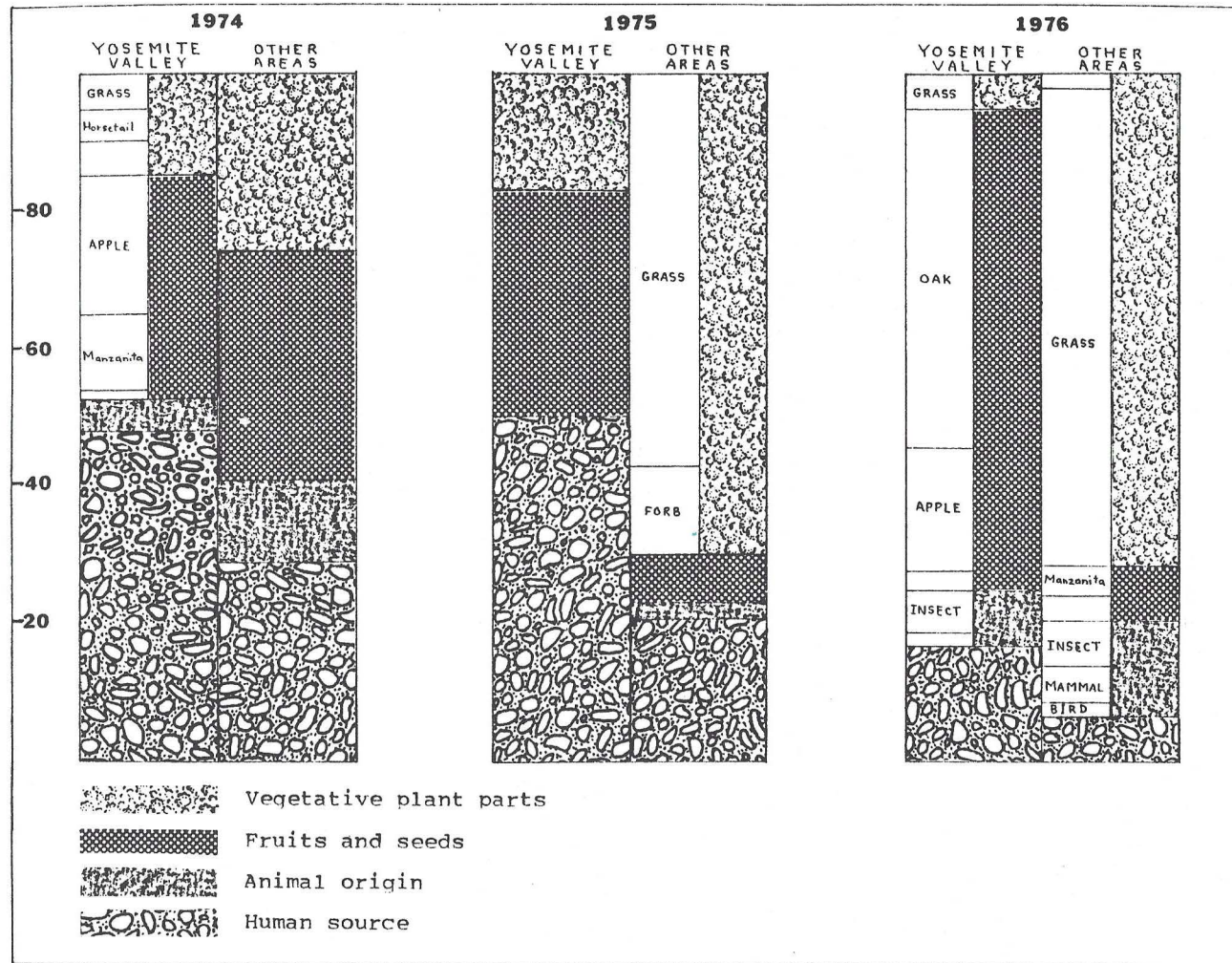


FIGURE 3. Summer foods (1 July - 30 Sept.) of black bears in Yosemite National Park from 1974 through 1977, based upon % volume of materials in 190 scats. Some of the foods in the larger samples are itemized on the left side of the bars. Other areas = areas at higher elevations (1800 m and above).

have reacted to diminished food resources by becoming more aggressive.

Back-country incidents, however, have increased in recent years. These incidents are not the product of front-country bears which have been relocated to become pests elsewhere. Capture efforts and visitor reports indicate that very few back-country incidents have been the work of transplanted bears. There are separate sub-populations of bears whose home ranges include one or more back-country camping areas. The most likely explanation for the increase in back-country incidents is the tremendous influx of hikers and campers in the past decade which has resulted in familiarity and a loss of fear of humans by bears, experience with human foods, and rapid development of new skills among bears enabling them to obtain foods from people. This pattern recapitulates the chain of events in the front-country in previous years.

Unfortunately, implementation of effective management procedures is much more difficult and costly in the back-country, and it is hampered by a desire to not further compromise wilderness character with bear-foiling hardware such as food lockers. A partially successful method of protecting food in bear-plagued camping areas uses a high, fixed metal cable suspended permanently between trees. A food container is tied to a rope, thrown over the cable, and then counter-balanced by tying another food container or a weight to the other end of the rope. A short rope keeps the food out of the reach of bears, and the camper retrieves the food with a stick.

A more easily used cable which passes through a pulley at one end and then down the trunk of a tree where it is hooked, permitting campers to raise and lower the cable, requires regular maintenance. Moreover, an adult female bear with cubs discovered in the summer of 1977 how to unhook and lower the cable herself, requiring the addition of a more complex latch system. A large male bear like wise discovered that he could climb one of the anchor trees, pull the cable from its usual slack to a taught position, using his teeth, and release it suddenly, causing any food-sacks not firmly tied to come flying off the cable. This maneuver was prevented later by attaching cable swages which prevent the cable from being pulled completely taut. These two anecdotes illustrate the high intelligence and surprising dexterity of black bears, and the extreme difficulty in breaking the bear-human foods connection.

CONCLUSIONS

Thus far, the Human-Bear Management Program in Yosemite National Park has shown success in reducing property damage, human injury, and the proportion of human foods in the diet of black bears. There are indications that the combined effects of drought and management are reducing the total black bear population in the Park. The social and ecological effects of trapping and relocation have not as yet been determined; they are important factors in light of the official goals of the park to "restore and maintain the natural distribution, abundance, and behavior of the black bear population."

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