

Ecology of High Mountain Black Bear Population In Relation to Land Use at Rocky Mountain NP

By Henry E. McCutchen

Rocky Mountain NP in Colorado is one of the most heavily used parks in the west. It receives more visitation than Yellowstone yet is only 1/8 the size. In addition, unlike other large western parks such as Glacier and Yellowstone, which were carved out of near wilderness, ROMO was established in an area that had been heavily homesteaded, hunted, logged, farmed and grazed for over 50 years.

By 1915 when the park was established, the large mammalian fauna populations had already collapsed (Newmark, 1987) from the impact of European settlement, and they have yet to recover. The elk, once numbering in the thousands, had become extinct by the 1900s. Transplants from Yellowstone were made just before the park was established, and under park protection the herds are now flourishing. Mule deer and bighorn persisted; however bighorn numbers declined in the 1930s and required transplants to supplement lost herds (Stevens and Hansen, 1986). The wolf became extinct before 1900; the grizzly was present until the early 1920s, then it also disappeared. The two other large carnivores, the mountain lion and the black bear, were present when the park was established but occurred in low numbers.

According to historical reports (Superintendents annual reports ROMO) after the park was established, black bears were extremely scarce. By the 1930s bears were observed fairly regularly yet were still believed to be low in numbers. From the 1930s to the 1980s the bear population was thought to be stable and occurring in low densities throughout the park.

Rocky Mountain, unlike other parks with black bear populations, has not experienced large numbers of bear depredations. For example, records of bear incidents from 1959 to 1983 totaled 133 with an average of about 5 per year compared to Sequoia and Kings Canyon NP which, between 1959 and 1976, had a total of 3,968 bear incidents for an average of 220 per year (McCutchen, 1987).

In 1984 bear depredations at ROMO unexpectedly became a problem in the backcountry, reaching a record of 90. Park management found there was no information on the population, and without an idea of the population and its dynamics there was no way to predict the impacts of a management or control program. In 1985 the park began a research program on the bear's population dynamics and ecology.

The southern 2/3 of the 265,000 acre park (about 190,000 acres)--the overall study area--was dissected by the Continental Divide, forming convenient east and west study areas. The area east of the Continental Divide (90,000 acres), where most of the bear depredations occurred in 1984, receives the highest front and backcountry use. Outside the park boundary to the east is a region of intensive urban and suburban development and human use, including the gateway town of Estes Park. The study area west of the continental divide (100,000

acres) provided a good "control." It receives less visitor use and most of the area outside and adjacent to the park is undeveloped USFS land.

Rocky Mountain NP, in north-central Colorado about 50 miles northwest of Denver, preserves the most rugged section of the Colorado Front range. Elevations are among the highest in the contiguous U.S., (8,000' to 14,000'+). Vegetation zonation is apparent. About 1/3 of the high study area is alpine tundra. Mid-slopes contain spruce/fir vegetation; lodgepole pine occurs on old burns and south facing slopes. At the lower elevations, north facing slopes contain Douglas fir and aspen; glacial moraines with Ponderosa pine intermixed with meadows occur in the dryer sites. The winter climate is cold with low precipitation; summers are cool, with moderate precipitation; the alpine tundra can demonstrate arctic conditions year round.

Because black bears are difficult to count, the study aimed at a total capture census. The bears were captured with foot snares, marked with ear tags and radiocollared. The east area census took two years. Low bear densities meant that a lot of country had to be covered to capture one bear and almost all the field work had to be done in the backcountry. Baiting and capture equipment was carried by backpack.

The west side study area was censused in 1987, 1988, and 1989. Following this, radiotracking and monitoring were performed until the study was terminated in the winter of 1992.

The study was hindered throughout by funding, manpower and logistics problems. Volunteers

in the Parks (VIPs) were increasingly utilized for lower risk tasks (radiotelemetry and assistance in bear capture). The park put out a call for volunteers and eventually a cadre of about 25 VIPs was available to meet project needs.

Most of the volunteers became highly skilled in radiotelemetry and bear handling assistance. The project could not have been done without them. The park staff, particularly the West Unit staff, also provided assistance and logistics support. Because of the rugged terrain the bears inhabited, it was not uncommon for a radiotracking team to spend an entire day hiking in order to get a single radiolocation on a bear. It was necessary to go to the bear dens in the winter to replace radiocollars, to obtain data for denning ecology and to check for reproduction and physical condition, which posed special logistic and safety problems. The bears tended to select cave dens near timberline, a little over 2 miles above sea level--from 10,000 to 11,000 feet, on steep north facing slopes, among cliffs, remote from human use and trails. The winter team had to snowshoe or ski, with heavy packs, coping with cold weather, high altitudes, blizzards, temperamental snow packs, steep slopes, snow covered cliffs and avalanche hazard.

Hazardous Work

Although the work was hazardous, as the winter crew gained experience with safety foremost in mind, the risk was reduced. There were minor mishaps on almost every trip - frost bite, tumbles down steep slopes, bruises and sprains,

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Author with 25 pound yearling black bear at its den in Rocky Mountain NP. The bears in the park were found to be among the smallest in North America



The bears in Rocky Mountain NP denned in caves on steep slopes, in remote areas far from roads and trails at 10,000' elevations. Radiolocating and snowshoeing to the dens was a difficult task. Research technician, Bill McEwen, clears den entrance as VIPs Damon Lamothe, Holly McCutchen and Jana McCutchen observe.

altitude sickness, and forced overnight hivouacs, but no serious injury occurred on any winter trip.

After all the census effort on the east side, only 6 adult and subadult bears were captured. Of these only 2 were adult females; 3 were subadult males, 1 was a subadult female, and 3 were cubs of the year. The study team believed that all resident bears in the area had been captured, as each was snared several times before the bears became trap wary.

Since the area had been well covered with capture sites, the study team concluded that the low capture rate was because of their low numbers. Because it had seemed logical that there should be more bears in the area, capture effort was maintained long after all the residents had been captured.

The research revealed the extremely low density of bears in this area. If 3 cubs were counted for a total of 9 bears, the density was only 1 per 16 square miles compared to 1 bear per 2.2 square miles found in the black bear research program conducted by the Colorado State Division of Wildlife in southern Colorado (Beck, 1991). About 40 percent of the east side study area was alpine habitat, which the bears did not utilize. If this area was not included and only forested habitat was calculated in relation to bear numbers, the density was 1 bear per 9.7 square miles--still a low density.

(The bear depredation problem was solved in 1985 by the capture and radiocollaring of the first subadult male, a 3-year-old. After his release his activities resulted in his recapture and transplant to a remote section of the park. He was killed by a hunter outside the park, and after his demise bear incidents in the backcountry dropped to previous low levels.)

West Area Results

The bear census on the west side study area (from 1987 to 1989), revealed a slightly better situation than the east side. Of 12 bears accounted for by 1989, 3 were adult females and 4 were adult males. Two subadult females, a subadult male, and two cubs completed the count. The bear density for the west side was one bear per 13 square miles of study area or one bear per 8.7 square miles of forested habitat below timberline.

A comparison of the east vs. the west side subpopulations showed no mortality of adult females on either side of the park during the study, but the male bear population on the east side of the park showed exploitation and considerable turnover. No adult resident males were captured here, only subadults. Males did not live long enough to become mature.

The study provided insight into the causes of this male mortality. Three of the 5 subadults eventually captured here were killed, 2 by legal hunting outside the park and 1 by unknown causes. In addition a fourth mysteriously disappeared from the population. The subadult males, apparently because of their less wary nature and needs for more space, wandered in and out of the park, subjecting them to human predation outside.

Boundary Effect

The project researchers noted a "boundary effect" of human use and development outside the park in relation to bear land use inside the park. Much of the area outside and adjacent to the eastern park boundary was occupied by the town of Estes Park and mountained subdivisions. Bears could not occupy these areas. The females inside the park on the east side survived

in home ranges far within the park boundaries. On the east side we found areas within the park that we called vacant bear habitat. These were areas extending inside the park for 1 to 2 miles where bear habitat was suitable but rarely used because of high human use outside the park.

The land tenure system and population structure of bears on the west side of the park was considerably different from the east. Here much of the area outside and adjacent to the park was USFS land. Mature males were found on this side in addition to subadults. There was no mortality of these bears while they were being radiotelemetered. Most of them had large home ranges that were partly in the park but extended for many miles to the west outside the park. Several females had home ranges straddling the boundary here, and they would move in and out of the park freely. One area outside and adjacent to the western park boundary did not contain park bear home ranges. This was the township of Grand Lake; park bears avoided this area.

Radiotelemetry showed the adult females had exclusive home ranges averaging about 20 square miles. Home ranges of the large males were not obtained; however 2 smaller males had ranges from 16 to 26 square miles in size.

Secretive Behavior

We found black bears at ROMO were unique in behavior compared to those in other parks. In many national parks black bears are highly visible and frequent human use areas. In contrast, the ROMO bears secretive and avoided human use areas. The park has about 600,000 visitor days of hiking use on the trails, but bears and bear sign are seldom observed. Intensive radiotracking of two east side female bears, which had home ranges in the areas of heaviest human use, indicated they were almost never found in human use areas. On average they were radiolocated about 1 km from trails, 2 km from trailheads, 2 km from dirt roads, 1 1/2 km from paved roads, 2 km from picnic areas, 3 km from human residences, 5 1/2 km from the major campgrounds, and stayed about 6 km from the park boundary (McCutchen, 1990). As we interpreted it, the bears partitioned the space, with humans using the network of roads and trails and the bears using the interstitial areas.

Because bears and other large carnivores reproduce so slowly, it requires several years of study to obtain some idea of their population dynamics. The research on the bears in the park was extended into 1990, 1991 and 1992 to gain this information.

Low Reproductive Rates

We found that reproductive rate and success among black bears at ROMO were among the lowest on record for any study of black bears in North America. Females in the park did not successfully reproduce and bear their first litters until they were about 7 years old. Generally black bears in the western U.S. have cubs at about 4 to 5 years of age (Beck, 1991), and the bears in the eastern U.S. reproduce at about 3 years (Alt, 1989). Litter size at ROMO varied from one to 3 cubs but overall was quite low, averaging 1.7 as compared to Beck's (1991)



Summer capture crew members Steve King (left) and Jeff Gould measure immobilized black bear snared in Rocky Mountain NP.

In summary, this 7 year study of black bears in Rocky Mountain NP reveals that the species is being heavily impacted by humans. The population is very low. The census of the study area on the lower 2/3 of the park indicated a population of 21 bears. Extrapolating for the entire park there is probably a population of about 30 to 35 bears. Recruitment of 2 subadult females to the breeding population set the trend slowly upward. Male age classes on the east side of the park show exploitation, however radiotelemetry revealed no evidence of poaching of bears inside the park.

The bears are of small body size and exhibit late maturation and low rates of reproduction. Their high avoidance behavior to humans explains why park areas of suitable habitat are not being fully utilized. The four factors of impact, coupled with the species very low reproductive capacity, have made this a subpopulation at risk. The population is so small in the park that the loss of 2 or 3 adult females would put it on a downward trend.

Although the habitat is marginal, research indicates that the bear population would be significantly larger (by perhaps as much as an estimated 30 percent) if human impacts were eliminated or mitigated. Periodic monitoring of the black bear population in the park is essential. The species is an indicator of the impacts of human use on the area as well as an indicator of ecosystem (forest) health.

From an ecosystem viewpoint the black bear population at Rocky Mountain NP provides a useful model of what can happen to large carnivores in a preserve when the area is too small to maintain a viable population and begins to suffer from the "island effect," being encroached upon by adverse human land uses.

The information obtained by this research project was incorporated into the bear management section of the park's Natural Resources Management Plan.

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findings in southern Colorado of 2.0. and Alt's (1989) 3.0 for Pennsylvania. To put this in perspective, assuming a 2 year litter interval, a 10 year old female black bear in Pennsylvania would have produced 12 cubs in her lifetime whereas a 10 year old female at Rocky Mountain National Park would have produced 3 or 4.

The sex ratio of cubs at ROMO was about 1:1 males to females, similar to other studies. Cub survival, e.g. the percent surviving from birth to 1 year of age, however, was extremely low, averaging about 43 percent as compared to 56 percent found by Beck (1991), who considered his cub survival low as compared to other studies. The causes for cub mortality at ROMO need further study. Two sources of cub mortality identified were starvation in the den and cannibalism by other bears.

The black bears at Rocky Mountain NP also were found to be among the smallest on record. Mature females weighed from 80 to 165 pounds as compared to weights of 130 to 235 pounds (Beck, 1991) for female black bears in southern Colorado. Mature males weighed from 140 to 240 pounds as compared to males in the southern Colorado study (Beck, 1991) which weighed from 176 to 350 pounds. Yearlings at ROMO were consistently small. Both females and males averaged about 26 pounds as compared to averages of 48 pounds for females and 50 pounds for males in southern Colorado (Beck). We surmised that one of the causes of yearling mortality was low body weight going into hibernation.

The small body sizes, late maturation and low rates of reproduction of the bears in Rocky Mountain NP appear to be functions of the habitat. Beck (1991) considered the park area marginal for bears and judged that his study area in southern Colorado was above average. In Beck's area, where the bear habitat was somewhat lower in average elevation, the bears had two major feeding economies to draw from; beginning in early summer and into the fall berry crops provided food; in late fall acorns (hard mast) from abundant oak stands were utilized. In this area also there is greater habitat diversity with many patches of vegetation in various seral stages.

At Rocky Mountain NP the growing season in the bear habitat is very short, and the climate is essentially subarctic (subalpine). The ex-

tremely high elevations and dry cold result in low productivity of food bearing plants. Further, the bears have only one major feeding economy - berry crops - from mid summer to early fall. There is no oak in the park. One important, but infrequently produced, hard mast crop which the bears did utilize was the tiny seeds from limber pine in late fall. Bear habitat diversity in the park is limited. Much of the park's forest is mature; there is not a good mosaic of various seral or age stands. This is due to the park's vigorous protection from wildfire for the 77 years since its establishment.

Multiple Pressures

The research indicates that low densities and numbers of black bears in Rocky Mountain NP result from a combination of factors. First, along the eastern park boundary the town of Estes Park, subdivisions, summer homes, resorts and other forms of urbanization have usurped and fragmented bear habitat and constricted travel corridors. These areas also act as "population sinks" where emigrating bears come into conflict with man and are removed from the population.

Second, hunting pressure along the eastern boundary appears to have been so great as to nearly eliminate the older male age classes. The Colorado State Division of Wildlife is aware of this hunting pressure and since 1986 has formulated more restrictive regulations for bear hunting in areas surrounding the park.

Third, visitor use on the east side is extremely heavy on roads and trails. Many human use areas are in highly productive bear habitat (riparian areas and aspen stands). Because of their unique human avoidance behavior, the bears do not use this habitat, which reduces the area's carrying capacity for the species.

Fourth, historic fire suppression has degraded the bear habitat causing further reduction of the black bear carrying capacity. The park is developing a fire management plan that will include prescribed burning. Restoring the park's fire regime eventually will create the needed vegetative mosaics and increase herbaceous and shrub primary productivity needed by the bears. Fifth, this high mountain area is marginal habitat for the bears, and their reproductive rate is correspondingly low.