

Science Year Article

V. THE RESEARCH TECHNIQUES DEVELOPED
TO STUDY BEHAVIOR

Early in our study of the grizzly bear it became evident that in order to place our observations on a quantitative level we would have to develop a research technique that would permit us to readily locate and observe these elusive animals at night when they were most active as well as over extensive areas of heavily timbered rough terrain. To accomplish this we turned to the field of electronics and in collaboration with engineers formulated specifications for a radiotracking system that appeared feasible. Our knowledge of field requirements to meet ecological objectives was translated into specifications on signal range, weight, power, battery life and frequency (32.02MHz).

In the fall of 1960 we tested a prototype transmitter and in the summer of 1961 instrumented our first grizzly #40, with a radio collar weighing approximately two pounds. We located and tracked this female bear intermittently for a period of a month. We picked up her pulsed signal or "beep" on a portable directional receiver at a maximum distance of 3/4 mile and the first eleven receptions averaged only 0.4 mile. Later modifications greatly improved the capability of this wildlife telemetry system but in no way detracted from that first thrill when we followed

the signal to the crest of a hill and saw the collared grizzly plodding along completely unaware of our presence. We realized that we now had the capability of arranging a meeting between bear and man at times and places of our own choosing and we had the means to obtain a variety of information from free-roaming animals continuously and afar with a minimum of time, effort and manpower. Inherent in the system was also the potential of gathering physiological information simultaneously with ecological data. We would exploit this possibility later in the study.

Another thrill of achievement mixed with a deep satisfaction occurred in November 1963 when we successfully tracked female grizzly #164 to her "hibernation" den as she entered it for her winter sleep. This was the first of twelve dens that we located by use of radio transmitters. We moved in on foot during a snowstorm and followed our signal to within twenty feet of the den housing the grizzly. Apprehensive over the possible sudden appearance of the bear but elated over our success we stood in the swirling snow savoring the moment. Here in isolated Yellowstone wilderness we had realized a breakthrough toward a major objective of our radiotracking. This was to locate grizzly bear dens and gather data on site selection, construction and pre-hibernation behavior. All dens were excavated by the grizzlies. No natural shelters were used. All were

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dug in isolated sites, the entrance facing north and usually at the base of a large tree. The dens were lined with boughs and over the years we observed that the grizzlies entered their dens during snowstorms thus effectively, if not intentionally, erasing tracks and all signs of their presence. This behavior trait could have had survival value by protecting the bear from his major enemy, man, at a time when the grizzly was most vulnerable.

During an eight year period of our research we put radio collars on 48 grizzlies, 23 of them different bears. We instrumented #40 for portions of eight consecutive years and tracked her to five different dens. From her plotted movements we determined a lifetime home range of about 30 square miles. These 23 bears were tracked or monitored by radio for over 1,200 tracking days. In order to distinguish between transmitters and thus bears, each transmitter was pulsed at a different rate. With our receivers coupled to different types of directional antennas--some stationary, others mobile--we could simultaneously monitor four grizzlies and discriminate between them. A fix, the intersection of two or more radio bearings, was used to plot the position of the animal on a map. By drawing connecting lines through peripheral fixes we were able to delineate seasonal, annual and home ranges of the bears. These varied in size from 12 square miles for the home range of a young female to 168 square miles for the summer range of a young mature male. Factors

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such as age, sex, food supply and den sites influenced the size of a grizzly's range. Most ranges overlapped and thus were shared by numerous bears. Grizzlies were not observed to be territorial. Defense of a home range, seasonal range or even den site has not been recorded. The Yellowstone bears form a social dominance hierarchy. A show of dominance when and where needed seems to substitute for any clear-cut defense of a definite territory, large or small.

Radiotracking and monitoring of grizzlies provided us with information difficult ^{to impossible} to obtain using more conventional methods. We were able to close in and observe grizzlies undetected thus learning more about their diets. When field mice and pocket gophers populations were high we monitored grizzlies in open habitats feeding on these small rodents. The combined depredations of grizzlies and other predators that concentrated where rodent densities were high tended to regulate the prey populations. During a season when pine nuts were plentiful the bears moved to the timbered ridges where the white bark and limber pines grew. In fall they used their long powerful "digging" claws to expose the edible bulbs of yampa and Melica. In spring they stripped the bark from lodgepole pines to consume the edible cambium. Though efficient scavengers, it took sow #150 and her cubs sixty hours to locate a fresh carcass only 1-3/4 miles away. The wind was unfavorable. On another occasion instrumented grizzly #158 led us to a carcass where 24 grizzlies were assembled and feeding at one time.

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us that we were approaching grizzlies in their daytime beds. We learned to associate an erratic signal with den digging. The shielding effect of the earth damped the signal when the grizzly entered the den to dig. When he emerged the signal was again audible. Sporadic trips to forage or to return to denning areas appear to be part of the normal pattern of grizzly movements. Grizzly #76 made a fifty airline mile excursion in seven days in the course of which he circled Mt. Washburn and crossed the Yellowstone River. A large boar, #14, led us from his summer to his fall range which was distant from his summer haunts. For four days and nights he managed to keep ahead of us when we attempted to move in and locate his den site. Sow #150 and her three cubs roamed a range of 27 square miles but in fall just before hibernation they foraged for a full month in a restricted area of about one square mile. Such information gave us clues to the carrying capacity of certain habitats for grizzlies.

Weaned yearling grizzly #202 established a range within the boundaries of his mother's--#65--and also dug his first and second winter dens within her home range. In contrast male yearling #188 moved far beyond the home range of his mother to hibernate.

Although in spring grizzlies prey on elk weakened by a severe winter we located resting bears in summer within 100 feet of elk in dense timber and windfall where the elk were at a distinct disadvantage. The elk showed no signs

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of alarm or uneasiness and the grizzlies no inclination to attack. This change of behavior may have been influenced by an abundance of summer food.

Large rivers appear to be no barrier to grizzly movement and travel. Sow #34 and her family made eleven known crossings of the Yellowstone River in less than a month. Radio enabled us to observe them swim the river at night and wait for a favorable time to cross the relatively busy Yellowstone highway. A radio-tagged sow and two yearlings when jumped ran a measured mile in three minutes, an average speed of 20 miles an hour across rolling sagebrush country.

The use of radio helped us to trace the sequence of events in the development of problem bears and to follow their movements after being transferred to remote areas. Almost invariably grizzlies transported and released within the Park soon returned to the original point of capture. Sow #170 was trapped, released, and radiotracked while travelling 34 air miles over timbered mountainous terrain in 62 hours to return to her home range near Gardiner, Mont. This averaged about 0.5 airline miles per hour.

Radiotracking can be a very useful tool in following the movements of transplanted bears whether problem ones or those moved in efforts to reestablish a grizzly population. It contributed to our knowledge of how problem bears developed. For example, young grizzly #202 expanded his home range to include Canyon campground. Though not an

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aggressive bear, he learned here to associate food with man and lost his earlier fear and wariness. His campground forays became bolder and bolder until his career was ended with a bullet. Grizzlies that develop such behavioral patterns can become extremely dangerous. During the fall of the eighth successive year that we tracked #40 she expanded her range to include Lake campground after she was deprived of a customary source of food from an earth-fill dump. This was the first time that this relatively docile grizzly had entered a campground area. A bullet from a Park Service ranger ended her many contributions to science. On one occasion the signal from #40 was so attenuated by the roots and earth clod of a fallen tree that we inadvertently approached too close. We jumped her from a daybed when only 40 feet away. Nevertheless, she elected to run rather than attack. While closely associating with grizzly #101 and her cubs, #40 led us to the den that #101 was digging. While tracking #40 we came to places where she had stopped to sit in the snow facing her tenacious pursuers. At other times when we approached too close a sprinkling of urine in the snow indicated nervousness. The radio from #40 informed us that she had started digging a den as early as September 8. It also was instrumental in revealing that when pregnant she lined her den with moss and grass rather than boughs--perhaps a coincidence but probably significant. #40 denned not only with her large cubs but also with her yearlings.

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WILDLIFE MANAGEMENT INSTITUTE
FISH AND WILDLIFE SERVICE, UNITED STATES DEPARTMENT OF THE INTERIOR

UNIVERSITY OF MONTANA
MISSOULA, MONTANA 59801

April 14, 1972

Dr. Frank C. Craighead Jr.
c/o Mrs. Jean C. George
20 Williams Street
Chappaqua, New York 10514

Dear Frank:

Enclosed is the article for Science Year. I sent the original to Washington for clearance and a carbon has gone to Darlene with the request that she hold this until I get final approval from Washington.

I have indicated authorship on a basis of total work on the manuscript and the fact that the original request came to me. If you have any questions on this, contact me by phone.

I sorted a large number of photographs, but Darlene informs me that she received a good selection from you, so I will forward only a transparency of the grizzly bears at the Trout Creek dump. I have informed Darlene by phone that other photographs are available from me upon request.

Hope your meetings in the East are progressing well and that you have a good vacation in Florida.

Regards,

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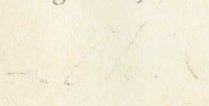
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Can the Grizzly Bear and Man Co-exist?

Introduction:

In Yellowstone National Park and the adjoining National Forests, approximately 200 grizzly bears (*Ursus arctos*^s ~~arctos~~) are engaged in a struggle to survive. This species does not readily mix with humans yet year by year the number of tourists visiting the Yellowstone area has steadily increased posing a threat to the grizzly. In 1971, 2 1/2 million people entered Yellowstone Park and the number will mount. To help insure that this grizzly bear population holds its own in the face of man's invasion of its habitat, we began to accumulate scientific information on the situation. An endangered species is one that has little prospect of surviving without help from man. Yet in 1959 when we began our scientific study there was so little known about the biology of grizzly bears that it was not possible to formulate an intelligent management program. The Yellowstone Park administration needed management guidelines based on scientific knowledge and former Superintendent Lemuel Garrison gave us a free hand to investigate.

To unravel the complex ecology of an endangered species, we have employed some of the most ancient and most modern ^{tools} ~~look~~ of science in man's oldest and perhaps most complex laboratory--the natural environment. Over the past 13 years, we, our students and our colleagues have captured and examined nearly 600 grizzlies. We have color marked 260 animals and returned them to the wilds so we could reobserve them as individuals in a population. With the aid of radio transmitters we have radiotracked and closely observed 23 grizzly bears, some for 2 or

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- I. Brief history of the decline of the grizzly
1. Former range - map
 2. ~~Attendance~~ ^{Abundance} and decline in California
 3. Stories of grizzlies aggressiveness

- II. How to study an aggressive, powerful animal that?:
1. Is endangered
 2. Is extremely difficult to observe because of:
 - a. timbered habitat.
 - b. nocturnal
 - c. hibernates 1/2 year
 3. Is long-lived and reproduces so slowly that years are required to record population changes in:
 - a. birth statistics
 - b. death
 - c. Year to year changes in age structure
 - d. activities and movements.

- III. How the research technique problems were solved to study the population.
1. Basically what we had to learn.
 - a. The dynamics of a grizzly bear population.
 - b. Briefly outline the dynamic process (Grizzly Management report).
 2. The techniques employed:
 - a. Immobilizing
 - b. color marking
 - c. measuring
 - d. recording sex and age structure
 - e. aging

IV. Information obtained about the dynamics of the population.

V. The research techniques developed to study behavior.

1. Development of electronic equipment.
 - a. How this was done.
 - b. instrumenting first grizzly.
2. Information obtained on:
 - a. Movement
 - b. Home ranges
 - c. Denning
 - d. Food habits
 - e. Problem of the dumps

VI. Management Recommendations:

1. Situation today.
 - a. Phasing out dumps.
 - b. Results of disruption of population. In spite of knowledge accumulated, the grizzly in Yellowstone is more endangered now than when the study began.

VII. What is needed for bears and man to co-exist in Yellowstone?

VIII. Can man himself survive if he cannot learn to apply knowledge so as to co-exist with the grizzly. What this implies:

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Note: Side story within a story.

The dangers of grizzly bears and what to do about them.

- a. How to travel
- b. How to camp
- c. Dos and don'ts
- d. Injury rate in Yellowstone and elsewhere.
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AUTHOR'S COPY

SCIENCE YEAR

ARTICLE _____ GRIZZLY BEARS

EDITOR _____ DS

DATE _____

SET: BASKERVILLE 10/12 (#353) OR 9/10 (#169) C/LC

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1 We approached the female grizzly on foot, at the end of a long day's
2 hike through a snowstorm. Cautiously we followed the radio signal to
3 within 20 feet of her den. Apprehensive that she might suddenly
4 emerge but elated over our success, we stood savoring the moment,
5 engulfed by swirling snow.

6 That day bear and man were brought together in Yellowstone Na-
7 tional Park's wilderness for a project breakthrough. We knew we had a
8 tool and a technique that could enable us to locate grizzly bear dens
9 and, for the first time, gather data on the denning behavior of the
10 grizzly. The testing phase for our equipment was over, and we were
11 ready to begin our ecological studies in earnest.

12 Our ^{research} ~~story~~ began in 1959, when we, along with some of our col-
13 leagues and students, undertook a long-range study of the grizzly bear
14 (*Ursus arctos horribilis*) in Yellowstone National Park. The grizzly was
15 ^{considered} ~~then thought to be~~ an endangered species, but scientists knew so little
16 about the biology ^{and population status} of these bears that they could not suggest ^{management procedures that would} ~~how to~~
17 ^{arrest} ~~prevent~~ the decline of the species.

18 Our goal was ^{steady} to accumulate the scientific information needed to
19 learn how this bear interacts with man. (This information we hoped
20 might help insure the survival of the Yellowstone grizzly population
21 in the face of man's accelerated invasion of its habitat.

22 To observe the grizzly in its natural state, we employed some of the
23 most ancient and some of the most modern tools of science in man's
24 oldest and perhaps most complex laboratory—the natural environ-
25 ment. Primarily, we combined the age-old method of observing free-

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1 roaming animals with the inventions of the electronic age.

2 Today between 200 and 250 grizzly bears live in the Yellowstone
3 National Park and the adjoining national forests (the Yellowstone
4 ecosystem). In 1971, more than 2 million people visited Yellowstone
5 National Park, and each year the number will surely mount. Grizzly
6 bears do not mix readily with humans, and when two aggressive,
7 unpredictable animals—grizzly bear and man—attempt to share the
8 same area, there is bound to be conflict. And even though the grizzly
9 possesses enormous physical strength, he is no match for the ways of
10 modern man. *ruthless*

11 The number of grizzly bears in the continental United States ~~have~~ *has*
12 rapidly declined since the early 1800's. Before the coming of the
13 white man, grizzly bears ranged from the Pacific Ocean to the Missis-
14 sippi River and from Mexico to the Arctic Circle. In California alone
15 there were once an estimated 10,000 grizzlies, but by 1924, all had
16 disappeared. Probably less than 800 or 900 grizzlies now exist in the
17 entire continental United States. They are generally found only in the
18 high mountain country and wilderness areas of large national parks
19 and forests. Only in Alaska and western Canada are grizzlies still
20 relatively abundant.

21 To understand and thus intelligently contribute to the management
22 of grizzly bears within the 5 million-acre Yellowstone ecosystem, we
23 had to find answers to questions about their birth rate, death rate, age
24 structure, and behavior. We also had to learn how they relate to man
25 and his use of the Yellowstone environment.

1 Envision how you would learn the vital statistics of life and death as
2 well as the daily and seasonal activities of 200 human beings if you
3 could not communicate with them or even identify individuals. Also,
4 consider how you would study a group whose habitat is 85 per cent
5 densely timbered terrain. Within this habitat, the grizzly is active
6 mostly at night. In addition, half of the year it spends sleeping in a
7 cave, ^{covered by} beneath a deep blanket of snow.

8 We solved the identification problem by developing techniques for
9 capturing and color marking bears so that we could observe them as
10 individuals ^{in the} population. We ^{captured} trapped them ^{or shot} or shot them ^{in the} in the
11 ~~open~~ with syringe darts containing immobilizing drugs from a rifle.
12 Our trap consisted of a ^{section} piece of metal culvert, ³⁻⁴ feet in diameter and
13 ¹⁰ feet long, mounted on a trailer frame. It had ^{a gate at one end and a} doors ^{on either end} on either end
14 that slammed shut when a grizzly entered ^{at the other} to take our bait of raw
15 meat or bacon. Through holes in the ^{and pulled the trigger} sides of the culvert trap, we
16 injected the bear with a muscle relaxant. After the grizzly was safely
17 immobilized, we attached ^{numbered} metal ear tags, stamped with a specific
18 number, and color-coded plastic ear markers. We also tattooed the
19 bear's number under one of its forearms.

20 Finding and following the elusive grizzlies posed greater difficulties.
21 We had to develop a research technique that would permit us to
22 locate and observe these animals at night as well as follow them over
23 extensive areas of their terrain. To accomplish this, we collaborated
24 with engineers to design a radio-tracking system. Our field require-
25 ments were translated into tracking-system specifications on signal

Author: What was size of culvert trap?

John can check these measurements.

for studying the ecology of the grizzlies

1 range, weight, power, battery life, and frequency (32.02 megahertz).

2 In the fall of 1960, we tested a prototype transmitter with a power

3 output of ¹⁰20 milliwatts, and by ~~the summer of 1961~~ ^{using 100 milliwatts} we were ready

4 ^{put a radio on} to ~~instrument~~ our first grizzly. We captured and immobilized a fe-

5 male, bear No. 40, and outfitted her with a special collar containing a

6 radio transmitter and weighing ^{about} ~~approximately~~ 2 pounds. Then we

7 released her and began testing our system. We tracked this female bear

8 intermittently for a month, picking up her pulsed signal, or "beep,"

9 on a portable directional receiver at distances of up to three quarters

10 of a mile. Later modifications greatly improved this wildlife telemetry

11 system. but nothing could detract from that first thrill when we fol-

12 lowed a signal to the crest of a hill and saw the radio-collared grizzly

13 plodding along, completely unaware of our presence. We then realized

14 that we could arrange a meeting between bear and man at times and

15 places of our own choosing.

16 With our receivers coupled to stationary and mobile directional

17 antennas we could simultaneously monitor four grizzlies and dis-

18 criminate between them. In order to distinguish between bears, each

19 transmitter was pulsed at a different rate. We used a fix, the intersec-

20 tion of two or more radio bearings, to plot the location of the animal

21 on a map. The system also had the potential of transmitting physio-

22 logical information, such as body temperature, simultaneously with

23 ^{location} ~~ecological~~ data.

24 We first concentrated on obtaining data on sex and age, growth and

25 development, and reproductive condition. Not only did we mark the

Author: One of your papers says
you could monitor 5 grizzlies.
Which is correct? 7

Author: Is this statement regarding
body temperature true?
OK

1 captured grizzlies, but we ^{also} measured and weighed them. We found that
2 a large adult female weighs from 350 to 450 pounds; a large male,
3 from 800 to 1,100 pounds. We even took an electrocardiogram (EKG)
4 of a grizzly and discovered that its heart action was similar to that of
5 a dog. But, some of the most important data we collected had to do
6 with age.

7 One of our most valuable "diagnostic" instruments for determining
8 the health of the grizzly bear population in Yellowstone is the age
9 structure. We knew the ages of some of the bears we had marked,
10 such as cubs and yearlings. But, the ages of ^{older} the grizzlies we captured
11 and marked as sub-adults and adults had to be determined by precise,
12 scientific means.

13 To do this, we ^{relied on techniques developed by other scientists. We} used dental stone to make foot and tooth impres-

4 14 sions and measured them to determine the ages of bears up to three

15 and four years old. Older bears' ages were found by extracting the

16 small fourth premolar. When the roots of these teeth were sectioned

17 and stained, we could count the cementum layers, just as one counts

18 the growth rings of a tree. By tabulating all of the annuli, or "rings", ^{to}

19 we could assign an accurate age to each adult we captured. The bear

20 was then released back into the population, minus a fourth premolar.

21 Information from thousands of observations and from systematic

22 censuses taken over a 12-year period of marked, ^{whose ages were} known-age bears,

23 plus the data we obtained from determining the ages of adult bears,

24 told us the age structure of the population. On the average, 19 per

25 cent of the population are cubs; 13 per cent, yearlings; 11 per cent,

whose ages were
definitely known,

2-
1 two-year olds; 13 per cent, ~~three~~ and four-year olds; and 44 per cent,
2 adults. 3H/# 4C

NO 9
3 This data told us that the Yellowstone grizzly bear population was
4 stabilized or perhaps increasing at a very slow rate. In other words,
5 the population was in delicate equilibrium.

6 Other important aspects of bear behavior that we studied included
7 their denning behavior. The den of bear No. 164 was the first of 12
8 that we located by radio tracking. We found that all bears excavate
9 their dens, they ^{did} ~~do~~ not use natural shelters. All dens ^{were} ~~are~~ dug in iso-
10 lated sites with the entrance facing north. Most ^{were} ~~are~~ situated at the
11 base of a large tree and lined with boughs.

12 The grizzlies use the claws on their forefeet to dig their dens. These
13 claws, which may be 3 to 4 inches long, or longer, are one of the
14 characteristics that distinguish the grizzly from the black bear. In
15 summer, the grizzlies dig "daybeds," shallow ^{depressions} ~~holes~~ in the ground
16 where they sleep in the morning or afternoon.

17 Grizzlies enter their ^{winter} dens during snowstorms. This effectively, if not
18 intentionally, erases their tracks and all other signs of their presence.
19 This behavior trait could help protect the bear from his major enemy,
20 man, when the grizzly is most vulnerable.

21 The grizzly is not a true hibernator. During the winter sleep, a
22 ^{bear's} ~~grizzly's~~ body temperature drops only by 5° to 11°F. Because the
23 temperature is still relatively high (90° to 96°F.) and the metabolic
24 rate is correspondingly high, grizzlies can be easily roused. Neverthe-
25 less, the grizzly apparently neither eats nor eliminates while in its

While we were accumu-
lating population statistics,
we were also studying
other

grizzly bear life, such as

Author: Did you get this
information by biotelemetry?
If so, how?

Body Temp. Telemetry
from black bears &
temp recordings made by
other on captive grizzlies

1 winter den, and this suggests that the grizzly's kidneys have some
2 remarkable properties to prevent uremic poisoning. Further research
3 in this area might provide information for treating human sufferings
4 from kidney ailments.

Author: Is this statement correct?

5 While in their winter dens, pregnant females give birth to between
6 one and four cubs. The average litter is two cubs. Birth ^{usually} always occurs
7 early in February. The newborn cubs weigh 12 to 16 ounces and are
8 blind and hairless. Around mid-April or early May, the mother and
9 cubs leave the den ^{site} and move to spring feeding areas. By this time the
10 cubs have fur and weigh 10 to 12 pounds.

Author: Does birth always occur around Feb. 1?

11 When they are about 6 months old, the cubs start feeding on vegeta-
12 tion and meat. In September and October, when the cubs weigh from
13 100 to 125 pounds apiece, they accompany their mother to an area
14 where she digs a new winter den. Seldom is a den reused. About the
15 middle of November, during a heavy snowfall, the family ^{returns to the den and} enters the
16 roughly 5 by 4 by 8-foot excavation.

17 The following spring, the female may wean her now year-old cubs,
18 or she may suckle them through another season, den with them, and
19 wean them as two-year-olds. She weans them just prior to the breed-
20 ing season in June and July. Until she has weaned her offspring, the
21 female will not accept a male.

22 One season, while tracking No. 40, we came upon female No. 101
23 and her cubs. Bear No. 40 led us to where No. 101 was digging a den.
24 We learned that two females and their cubs will sometimes travel
25 together, and that females will ^{regularly} also adopt orphaned cubs.

1 The male, however, has no role in the family life. Adult males are
2 avoided or even attacked by females with cubs because it is not un-
3 common for male bears to kill the helpless young. On many occa-
4 sions, we watched female grizzlies with cubs attack large males when

5 they approached too closely or exhibited aggressive behavior. A fe-
6 male with cubs reacts suddenly when confronted with an aggressive
7 male. She alerts her cubs, but they often flee in different directions,
8 making it impossible for her to retreat with them in an orderly
9 fashion. She appears confused. With head and neck extended and ears
10 laid back, she rotates, stepping first in one direction, then in another.
11 Suddenly she wheels and attacks the male. Her attack may last only
12 seconds, and then she quickly retreats to search for her cubs.

13 During the breeding season, the large males compete with each
14 other for the females. Fur flies and deep wounds may be inflicted. It
15 is not uncommon for a male's ear to be ripped off, a lip torn, or a jaw
16 fractured.

17 The grizzlies' complex social structure is most evident during the
18 breeding season. Dominant males win their positions in the social
19 hierarchy by aggressively competing for the females. Aggressiveness is
20 also a factor in determining a female's rung on the dominance ladder.

21 This socially useful arrangement of dominant and subdominant ani-
22 mals tends to reduce conflict among the grizzlies. Subdominant ani-
23 mals display certain submissive signs and postures to avoid fighting
24 with dominant animals. Submissive behavior can also end a fight
25 before lethal wounds are inflicted. The most common submissive

1 posture is lowering and turning the head to the side while slowly
2 retreating. At no time did we see grizzlies ~~staking out territories~~. We
3 never observed them defending an area, whether a range or a den site,
4 against other grizzlies. A show of dominance, when and where
5 needed, seems to substitute for any clear-cut defense of a definite
6 territory.

exhibiting definite territorial behavior

7 However, grizzlies do have home ranges and smaller seasonal ranges
8 within them. We plotted these ranges to determine how much space a
9 bear needs. During an 8-year period of our research, we studied 23
10 instrumented grizzlies. For example, we watched bear No. 40 for
11 portions of eight consecutive years and tracked her to five different
12 dens. Her plotted movements showed her lifetime home range to be
13 about 30 square miles.

the home ranges

radio-collared

14 We plotted the positions of all 23 grizzlies on maps, and by drawing
15 connecting lines through peripheral fixes, we were able to outline
16 seasonal, annual, and home ranges of the bears. These varied from 12
17 square miles for the home range of a young female to 168 square
18 miles for the summer range of a young mature male. The ranges of
19 some adult males were more than 1,000 square miles. Factors such as
20 age, sex, food supply, and den sites influence the size of a grizzly's
21 range. Most ranges overlap and are shared by more than one bear. For
22 example, weaned yearling grizzly No. 202 established his range within
23 the boundaries of his mother's and also dug his first and second
24 winter dens within her home range. *This also shared by other bears.*

25 Foraging tracks appear to be part of the grizzlies' normal pattern of

Mount

1 movements. Grizzly No. 76 made a 50/mile excursion in 7 days, ^[H] seven

2 circling Mt. Washburn and crossing the Yellowstone River. Female

3 No. 150 and her three cubs roamed a range of 27 square miles. But,

4 for a full month before hibernating, they forged in a restricted area of ^[a]

5 about ~~one~~ square mile. Such information gave us clues to how large an

6 area ^{could support} a grizzly ~~needs for feeding~~. We found that, on the average, 29

7 square miles ^{family} supports ~~one~~ grizzly in the Yellowstone ecosystem. ^{there are}

8 Because we could close in with our tracking system and observe

9 grizzlies undetected, we were able to learn more about their diets. In

10 early spring, when they emerge from their winter dens, grizzlies feed

11 on carcasses of elk and other large herbivores that have died during

12 the winter. After feeding on this carrion, the grizzly generally covers

13 the remaining portion of the carcass with soil and debris and returns

14 to feed on it for several days or a week. It does not vigorously defend

15 its food against other grizzlies but normally shares it with them.

16 Grizzlies, however, will defend food against black bears and coyotes,

17 and also against man. Grizzly No. 158 led us to a carcass where 24

18 other grizzlies had assembled and were feeding at one time. Their

19 behavior was governed by social status, with subdominant grizzlies

20 deferring to the dominant ones. ^{strategic placement of carcasses}

21 Grizzly bears are not efficient predators on large game. Their role as

22 a carnivore is first a scavenger, second a predator on small prey, and

23 last a killer of large prey animals.

24 During the summer, the grizzlies congregate in meadows and river

25 bottoms to dig roots and tubers and graze on sedges, clover, and

as a valuable management procedure for keeping grizzlies separated from people.

1 grasses. They also eat berries, feeding almost exclusively on them
2 when they are abundant. We monitored grizzlies in open habitats
3 feeding on field mice and pocket gophers when the populations of
4 these small rodents were high. During seasons when pine nuts were
5 plentiful, we moved with the bears to the timbered ridges where the
6 white bark and limber pines grew. In spring, we watched them strip
7 the bark from lodgepole pines to consume the edible cambium, the
8 soft tissue between the bark and wood of trees.

9 Although a relatively inefficient carnivore, the grizzly bear is an
10 extremely efficient omnivore. In the process of evolving omnivorous
11 feeding habits, the grizzly also evolved some useful social habits. He
12 can function as a "loner" or within a complex social structure. This
13 dual behavior has enabled this great bear to exploit a wide range of
14 food sources, but in modern times has also brought the grizzly trouble
15 by bringing it into conflict with man. The Yellowstone grizzly has
16 become a threat to park visitors, and this, in turn, is a threat to the
17 grizzly.

18 Since it is natural for grizzlies to congregate where food is abun-
19 dant, the garbage dumps near developed areas in Yellowstone Park
20 attracted large numbers of grizzly bears. Some of these naturally in-
21 quisitive animals wandered into ^{nearby} campgrounds ~~by accident~~ and fed on
22 food scraps ^{and food left} ~~they found~~ lying around.

23 Grizzlies that learn to forage in campgrounds ^{become} ~~are~~ more aggressive
24 than the bears that feed only at dumps, and thus are more dangerous
25 to man. We have found that such animals learn to associate food ^e

1 getting with humans and soon lose their natural fear of man and
2 human scent. Such animals may coexist with people for extended
3 periods of time. However, sooner or later, these man-^{food}conditioned ani-
4 mals are startled by humans at close range or, in attempts to get food,
5 completely disregard humans. This ^{can} may occur in a campground, on a
6 trail, or in the backcountry and may result in human injury or death.
7 But, for a grizzly to lose its shyness or fear of man requires coopera-
8 tion and encouragement, and the initiative is usually with man.

9 Bear No. 202, for example, expanded his home range to include a
10 campground. Though he was not an aggressive bear, he learned in the
11 campground to associate food with man and soon lost his natural fear
12 and wariness of park visitors. His campground forays become bolder
13 and bolder until he ^{was} had to be killed for safety's sake.

14 One way of dealing with these man-conditioned bears is to trans-
15 port them by truck or helicopter to remote regions of the park. We
16 attached radio collars to some of these transported bears and followed
17 their movements. The grizzlies demonstrated time after time that they
18 have strong homing instincts. Almost invariably, those transported
19 and released within the park returned quickly to the original point of
20 capture. We radio tracked bear No. 170 for 34 miles through
21 timbered, mountainous terrain. In 62 hours, she returned to her home
22 range. When these ^{troublesome} dangerous bears keep returning to areas heavily
23 populated with park visitors, they must be either killed or shipped to
24 zoos ^{or successfully transplanted.}

25 To keep grizzlies from becoming conditioned to man, the bears and

1 man must be kept apart in Yellowstone. This means that the bears
2 must ~~return to natural food sources~~ *eventually disperse in summer to forage in more remote* in wilderness areas of the park *and adjacent forests,*
3 Not only ~~must~~ *should* garbage dumps be eliminated, but the campgrounds
4 must be "sanitized." For example, bear-proof garbage cans will help *discourage*
5 prevent grizzlies from foraging in camping areas. But, campers must
6 also cooperate by not leaving food out in the open.

7 Within the park, the ranger staff controls troublesome grizzlies.
8 From 1931 to 1970, 140 grizzlies were killed. This is an annual aver-
9 age of 3.5 bears over a 40-year period.

10 However, twenty-two grizzlies were eliminated from the Yellow-
11 stone population in control measures in 1970. Twenty-one met death
12 from other causes. In 1971, the total known mortality inside and
13 outside Yellowstone Park was 45 grizzlies, making the known mortal-
14 ity for the 2-year period 88 grizzlies. Approximately 42 cubs were
15 born during the same period. This indicates a mortality rate twice as
16 great as the birth rate, and this in itself would appear to be serious.
17 But, even the high recorded death rate does not tell the entire story.
18 Statistics compiled during our study indicate that additional grizzlies
19 die from unknown and unrecorded causes. Consequently, the popula-
20 tion loss for 1970 and 1971 is even more serious than the death
21 statistics show.

22 Complex and sensitive biological factors maintain the balance in
23 this small population of grizzly bears. The females first breed success-
24 fully at 4½ years of age, though many may not produce cubs until
25 they are 8 or 9 years old. Only about 45 per cent of the adult females

with a change in management policies

22

two

NO 9

1 breed each year, and a relatively small number of productive females
 2 maintain the population level. Therefore, an increase in the death rate
 3 of adult females could jeopardize the population.

4 Furthermore, 27 per cent of the cubs born do not survive the first
 5 year and a half of life. So, not all of those 42 cubs born in 1970 and
 6 1971 may live to replace the 88 or more bears that died during the
 7 same period.

8 The effects of future environmental changes, hunting pressure, or
 9 management practices could be critical. To help us measure and assess
 10 them with the sensitive age-structure indicator, we are building a com-
 11 puter model of the Yellowstone grizzly populations. The model is
 12 based on the data collected from studying 260 color-marked and 28⁺
 13 radio-collared grizzlies over the past 13 years. Changes unfavorable to
 14 the population would be expected to show a decrease in the percent-
 15 age of cubs in relation to other age groups. If this ^{has occurred} occurs, or if the
 16 ratio of adult females to adult males ^{is changing} changes adversely, then we will
 17 be forewarned the grizzly is indeed in danger of disappearing from the
 18 Yellowstone ecosystem.

19 There are some who ^{have asked} will ask: what good is a grizzly, an animal that
 20 is potentially dangerous to man? The national parks, they ~~will~~ argue,
 21 are for people to enjoy in peace and without fear of attack from these
 22 animals. But, the grizzly is one of the many living things—plant and
 23 animal—that are intricately related and interdependent upon one an-
 24 other. It is this interdependence ^{that} makes continuing life on earth pos-
 25 sible, and we must learn more about it to insure our own survival. For

Authors: Is this statement
 about computer model
 essentially correct?

Author: Bio-Science shows 256 color-
 marked and 24 radio-collared bears.
 Which is correct? 24

respect it and

Put a statement like such as
 "We are indicating that this is happening
 slowly and for the future"

1 man to eliminate every species that appears to be a potential danger is

2 to betray a fundamental disrespect for life. And, if ^{man has} ~~man~~ grown so

3 intolerant and selfish in ^{his} ~~his~~ dominance of the environment that he

4 cannot coexist with some 200 grizzly bears, ^{can} ~~can~~ make himself survive?

5 For further reading:

6 Craighead, F. C., Jr. and J. J. Craighead, "Trailing Yellowstone's

7 Grizzlies by Radio," National Geographic, August 1966.

8 Olsen, J., *Night of the Grizzlies*, G. P. Putnam's Sons, 1969.

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