

AN ECOLOGICAL STUDY OF THE GRIZZLY BEAR

Fifth Annual Report
Summary of Work Accomplished
1963

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INTRODUCTION

A six-year ecological study of the grizzly bear (*Ursus arctos horribilis*) was initiated in 1959 and has been coordinated through the Montana Cooperative Wildlife Research Unit at Montana State University.

This report summarizes the work accomplished during the 1963 field season, the fifth year of intensive research.

Grizzly bears have disappeared from much of their former range in the United States. There is need for detailed ecological studies of this large carnivore if it is to be preserved and intelligently managed. This has been recognized for some time, but formidable obstacles have prevented intensive research. Some of these problems have been:

1. Overcoming the tremendous physical task of gathering data and supplying an operation over thousands of square miles of wilderness grizzly habitat.
2. Locating a grizzly bear population sufficiently large and localized that quantitative data could be obtained.
3. Adapting and improving methods of immobilizing wild bears for detailed inspection and measurement.
4. Developing a method or methods of marking grizzlies so individuals and known-age animals could be observed in the field.

After much fruitless searching in Montana for a suitable study site, Yellowstone National Park was investigated and found to have a relatively large population of grizzlies sufficiently free of artificiality that fundamental biological data could be obtained on a quantitative basis. Advantages of the Yellowstone area are that grizzlies are numerous, readily observed, and can be studied both in the vicinity of man and in the back country - a situation that has yielded basic ecological data as well as information on the interrelations of this large carnivore with man. The National Park Service indicated interest in a proposal for research and offered to cooperate in the study.

During the past five years field work has begun the last of May and terminated in early November. Quarterly and annual reports of the Montana Cooperative Wildlife Research Unit have reported on previous work accomplished. Findings and conclusions will be presented in technical papers as the study progresses. Some results of the investigations from 1959 through 1963 are here summarized for the benefit of financial supporters and the research team. The findings presented are tentative and cannot be considered as final conclusions.

General Objectives:

1. To develop and perfect methods and techniques of capturing, handling, marking, and immobilizing grizzly bears.
2. To study the population dynamics of grizzlies and with the aid of marked animals, determine population size, density, sex and age composition, breeding age, reproductive capacity, growth rate, mortality rate, and population turnover.
3. To study population behavior, family composition and activities, breeding behavior, and relationships between various units in the population.
4. To determine home ranges, daily and seasonal movements, and distances traveled to food, to hibernation sites, and for breeding purposes.
5. To determine carrying capacity and habitat requirements and relate these to existing conditions of food abundance, habitat types and hibernation sights.
6. To collaborate with specialists in conducting physiological, hematological, and pathological studies.
7. To adopt and utilize electronic equipment in obtaining ecological data.

Financial Support:

This project is supported by a five-year grant from the National Science Foundation and from annual grants from the Research and Exploration Committee of the National Geographic Society, the Wildlife Management Institute, the Boone and Crockett Club, the New York Zoological Society, and the National Park Service. Funds from the Montana Cooperative Wildlife Research Unit* are annually budgeted for operational expenses and some salaries. The National Park Service and the Yellowstone Park Company have made laboratory facilities and special equipment available. The radio-tracking phase is coordinated through the Environmental Research Institute and is supported by a three-year grant from the National Science Foundation and by funds allocated by Philco Corporation for development of radio-tracking equipment by engineers of their Western Research and Development Laboratory.

*Contribution from the Montana Cooperative Wildlife Research Unit; U. S. Fish and Wildlife Service, Montana State Fish and Game Department, Montana State University, and Wildlife Management Institute cooperating.

GENERAL RESEARCH METHODS AND TECHNIQUES

Capturing and Marking

Methods of Capture

Fifty-five grizzlies were captured and successfully immobilized and/or anesthetized during the 1963 field season. Thirty-three of these bears were captured in culvert traps and 22 were shot free-ranging with a gas-powered rifle and propulsive syringes. This makes a total of 282 grizzlies handled since the study began in 1959.

Trapping Success

As in 1962, trapping operations were largely confined to the Trout Creek area. Success with culvert traps increased over that of the previous year. Sixty-eight trap nights resulted in the capture of 28 bears for a trap success of 41.2 per cent. This is contrasted to 32.0 per cent for the 1962 season. The increased success was partially due to the greater number of yearlings present and subsequently captured (nine in 1963 compared to one in 1962). Some adults recorded in the area in past years were also captured and this tends to discount trap shyness as a major factor in the poor trapping success experience in 1962.

Number of Bears Captured

Twenty-four new individuals were captured, marked and released in 1963. These included seven cubs of the year, nine yearlings, two young adults, and six adults. Twelve of these bears were males and twelve were females.

The five-year total of marked individuals is now 165. Of these 165 marked bears, 87 were theoretically in the population in 1963. Seventy-four of these 87 were observed from one to many times during the 1963 field season.

Marking

All bears except two adult males were marked with polyethylene braided rope threaded through the ears. Polyvinyl tape "flags" were attached to the rope in most cases. This has proved to be the most durable color marker yet used. Colored metal tags were also placed in each ear. Placement of these tags has also helped immensely in identifying bears that have lost other markers. All bears were tattooed in the upper lip or behind the foreleg. This has proved invaluable in identifying marked bears from hides sent to tanneries. The combination of marking techniques has been virtually 100 per cent successful.

Recaptures

Twenty-four individuals were recaptured a total of 28 times in 1963. Of these, two were marked in 1959, nine in 1960, two in 1961, five in 1962, and six in 1963. These bears represented all age classes and yielded valuable data on growth rates, fat deposition, dentition development, blood chemistry, and general physical condition, as well as a great deal of information concerning seasonal movements.

During the five years the study has been underway, 83 individuals have been recaptured 115 times.

Immobilizing and Anesthetizing

The techniques of immobilizing and anesthetizing with succinylcholine chloride have been reported on extensively in Unit quarterly reports and in previous annual reports. Twenty-eight dosages of succinylcholine chloride only and 34 dosages of succinylcholine chloride followed by pentobarbital sodium were administered in 1963. This brings the five-year total of successful druggings of grizzlies of all ages and sizes to 310.

Sernylan, a fast-acting tranquilizer, was administered to two black bears and two grizzlies. Dosages were established for this drug and its capabilities for future application were explored.

One death in 1963 was caused by an overdose of drugs. Number 75, an old female, prematurely recovered from an initial dose of Sucostrin and jeopardized the research team. Of necessity she was injected a second time, became immobilized, and died 43 minutes later. The observers felt that this bear's age, combined with an accumulation of drugs beyond the tolerance level caused her death.

Concentration and Dispersal

Grizzlies in Yellowstone move long distances to major summer ranges or summering areas. This movement begins in late May and early June reaching a peak about the first of July. The movement is in response to "artificial" food at garbage dumps and to an abundance of natural food on the summer ranges. The latter appears to be the basic attraction bringing numbers of grizzlies to the extensive summer range area and the former tends to concentrate them within these areas. There now seems to be little doubt but that Hayden Valley and other ecologically similar areas in Yellowstone would support large summering populations of grizzlies whether "artificial" food at garbage dumps was available or not.

As in 1962 heavy and frequent precipitation throughout early summer produced lush vegetation. The abundance and the luxuriant growth of many of the choice plants used by grizzlies was thought to be an important factor in keeping them relatively dispersed throughout the summer range during 1962. A similar condition, however, did not appear to disperse the bears during the summer of 1963. More information is needed to better define the relations between availability of natural foods and the distribution of grizzlies, particularly during the summer months.

The Yellowstone area again experienced an unusually mild autumn season. Dispersal began in mid-August and by mid-October very few bears were frequenting the Trout Creek area. White-bark pine nuts, so

abundant in the fall of 1962, were practically non-existent this past fall. There were, however, near-plague populations of meadow voles (Microtus sp) throughout the Park. Examination of droppings during the fall showed that grizzlies were utilizing this food source to a large extent. Corms of Melica spectabilis were also utilized heavily during September and October. The abundance of major food items has varied from one fall season to the next. The grizzlies readily adapt to take advantage of the food source and their diets strikingly reflect their versatility as foragers. In October 1962 grizzlies were found on the high ridges between 8,000 and 9,000 feet, feeding exclusively on pine nuts. In the fall of 1963 they were observed feeding almost entirely in meadows and in lower open areas where meadow voles and tuberous plants were abundant. They remained in these areas until heavy snow fell the first week in November.

Enumeration of the Population

Direct counts at the concentration sites and in other areas of the Park were again used to determine minimum population figures. In 1963 a total of 177 different individuals was recorded--a slight increase over the four-year average of 164. This increase occurred entirely in the Trout Creek segment of the population--116 grizzlies were recorded in 1963 as compared to a four-year average of 98. This increase in numbers may be explained, at least in part, by the greater survival of yearlings (cubs in 1962). Among 26 cubs present in 1962, 21 were accounted for as yearlings in 1963. This constitutes a survival rate of 81 per cent, as compared with 50 per cent for the three preceding years. Twenty-seven cubs were tallied which also represents a new high for the Trout Creek area.

Classified Counts

Classified counts have been made since the start of the study. Cubs of the year (5-9 months), yearlings (17-21 months), two-year olds (29-33 months), three or four-year olds or young adults (41-45 and 53-57 months) and adults (65 months and over) have been recognized in the field. Early in the study some difficulty was experienced in classifying bears in the middle age classes. During the past three years, however, aging criteria obtained from known-age marked bears have been used to separate the two, three, and four-year olds.

Table I shows the 1963 age stratification of grizzlies throughout Yellowstone. It will be noted that the percentage of the total population that each age class comprised in 1963 closely approximates the five-year average.

TABLE I

Age Structure of the Population Throughout Yellowstone National Park, 1963

	<u>Number of Individuals</u> <u>1963</u>	<u>Percent of</u> <u>Total Population</u>	<u>Average</u> <u>Percentage for</u> <u>Five-year Period</u>
Cubs	40	22.1	20.1
Yearlings	29	16.5	11.3
Two Years	11	6.3	7.1
Young Adults	25	14.2	14.2
Adults	72	40.9	47.3
Total	177	100.0	100.0

The sex of 164 bears captured and marked since the start of the study was 81 males and 83 females—a 1:1 ratio.

Productivity

During 1963, sixteen sows were recorded with 40 cubs. This constitutes an average litter size of 2.5, the highest yet recorded. Five-year totals show a ratio of 77 sows to 170 cubs for an average litter size of 2.21. Of 17 sows with cubs in 1962 seven were observed with yearlings

in 1963. Only 29 sows with 66 yearlings (average litter size of 2.28) have been observed. (This, however, does not include those offspring weaned as yearlings.) Five-year totals show that 170 cubs have been observed, but only 95 yearlings. We have evidenced that mortality and dispersal account for a large number of young bears in their second year of life, particularly those weaned as yearlings.

Mortality

Fifteen mortalities were recorded in 1963. These included three cubs, two three-year olds, three four-year olds, and seven adults. Of these 15, six were killed by hunters outside Yellowstone and six were accounted for as a control measure by the National Park Service (two killed, four shipped to zoos). Since 1959 these two factors have accounted for the bulk of the recorded mortality in the population. During the five years of the study, 81 mortalities have been recorded. Hunters have killed 34, or 42 per cent, and the National Park Service has accounted for 23, or 28.4 per cent, through direct control measures and capturing and shipping to zoos (15 killed, 8 shipped to zoos). Eleven have died as a result of an overdose of drugs, often administered to immobilize troublesome or dangerous individuals, three have been sacrificed for study, and ten have died of miscellaneous or unknown causes.

Breeding Age and Behavior

Breeding Age

It was anticipated that in the summer of 1963 considerable data would be obtained on breeding age. We did not acquire as much information as we had hoped; however, some very valuable and interesting observations were made. Marked known-age females (3 to 5 year age classes) in the population did not appear with cubs and, furthermore, were not observed breeding during the season. This does not, however, rule out

the possibility that they were actually bred. One established-age five-year old female, No. 15, appeared with cubs. This female was observed copulating in both 1961 and 1962; however, she had no cubs in 1962.

No. 51, a known-age four-year old male was observed copulating on two different occasions. This is the first mating activity recorded for a known-age male. No. 76, an established-age five-year old also mated with females on two different occasions.

Activity and Movement

Sight records and returns from marked animals killed outside Yellowstone have shown over the years that grizzlies make seasonal migrations to areas of food abundance. We have also considerable evidence that individuals return in the fall to areas where they were observed in early spring. Additional data are showing the movement of particular segments of the population, such as the movement habits of a certain age class and the differences in movement of the sexes of that age class. For example, the average adult male travels much farther than does the adult female. The Yellowstone population appears to be made up of a nucleus of mature females, most of which spend their entire lives within the borders of the Park. Males, particularly young males, often travel far beyond the confines of Yellowstone. Movement of these young males cannot be attributed entirely to food seeking; population density, or some as yet undetermined factor, appears to dictate movement patterns of this age class. Females in the one-to-four-year class, however, do not ordinarily travel great distances.

Aging Techniques

Eighty-four known-age and established-age bears have been individually marked in the past four years. These include 40 cubs, 23 yearlings, and 16 two-year olds. From the majority of these, impressions have been made

of the dentition and forepaws. Casts made from the impressions have proved invaluable in establishing the age of other bears from the age of six to 45 months. A total of 110 dental casts and 51 foot casts have been made since 1960. Several bears have been captured in successive years and casts made of their dentition and forefeet. One bear, No. 6, has been recaptured for three successive years and casts obtained; others have been captured in alternate years. These casts not only show annual growth changes in individuals but, collectively, show striking growth changes among the different age classes.

In arriving at reliable aging criteria, weights and measurements of all known-age bears have been carefully considered. While a correlation does exist between age and weight, it is not considered reliable. A number of factors determine bear weights. These include: genetic differences governing size, rate of fat deposition in individuals, age at which bears are weaned, degree of parasitism, food habits and preferences, and season of year when the bear is weighed. The growth and development of the teeth and jaws are also affected by some of the above factors, but there appears to be a significant correlation between tooth development and age and between foot size and age up to three and four years of age.

Physiology, Pathology, and Hematology

Physiology and Pathology

Complete autopsies were performed on three grizzlies and one black bear, bringing the total for the past three years to seven grizzlies and five black bears. Organs, tissues, and internal parasites were collected and preserved for future study. The circulatory system again received particular attention.

Post-mortem studies of adult grizzly bears showed that they were free or almost free of vascular disease arteriosclerosis, of the type

commonly found in humans. Serum cholesterol values were consistently higher in grizzly bears than is normal in man with the range from 325 to 425 mgm. per cent compared to normal human values of from 150 to 250 mgm. per cent. Protein bound iodine determinations also consistently indicated low values for bears with the range of 1.3 to 3.2 mcgm. per cent compared to normal human values of 3.5 to 7.5 mcgm. per cent. Humans with hypercholesterolemia and/or hypothyroidism are susceptible to arteriosclerotic disease; however, it appears that grizzly bears with high cholesterol levels and low levels of circulating thyroid hormone are not susceptible to the disease.

Hematology

Blood specimens were obtained from 35 grizzlies and two black bears, were centrifuged at the field laboratory, and the serum frozen and air-mailed to Dr. Berthrong. Specimens were collected from early June through late October—only the "hibernating" period is now lacking from the blood chemistry picture. (Specimens have been obtained from hibernating black bears, however). A mature female, No. 164, has been located in her winter den; this was accomplished by use of the radio-tracking equipment. Plans call for immobilizing this bear in the winter and collecting blood specimens and other physiological data.

RADIO TRACKING

The radio-tracking system and a bio-electronic laboratory were in full operation during 1963. Eight bears were instrumented during 1963 for a total of 13 to date. The last grizzly to receive its transmitter, No. 164, was tracked to its "hibernating" den on November 5. The distinctive signal was first received at a distance of about 12 miles. Using directional receivers, the source of the signal was located deep in wilderness country during a snowstorm and the instrumented bear was located in the den.

Prior to this fall no "hibernating" dens of grizzlies had been located in spite of intensive search and observation. We can safely say that locating the den of a specific grizzly bear at the precise time that it entered the den could not have been accomplished without the use of radio-tracking equipment. The ability to do this in the future will make possible field research on the phenomenon of "hibernation" and greatly aid in the study of infant mortality, the overwintering mortality of cubs, yearlings, and the aged. Physiological data can be telemetered from instrumented bears during hibernation and blood samples can be obtained for chemical analysis.

During the summer of 1963, an instrumented male grizzly was kept under almost continuous radio surveillance for a period of a week. During this time, it traveled a 50 to 60 mile airline loop over extremely rugged terrain. Both diurnal and nocturnal activity and movement were recorded.

MANAGEMENT SUGGESTIONS

The grizzly population in Yellowstone National Park has remained quite stable for the past five years, indicating annual increment and annual mortality are in balance. This population stability also indicates the mortality is not excessive. Eighty-one mortalities have been recorded since the start of the study. Since 1959, sport hunting outside the borders of Yellowstone and control practices by the National Park Service within the Park have accounted for 57 grizzlies or 70.4% of the total mortality (34 by hunters, 23 by NPS). Measures designed to affect either of these factors could be quite important in any future manipulation of the Yellowstone population. Altering hunting regulations to increase or decrease the sport hunting kill of grizzlies in the states surrounding the Park should have a pronounced effect on the population.

The National Park Service exercises control measures only when a grizzly becomes a menace to campers or other park visitors. Bears who have become bold enough to repeatedly enter campgrounds or other inhabited areas are either killed or captured and shipped to zoos. As park visitation increases and more facilities are needed, it will become increasingly important to exercise care in the selection of new camp sites and installations. Areas known to support concentrations of grizzlies during the summer months should be ruled out as sites for further development. The Hayden Valley-Central Plateau area supports more than one-half the total Yellowstone population of grizzlies during the months of July and August. Moreover, the area within the "Grand Loop", the geographical heart of Yellowstone Park, maintains 80 to 90 per cent of the total population. From the standpoint of grizzly preservation and lessening of bear-man encounters, any further development within this area should be weighed carefully. Maintenance of this area in essentially a wilderness state,

could, in future years, be the most important single factor in maintaining significant populations of grizzly bears in Yellowstone National Park.

Pilot studies involving the application of techniques for obtaining censuses in remote areas have been underway for the past three years. The methods used have been very successful and an intensive Park-wide back-country census is planned for 1964. This census would coincide with the peak in bear numbers at the four major concentration sites; this occurs the last two weeks in July. The techniques involved function equally as well in determining black bear numbers in a wilderness environment. A census of this type will yield information unobtainable by other means and will be invaluable in the management of both grizzly and black bears in Yellowstone National Park.