

AN ECOLOGICAL STUDY OF THE GRIZZLY BEAR

Fifth Annual Report  
Summary of Work Accomplished  
1959 - 1963

NOT FOR PUBLICATION

John J. Craighead  
Frank C. Craighead  
Maurice G. Hornocker

Montana Cooperative  
Wildlife Research Unit  
Montana State University  
Missoula, Montana

*Immobilizing and anesthetizing - p. 8*  
*Cub + yearling survival - p. 12*  
*Mortality - p. 22*  
*Productivity - p. 14*  
*Breeding age - p. 25*  
*aging techniques - casts - p. 27*  
*age + wt. - p. 27*  
*Physiology & pathology - p. 28*  
*# 27 radio bear*

*Bear milk - p. 31*

## 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.

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. This report is primarily a compilation of data with no attempt at this time to fully interpret the data or to arrange it for eventual publication. Some findings and conclusions have been presented in technical papers as the study progressed. The gross 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 RESEARCH METHODS AND TECHNIQUES

##### Capturing and Marking

###### Methods of Capture:

Two hundred nineteen grizzlies have been captured in culvert traps and 63 have been shot free-ranging in the field with a CO<sub>2</sub> gun using drug-laden propulsive syringes. Methods of capture for the five years are summarized in Table I.

###### Trapping Success:

Trapping success (for culvert traps) for all five years is presented in Table II. An increase in trapping success occurred this year over that of 1962 (Table II). It was partially explained by the number of young bears, mainly yearlings, present in the population and subsequently captured (Table IX).

###### Number of Bears Captured:

One hundred and sixty-five different individuals have been captured and marked since field work began in 1959.

Twenty-four new individuals were trapped during the 1963 season, immobilized, individually marked, weighed, measured, and released. Of the 24 bears captured, 12 were males and 12 were females. Seven cubs and nine yearlings were among those captured.

Table I

Summary, Method of Capture 1959-1963

| Year   | Total No. Bears<br>Handled (Initial<br>Capture and Recaptures) | Total<br>No.<br>Trapped | Total Number Shot<br>Free Ranging |
|--------|----------------------------------------------------------------|-------------------------|-----------------------------------|
| 1959   | 33                                                             | 27                      | 6                                 |
| 1960   | 64                                                             | 56                      | 8                                 |
| 1961   | 95                                                             | 74                      | 21                                |
| 1962   | 35                                                             | 29                      | 6                                 |
| 1963   | 55                                                             | 33                      | 22                                |
| Totals | 282                                                            | 219                     | 63                                |

Table II

Trapping Success (Culvert Traps) 1959-1963

| Year | Trap Nights | Successful<br>Trap Nights | Percent<br>Trapping Success |
|------|-------------|---------------------------|-----------------------------|
| 1959 | 21          | 14                        | 66.7                        |
| 1960 | 71          | 51                        | 71.8                        |
| 1961 | 77          | 46                        | 59.7                        |
| 1962 | 75          | 24                        | 32.0                        |
| 1963 | 68          | 28                        | 41.2                        |

A summary of the number of bears captured and marked since the start of the study is presented in Table III. Table III also shows the number of marked bears known to be dead and those considered dead (or unmarked). Thus, out of 165 marked bears, 81 were theoretically in the population during the summer of 1963, of which 67 were observed one or more times.

Table III

Marked Grizzlies and the Number of Marked Bears  
Theoretically in the Population in 1963

| Year   | No.<br>Marked | No.<br>Known<br>Dead | No. Considered<br>Dead or<br>Unmarked* | No. of Marked<br>Bears Theoret-<br>ically in 1963<br>Population | No.<br>Observed<br>in 1963 | No. not<br>Observed<br>in 1963 |
|--------|---------------|----------------------|----------------------------------------|-----------------------------------------------------------------|----------------------------|--------------------------------|
| 1959   | 31            | 11                   | 9                                      | 11                                                              | 9                          | 2                              |
| 1960   | 47            | 14                   | 19                                     | 14                                                              | 12                         | 2                              |
| 1961   | 44            | 9                    | 17                                     | 18                                                              | 12                         | 6                              |
| 1962   | 19            | 4                    |                                        | 15                                                              | 11                         | 4                              |
| 1963   | <u>24</u>     | <u>1</u>             | <u>—</u>                               | <u>23</u>                                                       | <u>23</u>                  | <u>—</u>                       |
| Totals | 165           | 39                   | 45                                     | 81                                                              | 67                         | 14                             |

\*Bears that have not been observed or retrapped for two or more years are considered to have lost their markings or to have died - they are not considered in population figures.

Marking:

At the inception of the study it was recognized that any single marking technique would not prove entirely effective. Accordingly two separate systems were used with the assumption that where one might fail the other would remain intact and vice versa. This assumption has proved correct and to date practically all bears that have been marked and subsequently observed have been individually identifiable by either colored markers, colored ear tags, or a combination of both.

Varying the placement of the colored aluminum ear tags has proved even more useful than was originally anticipated for identifying bears that have lost all other markers. Retention of these metal tags has been excellent - very few properly placed tags have been lost. Some have been worn by the bears for more than 48 months.

Polyvinyl tape, the first material used experimentally as a color marker, has been placed on 67 bears. Retention of this material is recorded in Table IV. Unfortunately, this highly visible tape is not so durable as some other materials.

The use of Herculite, a nylon-impregnated fabric, was discontinued in 1962 after one year of use because this material was not so visible as other materials in use. Durability, however, was reasonably good. Twenty-two bears were marked in one or both ears with 31 Herculite markers in 1961. The 22 bears observed in 1962 still retained 23 Herculite markers, only eight having been lost (Table IV). The following year, however, only one of nine markers remained intact.

Polyethylene braided rope (1/4" size) has proved to be the most durable color-marker material used to date. Since 1960, 59 bears have been marked with this material. Although the observability of this material is not so good as polyvinyl tape, it is sufficiently visible for most field conditions and the relative loss of observability is more than compensated for by its excellent wearing qualities. To improve visibility one to two inch "flags" of polyvinyl tape were attached to the rope marker. This combination has proved to be the best marking method used to date. Polyethylene rope collars were used experimentally on several bears. These were retained over a year until removed. A similar collar using Saf-T-Flag streamers was used on elk and has proved extremely effective.

Adult male bears were not color marked but were marked with metal ear tags and were tattooed.

An evaluation of the durability of the different materials used for marking grizzlies appears in Table IV. This table evaluates only those markers worn by bears observed in the field or those recaptured. The column "Number of Markers" refers only to those markers observed on bears the year after they were marked - it does not include markers on bears that were not observed or recaptured in succeeding years. The possibility exists that some bears lost all their markers and were not identified. It is believed, however, that this possibility is slight.

TABLE IV  
EVALUATION OF DURABILITY OF COLOR-MARKING  
MATERIALS FROM OBSERVATIONS OF COLOR-MARKED BEARS  
1959-1963

| Marking<br>Material      | No. of Bears<br>With Markers | No. of<br>Markers | Markers Intact |          | Markers Broken<br>But Visible |          | Markers Lost |          |
|--------------------------|------------------------------|-------------------|----------------|----------|-------------------------------|----------|--------------|----------|
|                          |                              |                   | Number         | Per Cent | Number                        | Per Cent | Number       | Per Cent |
| <u>POLY-VINYL TAPE</u>   |                              |                   |                |          |                               |          |              |          |
| One Year                 | 67                           | 116               | 40             | 34.5     | 30                            | 25.9     | 46           | 39.7     |
| Two Years                | 35                           | 65                | 19             | 29.2     | 8                             | 12.3     | 38           | 58.5     |
| Three Years              | 17                           | 33                | 0              | 0.0      | 7                             | 21.2     | 26           | 78.8     |
| Four Years               | 4                            | 7                 | 0              | 0.0      | 0                             | 0.0      | 7            | 100.0    |
| <u>POLYETHYLENE ROPE</u> |                              |                   |                |          |                               |          |              |          |
| One Year                 | 27                           | 32                | 32             | 100.0    | 0                             | 0.0      | 0            | 0.0      |
| Two Years                | 7                            | 8                 | 8              | 100.0    | 0                             | 0.0      | 0            | 0.0      |
| Three Years              | 1                            | 2                 | 2              | 100.0    | 0                             | 0.0      | 0            | 0.0      |
| <u>HERCULITE</u>         |                              |                   |                |          |                               |          |              |          |
| One Year                 | 22                           | 31                | 23             | 74.2     | 0                             | 0.0      | 8            | 25.8     |
| Two Years                | 7                            | 9                 | 1              | 11.1     | 0                             | 0.0      | 8            | 88.9     |

Table IV shows that 39.7 percent of the polyvinyl tape markers were lost after one year. This figure increased to 58.5 percent at the end of two years and to 78.8 percent after three years. All polyvinyl markers (100 percent) were lost within four years. This loss of color plastic markers did not present a serious problem in making individual field identifications of bears. The colored ear tags were retained and by using the alternate system of colored metal ear tags, those that had lost color markers were all readily identified.

To date, none of the polyethylene rope markers have been lost; some have been worn for more than three years. Eight, or 25.8 percent, of the 31 Herculite markers were lost after one year, and after two years, only one of nine markers remained intact.

A detailed evaluation of the durability of color-marking materials, by specific years, is presented in the Appendix.

#### Tattoo:

Except for a few individuals, all bears were tattooed in the upper lip or behind the foreleg. This permanent mark has proved very helpful in identifying bears that have been shot by hunters and the hides turned in to taxidermists. Two bears killed by hunters outside the Park, No. 32 in 1961 and No. 69 in 1962, were positively identified by the tattoo alone. Tattoos properly placed four years ago are still easily readable - they are expected to remain identifiable for the life of the bear.

#### Recaptures:

Table V shows the number of individual bears recaptured and the total number of recaptures from 1959 through 1963. The 115 recaptures have yielded valuable data on growth rates, fat deposition, dentition development, and movement on 83 individual grizzlies. Both the number of individuals recaptured and the total number of recaptures reached a peak in 1961. During 1963, 24 grizzlies were recaptured; of these, two were marked in 1959, nine in 1960, two in 1961, five in 1962, and six in 1963.

Table V

Summary of the Number of Bears Recaptured, 1959-1963

| Year                 | No. Individuals Recaptured | Total No. of Recaptures |
|----------------------|----------------------------|-------------------------|
| 1959                 | 3                          | 3                       |
| 1960                 |                            |                         |
| Bears marked in 1959 | 6                          | 7                       |
| Bears marked in 1960 | 7                          | 10                      |
| 1961                 |                            |                         |
| Bears marked in 1959 | 8                          | 10                      |
| Bears marked in 1960 | 12                         | 25                      |
| Bears marked in 1961 | 10                         | 15                      |
| 1962                 |                            |                         |
| Bears marked in 1959 | 1                          | 2                       |
| Bears marked in 1960 | 4                          | 5                       |
| Bears marked in 1961 | 6                          | 6                       |
| Bears marked in 1962 | 2                          | 3                       |
| 1963                 |                            |                         |
| Bears marked in 1959 | 2                          | 3                       |
| Bears marked in 1960 | 9                          | 11                      |
| Bears marked in 1961 | 2                          | 3                       |
| Bears marked in 1962 | 5                          | 5                       |
| Bears marked in 1963 | 6                          | 7                       |
| Total                | 83                         | 115                     |

Immobilizing and Anesthetizing

The techniques of immobilizing and anesthetizing have gradually been improved and perfected. Succinylcholine chloride (brand name - "Sucostrin") may be administered singly for brief immobilization or in combination with pentobarbital sodium for anesthetization. Table VI shows dosages by age groups for immobilization only or immobilization followed by anesthetization. Briefly, the latter procedure consists of estimating the bear's weight, computing a dosage of succinylcholine chloride at about 1 mg. (100 mg. per cc solution) for every six pounds of body weight (Table VI). The succinylcholine chloride is administered intramuscularly and when the effects have begun to "wear off" pentobarbital sodium is administered by intra-pulmonary injection. The dosage of pentobarbital sodium (250 mg. per cc. solution) is also calculated on a basis of body weight and averages about

1 cc for every 16 pounds of body weight (Table VI). Individuals vary considerably in their reaction to these drugs and tolerance may be affected by age, physical condition, stress and other factors.

Data concerning average dosages administered to different age classes and the number of individuals handled in each age class for all five years also appear in Table VI. 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.

Table VII compares the dosages of succinylcholine chloride administered to free-ranging bears and those administered to bears captured in culvert traps. Trapped bears have consistently required lighter doses than free-ranging bears. This is believed to be related to stress.

"Sernylan", a fast-acting tranquilizer, was administered experimentally 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. No. 75, an old female, prematurely recovered from an initial dose of succinylcholine chloride and jeopardized the research team. Of necessity she was injected a second time, became immobilized and died 43 minutes later. The observers believe that this bear's age, combined with an accumulation of drugs beyond the tolerance level, caused her death.

Table VI

\* Average Drug Dosages Administered to Different Age Grizzly Bears 1959 - 1963

| Succinylcholine Chloride Only* |                        |                                         | Succinylcholine Chloride Followed by<br>Pentobarbital Sodium** |                                                            |                                                         |
|--------------------------------|------------------------|-----------------------------------------|----------------------------------------------------------------|------------------------------------------------------------|---------------------------------------------------------|
| Age                            | No.<br>Doses<br>Admin. | Avg. Dosage,<br>Mg. per Lb.<br>Body Wt. | No.<br>Doses<br>Admin.                                         | Avg. Dosage,<br>Succinylcholine<br>Mg. per Lb.<br>Body Wt. | Avg. Dosage,<br>Pentobarbital<br>cc per Lb.<br>Body Wt. |
| Cubs                           | 28                     | 1:4.6                                   | 32                                                             | 1:6.5                                                      | 1:16.3                                                  |
| Yearlings                      | 20                     | 1:4.4                                   | 32                                                             | 1:6.1                                                      | 1:15.8                                                  |
| Two yr. olds                   | 17                     | 1:5.5                                   | 22                                                             | 1:6.5                                                      | 1:16.5                                                  |
| Three yr. olds                 | 9                      | 1:6.1                                   | 12                                                             | 1:6.9                                                      | 1:17.2                                                  |
| Four yr. olds                  | 3                      | 1:4.9                                   | 4                                                              | 1:5.5                                                      | 1:13.9                                                  |
| Young adults                   | 11                     | 1:5.2                                   | 18                                                             | 1:7.1                                                      | 1:17.4                                                  |
| Adults                         | <u>58</u>              | 1:4.9                                   | <u>44</u>                                                      | 1:6.4                                                      | 1:16.6                                                  |
|                                | 146                    |                                         | 164                                                            |                                                            |                                                         |

\*Succinylcholine Chloride: 100 mg. per cc solution

\*\*Pentobarbital Sodium : 250 mg. per cc solution

Table VII

Comparison of Dosages of Succinylcholine Chloride Administered to Free-Ranging Bears and Trapped Bears (All Age Classes), 1961-1963

|                                   | Free-Ranging<br>Bears | Trapped<br>Bears |
|-----------------------------------|-----------------------|------------------|
| 1961                              |                       |                  |
| No. doses administered            | 25                    | 85               |
| Avg. Dosage, mg. per lb. body wt. | 1:4.0                 | 1:6.4            |
| 1962                              |                       |                  |
| No. doses administered            | 6                     | 30               |
| Avg. dosage, mg. per lb. body wt. | 1:6.1                 | 1:7.0            |
| 1963                              |                       |                  |
| No. doses administered            | 28                    | 34               |
| Avg. dosage, mg. per lb. body wt. | 1:4.9                 | 1:7.5            |
| Totals:                           |                       |                  |
| No. doses administered            | 59                    | 149              |
| Avg. dosage, mg. per lb. body wt. | 1:5.0                 | 1:7.0            |

### Concentration and Dispersal

Grizzlies in Yellowstone move long distances to major summer ranges or summering areas. This movement begins in 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 areas 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 experienced an unusually mild autumn season in 1963. 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 in the fall of 1963. 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 food sources 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. Censuses for all five years are presented in Table VIII. In 1963 a total of 177 different individuals was recorded - a slight increase over the 1959 through 1962 average of 161. 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 percent as compared with 50 percent 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 VIII  
CENSUS OF GRIZZLY BEARS  
1959-1963

| Site              | 1959          |              | 1960          |              | 1961          |              | 1962          |              | 1963          |              |
|-------------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|---------------|--------------|
|                   | No.<br>Counts | No.<br>Bears | No.<br>Counts | No.<br>Bears | No.<br>Counts | No.<br>Bears | No.<br>Counts | No.<br>Bears | No.<br>Counts | No.<br>Bears |
| Trout Creek       | 17            | 96           | 24            | 98           | 31            | 98           | 31            | 98           | 26            | 116          |
| Rabbit Creek      | 2             | 22           | 6             | 40           | 7             | 31           | 5             | 29           | 3             | 31           |
| W. Yellowstone    | 2             | 27           | 3             | 16           | 4             | 19           | 2             | 7            | 3             | 13           |
| Gardiner          | 2             | 9            | 2             | 9            | 2             | 10           | 2             | 11           | 1             | 10           |
| Thumb Area        | -             | -            | 2             | 4            | 1             | 4            | 1             | 8            | 1             | 5            |
| Pelican Cr. Area* | -             | -            | -             | 2            | -             | 4            | -             | 2            | -             | 2            |
| Totals:           | 23            | 154          | 37            | 169          | 45            | 166          | 41            | 155          | 34            | 177          |

\*No counts made; bears trapped.

Age structure of the population throughout Yellowstone National Park for the years 1959-1963, is presented in Table IX. The age classification at the different concentration sites for the past three years is presented in Table X.

Age and sex of all bears marked since 1959 are presented in Table XI. These data show a sex ratio of 1:1 and an age classification quite similar to that obtained from the classified counts of all bears (Table IX). This would indicate that the average age structure of the population has been accurately determined. These data will be subjected to statistical analysis when the study has terminated. A comparison of the age composition of marked bears to that of the average total population is made in Table XII.

Table XIII shows the number of bears in each age class and the percent of the total population comprised by each age class during 1963. This is based on a total population of 177, the number of bears actually observed. Theoretically, 81 or 45.9 percent of the 1963 population were marked; of these, 67 or 82.7 percent of marked bears theoretically in the population were actually observed.

#### Productivity

The number of females with cub or yearling litters recorded throughout Yellowstone for the past five years are presented in Table XIV.

During 1963, sixteen females 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 females to 170 cubs for an average litter size of 2.21. Of 17 females with cubs in 1962, only seven of these females were observed with their yearlings in 1963. During the five years of study only 29 females 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 and recorded, but only 95 yearlings (Table XV). Table XV includes weaned yearlings. We have evidence that mortality and dispersal account for a large number of young bears in their second year of life, particularly those weaned as yearlings.

TABLE IX

AGE STRUCTURE OF THE POPULATION THROUGHOUT  
YELLOWSTONE NATIONAL PARK, 1959-1963

| Age          | No. of<br>Indiv.<br>1959 | Percent<br>of<br>Total | No. of<br>Indiv.<br>1960 | Percent<br>of<br>Total | No. of<br>Indiv.<br>1961 | Percent<br>of<br>Total | No. of<br>Indiv.<br>1962 | Percent<br>of<br>Total | No. of<br>Indiv.<br>1963 | Percent<br>of<br>Total | Average<br>Percent<br>for<br>5-year<br>period* |
|--------------|--------------------------|------------------------|--------------------------|------------------------|--------------------------|------------------------|--------------------------|------------------------|--------------------------|------------------------|------------------------------------------------|
| Cubs         | 26                       | 16.9                   | 35                       | 20.8                   | 30                       | 18.1                   | 39                       | 25.2                   | 40                       | 22.1                   | 20.1                                           |
| Yearlings    | 23                       | 14.9                   | 15                       | 8.9                    | 17                       | 10.2                   | 13                       | 8.4                    | 29                       | 16.5                   | 11.3                                           |
| Two Years    | 17                       | 11.0                   | 5                        | 2.9                    | 17                       | 10.2                   | 9                        | 5.8                    | 11                       | 6.3                    | 7.1                                            |
| Young Adults | --                       | ----                   | 12                       | 7.2                    | 23                       | 13.9                   | 35                       | 22.6                   | 25                       | 14.2                   | 14.2                                           |
| Adults       | 88                       | 57.2                   | 102                      | 60.3                   | 79                       | 47.6                   | 59                       | 38.0                   | 72                       | 40.9                   | 47.3                                           |
|              | 154                      | 100.0                  | 169                      | 100.0                  | 166                      | 100.0                  | 155                      | 100.0                  | 177                      | 100.0                  | 100.0                                          |

\*Computed from average total population of 169 (see Table XII).

TABLE X  
RESULTS OF CLASSIFICATION COUNTS  
BY AREAS  
1961-1963

| Site              | Cubs |     |     | 1 year |     |     | 2 years |     |     | 3, 4, 5 years |     |     | Adults |     |     | Total |     |     |
|-------------------|------|-----|-----|--------|-----|-----|---------|-----|-----|---------------|-----|-----|--------|-----|-----|-------|-----|-----|
|                   | '61  | '62 | '63 | '61    | '62 | '63 | '61     | '62 | '63 | '61           | '62 | '63 | '61    | '62 | '63 | '61   | '62 | '63 |
| Trout Creek       | 18   | 25  | 27  | 9      | 12  | 21  | 11      | 3   | 8   | 14            | 19  | 14  | 46     | 39  | 46  | 98    | 98  | 116 |
| Rabbit Creek      | 6    | 8   | 8   | --     | 1   | 2   | 3       | --  | 3   | 4             | 7   | 6   | 18     | 13  | 12  | 31    | 29  | 31  |
| West Yellow-stone | 6    | --  | 5   | --     | --  | --  | 3       | --  | --  | --            | 4   | --  | 10     | 3   | 8   | 19    | 7   | 13  |
| Gardiner          | --   | 3   | --  | 4      | --  | 3   | --      | 3   | --  | 4             | 2   | 5   | 2      | 3   | 2   | 10    | 11  | 10  |
| Thumb Area        | --   | 3   | --  | 2      | --  | 3   | --      | 2   | --  | --            | 2   | --  | 2      | 1   | 2   | 4     | 8   | 5   |
| Pelican Cr. Area  | --   | --  | --  | 2      | --  | --  | --      | 1   | --  | 1             | 1   | --  | 1      | --  | 2   | 4     | 2   | 2   |
|                   | 30   | 39  | 40  | 17     | 13  | 29  | 17      | 9   | 11  | 23            | 35  | 25  | 79     | 59  | 72  | 166   | 155 | 177 |

TABLE XI  
AGE AND SEX DESIGNATION OF MARKED BEARS  
1959-1963

| Age           | 1959         |    |    |   | 1960     |    |    | 1961     |    |    | 1962     |    |   | 1963     |    |    | 4-        | 5-        | Percent of Total |         |
|---------------|--------------|----|----|---|----------|----|----|----------|----|----|----------|----|---|----------|----|----|-----------|-----------|------------------|---------|
|               | Tot. M F U** |    |    |   | Tot. M F |    |    | Tot. M F |    |    | Tot. M F |    |   | Tot. M F |    |    | Yr. Tots. | Yr. Tots. | 4th Yr.          | 5th Yr. |
|               |              |    |    |   |          |    |    |          |    |    |          |    |   |          |    |    | 1962      | 1963      | 1962             | 1963    |
| Cubs          | 5            | 2  | 2  | 1 | 6        | 4  | 2  | 13       | 6  | 7  | 9        | 7  | 2 | 7        | 6  | 1  | 33        | 40        | 23.4             | 24.2    |
| Yearlings     | 3            | 0  | 3  | 0 | 5        | 4  | 1  | 5        | 3  | 2  | 1        | 1  | 0 | 9        | 2  | 7  | 14        | 23        | 9.9              | 13.9    |
| 2 years       | 4            | 1  | 3  | 0 | 4        | 2  | 2  | 7        | 3  | 4  | 1        | 1  | 0 | 0        | 0  | 0  | 16        | 16        | 11.3             | 9.8     |
| 3 or 4 years* | 0            | 0  | 0  | 0 | 9        | 4  | 5  | 8        | 2  | 6  | 1        | 1  | 0 | 2        | 2  | 0  | 18        | 20        | 12.8             | 12.1    |
| Adults        | 18           | 11 | 7  | 0 | 23       | 10 | 13 | 12       | 6  | 6  | 7        | 1  | 6 | 6        | 2  | 4  | 60        | 66        | 42.6             | 40.0    |
|               | 30           | 14 | 15 | 1 | 47       | 24 | 23 | 45       | 20 | 25 | 19       | 11 | 8 | 24       | 12 | 12 | 141       | 165       | 100.0            | 100.0   |

\*Not classified in 1959.

\*\*Sex of one individual not determined

Totals, 1963: 165 individuals

81 males

83 females

1 undetermined

Table XII  
COMPARISON OF THE AGE SAMPLE OF ALL MARKED BEARS  
AT AGE OF INITIAL MARKING  
TO THE AVERAGE AGE STRUCTURE OF THE POPULATION  
1959 - 1963

| Age          | <u>Age Sample of<br/>Marked Bears Only</u> |                                     | <u>Average Age Status of<br/>Total Population</u> |                                   |
|--------------|--------------------------------------------|-------------------------------------|---------------------------------------------------|-----------------------------------|
|              | No.<br>Bears                               | Percent<br>of Total<br>Marked Bears | No. of<br>Bears in<br>Population*                 | Percent<br>of Total<br>Population |
| Cubs         | 40                                         | 24.2                                | 34                                                | 20.1                              |
| Yearlings    | 23                                         | 13.9                                | 19                                                | 11.3                              |
| Two years    | 16                                         | 9.8                                 | 12                                                | 7.1                               |
| Young adults | 20                                         | 12.1                                | 24                                                | 14.2                              |
| Adults       | <u>66</u>                                  | <u>40.0</u>                         | <u>80</u>                                         | <u>47.3</u>                       |
| Totals       | 165                                        | 100.0                               | 169                                               | 100.0                             |

\*Figures in this column represent average numbers for each age class obtained over a five-year period (1959-1963).

TABLE XIII

RELATION OF THE NUMBER OF MARKED BEARS IN THE POPULATION\*  
TO THE TOTAL NUMBER OF BEARS IN THE POPULATION  
1963

| Age Class           | Number of Bears in Population In 1963 (census) | Number of Marked Bears Theoretically in Population In 1963 | Number of Marked Bears Actually Observed In 1963 | Per Cent of Total Population By Age Class | Per Cent of Total Population of Marked Bears By Age Class | Per Cent of Total Marked Bears Actually Observed in Each Age Class | Per Cent of Each Age Class Actually Observed By Means of Marked Bears |
|---------------------|------------------------------------------------|------------------------------------------------------------|--------------------------------------------------|-------------------------------------------|-----------------------------------------------------------|--------------------------------------------------------------------|-----------------------------------------------------------------------|
| Cubs                | 40                                             | 7                                                          | 7                                                | 22.6                                      | 4.0                                                       | 100.0                                                              | 17.5                                                                  |
| One Year            | 29                                             | 17                                                         | 15                                               | 16.4                                      | 9.6                                                       | 88.2                                                               | 51.7                                                                  |
| Two Years           | 11                                             | 7                                                          | 5                                                | 6.2                                       | 4.0                                                       | 71.4                                                               | 45.5                                                                  |
| Three Years         | 6                                              | 4                                                          | 3                                                | 3.4                                       | 2.3                                                       | 75.0                                                               | 50.0                                                                  |
| Four and Five Years | 19                                             | 9                                                          | 7                                                | 10.7                                      | 5.1                                                       | 77.8                                                               | 36.8                                                                  |
| Adults              | 72                                             | 37                                                         | 30                                               | 40.7                                      | 20.9                                                      | 81.1                                                               | 71.7                                                                  |
|                     | —                                              | —                                                          | —                                                | —                                         | —                                                         |                                                                    |                                                                       |
|                     | 177                                            | 81                                                         | 67                                               | 100.0                                     | 45.9                                                      |                                                                    |                                                                       |

\*Bears marked from 1959 through 1963.

Table XIV

FEMALES WITH CUB OR YEARLING LITTERS,  
YELLOWSTONE NATIONAL PARK, 1959-1963

|                        | Litter Size |     |       |      | No. Females<br>with<br>Litters | No. Cubs<br>and/or<br>Yearlings<br>with Females | Average<br>Litter<br>Size |
|------------------------|-------------|-----|-------|------|--------------------------------|-------------------------------------------------|---------------------------|
|                        | One         | Two | Three | Four |                                |                                                 |                           |
| 1959                   |             |     |       |      |                                |                                                 |                           |
| Females with cubs      | 4           | 8   | 2     | -    | 14                             | 26                                              | 1.86                      |
| Females with Yearlings | 2           | 3   | 1     | 1    | 7                              | 15                                              | 2.14                      |
| 1960                   |             |     |       |      |                                |                                                 |                           |
| Females with Cubs      | 4           | 8   | 5     | -    | 17                             | 35                                              | 2.06                      |
| Females with Yearlings | 1           | 3   | 2     | -    | 5                              | 10                                              | 2.00                      |
| 1961                   |             |     |       |      |                                |                                                 |                           |
| Females with Cubs      | 2           | 5   | 6     | -    | 13                             | 30                                              | 2.30                      |
| Females with Yearlings | 1           | 3   | 1     | -    | 5                              | 10                                              | 2.00                      |
| 1962                   |             |     |       |      |                                |                                                 |                           |
| Females with Cubs      | 3           | 7   | 6     | 1    | 17                             | 39                                              | 2.30                      |
| Females with Yearlings | -           | 2   | 3     | -    | 5                              | 13                                              | 2.60                      |
| 1963                   |             |     |       |      |                                |                                                 |                           |
| Females with Cubs      | -           | 8   | 8     | -    | 16                             | 40                                              | 2.50                      |
| Females with Yearlings | -           | 3   | 4     | -    | 7                              | 18                                              | 2.57                      |
| Totals:                |             |     |       |      |                                |                                                 |                           |
| Females with Cubs      |             |     |       |      |                                | 77                                              |                           |
| Number of Cubs         |             |     |       |      |                                | 170                                             |                           |
| Avg. Litter Size       |             |     |       |      |                                | 2.21                                            |                           |
| Females with Yearlings |             |     |       |      |                                | 29                                              |                           |
| Number of Yearlings    |             |     |       |      |                                | 66                                              |                           |
| Avg. Litter Size       |             |     |       |      |                                | 2.28                                            |                           |

Note: Weaned yearlings are not included in this table.

Table XV

CUB AND YEARLING COUNTS, 1959 - 1963

|                                      | 1959 | 1960 | 1961 | 1962 | 1963 | Total |
|--------------------------------------|------|------|------|------|------|-------|
| Cubs                                 | 26   | 35   | 30   | 39   | 40   | 170   |
| Yearlings                            | 23   | 13   | 17   | 13   | 29   | 95    |
| Total bears 6 mo. to 1½<br>years old | 49   | 48   | 47   | 52   | 69   |       |

The number of females with cub or yearling litters expressed as a percent of the total adult female population appears in Table XVI. The number of adult females is considered to be one-half the total adult population - this is based on a 1:1 sex ratio (Table XI). The percent of adult females with cubs of the year has varied only from 25.5 to 36.2 with an average of about 33 percent, or one-third of the total adult female population. The percentage of adult females with yearling litters has also been quite consistent during the five years, varying from 9.8 to 15.9 and averaging 13 percent of total females.

Table XVI

Number of Females with Cubs or Yearlings Expressed as Percent of Total Adult Female Population 1959-1963

|      | Computed Adult<br>Female Pop.* | Number<br>Females<br>With Cubs | Percent of Adult<br>Female Pop.<br>with Cubs | No. Females<br>With Yearlings | Percent of Adult<br>Female Pop.<br>with Yearlings |
|------|--------------------------------|--------------------------------|----------------------------------------------|-------------------------------|---------------------------------------------------|
| 1959 | 44                             | 14                             | 31.8                                         | 7                             | 15.9                                              |
| 1960 | 57                             | 17                             | 29.9                                         | 6                             | 10.5                                              |
| 1961 | 51                             | 13                             | 25.5                                         | 5                             | 9.8                                               |
| 1962 | 47                             | 17                             | 36.2                                         | 5                             | 10.6                                              |
| 1963 | 49                             | 16                             | 32.7                                         | 7                             | 14.3                                              |

\*Based on sex ratio of 1:1 (See Table XI).

Complete histories have been kept on a number of marked families - age when offspring are weaned, breeding interval of individual females, interval between litters for individual females, age when offspring reach maturity and breed, etc. These studies are contributing materially to an understanding of the population dynamics. While there are sufficient data to establish productivity levels for the Yellowstone population, we believe these data can be much better interpreted when more information is acquired on the marked families and geneology can be traced through several additional years.

### 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 (Table XVII). During the five years of the study, 81 mortalities have been recorded. Hunters have killed 34, or 42 percent, and the National Park Service has accounted for 23, or 28.4 percent, 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.

Tables XVIII and XIX show the observed survival and mortality of 130 grizzly cubs through one and one-half years of life. Of the original 130 cubs:

1. Seventy-one, or 54.6 percent, lived through one and one-half years;  
51 were observed with their mothers during their second year; four of 12 orphans survived through their second year;
2. Fourteen, or 10.8 percent, were known to have died; six were killed as cubs, eight as yearlings;
3. Forty-five, or 34.6 percent, were not observed or accounted for after their first year of life.

Final conclusions concerning mortality of the younger age classes, as well as overall mortality within the population, are reserved until more data are available and until all factors can be more completely evaluated. From the foregoing data, however, it does appear that many young bears do not live two years, and that this may be the most important single factor in keeping population numbers stable.

TABLE XVII  
GRIZZLY BEAR MORTALITY, 1959-1963

| Year           | Hunters<br>Outside<br>Yellowstone |               | NPS, as<br>Control<br>Measure |               | Drug Overdose |               | Sacrificed<br>for Study |               | Misc. Causes<br>Inc. Bears<br>Shipped to Zoos |               | Total | Per Cent<br>of Total<br>Population<br>Respective<br>Year |
|----------------|-----------------------------------|---------------|-------------------------------|---------------|---------------|---------------|-------------------------|---------------|-----------------------------------------------|---------------|-------|----------------------------------------------------------|
|                | Marked                            | Un-<br>marked | Marked                        | Un-<br>marked | Marked        | Un-<br>marked | Marked                  | Un-<br>marked | Marked                                        | Un-<br>marked |       |                                                          |
| 1959           | 1                                 | 3             | 2                             | 2             | 3             | -             | -                       | -             | -                                             | 1             | 12    | 7.8                                                      |
| 1960           | 1                                 | 10            | 1                             | 2             | 3             | 1             | -                       | -             | 1                                             | -             | 19    | 11.2                                                     |
| 1961           | 5                                 | 3             | -                             | 1             | 2             | -             | 3                       | -             | 2                                             | 4             | 20    | 12.0                                                     |
| 1962           | 2                                 | 3             | 1                             | 4             | 1             | -             | -                       | -             | 3                                             | 1             | 15    | 9.7                                                      |
| 1963           | 2                                 | 4             | 2                             | -             | 1             | -             | -                       | -             | 2                                             | 4             | 15    | 8.5                                                      |
|                | —                                 | —             | —                             | —             | —             | —             | —                       | —             | —                                             | —             | —     |                                                          |
| Total          | 11                                | 23            | 6                             | 9             | 10            | 1             | 3                       | -             | 8                                             | 10            | 81    |                                                          |
| Grand<br>Total | 34                                |               | 15                            |               | 11            |               | 3                       |               | 18                                            |               | 81    |                                                          |

TABLE XVIII

## OBSERVED SURVIVAL AND MORTALITY OF 130 GRIZZLY CUBS THROUGH ONE AND ONE-HALF YEARS OF LIFE

| Year  | No. of<br>Females<br>With<br>Cubs | No.<br>of<br>Cubs | No. of<br>Cubs<br>Killed | No. of<br>Cubs<br>Orphaned | No. of<br>Cubs<br>Theo-<br>reti-<br>cally<br>in Pop.<br>as Yrls.<br>Follow-<br>ing Yr. | No. of<br>Yrls.<br>With<br>Females<br>Follow-<br>ing Yr. | No. of<br>Orphans<br>Known<br>to<br>Survive | No. of<br>Yrls.<br>Known<br>Weaned | No. of<br>Yrls.<br>Known<br>Killed | No. of<br>Yrls. Not<br>Observed<br>or<br>Account-<br>ed For | Per Cent<br>Yrls. Not<br>Observed<br>or<br>Account-<br>ed For |
|-------|-----------------------------------|-------------------|--------------------------|----------------------------|----------------------------------------------------------------------------------------|----------------------------------------------------------|---------------------------------------------|------------------------------------|------------------------------------|-------------------------------------------------------------|---------------------------------------------------------------|
| 1959  | 14                                | 26                | 1                        | 2                          | 25                                                                                     | 10                                                       | 1                                           | 2                                  | 2                                  | 10                                                          | 40.0                                                          |
| 1960  | 17                                | 35                | 2                        | 7                          | 33                                                                                     | 10                                                       | 3                                           | 4                                  | 3                                  | 13                                                          | 39.4                                                          |
| 1961  | 13                                | 30                | 2                        | 3                          | 28                                                                                     | 13                                                       | 1 <sup>1</sup>                              | 3 <sup>2</sup>                     | 3 <sup>2</sup>                     | 12                                                          | 42.9                                                          |
| 1962  | 17                                | 39                | 1                        | -                          | 38                                                                                     | 18                                                       | -                                           | 11 <sup>3</sup>                    | -                                  | 10                                                          | 26.3                                                          |
| Total | 61                                | 130               | 6                        | 12                         | 124                                                                                    | 51                                                       | 5                                           | 20                                 | 8                                  | 45                                                          |                                                               |

<sup>1</sup>Recaptured early following spring, not observed later in season; included under "not observed or accounted for."

<sup>2</sup>Three yearlings known weaned, later were killed (two unmarked littermates at Old Faithful killed by NPS and No. 92 shot by hunter).

<sup>3</sup>One weaned yearling adopted by female with yearlings; included under "No. of Yrls. with Females Following Year."

Table XIX

Fate of 130 Grizzly Cubs

|                                                                     |      |
|---------------------------------------------------------------------|------|
| Total No. of Cubs . . . . .                                         | 130  |
| Number known living through one and one-half years. . . . .         | 71   |
| Percent of total. . . . .                                           | 54.6 |
| Number known to have died . . . . .                                 | 14   |
| Percent of total. . . . .                                           | 10.8 |
| No. not observed or accounted for after first year of life. . . . . | 45   |
| Percent of total. . . . .                                           | 34.6 |

Breeding Age and Behavior

Breeding Age

It was anticipated that in the summer of 1963 considerable data would be obtained on breeding age of known-age animals. 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.

We have considerable evidence that some females copulate but fail to become pregnant. In 1961, both No. 15, a three-year-old, and No. 39, a rather old

female, were observed copulating but neither had cubs the following spring (1962). (Both, however, had cubs in 1963.) In 1962, No. 6, a three-year-old, and No. 81, an established-age five-year-old, mated but did not produce young. The same year, No. 29 and No. 86, three-year-olds, were not actually observed in copulation but both displayed characteristic breeding behavior. No. 86 was killed in the fall of 1962; No. 29 had no cubs in 1963. With the exception of No. 39, a rather old animal, all were young sows and probably breeding for the first time. It is possible that estrus is of short duration in these young females and they fail to become fertilized. This may also explain the seemingly prolonged estrus period in the more mature sows, their acceptance of several different males, and the frequency of copulation - these may all be necessary for the female to become impregnated.

#### 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. We have obtained sight records on 27 different individuals in at least two widely separated areas both within and outside the borders of Yellowstone. Induced movements have been recorded from 20 different bears trapped in one area and released in another. Many of these bears exhibited strong homing tendencies, returning to the area where originally trapped.

Additional data are showing the movement of particular segments of the population, such as the movement habits of certain age classes. Also the differences in movement of the sexes is proving to be quite pronounced. For example, the average adult male travels much farther than does the adult female. The Yellowstone population appears to consist 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 the younger age classes. Females in the one- to four-year-age bracket, however, do not ordinarily travel great distances.

#### Aging Techniques

Eighty-four known-age and established-age bears have been individually marked in the past five 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 57 months. A total of 110 dental casts and 53 foot casts have been made since 1960. Several bears have been captured in successive years and casts made of their dentition and fore feet. Two bears, No. 6 and No. 37, have 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. The data on growth changes are being prepared for statistical analysis.

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.

*Aging  
Foot & teeth*

## 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 the 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. percent compared to normal human values of from 150 to 250 mgm. percent. Protein bound iodine determinations also consistently indicated low values for bears with the range of 1.3 to 3.2 mcgm. percent compared to normal human values of 3.5 to 7.5 mcgm. percent. 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. The blood was 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 radiotracking equipment. Plans call for immobilizing this bear in the winter and collecting a blood specimen.

Table XX shows the number of specimens obtained over a five-year period and the age class breakdown. One hundred four specimens have been obtained from 98 different individuals.

Table XXI presents the analysis of the blood chemistry of eleven grizzlies and one black bear.

Physiology  
& Hematology  
Cholesterol

TABLE XX  
BLOOD SPECIMENS, 1959-1963

| Age Class   | No. Different<br>Bears From Which<br>Specimens Obtained | Total No.<br>Specimens<br>Obtained | Number Specimens Obtained, by Month |      |        |           |         |
|-------------|---------------------------------------------------------|------------------------------------|-------------------------------------|------|--------|-----------|---------|
|             |                                                         |                                    | June                                | July | August | September | October |
| Cubs        | 16                                                      | 17                                 | 0                                   | 6    | 10     | 1         | 0       |
| Yearlings   | 22                                                      | 23                                 | 6                                   | 5    | 11     | 0         | 1       |
| Two Years   | 9                                                       | 9                                  | 0                                   | 4    | 5      | 0         | 0       |
| Three Years | 7                                                       | 8                                  | 1                                   | 4    | 2      | 0         | 1       |
| Four Years  | 14                                                      | 15                                 | 0                                   | 4    | 11     | 0         | 0       |
| Five Years  | 3                                                       | 3                                  | 0                                   | 2    | 1      | 0         | 0       |
| Adults      | 27                                                      | 29                                 | 0                                   | 13   | 8      | 6         | 2       |
|             | —                                                       | —                                  | —                                   | —    | —      | —         | —       |
| Totals      | 98                                                      | 104                                | 7                                   | 38   | 48     | 7         | 4       |

TABLE XXI  
BLOOD CHEMISTRY

| Bear No.               | Sex | Age, Years | Weight     | Date<br>Specimen<br>Obtained | PBI                     | Cholesterol         | Uric Acid  |
|------------------------|-----|------------|------------|------------------------------|-------------------------|---------------------|------------|
| 127                    | M   | 3          | 275        | 8-2-62                       | 3.2                     | 410                 | 1.6        |
| 92                     | M   | 1          | 140        | 8-4-62                       | 1.7                     | 358                 | 1.2        |
| 121                    | F   | 1          | 140        | 10-17-61                     | 2.8                     | 325                 | 0.6        |
|                        |     | 2          | 130        | 8-6-62                       | 2.5                     | 425                 | 1.4        |
| 51                     | M   | 3          | 275        | 8-7-62                       | 3.2                     | 383                 | 1.3        |
| <i>radio bear</i> (37) | M   | 3          | 315        | 9-12-61                      | 1.7                     | 351                 | 1.0        |
|                        |     | 4          | 440        | 10-4-62                      | 1.3                     | --                  | --         |
| 135                    | M   | 1/2        | 65         | 8-8-62                       | 3.1                     | 413                 | 1.9        |
| 136                    | M   | 1/2        | 65         | 8-8-62                       | --                      | --                  | --         |
| 133                    | M   | 1/2        | 70         | 7-27-62                      | 3.1                     | 400                 | 1.7        |
| 131                    | F   | 5 (est.)   | 320        | 7-27-62                      | 2.1                     | 358                 | 1.2        |
| 132                    | F   | 1/2        | 60         | 7-27-62                      | 3.2                     | 368                 | 1.9        |
| 140                    | F   | ? adult    | 375        | 9-21-62                      | 1.5                     | 373                 | 1.3        |
| Black Bear             | F   | ? adult    | 200 (est.) | 1-31-63                      | 0.7                     | 463                 | --         |
| Human Limits, normal   |     |            |            |                              | 3.5 - 7.5<br>microgms % | 150 - 250<br>mgms % | 2.6 mgms % |
| Human Mean             |     |            |            |                              | 5                       | 180 - 200           | 4.5 - 5    |

### Chemical Analysis of Milk

Over the past five years a number of milk samples have been taken from lactating grizzlies and sent to research scientists throughout the country. Milk samples were obtained by immobilizing lactating sows with succinylcholine chloride and in some cases this was followed with an intra-pulmonary injection of pentobarbital sodium. Oxytocin was administered intramuscularly and the milk sample collected in glass vials. The samples were then refrigerated and shipped airmail to the various destinations.

Three samples of grizzly bear milk and three samples of black bear milk were sent to Dr. Robert Jenness, Department of Agricultural Biochemistry, University of Minnesota, for analysis.

Gross analysis of the samples appears in Table XXI and the vitamin content of the milks as determined by Dr. Margaret E. Gregory appear in Table XXII.

The composition of the bear milks are somewhat variable, although certain general characteristics are apparent. It appears probable that some of the variation is due to the state of lactation, age of the young, and perhaps general physical condition of the animal.

Both black and grizzly bear milk have high contents of fat and total solids and have the very peculiar feature that most of the carbohydrates consist of oligosaccharides of low reducing power. They contain amounts of B vitamins roughly comparable to cow milk and generous quantities of fat-soluble vitamins A and E.

From the analyses made to date, it would appear bear milks are distinctive in that they have a very low lactose content; the principal carbohydrate is most probably a trisaccharide, and a number of oligosaccharides are present.

A new comparison of the milk proteins by the technique of electrophoresis in acrylamide gel has been initiated and Dr. Jenness will provide data on this when the experiments are completed.

TABLE XXII

## SUMMARY OF GROSS ANALYSES OF BEAR MILK SAMPLES

|                                 | Grizzly Bear     |                  |            | Black Bear       |                           |                     | Polar Bear<br>(Baker, et al.) |
|---------------------------------|------------------|------------------|------------|------------------|---------------------------|---------------------|-------------------------------|
|                                 | I                | II               | III        | I                | II                        | III                 |                               |
| Date Collected                  | Sept. '60        | 8/15/61          | 8/29/61    | 8/1/61           | 8/4/61                    | 8/13/61             |                               |
| Vol. (ml)                       | 44               | 32               | 19         | 12               | 19                        | 32                  |                               |
| pH                              | 6.2              | 5.9              | 6.4        | 6.6              | 6.6                       | 6.4                 |                               |
| Condition                       | thick<br>viscous | Cheesy<br>rancid | not rancid | cheesy<br>rancid | cheesy<br>rancid<br>dirty | not rancid<br>lumpy |                               |
| Constituents (%)                |                  |                  |            |                  |                           |                     |                               |
| Total Solids                    | 38.6             | 44.4             | about 45.  | 45.0             | 50.5                      | about 45.           | 44.1                          |
| Fat                             | 19.8             | 25.8             | - - - - -  | 23.4             | 26.5                      | 23.3                | 31.1                          |
| Casein                          | 8.0              | 4.7              | - - - - -  | 8.3              | 7.6                       | 5.2                 | ) 10.2                        |
| Whey Protein                    | 5.4              | 3.9              | - - - - -  | 5.9              | 5.9                       | 5.7                 |                               |
| Ash                             | 1.3              | 1.0              | - - - - -  | 2.1              | 2.0                       | 1.4                 | 1.2                           |
| Crude Carbohydrate <sup>1</sup> | 4.1              | 9.0              | - - - - -  | 5.3              | 8.5                       | about 9.4           | 1.6                           |
| Apparent Lactose <sup>2</sup>   | 0.7              | - - -            | - - - - -  | - - -            | - - -                     | - - -               | 0.5                           |
| Non-Protein N                   | .05              | .14              | - - - - -  | .13              | .13                       | .20                 |                               |
| Calcium                         | - - -            | .18              | - - - - -  | .51              | .42                       | .20                 |                               |
| Phosphorus                      | - - -            | .13              | - - - - -  | .36              | .33                       | .14                 |                               |

<sup>1</sup> Crude Carbohydrate = Total solids - (fat + casein + whey protein + ash).

<sup>2</sup> Apparent lactose = Lactose equivalent of reducing power (picric acid method).

Analysis of the bear milks made by Dr. Robert Jenness, University of Minnesota.

TABLE XXIII

VITAMIN CONTENT OF BEAR MILKS

|                         |          | Vitamins as Milligrams per Liter                                    |                                                                      |
|-------------------------|----------|---------------------------------------------------------------------|----------------------------------------------------------------------|
|                         |          | Grizzly Bear<br>Composite of<br>Equal Parts<br>Specimens II and III | Black Bear<br>Composite of<br>Equal Parts<br>Specimens I, II and III |
|                         | Cow Milk |                                                                     |                                                                      |
| Biotin                  | .015     | .0054                                                               | .0094                                                                |
| Nicotinic acid          | 1.0      | 5.0                                                                 | 5.4                                                                  |
| Ca. Pantotherate        | 3.5      | about 0.22                                                          | about 0.27                                                           |
| Riboflavin              | 1.5      | 1.3                                                                 | 1.8                                                                  |
| Thiamine                | 0.45     | 0.63                                                                | 0.58                                                                 |
| Vitamin B <sub>6</sub>  | 0.35     | 0.09                                                                | 0.11                                                                 |
| Vitamin B <sub>12</sub> | 0.003    | 0.010                                                               | 0.009                                                                |
| Vitamin A               | 0.3      | 0.73                                                                | 1.0                                                                  |
| Vitamin E               | 1.0      | 3.9                                                                 | 3.4                                                                  |

Analysis of the bear milks made by Dr. Margaret E. Gregory,  
National Institute for Research in Dairying, Reading, England.