



Human wildlife interactions in the Gallatin Range, Yellowstone National Park, 1973-1974
by James Michael Chester

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Fish and Wildlife Management

Montana State University

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Abstract:

The relationships between the intensity and kinds of human use and the distribution, movements, and behavior of seven species of wildlife in the backcountry areas of the Gallatin Range in Yellowstone National Park were investigated in 1973 and 1974. During this period, human use peaked in July and August and was concentrated in a few locations creating the potential for environmental damage and habituation of bears to given areas. Backcountry parties engaged in activities which could increase detrimental encounters with wildlife. Elk were the most frequently observed species while bighorn sheep and bears were the least. High frequencies of human-wildlife interactions occurred in the off-trail portions of the Fawn Pass East, Sportsman Lake East, and Sportsman Lake West areas. Combined on and off-trail observations of wildlife occurred with the greatest frequencies in the May-June and Sep-tember-October periods. Off-trail travelers observed wildlife more frequently than on-trail travelers. Frequencies of observations for on-trail travelers peaked in early summer and early fall. Much of the variation in the area and period of observability and on versus off-trail observability appeared to be the result of the average elevation at which a given species was found and as a result of seasonal changes therein. The on to off-trail observation frequency ratio tended to be highest in those species occupying lower elevations, (moose, coyotes, mule deer), and lowest in those occupying higher elevations, (bighorn sheep, grizzly bear, elk, black bear). Only elk and grizzly bear exhibited upward elevational movement in the early summer followed by downward movement in the fall. The downward movement was usually reflected in more frequent total and on-trail observations in the May-June and September-October periods. Except for minor shifts in elk distribution around campsites, variation in the intensity of human use did not appear to be responsible for shifts in wildlife distribution. Wildlife encounters most commonly occurred at distances between 100 and 300 feet, (30.5 m.-91.5 m.). Encounter distances were shortest for mule deer and moose and greatest for bears. Except for deer and coyotes, which were usually alert or running, all species were most commonly feeding when first observed. In response to knowledge of the human presence, the moose was most likely to stand its' ground, while bears were the least likely. Wildlife belligerency toward humans was rare. When it occurred, bear or moose were usually involved. Groups of four or more persons experienced lower observation frequencies than smaller groups. Parties of two or less were the most prone to encounter grizzly bears. The use of noise did not appear to affect the frequency of wildlife observations or encounters.

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YELLOWSTONE NATIONAL PARK, 1973-1974

by

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A thesis submitted in partial fulfillment
of the requirements for the degree

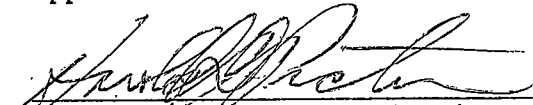
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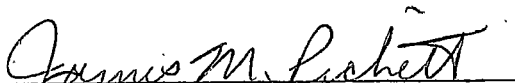
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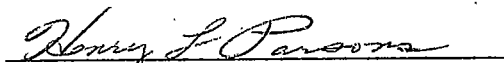
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Approved:


Chairperson, Graduate Committee


Head, Major Department


Graduate Dean

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ABSTRACT

The relationships between the intensity and kinds of human use and the distribution, movements, and behavior of seven species of wildlife in the backcountry areas of the Gallatin Range in Yellowstone National Park were investigated in 1973 and 1974. During this period, human use peaked in July and August and was concentrated in a few locations creating the potential for environmental damage and habituation of bears to given areas. Backcountry parties engaged in activities which could increase detrimental encounters with wildlife. Elk were the most frequently observed species while bighorn sheep and bears were the least. High frequencies of human-wildlife interactions occurred in the off-trail portions of the Fawn Pass East, Sportsman Lake East, and Sportsman Lake West areas. Combined on and off-trail observations of wildlife occurred with the greatest frequencies in the May-June and September-October periods. Off-trail travelers observed wildlife more frequently than on-trail travelers. Frequencies of observations for on-trail travelers peaked in early summer and early fall. Much of the variation in the area and period of observability and on versus off-trail observability appeared to be the result of the average elevation at which a given species was found and as a result of seasonal changes therein. The on to off-trail observation frequency ratio tended to be highest in those species occupying lower elevations, (moose, coyotes, mule deer), and lowest in those occupying higher elevations, (bighorn sheep, grizzly bear, elk, black bear). Only elk and grizzly bear exhibited upward elevational movement in the early summer followed by downward movement in the fall. The downward movement was usually reflected in more frequent total and on-trail observations in the May-June and September-October periods. Except for minor shifts in elk distribution around campsites, variation in the intensity of human use did not appear to be responsible for shifts in wildlife distribution. Wildlife encounters most commonly occurred at distances between 100 and 300 feet, (30.5 m.-91.5 m.). Encounter distances were shortest for mule deer and moose and greatest for bears. Except for deer and coyotes, which were usually alert or running, all species were most commonly feeding when first observed. In response to knowledge of the human presence, the moose was most likely to stand its' ground, while bears were the least likely. Wildlife belligerency toward humans was rare. When it occurred, bear or moose were usually involved. Groups of four or more persons experienced lower observation frequencies than smaller groups. Parties of two or less were the most prone to encounter grizzly bears. The use of noise did not appear to affect the frequency of wildlife observations or encounters.

INTRODUCTION

Upon its establishment in 1872, Yellowstone National Park was "dedicated and set apart as a public park or pleasuring-ground for the benefit and enjoyment of the people" and "for the preservation, from injury or spoilation of all timber, mineral deposits, natural curiosities, or wonders . . . and their retention in their natural condition" (National Park Service, 1974). Houston (1971) points out the difficulty inherent in the above dedication by noting that, "Providing for the educational and esthetic enjoyment of man, while maintaining pristine ecological relationships, represents the greatest challenge in the management of natural areas." The difficulties in meeting this challenge in our national parks has produced situations which have often been detrimental to both wildlife and the park visitor. Within the past few years, the human-wildlife interface in Yellowstone National Park has spread from relatively narrow corridors surrounding developed areas to zones deep within the Yellowstone backcountry. Backcountry camping, in contrast to a stabilizing trend in overnight use of the Park, increased more than 100 percent from 1969 through 1973 (National Park Service, 1974). The increased human use of the Park's backcountry appears to have increased human-grizzly bear encounters in the backcountry (Cole, 1973), and has probably changed the relationships of man and wildlife in less apparent ways.

To date, little research has been done on the specific problem of human-wildlife interactions in backcountry settings. Herrero (1970) analyzed accounts of human-grizzly bear encounters in North America's national parks for casual factors. Martinka (1971, 1974) and Cole (1973) related increasing numbers of backcountry human-grizzly bear encounters to greater backcountry use by hikers and campers in Glacier and Yellowstone National Parks. Burghardt *et al.* (1972) and Bryan and Jansson (1973) analyzed the attitudes and perceptions of visitors to the Great Smokey Mountains and Jasper National Parks, respectively, toward wildlife and wildlife hazards. Geist (1971b) speculated on the effects of human disturbance on the biology of wild ungulates. Dunaway (1971) suggested that human disturbance is a limiting factor in Sierra Nevada bighorn sheep. A number of investigators including Altmann (1952, 1956, 1958), Behrend and Lubeck (1968), McMillan (1954), Townsend and Smith (1933) and Walther (1969) discussed the flight behavior of wildlife as a response to human disturbance.

This study of human-wildlife interactions was carried out in the Gallatin Range of Yellowstone National Park from July to mid-September in 1973, and from July to October in 1974. Considerable emphasis was placed upon humans and grizzly bears. The Gallatin backcountry is well suited to such an investigation with abundant wildlife, including a high density of grizzly bears (Knight, 1974) and a steadily increasing rate of human use. The specific objectives were: (1) to gather

quantitative data on the intensity and kinds of human use in the study area; (2) to gather quantitative data on the distribution, movements, and behavior of wildlife in the study area; (3) to analyze the relationships between these factors as to the cause and the predictability of human-wildlife interactions; and (4) to make recommendations concerning humans and wildlife in the backcountry setting consistent with the Park goals stated above.

DESCRIPTION OF STUDY AREA

Geographic Location and Topography

The study area of roughly 400 square miles (1036 km.²) includes the Gallatin Range in northwestern Yellowstone National Park (Figure 1). This area is a north-south ridge of mountains, with an average crest elevation of 9435 feet (2876 m.). Stream valleys of the Gallatin, Gardner and Madison River drainages dissect the range. Area elevations vary from 6720 feet (2049 m.) near Campanula Creek to 10,922 feet (3330 m.) on Electric Peak. The average elevation is 8117 feet (2474 m.).

Climate

The climate of the Gallatin Range is severe with long winters, heavy snowfall, and short summers. Considerable snow usually remains on the higher portions of the area into July, while fall accumulations generally begin in October and November. Snow depth dictates the beginning and end of the hiking season.

During 1930-1959, the annual mean temperature was 39.8°F. (4.33°C.) at Mammoth, on the northern periphery of the study area (Meagher, 1973). The coldest month was January with a mean temperature of 18°F. (-7.78°C.). The warmest month was July, averaging 62.8°F. (17.11°C.). Snowfall for Yellowstone Park elevations between 7,000 feet (2134 m.) and 8500 feet (2590 m.) averaged 150 inches (381 cm.).

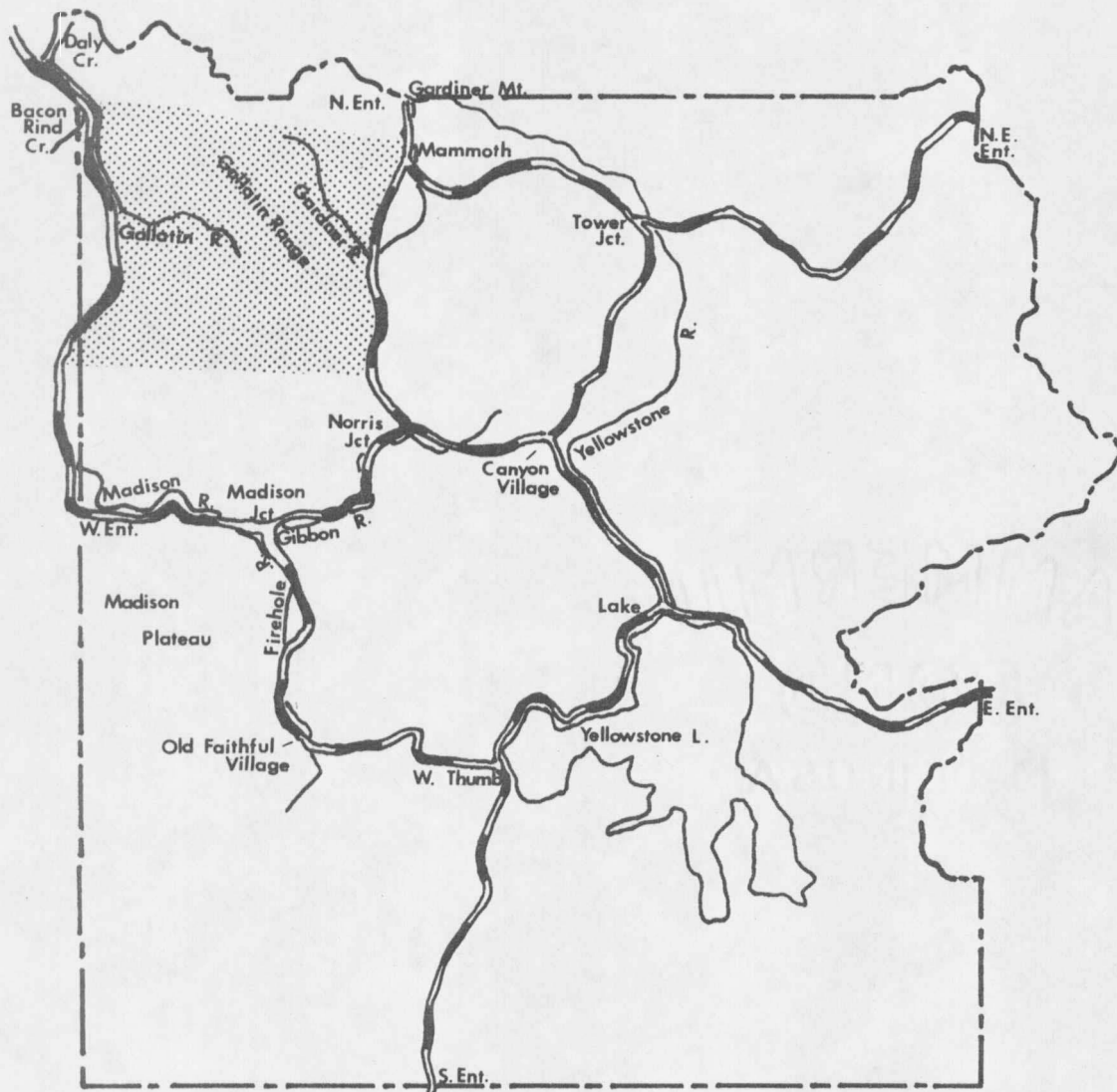


Figure 1. Location of the study area within Yellowstone National Park, Wyoming.

Fauna and Flora

Large herbivores and carnivores exist in the study area. The most abundant species is the elk (*Cervus canadensis nelsoni*). Other large herbivores found in lesser numbers include the moose (*Alces alces shirasi*), mule deer (*Odocoileus hemionus hemionus*), and the big-horn sheep (*Ovis canadensis canadensis*). Occasional observations of bison (*Bison bison*), and pronghorn antelope (*Antilocapra americana*) have been reported. The major carnivores in the area are the grizzly bear (*Ursus arctos horribilis*) and the black bear (*Ursus americanus*). The only other large carnivore commonly present is the coyote (*Canis latrans*). Wolves (*Canis lupus*) have been reported (Cole, 1971)

According to Despain (1973), the study area includes three major vegetation zones: an alpine tundra zone, a spruce-fir zone, and a lodgepole pine zone.

Alpine Tundra Zone. This zone generally occurs in the study area on the crest of the range at elevations over 10,000 feet (3048 m.) (Figure 2). Tundra vegetation is usually dense and mat like. Characteristic species include *Silene acaulis*, *Dryas octopetala*, *Carex* spp., *Phleum alpinum*, *Trifolium* spp., *Trisetum subspicatum*, *Festuca* spp., *Polygonum viviparum*, and *Potentilla* spp. (Despain, 1973 and Hornocker, 1960).

Spruce-Fir Zone. This is the predominant vegetation zone within the study area (Figure 3). Despain (1973) considers this zone to lie



Figure 2. The Alpine Tundra Zone (on mountain and ridge crests)
in the Gallatin Range, Yellowstone National Park.



Figure 3. The Spruce-Fir Zone in the Gallatin Range, Yellowstone National Park.

above 8400 feet (2560 m.) in Yellowstone and to be usually dominated at climax by Engelmann spruce (*Picea engelmanni*) and subalpine fir (*Abies lasiocarpa*). Whitebark pine (*Pinus albicaulis*) becomes common in the higher elevations, while sub-climax communities in this zone are usually dominated by lodgepole pine (*Pinus contorta*). Understory vegetation includes *Vaccinium scoparium*, *Arnica cordifolia*, and *Carex geyeri* (Hornocker, 1960). This zone is characteristically park-like with clumps of conifers. Parks are dominated by *Artemisia tridentata*, grasses and forbs.

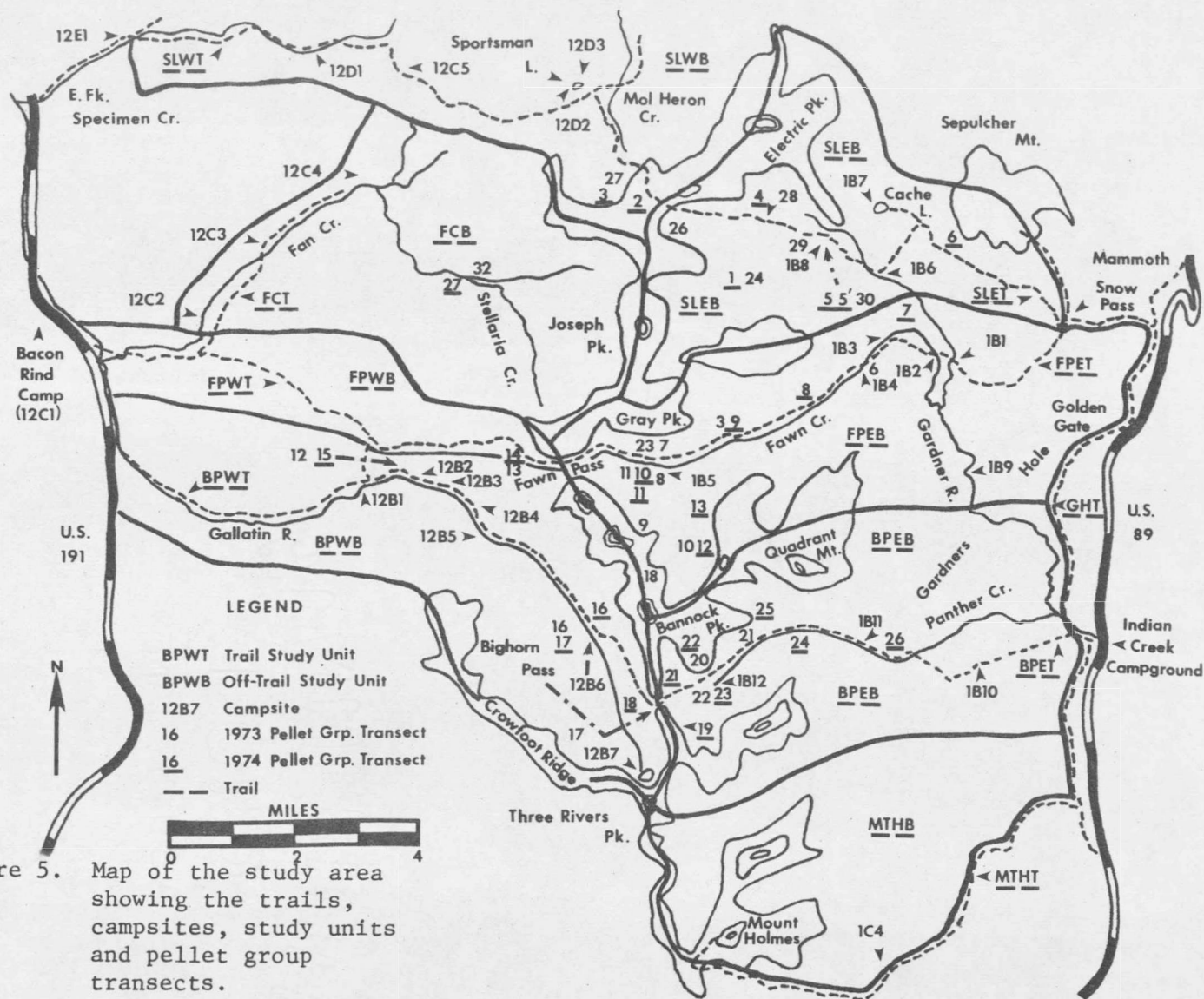
Lodgepole Pine Zone. This zone is generally confined to the peripheral low areas on the east and west sides of the Gallatin crest (Figure 4). Despain (1973) places this zone between 7600 feet (2316 m.) and 8400 feet (2560 m.). In the study area it consists of dense stands of lodgepole pine (*Pinus contorta*) interrupted by large treeless areas dominated by sagebrush-grass communities. Willow (*Salix* spp.) and *Carex* spp. occur in moist areas along stream bottoms and near springs (Hornocker, 1960).

Trails and Campsites

The study area is traversed by four major east-west trails (Figure 5). Total trail mileage in the area is 88 miles (141.59 km.). The trails follow stream drainages with the exception of the upper portions of the Fawn Pass West trail. Consequently, they are lower



Figure 4. The Lodgepole Pine Zone in the Gallatin Range, Yellowstone National Park.



than the surrounding terrain. The trails gain an average of 2251 feet (686 m.) in passing from their low points to the Gallatin crest. Twenty-nine wilderness camps are scattered throughout the area (Figure 5). They are unimproved except for at least one fire ring per site. The camps have various restrictions upon the numbers of persons or parties that may use them and upon the type of use they may receive (horse parties vs. hikers). Most of the sites were officially designated as backcountry camps in 1972. However, several of them have been used for many years, as evidenced by old trash dumps.

METHODS

Area Analysis

General topographic features and vegetation cover types of the segments of each trail were recorded. Elevations for different segments of the area were determined by averaging the means of the highest and lowest elevations in each square of a kilometer grid of the 1:62500 USGS topographic maps covering the area. Ground distances cited were determined from topographic maps, using a map measurer. For recording and analysis purposes, the study area was divided into 17 units, nine of which comprised established trails (Figure 5). Unit divisions generally coincided with drainage boundaries.

Kinds, Intensity, and Distribution of Human Use

Backcountry Use Records

All overnight backcountry campers and backcountry day users building a fire in Yellowstone National Park are required to secure a backcountry use permit. Records of these permits were utilized to determine the following information for 1972-1974: numbers of persons and parties utilizing segments of the area, distribution of campsite use, party size, and mode of backcountry travel. Records were too fragmentary to ascertain the magnitude of single day use in the study area.

Questionnaires

Questionnaires were sent to backcountry users for whom names and addresses were available, during both 1973 and 1974. These were the primary sources of data pertaining to camp and trail procedures, and wildlife observations and encounters by backcountry visitors. In 1973, questionnaires were mailed in September to those persons visiting the study area during May through September. In 1974, questionnaires were mailed approximately every two weeks throughout the summer to persons visiting the area between May and the 18th of October. In both years, second requests were sent to those persons failing to reply. A total of 285 questionnaires were returned, representing replies from 43.4 percent of the parties issued permits for the study area during 1973 and 1974.

Personal Observations and Interviews

Additional data on the characteristics of human backcountry use was obtained through personal observations of parties at camp and on the trail. A total of 64 groups were interviewed during the study period. In 1974, campsite sanitation was investigated by systematically searching nineteen campsites approximately every two weeks. Food and food related items were collected for later tabulation. Occupied campsites were not searched.

Distribution and Behavior of Wildlife

The bulk of the wildlife distribution and behavior data was obtained while periodically and systematically traversing the study area, either on foot or horseback. The area was traversed six times at two week intervals in both 1973 (30 June-29 September) and 1974 (4 July-7 October) for a total of 127 field days. Each trip consisted of a relatively fixed circuit through the study area with three to four days being spent in the Fawn Pass, Bighorn Pass and Sportsman Lake areas, respectively. Circuits included established trails as well as areas seldom visited by humans.

Observations and Encounters

In this investigation, wildlife encounters were defined as a mutual interaction between humans and the animals encountered. An observation did not necessarily involve a mutual interaction.

Encounter or observation records were completed for elk, mule deer, moose, black bear, grizzly bear, bighorn sheep and coyotes. Where feasible, wildlife was approached in order to gather data about flight distance, distances of flight and the behavioral responses to approach.

Aerial Observation

To supplement the ground observations, three aerial observation flights were made during 1974 using a Piper Super Cub.

Pellet Group Transects

In 1973, 23 pellet group transects were established on the study area (Figure 5). These transects were used to follow the distribution of wildlife use (primarily elk) over the study period. Permanently marked transects were established at various altitudes, near trails, away from trails, and near camps. Criteria for transect establishment was an indication of use by wildlife, an open area, and similarity in vegetation and topography within elevation classes. Each transect was 6600 square feet (550' x 12', .06 ha.) in size. Each was visited approximately every two weeks. New pellet groups were recorded and removed.

In 1974, 27 transects were established (Figure 5). Fourteen of the 1973 areas were reused. Near-trail (within 100 yards) transects for a given altitude were matched with equivalent off-trail transects usually in the same drainage. Four campsite transects and controls were established (Figure 5). The 1974 transects were divided into segments a fiftieth of an acre (87.1' x 10', .008 ha.) in size. Each transect was made up of from two to five segments depending upon the size of the area sampled.

Bear Sign Observation

In 1974, a record was maintained of all bear sign observed following procedures utilized by Knight (1974). Species determinations

from scats and tracks were made by a combined evaluation of the locality where the sign was found and of the measurements of the sign (Greer, 1971, and Murie, 1954). Ages of the scats were estimated by noting the moisture content, freshness of the constituents, and decomposer activities. Tracks were aged by the clarity and sharpness of the impression in relation to the medium in which they were found. It was often possible to calculate a maximum age of sign, since it had been left subsequent to the last trip through the area.

Additional bear sign and bear observation data for the Gallatin Range during the 1970-1974 period was provided by the National Park Service and the Grizzly Bear Study Team.

RESULTS

Human Use of the Gallatin Range

In 1974, 36.7 percent of the 199 parties returning questionnaires did not deviate from their backcountry use permit, 58.7 percent deviated in some manner, while 4.5 percent did not take the trip at all. Of those parties that deviated from their permit, 29.9 percent stayed at at least one incorrect or non-established camp; 38.5 percent stayed additional or fewer days than anticipated; and 31.6 percent deviated in both of these ways. Common causes for such deviations were over or underestimation of hiking ability, inability to find the correct campsite, poor weather, insects, and dislike of an assigned campsite.

These deviations introduced an element of error into human use data taken solely from National Park Service records. For example, 1973 records showed a total of 2029 camp days in the Gallatin Range as compared to a corrected value of 1,878 (a deviation of -7.4 percent). The 1974 deviation was -10.6 percent. This error could only be detected and corrected on those permits for which a questionnaire had been returned. Data included here has been corrected to the extent made possible by the return of questionnaires. No attempt was made to compute a "correction factor" and apply it to the human use data as a whole, since that figure would probably not be more valid than the partially corrected value.

Trends in Backcountry Use, 1972-1974

From 1972 through 1974, backcountry use in the Gallatin Range increased by over 100 percent as determined from uncorrected Park Service permits (Figure 6). Uncorrected values were used so that a comparison could be made with 1972 values. The Fawn Pass trail was closed during the latter part of August 1972 because of a human-grizzly bear incident. This probably depressed use figures for that year. Smaller party sizes and shorter trips were seen in 1974 as compared with 1973. While the numbers of groups increased by 33 percent, the number of people increased by only 14.6 percent and camp days by 11 percent from 1973 to 1974.

Distribution of Human Use, 1973-1974

A camp day index and man traverse index were utilized in assessing human use of trail complexes in the study area. A camp day is equivalent to one person spending one night at a camp. A man traverse is defined as one person traversing a given area. Individual trails were considered as a single area. Therefore, the same traverse value was assigned regardless of whether the whole trail or only a portion of it was traversed. Repeated traverses of the same area by the same party were given a separate value, as was daily off-trail travel in a given area. These were then added to the base traverse value. Camp day and traverse data were corrected for any deviation from the use

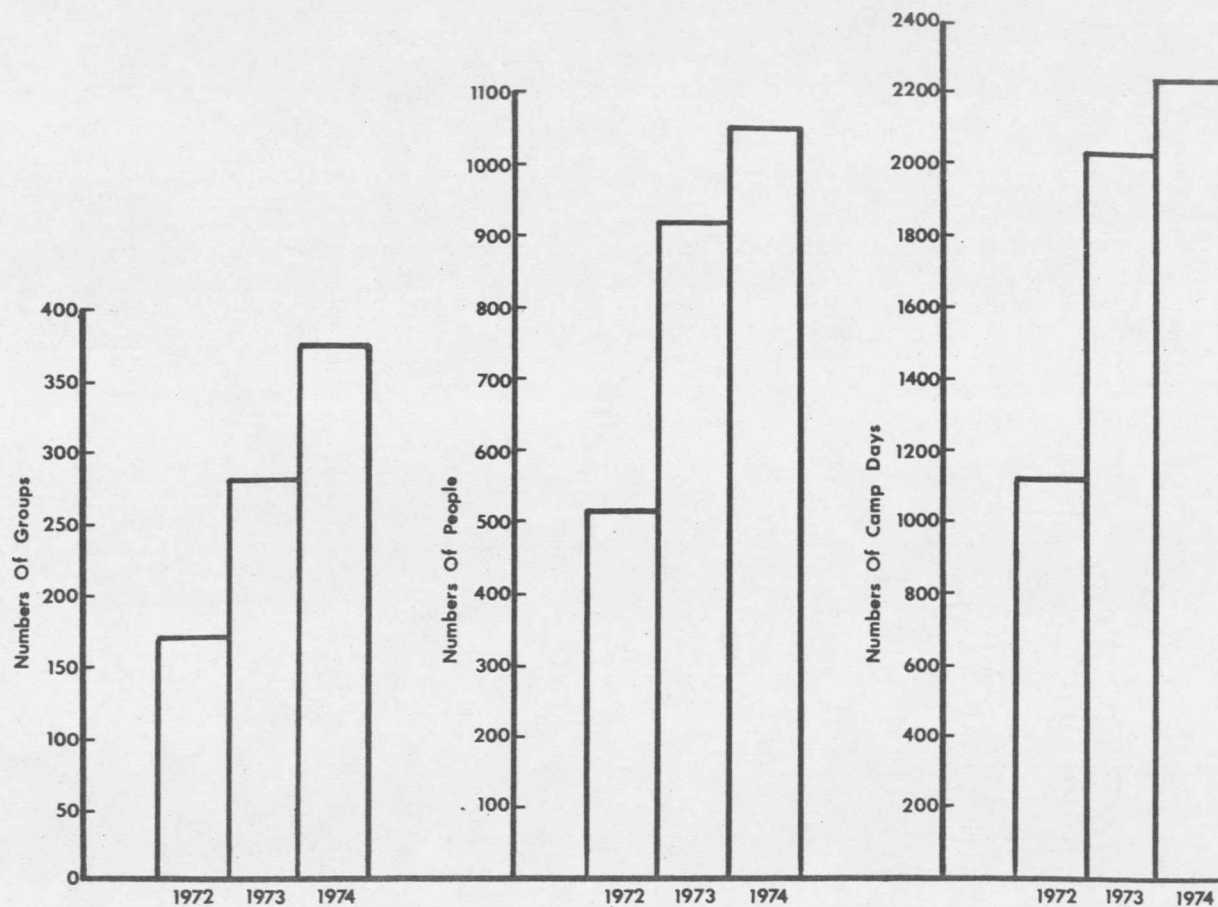


Figure 6. A comparison of the numbers of groups, people, and camp days in the Gallatin Range, Yellowstone National Park, between 1972 and 1974.

permit as indicated by the questionnaires.

The Fawn Pass East trail and the Bighorn West trail received the heaviest camp day use during the study period (Figure 7). Camp day use on these two trails was 46.4 percent of the total camp day use for the study area. It appeared camp day use of an area was not strictly related to the number of campsites in the area (Table 1). The Fawn Pass East trail in particular received a disproportionately high amount of use in relation to the number of campsites present.

Camp day figures for individual campsites generally showed that a few campsites received the bulk of the use (Appendix Figure 23). Six of the 29 campsites averaged over 100 camp days of use over the two year period and made up 41.8 percent of the camp day use. Each trail appeared to have one or two heavily used campsites with others receiving moderate to light use.

A further index to campsite use is the number of days that a particular site was occupied over a monthly period. During the study period, those sites that were used were occupied an average of 5.4 nights (.5-18.5) per month (Appendix Table 25).

The traverse index and the camp day index generally showed the same pattern of use with the Fawn Pass East and Bighorn Pass West on-off trail complexes among the most frequently traversed areas (Figure 7). However, the traverse index indicated that the Sportsman Lake East and the Bighorn Pass East complexes were used to a greater extent

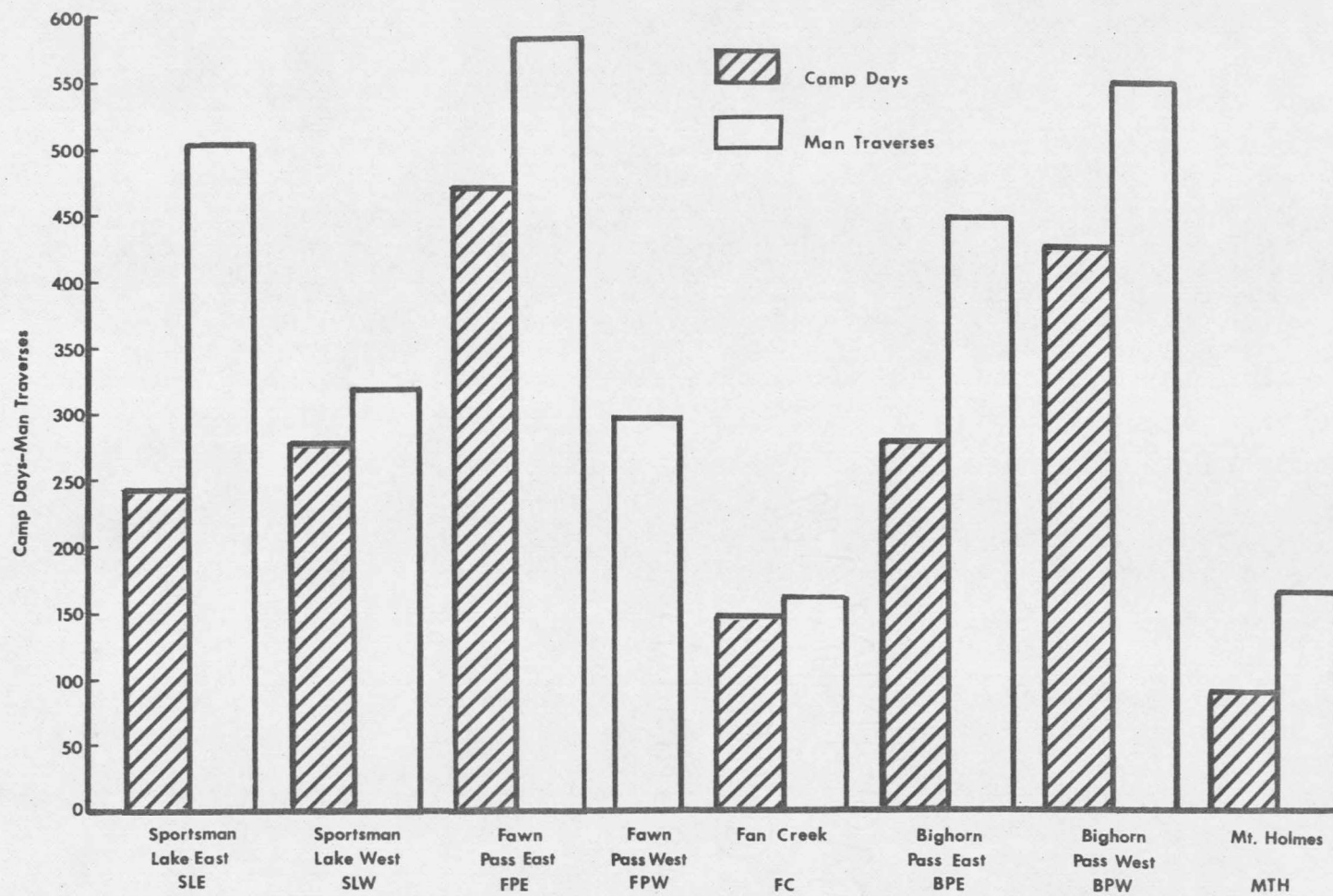


Figure 7. Average yearly camp day and man traverse use of individual trail complexes during 1973-74.

TABLE 1. THE PERCENTAGE OF TOTAL CAMP DAY USE ON EACH TRAIL COMPLEX COMPARED WITH THE PERCENTAGE OF THE TOTAL STUDY AREA CAMPSITES ON EACH COMPLEX.

Trail Complex	Percent of Total Camp Day Use, 1973-1974	Percent of Total Study Area Camps
Sportsman Lake East	12.6	10.3
Sportsman Lake West	14.4	17.2
Fawn Pass East	24.4	17.2
Fan Creek	7.7	13.8
Bighorn Pass East	14.4	13.8
Bighorn Pass West	22.0	24.1
Mt. Holmes	4.6	3.5

than indicated by campsite data. Therefore, they are considered among the heavily used trail complexes of the study area.

Seasonal Use of the Study Area

Backcountry use in the Gallatin Range was highest during July and August, totaling 76.1 percent of the camp use and 76.5 percent of the traverses (Figure 8). All individual trail complexes registered peak use during this period. However, some areas received a proportionately greater amount of their use during the early season months of May and June, and the late season months of September and October than others (Table 2). No clear relationship between seasonal use and elevation was apparent. The seasonal and elevational distribution of human use in an area appears to depend largely upon the preferences of the persons securing the permit and those issuing it.

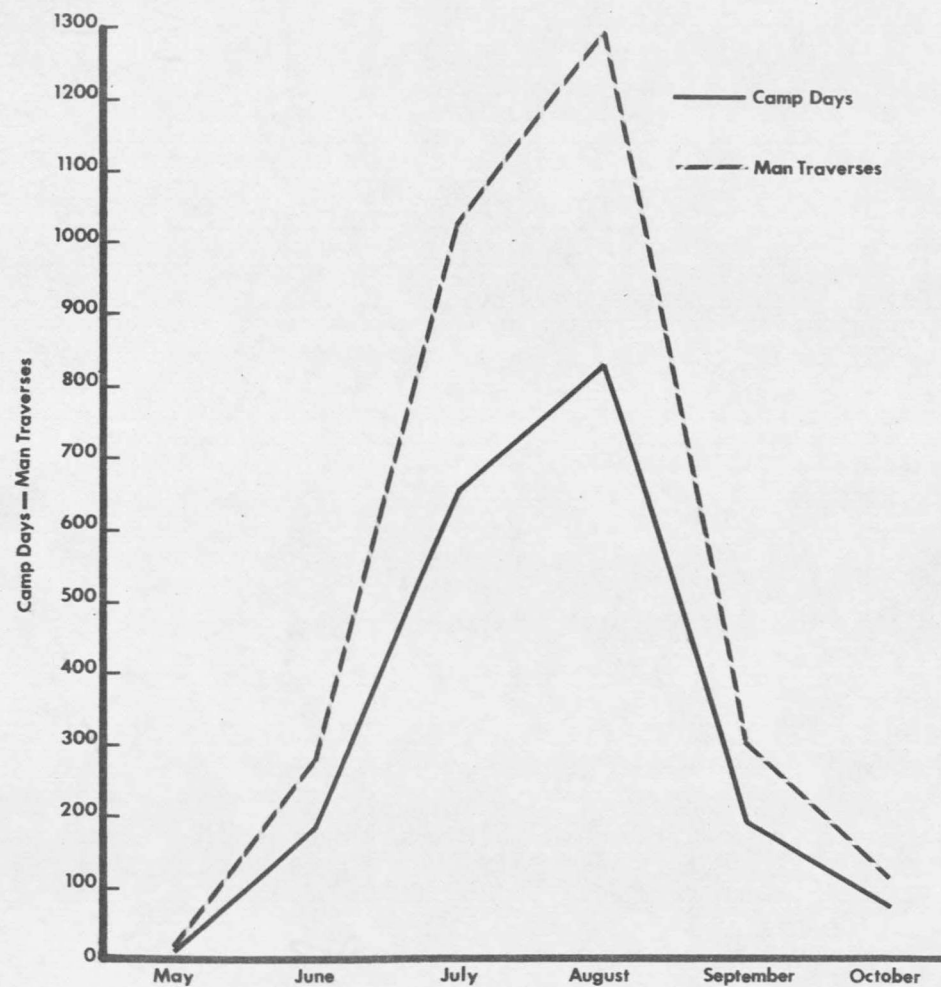


Figure 8. Seasonal human use of the Gallatin Range, 1973-1974.

TABLE 2. THE PERCENT OF CAMP DAY AND MAN TRAVERSE USE OCCURRING DURING THE MONTHS OF MAY, JUNE, SEPTEMBER, AND OCTOBER ON EACH TRAIL COMPLEX, 1973-1974.

Trail Complex	Percent/ Camp Days	Percent/ Man Traverses
Sportsman Lake East	27.6	27.4
Sportsman Lake West	28.0	29.6
Fawn Pass East	26.7	23.9
Fawn Pass West	No Camps	13.5
Fan Creek	6.7	7.6
Bighorn Pass East	37.1	35.8
Bighorn Pass West	15.2	18.2
Mt. Holmes	14.5	15.9

Period and Location of Wildlife Observations - All Species

In this and the following sections, the frequency of wildlife observations is used as an index of the relative probabilities of frequent human-wildlife interactions per party for a given area and time. All subsequent statements and data in the text, tables, and figures concerning frequencies of interactions, or the likelihood or probabilities of frequent interactions, are on a per party basis so as to eliminate the influence of variable numbers of groups in comparative areas and time frames. A large percentage of the observations were of elk. Thus, data on all species combined reflects to a considerable degree the movements, distribution, and behavior of this species.

During the study period, I made 379 wildlife observations while visitors returning questionnaires reported 358 observations which could be related to a specific time period. There is a considerable

difference in the rate at which wildlife was observed between myself and other backcountry visitors, with the visitor observing wildlife only about one-fourth as often as I (Table 3). Both observation sets

TABLE 3. THE FREQUENCY OF WILDLIFE OBSERVATIONS MADE IN THE ENTIRE STUDY AREA DURING 1973-1974.

	Personal Observations			Questionnaire Observations		
	All Obser- vations	On-Trail Obser- vations	Off-Trail Obser- vations	All Obser- vations	On-Trail Obser- vations	Off-Trail Obser- vations
1973-1974 Observations Per Hour	.50	.37	.67	.13	.11	.20

showed that wildlife was more frequently observed or encountered in off-trail sections of the study area (Table 3).

Locations of Observations

The number of wildlife observations per hour for myself and the backcountry visitor on each segment of the study area is shown in Table 4. Combining both data sources, the Fawn Pass East backcountry, Sportsman Lake East backcountry and Sportsman Lake West backcountry are units where groups would have high probabilities for frequent observations of wildlife. Backcountry in the above context is equivalent to off-trail units. The Bighorn West, Sportsman Lake West and Gardners Hole trails are units in which groups would be least likely to observe wildlife.

TABLE 4. THE FREQUENCY OF WILDLIFE OBSERVATIONS ON INDIVIDUAL UNITS OF THE STUDY AREA, 1973-1974.

Location	Personal Observations	Questionnaire Observations
	Obser- vations Per Hour	Obser- vations Per Hour
Sportsman Lake East Trail-SLET	.64	.12
Sportsman Lake East Backcountry-SLEB	.67	.17
Sportsman Lake West Trail-SLWT	.18	.05
Sportsman Lake West Backcountry-SLWB	.70	.33
Fawn Pass East Trail-FPET	.48	.17
Fawn Pass East Backcountry-FPEB	.95	.21
Fawn Pass West Trail-FPWT	.52	.13
Fawn Pass West Backcountry-FPWB	.81	<.15
Fan Creek Trail-FCT	.32	.04
Fan Creek Backcountry-FCB	.25	.18
Bighorn Pass East Trail-BPET	.28	.14
Bighorn Pass East Backcountry-BPEB	.28	.23
Bighorn Pass West Trail-BPWT	.14	.05
Bighorn Pass West Backcountry-BPWB	.51	.16
Mt. Holmes Trail-MTHT		.16
Mt. Holmes Backcountry-MTHB		.12
Gardners Hole Trail-GHT	.19	.05

In four of eight pairs of trails and corresponding off-trail areas, both personal and questionnaire results indicate that groups would most frequently observe wildlife in the backcountry component of the pair (Table 4). In the Fan Creek, Bighorn East, and Fawn Pass West complexes, relative observability of wildlife in on-trail versus off-trail areas differed in the two sets of data. Only questionnaire results were available for the Mt. Holmes complex. These showed greater observation frequencies in the on-trail component.

Periods of Observations

Data from my trips were combined so as to roughly approximate the months of July, August, and September (Table 5). Personal observation frequencies of wildlife were greatest in the September-October period (Table 5). Wildlife was least frequently observed in July and August. Generally, questionnaire data conformed to my personal observations, with the addition of a secondary peak in the May-June period.

Observations were more frequent in trail areas than off-trail areas in only one (May-June) of the seven time periods (Table 5). Peak personal on-trail observation frequencies occurred in September-October, while there were two distinct backcountry visitor on-trail observation peaks (May-June and September-October). Personal observations were not made in May-June. Three aerial surveys support the idea that wildlife is increasingly observable on the trails in the early and latter portions of the field season. On the June flight, 26.3 percent of all animal observations were in kilometer grids containing trails within them. During the August flight, this percentage decreased to 14.5 percent followed by an increase in October to 25 percent.

TABLE 5. THE FREQUENCY OF WILDLIFE OBSERVATIONS ON THE STUDY AREA, BY PERIOD, 1973-1974.

Period	Personal Observations			Questionnaire Observations		
	All	On-Trail	Off-Trail	All	On-Trail	Off-Trail
	Observations Per Hour	Observations Per Hour	Observations Per Hour	Observations Per Hour	Observations Per Hour	Observations Per Hour
May-June				.13	.13	.08
July						
6/30-8/1	.43	.28	.59	.10	.09	.15
August						
7/31-9/3	.35	.25	.51	.12	.10	.25
Sept.-Oct.						
8/30-10/7	.75	.61	.95	.17	.14	.34

Period and Location of Wildlife Observations-
Individual Species

During the study period, I made 258 elk, 42 mule deer, 40 moose, 9 grizzly bear, 8 black bear, 5 bighorn sheep and 17 coyote observations. Persons returning the questionnaires reported 155 elk, 39 mule deer, 95 moose, 13 grizzly bear, 13 black bear, 10 bighorn sheep, 31 coyote, and 2 antelope observations which could be related to a specific time period. The antelope observations were excluded because of uncertainty that the animals were correctly identified. The proportions of animals seen in aerial surveys generally agreed with the above observation patterns except for bighorn sheep, which inhabited areas of high aerial observability, and coyotes, which were relatively inconspicuous from the air (Table 6). In examining the results of this

TABLE 6. A RANKING OF OBSERVABILITY OF INDIVIDUAL WILDLIFE SPECIES BASED UPON THE FREQUENCY OF PERSONAL AND BACKCOUNTRY VISITOR GROUND OBSERVATIONS AND UPON PERSONAL AERIAL OBSERVATION PERCENTAGES.

Species	Personal		Visitor		Flight	
	Obser- vations Per Hour	Rank	Obser- vations Per Hour	Rank	Obser- vation Percentages	Rank
Elk	.34	1	.05	1	84.7	1
Mule Deer	.06	2	.01	3	3.4	3-4
Moose	.05	3	.03	2	3.4	3-4
Grizzly Bear	.01	5	.004	5-6	2.0	5
Black Bear	.01	6	.004	5-6	1.0	6-7
Bighorn Sheep	.007	7	.004	7	4.4	2
Coyote	.02	4	.01	4	1.0	6-7

section, the possible misidentification of a species, particularly of bears, by the backcountry visitor should be kept in mind. Sample sizes of bears, bighorn sheep, and coyotes were small. However, due to the significance of the human-bear interface, and supplementation of bear observations with bear sign data all bear data are commented upon in the text.

All species except moose were more frequently observed in off-trail areas (Table 7). Mule deer were observed from slightly less than one and one-half to two times as often from off the trail as on it. Elk and black bear off-trail observations occurred roughly two to three times as frequently as on-trail observations. Personal data showed that the bighorn sheep and the grizzly bear had the lowest on- to off-trail ratio of all species. Questionnaire data indicated this

TABLE 7. THE FREQUENCY OF AND RELATIONSHIPS BETWEEN ON- AND OFF-TRAIL OBSERVATIONS FOR EACH SPECIES.

Species	Personal Observations			Questionnaire Observations		
	On-Trail Observations Per Hour	Off-Trail Observations Per Hour	On/Off Trail Ratio	On-Trail Observations Per Hour	Off-Trail Observations Per Hour	On/Off Trail Ratio
Elk	.22	.50	.44	.05	.10	.50
Mule Deer	.05	.07	.71	.01	.02	.50
Moose	.07	.03	2.33	.04	.03	1.33
Grizzly Bear	.005	.02	.25	.003	.01	.30
Black Bear	.007	.02	.35	.004	.009	.44
Bighorn Sheep	<.002	.02	~.10	.002	.01	.20
Coyote	.02	.02	1.00	.008	.03	.27

distinction for the same two species plus the coyote. In the case of the grizzly bear, my observations and those of visitors suggested that the likelihood of observing this species was three to four times greater while off the trail. I observed moose two to three times more often in on-trail situations. The on- and off-trail frequencies of back-country visitor moose observations indicated that up to one-third more time was required to observe a moose in off-trail versus on-trail areas.

The percent of aerial observations of each species which were in kilometer grid sections containing trails were as follows: black bear, 50 percent; moose, 42 percent; mule deer, 29 percent; elk, 22 percent; and bighorn sheep, 11 percent. None of the coyote and grizzly bear observations occurred in kilometer grid sections containing trails.

The frequency of discovery of fresh grizzly bear sign (within two weeks) was .22 discoveries per hour on the trail as compared to .28 off the trail. In contrast, the discovery frequency of black bear sign was .07 discoveries per hour for on-trail areas and .05 off the trail. Thus, most data indicates that grizzly bear and bighorn sheep are more prone to use areas away from trails than the other five species.

Location of Observations

The frequency of observations of individual species on each unit of the study area is shown in Tables 8-10. In addition, each unit has been ranked according to the likelihood of frequent observations per party of a particular species on that area. This was accomplished by averaging the rank of the unit in personal and questionnaire observations. For bears, unit rank as the result of sign discovery was also averaged in with those of personal and questionnaire data. The Mt. Holmes and Mt. Holmes backcountry units were used in determining an area rank for questionnaire observations but are not included in the composite rankings since only values for questionnaire observations were available for these units.

Elk were observed in all units of the study area (Table 8). However, the highest observation frequencies tended to occur in the northern two-thirds of the study area along the eastern slope and crest of the Gallatin Range. These areas encompass the highest portions of

TABLE 8. A WILDLIFE OBSERVABILITY RANKING OF THE INDIVIDUAL UNITS OF THE STUDY AREA BASED UPON THE FREQUENCY OF PERSONAL AND BACKCOUNTRY VISITOR OBSERVATIONS OF ELK, MULE DEER, AND MOOSE.

Composite Rank	Area	Elk		Area	Mule Deer		Area	Moose	
		Personal Observations Per Hour	Visitor Observations Per Hour		Personal Observations Per Hour	Visitor Observations Per Hour		Personal Observations Per Hour	Visitor Observations Per Hour
1	Sportsman Lake West Backcountry	.60	.15	Sportsman Lake West Backcountry	.10	.02	Fawn Pass East Trail	.11	.07
2	Fawn Pass East Backcountry	.78	.07	Fawn Pass East Backcountry *	.08	.04	Fan Creek Trail	.19	.04
3	Sportsman Lake East Backcountry	.29	.08	Fawn Pass West Trail *	.12	.02	Fawn Pass West Trail	.12	.02
4	Sportsman Lake East Trail	.53	.05	Bighorn Pass West Backcountry	.07	.05	Fawn Pass East Backcountry	.05	.04
5	Fan Creek Backcountry *	.17	.15	Fawn Pass East Trail	.08	.009	Bighorn Pass West Backcountry	.02	.05
6	Bighorn Pass East Backcountry	.19	.13	Sportsman Lake East Trail *	.03	.02	Sportsman Lake East Trail	.07	.02
7	Bighorn Pass East Trail	.20	.07	Sportsman Lake East Backcountry *	.05	.02	Bighorn Pass East Trail	.02	.05
8	Fawn Pass East Trail *	.24	.06	Gardners Hole Trail	.06	.006	Sportsman Lake East Backcountry *	.03	.02
9	Bighorn Pass West Backcountry *	.29	.03	Bighorn Pass East Trail	.04	.009	Gardners Hole Trail	.06	.02
10	Fawn Pass West Trail	.20	.06	Fan Creek Backcountry	.06	<.03	Bighorn Pass East Backcountry *	<.03	.02
11	Fawn Pass West Backcountry	.23	<.15	Sportsman Lake West Trail *	.01	.009	Bighorn Pass West Trail	.03	.02
12	Sportsman Lake West Trail	.08	.03	Fan Creek Trail	.05	<.04	Sportsman Lake West Backcountry *	<.05	.02
13	Gardners Hole Trail	.06	.02	Bighorn Pass West Trail	.02	.006	Sportsman Lake West Trail	<.01	<.004
14	Bighorn Pass West Trail	.08	.006	Fawn Pass West Backcountry *	<.23	<.15	Fawn Pass West Backcountry	<.23	<.15
15	Fan Creek Trail	.02	<.04	Bighorn Pass East Backcountry *	<.03	<.01	Fan Creek Backcountry *	<.03	<.03
A	Mt. Holmes Backcountry		.12	Mt. Holmes Trail		.01	Mt. Holmes Trail		.05
B	Mt. Holmes Trail		.04	Mt. Holmes Backcountry		<.04	Mt. Holmes Backcountry		<.04

*Areas connected by asterisk are of equal rank.

the range and include considerable terrain in the Alpine Tundra and Spruce-Fir Zones, the predominant zones of summer elk occupation.

Mule deer were observed in all units of the study area with the exception of the Mt. Holmes, Fawn Pass West and Bighorn East backcountries (Table 8). As with elk, the Sportsman Lake West and Fawn Pass East backcountries were among the units where frequent observations of deer occurred. The Fawn Pass region was a particularly significant area in terms of mule deer observation frequencies, with three of its units ranking in the top five.

No moose observations were recorded in the Mt. Holmes, Fawn Pass West and Fan Creek backcountries or on the Sportsman Lake West trail (Table 8). High observation frequencies primarily occurred in the low elevation trail areas of the East and West Fawn Creek and the Fan Creek drainages. These areas generally lay in the Lodgepole Pine Zones and were associated with running streams and abundant willow bottoms. Moose were more frequently seen along Fan Creek than any other species.

No grizzly bears were observed from the Mt. Holmes, Fan Creek, Bighorn East, and Fawn Pass East trails or from the Mt. Holmes backcountry (Table 9). However, with the exception of the Mt. Holmes complex, grizzly sign was observed in all of these units (Figure 9). In the case of the Fan Creek trail, scat and track discoveries resulted in this unit receiving a rank of two, indicating high but apparently unobserved grizzly bear activity. The Sportsman Lake

TABLE 9. A WILDLIFE OBSERVABILITY RANKING OF THE INDIVIDUAL UNITS OF THE STUDY AREA BASED UPON THE FREQUENCY OF PERSONAL AND BACKCOUNTRY VISITOR OBSERVATIONS OF BLACK BEAR AND GRIZZLY BEAR AND DISCOVERY OF THEIR SIGN.

Composite Rank	Area	Grizzly Bear			Area	Black Bear		
		Personal Observations Per Hour	Visitor Observations Per Hour	Sign Discovery Per Hour		Personal Observations Per Hour	Visitor Observations Per Hour	Sign Discovery Per Hour
1	Sportsman Lake East Backcountry	.01	.02	.37	Sportsman Lake East Backcountry	.01	.02	.17
2	Bighorn Pass West Backcountry	.05	<.03	.55	Sportsman Lake East Trail	<.01	.006	.14
3	Sportsman Lake West Backcountry	<.05	.04	.31	Fawn Pass East Trail	.02	.006	.04
4	Bighorn Pass West Trail	<.02	.009	.34	Fawn Pass West Trail	.04	<.006	.14
5	Sportsman Lake West Trail	.01	.004	.24	Sportsman Lake West Backcountry	<.05	.02	<.10
6	Fan Creek Trail	<.02	<.04	.40	Bighorn Pass West Trail	<.02	.003	.13
7	Fawn Pass West Trail	.04	.006	<.14	Fawn Pass East Backcountry	.02	.01	.04
8	Fawn Pass East Backcountry	.01	<.01	.27	Fawn Pass West Backcountry	.23	<.15	<.57
9	Fawn Pass West Backcountry	.23	<.15	<.58	Sportsman Lake West Trail	<.01	<.004	.04
10	Bighorn Pass East Backcountry	<.03	.01	.05	Gardners Hole Trail	<.06	.003	<.57
11	Fan Creek Backcountry	.03	<.03	.06	Bighorn Pass East Trail	<.02	.002	<.03
12	Sportsman Lake East Trail	<.01	.003	.20	Bighorn Pass West Backcountry	<.02	<.03	.04
13	Bighorn Pass East Trail	<.02	<.002	.22	Fan Creek Trail	<.02	<.04	<.04
14	Fawn Pass East Trail	<.01	<.003	.10	Fan Creek Backcountry	<.03	<.03	<.06
15	Gardners Hole Trail	<.06	.003	<.57	Bighorn Pass East Backcountry	<.03	<.01	<.05
A	Mt. Holmes Backcountry		<.04		Mt. Holmes Trail		.02	
B	Mt. Holmes Trail		<.01		Mt. Holmes Backcountry		<.04	

*Areas connected by asterisk are of equal rank.

region (with the exception of the East trail) and the West side of the Bighorn Pass region appear to be the areas where groups would have the highest probabilities of frequent grizzly bear observations or encounters. In the Sportsman Lake West units, observations and sign were generally limited to the areas connecting Sportsman Lake with Electric Peak and the northern park boundary. Although the Fawn Pass region ranked relatively low under the system used, two of the three cases of human injury caused by grizzlies in the Gallatin Range since 1972 occurred in this area. Additionally, personal observation frequencies of grizzlies were highest in the Fawn Pass West off-trail unit.

As in the case of the grizzly bear, the Sportsman Lake region ranked near the top in frequencies of black bear observations. The entire Fawn Pass region also ranked high. Black bear were not observed in either the Bighorn West or East backcountry, the Fan Creek complex, Sportsman Lake West trail and the Mt. Holmes backcountry. In a situation analogous to that of elk, those units containing higher elevation areas encompassing considerable terrain in the Spruce-Fir and Alpine Tundra Zones are most important in terms of frequent observations of both grizzly and black bears. In the Gallatin Range, the large tracts of whitebark pine on the east side of the Sportsman Lake and Fawn Pass regions enhance the habitat for the black bear.

Bighorn sheep were observed in only seven of the seventeen units and thus were the most limited in distribution of any of the species

studied (Table 10). High observation frequencies of sheep were limited to the high elevation areas of the Sportsman Lake and Bighorn Pass regions and generally occurred on or near peak complexes with vegetation comprised primarily of alpine tundra.

Coyotes were observed in all units except Fawn Pass West backcountry, the Gardners Hole trail and Mt. Holmes backcountry (Table 10). They were observed most frequently in the backcountry portions of the Sportsman Lake and Bighorn Pass regions and on the east side of the Fawn Pass region.

The on- and off-trail observation frequencies for each species on each trail-backcountry complex are shown in Tables 8-10. In 71 percent of the on-off trail complexes, I was able to observe elk more frequently in the off-trail unit as compared with 88 percent for the backcountry visitor. Higher frequencies of elk observations for both myself and backcountry parties occurred in the off-trail component of four of the complexes (Table 8) and our observations varied in the other four (Table 8).

Personal observations of mule deer occurred most frequently in the off-trail unit in 57 percent of the on-off trail complexes. The comparable questionnaire value was 43 percent (of complexes where deer were observed). Both sets of data showed higher observation frequencies on the backcountry unit of the Sportsman Lake West and the Bighorn West complexes and on the trail in the Fawn Pass West and Bighorn East

TABLE 10. A WILDLIFE OBSERVABILITY RANKING OF THE INDIVIDUAL UNITS OF THE STUDY AREA BASED UPON THE FREQUENCY OF PERSONAL AND BACKCOUNTRY VISITOR OBSERVATIONS OF BIGHORN SHEEP AND COYOTES.

Composite Rank	Area	Bighorn Sheep		Area	Coyotes	
		Personal Observations Per Hour	Visitor Observations Per Hour		Personal Observations Per Hour	Visitor Observations Per Hour
1	Bighorn Pass East Backcountry	.07	.03	Fawn Pass East Backcountry	.04	.04
2	Sportsman Lake West Backcountry	<.05	.02	Bighorn Pass West Backcountry	.05	.03
3	Sportsman Lake East Backcountry	<.01	.02	Sportsman Lake West Backcountry	<.05	.04
4	Fawn Pass West Trail	<.04	.006	Fawn Pass East Trail	.03	.01
5	Bighorn Pass East Trail	<.02	.004	Bighorn Pass East Backcountry	<.03	.03
6	Bighorn Pass West Backcountry	.02	<.03	Sportsman Lake East Backcountry	.01	.02
7	Sportsman Lake East Trail	<.01	<.003	Fan Creek Backcountry	<.03	.03
8	Sportsman Lake West Trail	<.01	<.004	Sportsman Lake East Trail	.01	.01
9	Fawn Pass East Trail	<.01	<.003	Fawn Pass West Trail	<.04	.01
10	Fawn Pass East Backcountry	<.01	<.01	Fan Creek Trail	.05	<.04
11	Fawn Pass West Backcountry	<.23	<.15	Bighorn Pass East Trail	.02	.008
12	Fan Creek Trail	<.02	<.04	Bighorn Pass West Trail	.02	.003
13	Fan Creek Backcountry	<.03	<.03	Sportsman Lake West Trail	<.01	.009
14	Bighorn Pass West Trail	<.02	<.003	Fawn Pass West Backcountry	<.23	<.15
15	Gardners Hole Trail	<.06	<.003	Gardners Hole Trail	<.06	<.003
A	Mt. Holmes Trail		.01	Mt. Holmes Trail		.01
B	Mt. Holmes Backcountry		<.04	Mt. Holmes Backcountry		<.04

*Areas connected by asterisk are of equal rank.

complexes.

Backcountry visitors observed moose more frequently on the off-trail unit in only 25 percent of the on-off trail pairs (Table 8). The only complexes where moose were not observed most frequently on the trail segment by both the backcountry user and myself were Sportsman Lake East and Bighorn and Sportsman Lake West.

The frequency of my observations of grizzly bears in the off-trail unit of an on-off trail complex was greater than on the corresponding on-trail segment in 83 percent of the areas where grizzly bear were observed (Table 9). The corresponding value for the questionnaires and for sign discovery was 60 percent and 67 percent, respectively. The sign, personal, and questionnaire sources were in agreement that higher frequencies of grizzly bear observations were most likely in the off- rather than on-trail unit of the Sportsman Lake East complex. In other areas, the off- versus on-trail observation frequencies varied with the source of data.

The off-trail unit provided a higher frequency of black bear observations in 67 percent of the on-off trail complexes in which I observed black bear (Table 9). This was the case in 50 percent of the on-off trail pairs where black bear were observed by the backcountry visitor. In contrast to the above, sign discovery occurred most frequently in the off-trail unit in only 20 percent of the on-off trail pairs where sign was observed. In only the Sportsman Lake East complex

did all three sources of data agree that off-trail travel would result in a higher frequency of black bear observation than on-trail travel.

In both complexes where I observed bighorn sheep, observations were made most frequently in the off-trail unit of the complex (Table 10). This occurred in 60 percent of the on-off trail pairs in which visitors observed bighorn sheep.

I observed coyotes most frequently in off-trail areas in 40 percent of the complexes where coyotes were seen (Table 10). The back-country visitor found the frequency of coyote observations greatest in off-trail units of 75 percent of the complexes.

Monthly Patterns of Observations

The frequency of observation of each species during the study period is shown by month in Table 11. There appeared to be a trend toward more frequent observations of both elk and mule deer in early summer (May-June) and early fall (September-October). The early season trend was based solely upon backcountry visitor results due to the lack of May-June field work by myself.

The frequency of moose observations remained relatively constant during the field season for backcountry visitors. Personal observation frequencies were lowest in July and increased by 50 percent to a high in September-October.

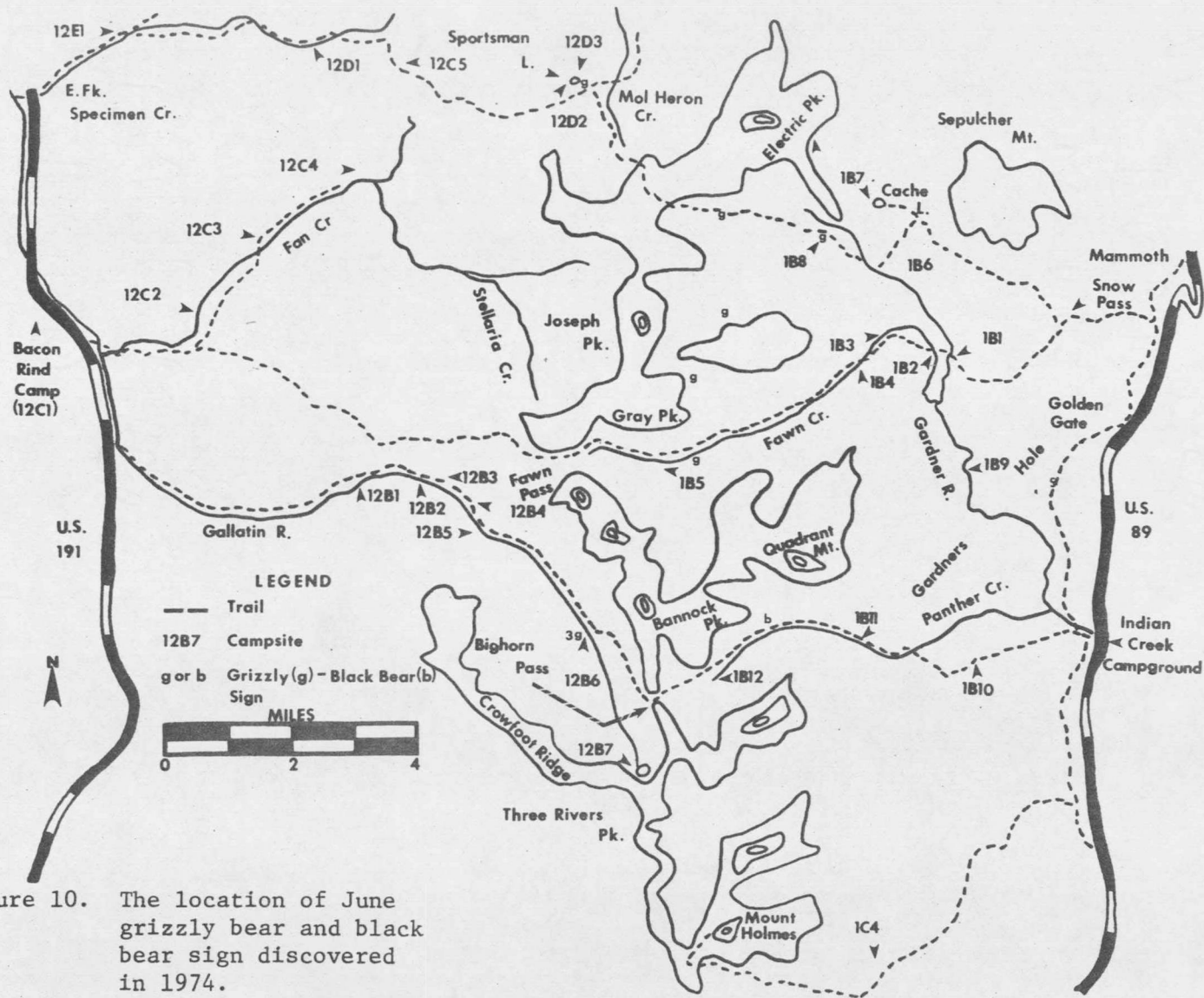
TABLE 11. THE FREQUENCY OF OBSERVATION OF WILDLIFE SPECIES (1973-1974) AND DISCOVERY OF BEAR SIGN (1974) DURING THE COURSE OF THE FIELD PERIOD.

Species	Form of Interaction	Observations or Discoveries Per Hour			
		May-June	July	August	September-October
Elk	Personal Observation		.32	.21	.52
	Visitor Observation	.06	.04	.05	.08
Mule Deer	Personal Observation		.04	.05	.08
	Visitor Observation	.02	.01	.01	.02
Moose	Personal Observation		.04	.05	.06
	Visitor Observation	.03	.03	.04	.03
Grizzly Bear	Personal Observation		.02	.01	.01
	Sign Discovery		.20	.26	.28
	Visitor Observation	.009	.003	.003	.005
Black Bear	Personal Observation		.003	.008	.02
	Sign Discovery		.02	.06	.11
	Visitor Observation	.002	.005	.003	.007
Bighorn Sheep	Personal Observation		.003	.004	.01
	Visitor Observation	.006	.003	.003	.002
Coyote	Personal Observation		.003	.03	.04
	Visitor Observation	.002	.005	.01	.02

Grizzly bear observations by backcountry visitors occurred most frequently during May-June and September-October, with observations in July and August occurring at a frequency of three-fifths to one-third of the May-June and September-October values. The frequency of my observations was greatest in July followed by a uniform rate through September. Discovery frequency of grizzly bear scats and tracks corresponded most closely with observation frequencies of the backcountry visitor (Table 11). The fact that personal observation frequencies peaked in July may indicate that a portion of my route of travel encompassed areas of higher July bear density through which the average backcountry group did not travel. Figures 9-13 suggest that there are seasonal shifts in patterns of grizzly bear use.

Visitor and personal observations indicated that the black bear was most frequently observed in September and early October. Discovery frequencies of black bear sign were also highest during this period. Observation of sign and personal black bear observations increased in frequency as the field season progressed. The frequency of black bear observations by backcountry users fluctuated considerably during the field season.

The on- and off-trail observation frequency of each species during each month of the study period is shown in Table 12. Elk were observed more frequently from off rather than on the trail in all months except June. In both sets of data, there was a trend toward peak frequencies



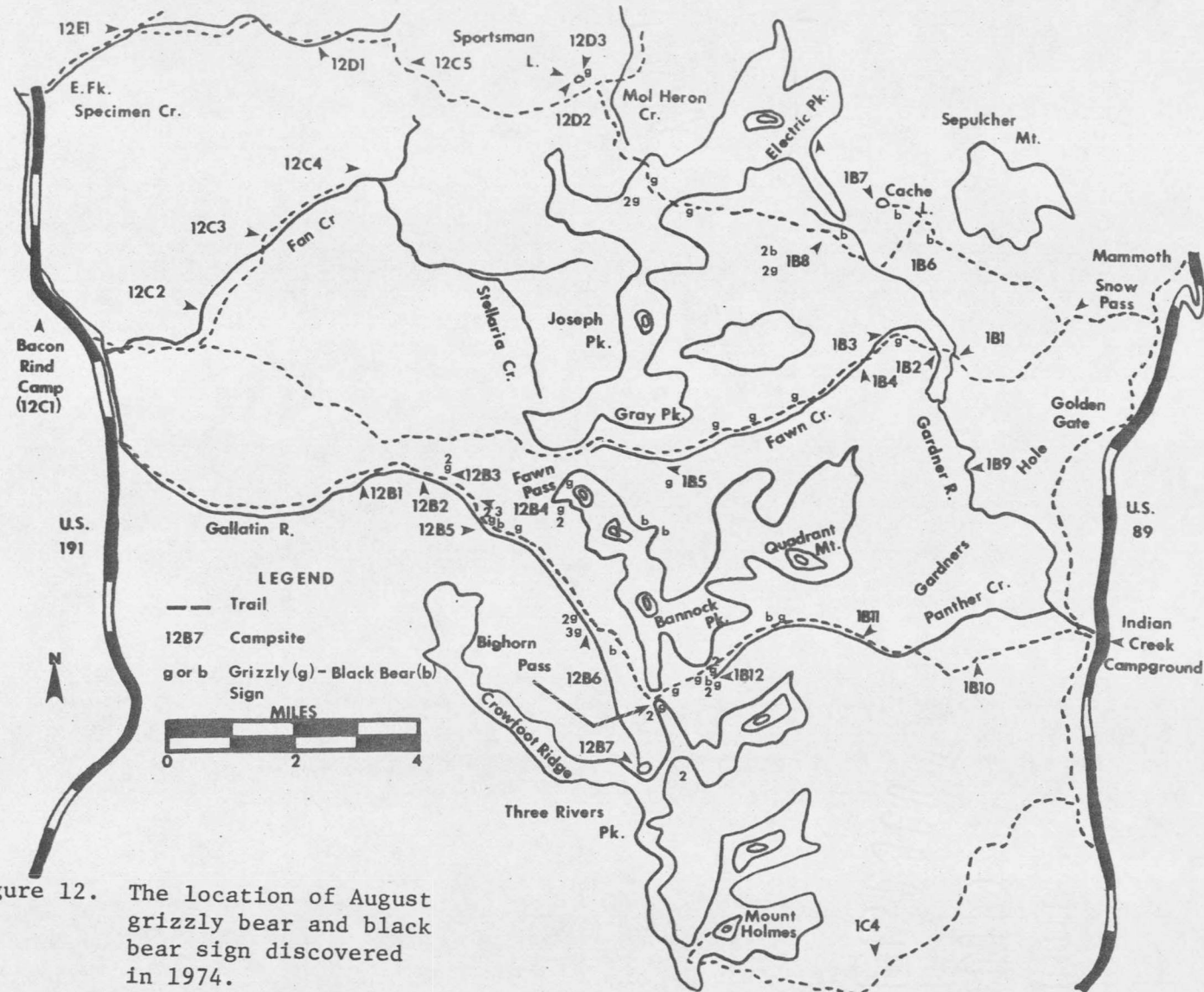


Figure 12. The location of August grizzly bear and black bear sign discovered in 1974.

TABLE 12. THE FREQUENCY OF ON- AND OFF-TRAIL OBSERVATIONS OF EACH SPECIES AND DISCOVERY OF BEAR SIGN DURING THE COURSE OF THE FIELD PERIOD.

Species	Form of Interaction	Observations or Discoveries Per Hour							
		On-Trail				Off-Trail			
		May- June	July	Au- gust	September- October	May- June	July	Au- gust	September- October
Elk	Personal Observation		.18	.10	.40		.46	.37	.69
	Visitor Observation	.06	.03	.04	.07	.04	.07	.11	.18
Mule Deer	Personal Observation		.03	.04	.07		.05	.05	.10
	Visitor Observation	.01	.009	.01	.01	.03	.02	.02	.02
Moose	Personal Observation		.05	.08	.09		.04	.02	.02
	Visitor Observation	.03	.03	.04	.03	<.01	.03	.02	.04
Grizzly Bear	Personal Observation		<.007	.007	.008		.04	.01	.01
	Sign Discovery		.13	.31	.23		.29	.18	.34
	Visitor Observation	.01	.003	<.001	.004	<.01	.006	.02	.01
Black Bear	Personal Observation		.007	.007	.008		<.007	.01	.04
	Sign Discovery		.04	.09	.07		<.02	<.02	.16
	Visitor Observation	.003	.007	.001	.004	<.01	<.006	.02	.02
Bighorn Sheep	Personal Observation		<.007	<.007	<.008		.007	.01	.03
	Visitor Observation	.005	.001	<.001	.002	<.01	<.006	.02	.02
Coyote	Personal Observation		.007	.03	.03		<.007	.02	.06
	Visitor Observation	.003	.004	.009	.01	<.01	.01	.03	.07

of on-trail observation in early summer and early fall. Off-trail frequencies either mirrored this trend or steadily increased from June through September. The aerial surveys reflect the above trend in on-trail observability. During the June 23 flight, 27 percent of the elk observations were in sections with a trail in them, and on the October 14 flight, 25 percent. These percentages compare with only 14 percent on the August 18 flight.

Mule deer were most frequently observed from off the trail during all months of the study period. Personal on- and off-trail observation frequencies of deer remained relatively constant during July and August but increased sharply in September and early October. The frequency of backcountry visitor on-trail observations of deer remained nearly static during the entire study period, while the frequency of off-trail observations dropped from June to July, then remained constant through September.

With the exception of July and September-October backcountry visitor observations, moose were most frequently seen from on the trail during all periods of the field season. Personal data generally showed increasing frequencies of on-trail observations and decreasing off-trail frequencies as the season progressed. In contrast, backcountry visitor observation frequencies for on-trail areas remained relatively constant while the frequencies in off-trail areas fluctuated considerably.

Grizzly bear were most frequently observed from off the trail in nearly all months of the study period except for a higher on-trail frequency reported by backcountry visitors in June. In both sets of data, the greatest frequency of on-trail observation occurred in June and/or September with the lowest frequency occurring during July and August. Off-trail frequencies reflected the opposite with peak frequencies of off-trail grizzly bear observations coming in either July or August. The sign data indicated that grizzly bears would be most frequently encountered off rather than on the trail in July and September-October and on the trail in August. However, most of the on-trail sign observed in August was discovered near the end of the month, indicating an end of season trend toward relative equalization of on- and off-trail use by grizzly bears. This seems to be verified by the increased September on- to off-trail discovery frequency ratio as compared to that of July.

Personal and backcountry visitor data both showed that the frequency of on-trail black bear observations exceeded off-trail observations in May-June and July and was less than off-trail observations in August and September-October. Black bear sign were discovered more frequently on, as compared to off, the trails in July and August and off the trails in September-October. Personal on-trail observation frequencies remained quite constant during the field period, while backcountry visitor on-trail observation frequencies and on-trail sign

discovery frequencies fluctuated considerably with no apparent trend. Off-trail observation and discovery frequencies all tended to increase as the season progressed.

Factors Influencing Contacts Between Humans and Wildlife

The nature of the human-wildlife interface in a given area is dependent upon a number of factors such as topography, weather, distribution and phenology of vegetation, distribution of food and water, elevation of the area, species behavior and numbers, visitor behavior and numbers, and the temporal and spacial distribution of human use. Several of these factors are discussed below.

Diurnal Observability

Table 13 shows the daily time periods of highest and lowest observability for each species according to personal observations. Elk, moose, and mule deer observations reflect diurnal patterns of activity, with peak observability occurring during early morning and late afternoon or evening. Grizzly bear, black bear, and bighorn sheep were most frequently observed in the morning hours, with a single peak of observability occurring during the 6:00-9:00 a.m. period. In the case of the grizzly bear, the peak was maintained through the morning. Coyote observability fluctuated considerably with no consistent daily pattern of high and low observation frequencies.

TABLE 13. THE FREQUENCY OF PERSONAL OBSERVATIONS OF EACH WILDLIFE SPECIES DURING VARIOUS PERIODS OF THE DAY, 1973-1974.

Time	Observations Per Hour						
	Elk	Moose	Mule Deer	Grizzly Bear	Black Bear	Bighorn Sheep	Coyote
6:00 a.m.- 8:59 a.m.	.64	.06	.08	.02	.04	.06	0.0
9:00 a.m.-11:59 a.m.	.35	.03	.04	.02	.01	.01	.03
12:00 p.m.- 2:59 p.m.	.19	.03	.03	.01	.01	.004	.01
3:00 p.m.- 5:59 p.m.	.26	.07	.06	.01	.01	0.0	.03
6:00 p.m.-	.45	.05	.08	.01	.01	0.0	.03

Encounter Distances

It is likely that the distance at which wildlife is first encountered will effect the eventual outcome of an interaction between humans and wildlife. Thus, personal encounter distances were determined for all species combined and for each individual species (Table 14). The data for all species combined showed that encounters occurred most commonly at distances between 100 and 300 feet (30.5 m.-91.5 m.) with over 50 percent of the encounters occurring in this range. Three species, the mule deer, moose, and bighorn sheep, were encountered at distances averaging less than 300 feet (91.5 m.) (Table 14). Although no bears were encountered at distances of less than 100 feet (30.5 m.), 60 percent of the black bear encounters occurred at less than 200 feet (61 m.). The grizzly bear does not appear to be as easily approached with only 12.5 percent of the encounters occurring at distances of less than 200 feet (61 m.). These data are reinforced by the fact that in

TABLE 14. THE PERCENTAGE OF PERSONAL ENCOUNTERS OF EACH SPECIES AND ALL SPECIES COMBINED OCCURRING IN VARIOUS ENCOUNTER DISTANCE CATEGORIES AND THE MEAN DISTANCE AT ENCOUNTER FOR EACH SPECIES.

Encounter Distance Categories	Elk	Moose	Mule Deer	Grizzly Bear	Black Bear	Bighorn Sheep	Coyote	All Species
0' - 99'	6.3%	15.0%	20.0%	0.0%	0.0%	0.0%	16.7%	9.5%
0 m. - 30 m.	n= 7	n= 3	n= 6	n= 0	n= 0	n= 0	n= 2	n=18
100' - 199'	25.9%	45.0%	33.3%	12.5%	60.0%	0.0%	8.3%	28.0%
31 m. - 61 m.	n=29	n= 9	n=10	n= 1	n= 3	n= 0	n= 1	n=53
200' - 299'	22.3%	10.0%	26.7%	25.0%	0.0%	100.0%	33.3%	22.8%
61 m. - 91 m.	n=25	n= 2	n= 8	n= 2	n= 0	n= 2	n= 4	n=43
300' - 399'	8.9%	20.0%	10.0%	25.0%	0.0%	0.0%	16.7%	11.1%
92 m. - 122 m.	n=10	n= 4	n= 3	n= 2	n= 0	n= 0	n= 2	n=21
400' - 499'	16.1%	5.0%	6.7%	0.0%	0.0%	0.0%	8.3%	11.6%
122 m. - 152 m.	n=18	n= 1	n= 2	n= 0	n= 0	n= 0	n= 1	n=22
500' - 599'	8.0%	0.0%	3.3%	12.5%	20.0%	0.0%	0.0%	6.3%
152 m. - 183 m.	n= 9	n= 0	n= 1	n= 1	n= 1	n= 0	n= 0	n=12
600' - 699'	2.7%	5.0%	0.0%	12.5%	0.0%	0.0%	0.0%	2.6%
183 m. - 213 m.	n= 3	n= 1	n= 0	n= 1	n= 0	n= 0	n= 0	n= 5
700' - 799'	5.4%	0.0%	0.0%	12.5%	0.0%	0.0%	0.0%	3.7%
213 m. - 244 m.	n= 6	n= 0	n= 0	n= 1	n= 0	n= 0	n= 0	n= 7
800' - 899'	.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
244 m. - 274 m.	n= 1	n= 0	n= 0	n= 0	n= 0	n= 0	n= 0	n= 1
900' - 999'	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.3%	0.5%
274 m. - 305 m.	n= 0	n= 0	n= 0	n= 0	n= 0	n= 0	n= 1	n= 1
≥ 1000'	3.6%	0.0%	0.0%	0.0%	20.0%	0.0%	8.3%	3.2%
≥ 305 m.	n= 4	n= 0	n= 0	n= 0	n= 1	n= 0	n= 1	n= 6
Mean Distance at Encounter	355' 108 m. n=112	226' 69 m. n=20	217' 66 m. n=30	398' 121 m. n=8	464' 142 m. n=5	274' 84 m. n=2	363' 111 m. n=12	

60 percent of the cases where I observed grizzlies, the bear was aware of my presence. In contrast, this only occurred in 37.5 percent of the black bear observations.

The average encounter distance for each species is undoubtedly related to the nature of its habitat, particularly the cover, and to the behavioral characteristics of the animal.

Initial Activity Upon Observation or Encounter

When wildlife is encountered or observed, two categories of wildlife activity are of interest: the initial activity immediately upon observation or encounter, and the ultimate response to the human presence. Initial activities were categorized into resting, feeding, alert response, ambling, and running. The most common activity of all species combined at the point of observation or encounter was feeding and the least common activity was resting (Figure 14). Feeding was the most commonly observed activity at the time of observation or encounter of elk, moose, grizzly bear, black bear, and bighorn sheep. In contrast, deer and coyotes were most often alert or running when they were first noticed. Less than 10 percent of the observations or encounters of bighorn sheep and moose involved an initial fleeing activity. This compares to 12.5 percent for grizzly bears. The absence of fleeing activity combined with the low encounter distance of moose suggests that one would be quite likely to confront a

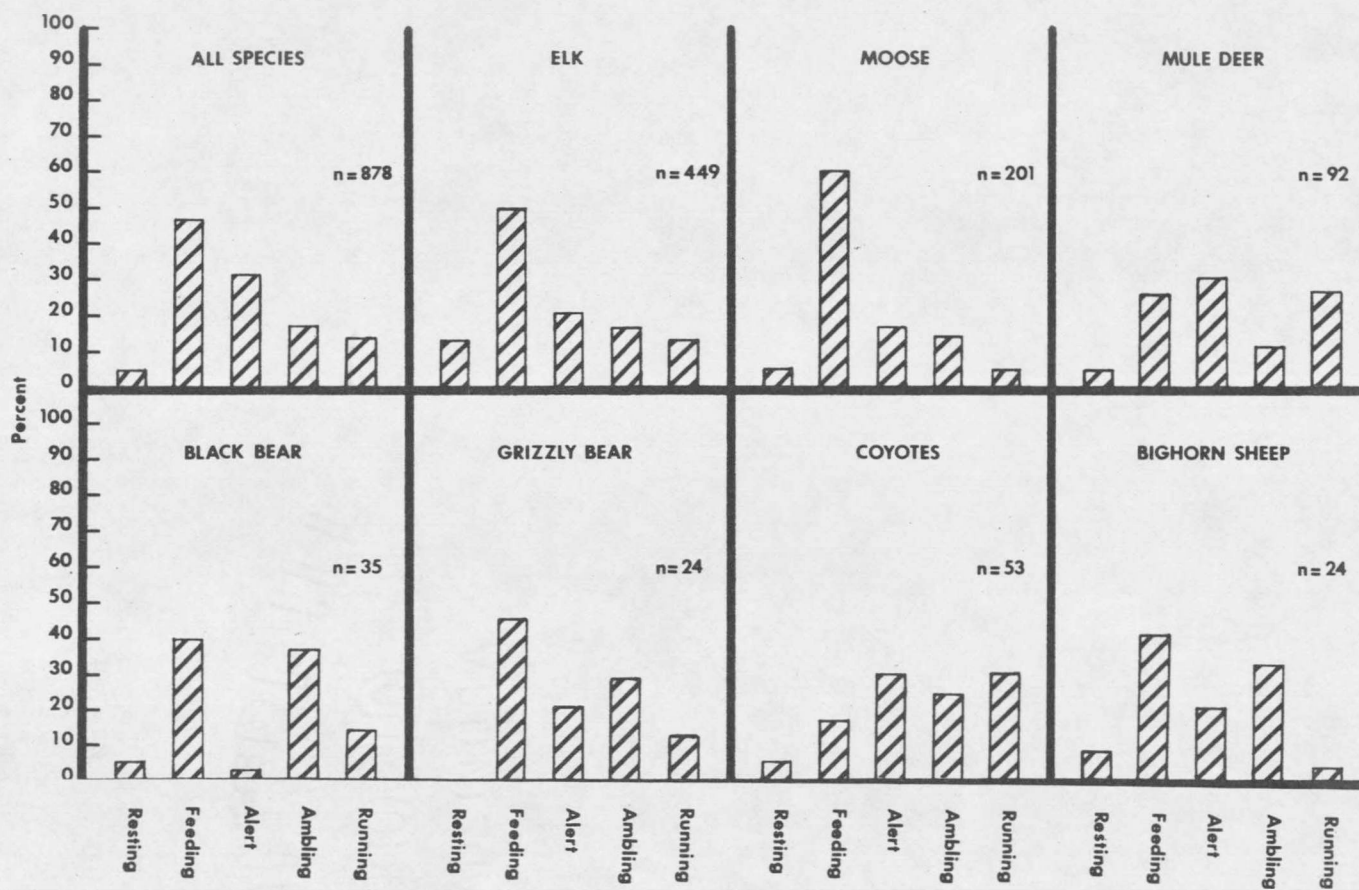


Figure 14. The initial activities of all species combined and of each species upon encounter or observation by the investigator and the backcountry visitor.

stationary moose at very close distances. Black bear appeared to be relatively oblivious to the human presence with just over 15 percent of the observations or encounters involving either initial alert or running responses.

Wildlife Response to the Presence of Humans

Two categories of wildlife response to the human presence were examined: alert responses including flight, and aggression. Since my efforts to obtain flight distances and distances of flight undoubtedly modified the normal response of a given species to the human presence, only backcountry visitor results were examined in terms of alert responses of elk, moose, mule deer, coyotes, and bighorn sheep. Both sets of data were used in analysis of bear alert responses and aggressive responses of all species.

Table 15 shows the percent of occurrence of alert flight and stationary alert responses during visitor observations or encounters of each species and for personal encounters with black and grizzly bears. Flight following aggressive response was not included in the flight percentages. These were not the only responses reported. However, due to my inability to always distinguish encounters from observations in the questionnaires, I was able to utilize only the two categories implying awareness of the human presence by wildlife. The relative comparison of these two categories shows that the ratio of

TABLE 15. A SPECIES COMPARISON OF THE PERCENTAGES OF OCCURRENCE OF ALERT FLIGHT AND STATIONARY ALERT RESPONSE DURING WILDLIFE OBSERVATIONS AND ENCOUNTERS.

Species	Total Number	Percentage of Occurrence	
		Alert Stood Ground	Alert Flight Running or Walking
Elk*	214	15.9% n=34	40.7% n=87
Moose	164	24.4% n=40	34.1% n=56
Mule Deer	53	9.4% n= 5	64.2% n=34
Grizzly Bear			
Visitor**	7	0.0% n= 0	85.7% n= 6
Personal**	6	0.0% n= 0	83.3% n= 5
Black Bear			
Visitor**	17	5.9% n= 1	94.1% n=16
Personal**	3	0.0% n= 0	100.0% n= 3
Coyote	39	7.7% n= 3	74.3% n=29
Bighorn Sheep	19	10.5% n= 2	52.6% n=10

*Elk, moose, mule deer, coyote, and bighorn sheep percentages are based upon backcountry visitor results.

**Analysis of encounters only.

the stationary alert response to the alert flight response was far greater in moose than in any other species. Interestingly enough, the ratio was least in the bears. Not once during the study period did I encounter a bear which ultimately stood its ground. Similarly, the backcountry visitor reported only one such case, a black bear standing its ground while a cub was in a tree. A further analysis of all bear observations or encounters is shown in Appendix Tables 27 and 28.

A number of different alarm reactions on the part of mule deer and elk were observed. These reactions were usually components of the alarm posture described by Geist (1971a) and included strutting parades, forelimb stomping, head elevated movement, and defecation. With the exception of defecation, these reactions were not generally observed in the other species. Flight in elk usually consisted of an alert trot or gallop. Stotting and alert walking occurred on rare occasions. Mule deer flight consisted primarily of rapid bounding movement. Moose often appeared reluctant to flee and utilized a slow alert trot when they did so. Bears generally fled with a deceptively fast lumbering gait. However, one grizzly bear walked slowly off after becoming aware of my presence. All species had a tendency to stop after a distance and stare back at the source of alarm. This was particularly pronounced in the coyote, with his flight punctuated by numerous stops. Limited data was gathered on the initial distance of flight. Moose (n=25), elk (n=9), and mule deer (n=8), fled an average of 128 feet

(39 m.), 136 feet (41.5 m.), and 176 feet (53.7 m.), respectively, before stopping. That distance was 270 feet (82.3 m.) for the grizzly bear (n=1), and 198 feet (60.4 m.) for the black bear (n=1). The distance of flight for two coyotes averaged 58 feet (17.6 m.).

Backcountry visitors reported eight wildlife encounters which I considered to exhibit aggressiveness on the part of the species involved. Moose were the antagonistic species in six of the eight incidents (3.4 percent of the total moose observations) while bears were involved in the others (3.4 percent of the black bear observations; one bear incident was not observed). In all of the moose encounters, the backcountry visitors were approached. Two encounters involved cows with calves. In one of these cases, the cow forced the hikers off the trail, while in the other the cow "snorted and advanced" upon approach of the party. In a third incident, a cow trotted toward the visitor until he moved into the trees. Bull moose were involved in three cases, one in which a solitary bull was startled at close range. In the other two episodes, a bull in the presence of another bull "snorted and charged" and a bull browsing with two others lowered its rack and approached. The latter incident was terminated upon the backcountry visitor disappearing from sight and initiated again upon the reappearance of the visitor.

One of the bear incidents occurred in the Bacon Rind parking lot, where a pickup camper was damaged. Food was stored in the camper at

the time. The other case involved a two year old black bear which entered camp 1B-10. He was chased off by campers after approaching to within 20 feet (6.1 m.). It should be noted that during the summer of 1975, two grizzly bear maulings occurred in the Gallatin Range.

Despite a constant effort during the study period to elicit either flight or aggressive responses in wildlife, there were only six personal cases in which I felt aggression possibly was the dominant behavior. Elk were involved in three of the incidents (1.2 percent of the elk observations), moose in two (5 percent of the moose observations), and grizzly bear in one (10 percent of the grizzly bear observations). All three elk cases involved bulls. Two of them were probably related to the rut, as they occurred on 15 September and 2 October. In the 15 September incident, the elk bugled and rapidly approached me. He came to within 116 feet (35.4 m.) before halting and rapidly retreating into the trees. In the second case, an elk, originally estimated to be 1320 feet (402 m.) from me, haltingly approached to within 457 feet (139 m.) before stopping. He then fled upon my approach. The third elk incident occurred in July. I was on horseback, while a second person was standing beside his horse. A bull elk which we had been observing started a stumbling, halting run toward us while nodding his head and antlers. When he had approached to within 176 feet (53.6 m.) the person on foot made a move to mount the horse. The bull then veered and fled. In all three cases, I remained stationary in the

face of the approach.

The two moose incidents involved cows. In one case, I was forcing a flight response and had approached a cow, a calf, and a bull to a distance of 138 feet (42 m.). The calf fled, closely followed by the bull. The cow started to flee but then turned about and ran a few steps toward me and stopped. She fled upon my continued approach. The other moose incident occurred when I encountered an obviously aggravated moose at a distance of 94 feet (29 m.). It snorted, had a noticeable shoulder hump and its hackles were raised. It fled upon my approach.

The grizzly bear incident occurred on 7 August 1973 on Electric Peak when I encountered a sow and two 2 year olds twice within 15 minutes. These bears fled at the first encounter and were unaware of my presence on the second until I alerted them. At that point I was 902 feet (275 m.) from the bears. Upon being disturbed, all three bears stopped grazing and became very alert. They then ran toward the trail and toward me. After 40-50 feet (12-15 m.), they bunched up and stopped, remaining motionless for several seconds. They then resumed their approach and came 295 feet (90 m.) closer to me. The bears halted when I shouted and waved my arms. The sow stood up momentarily, then fled with one cub in front of her and one behind.

I experienced 13 other cases of approach in reaction to my presence. Nine of the cases involved elk, three involved deer, and

one involved a coyote. Most of these incidents consisted of approaches of less than 15 feet (5 m.). I attributed them to curiosity on the part of the species involved. The three cases where bears rose on their hind legs in response to my presence likewise appeared to be the result of curiosity. It is interesting to note that without exception wildlife yielded either to my stationary presence or straightforward approach.

The Intensity of Human Use and the Human-Wildlife Interface

It was hypothesized that one likely effect of human visitation upon wildlife in the Gallatin Range would be a shift in distribution of wildlife away from areas of intense human activity. This type of behavior has been reported for elk by Ward *et al.* (1973), for bighorn sheep by Dunaway (1971) and Geist (1971a), for red deer and chamois by Douglas (1971) and Batcheler (1968), and for ungulates in general by Geist (1971b). Similar shifts in distribution of wildlife as the result of the human presence in the Gallatin Range might be reflected in decreasing observation frequencies per party as the intensity of human use increases. Observation frequencies were examined for each month over the study area as a whole, and for each portion of the study area over the entire study period. If both cases were to reflect decreased observation frequencies as the intensity of human use increased, it could probably be said that visitor use was at least

partially responsible for shifts in wildlife distribution. Figure 15 shows a general inverse relationship on a monthly basis between intensity of human use and the frequency of wildlife observations. To further quantify the association between these two non-parametric variables, Kendall's Rank Correlation Coefficient (Campbell, 1974) was calculated (Table 16). The test was done on the six individual monthly periods that I spent in the field and on the eight monthly periods for which visitor results were examined. The inverse relationship evident in Figure 15 tends to be verified by these tests (Table 16). Generally, the inverse relationship between the intensity of human use and frequency of wildlife observation is strongest in backcountry visitor results.

However, when the association between the intensity of human use in a given on-off trail complex and the frequency of observation in that complex is examined, an inverse relationship is not apparent (Figures 16 and 17). In fact, the coefficients for both personal and questionnaire data are slightly to moderately positive (Table 16). With the exception of the association between man traverses and personal observation frequencies, there appears to be little relationship between the intensity of visitor use in a given area and the frequency of wildlife observation in that area.

The elk pellet group transects also were used to assess the relationship between intensity of human use and the amount of wildlife

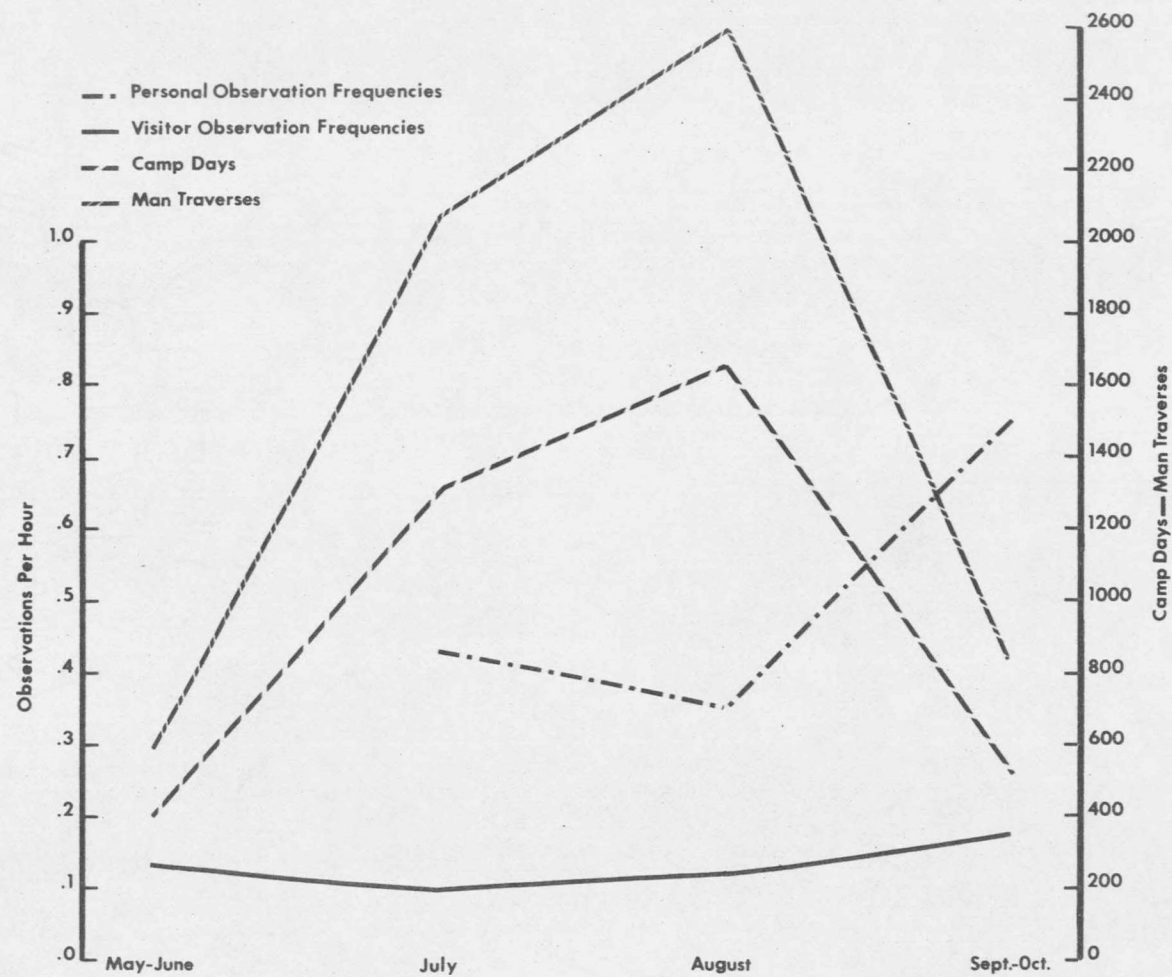


Figure 15. A monthly comparison of the intensity of human use in the study area with personal and visitor wildlife observation frequencies.

TABLE 16. KENDALL'S COEFFICIENTS OF RANK CORRELATION FOR MONTHLY AND AREA ASSOCIATION BETWEEN INTENSITY OF HUMAN USE OF THE STUDY AREA AND PERSONAL AND VISITOR WILDLIFE OBSERVATION FREQUENCIES.

Measure of Human Use	Monthly		Area	
	Personal	Visitor	Personal	Visitor
Man Traverse	-.333* P=.47 n=6	-.473 ~ P=.18-.11 n=8	+.451 P=.24 n=7	+.074 P=.90 n=8
Camp Day	-.467 P=.27 n=6	-.545 ~ P=.11-.06 n=8	+.150 P=.77 n=7	+.074 P=.90 n=8

*A value of plus one shows a positive relationship; zero, no relationship; and minus one an inverse relationship. The P value is the probability of obtaining a given coefficient when the population rankings of the two variables are unrelated.

usage of an area. An analysis comparing six camp transects with six controls over the two year period reflected lower elk usage on the camp transects. In 11 of 16, or nearly 70 percent of the cases involving the six camp and six control transects, the controls had more elk scats per acre than the camp transects, indicating limited shifts in elk distribution (Table 17). A T test indicated that the mean number of pellet groups per acre on the control transects (74.8) was significantly greater than the mean number on the camp transects (31.6), ($P \leq .05$).

Although an inverse relationship was apparent between intensity of human use and frequency of wildlife observation on a monthly basis,

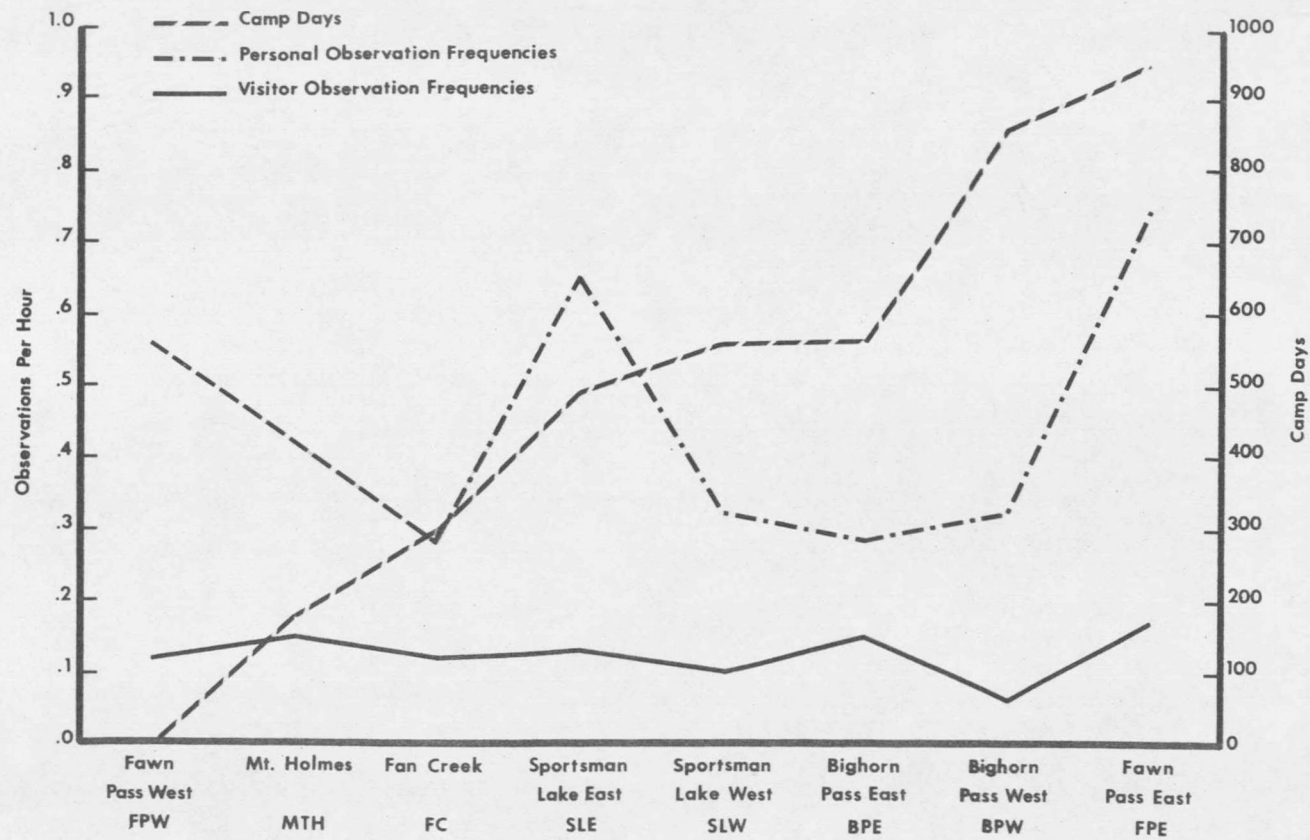


Figure 16. An area comparison of total camp days with personal and visitor wildlife observation frequencies.

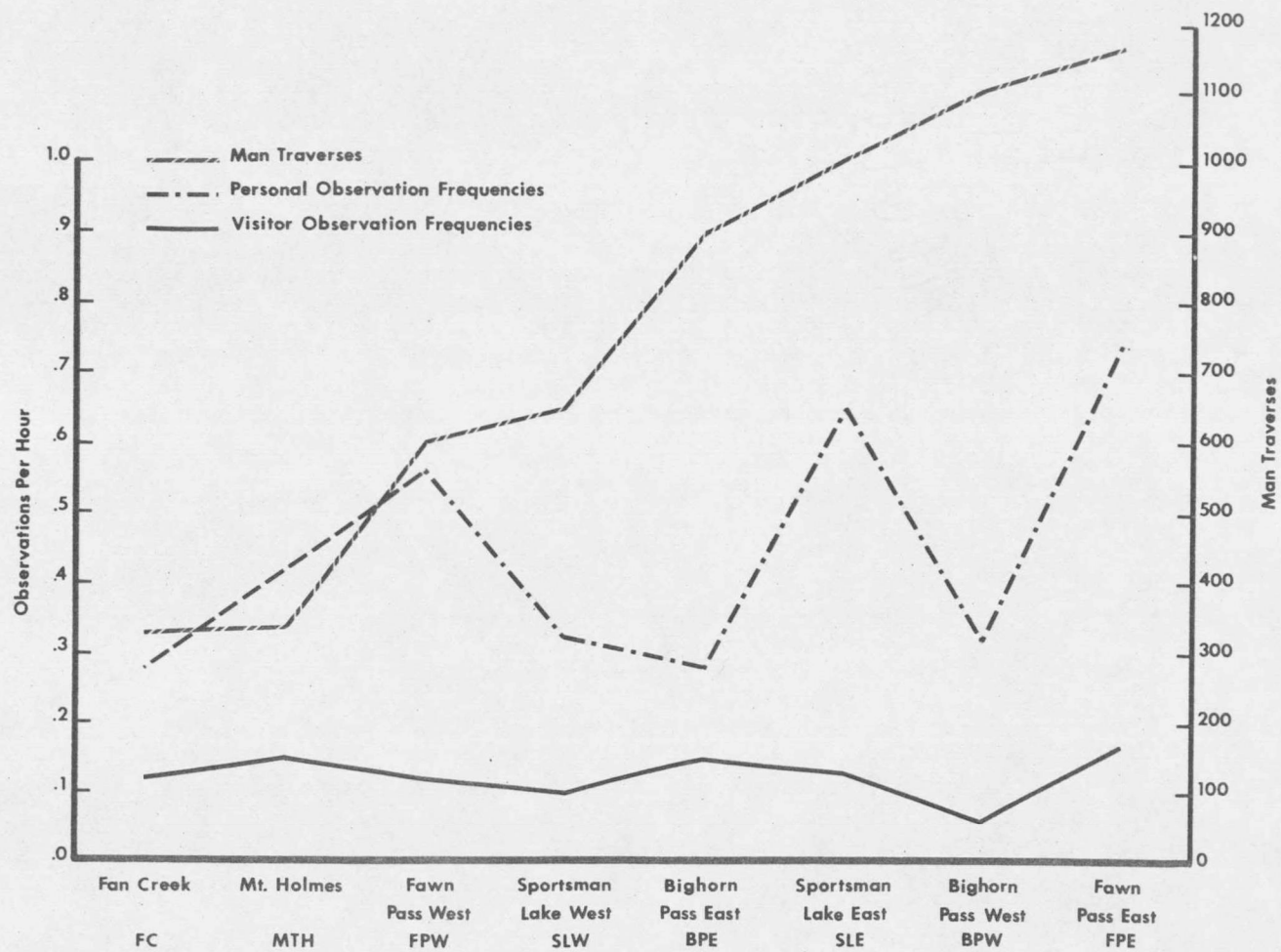


Figure 17. An area comparison of total man traverses with personal and visitor wildlife observation frequencies.

TABLE 17. A COMPARISON OF THE NUMBER OF ELK PELLET GROUPS PER ACRE ON TRANSECTS LOCATED IN THE VICINITY OF CAMPSITES WITH THE NUMBER OF PELLET GROUPS PER ACRE ON CONTROL TRANSECTS REMOTE FROM CAMPSITES.

Transect	Elk Pellet Groups Per Acre		
	Trips 1 & 2 ~July	Trips 2 & 3 ~August	Trips 5 & 6 ~September-October
<u>1974</u>			
#5 - Camp	20.8	116.7	25.0
#5 - Control	150.0	212.5	137.5
#10 - Camp	16.7	16.7	16.7
#11 - Control	100.0	116.7	16.5
#17 - Camp	0.0	50.0	75.0
#18 - Control	12.5	50.0	37.5
#23 - Camp	100.0	0.0	25.0
#22 - Control	33.4	0.0	68.8
<u>1973</u>			
#11 - Camp		13.2	9.9
#8 - Control		92.4	66.0
#22 - Camp		16.5	3.3
#20 - Control		62.7	6.6

the intensity of human use in a given complex appeared to have little or no effect upon the frequency of observation. Thus, it seems unlikely that the intensity of human use in the study area was generally responsible for shifts in wildlife distribution, as evidenced by changing frequencies of observation. Other factors would seem to be responsible. Nevertheless, the transect information does suggest that recurring, long period use of a limited area has an effect upon wildlife.

Elevation and Human-Wildlife Interactions

Data summarized in Figure 18 shows a trend toward higher frequencies of wildlife observations in the complexes with the highest average trail elevations (Spruce-Fir and Alpine Tundra Zones). Kendall's coefficients of rank correlation for these two variables tend to verify the above relationship with values of $+ .50$ ($n=7$, $P=.24-.14$) for personal results, and $+ .59$ ($n=8$, $P=.06$) for the back-country visitor. The reason for this relationship is apparent upon examination of the average observation elevations for each species (Table 18). All species except the moose were observed at elevations in excess of the study area's average trail elevation (7935'-2419 m.). Thus, the higher elevation trail areas more nearly approach the elevations at which most wildlife species are to be found.

There is considerable monthly variation in observation elevations (Table 18) for each species. Monthly variations in wildlife elevation are likely to affect the frequency and nature of wildlife observations. The big game species could be divided into two categories, those that migrated from low to high elevations (elk and grizzly bear) and back to low elevations during the course of the study period and those that remained either relatively static (black bear, moose, and mule deer) in their elevational distribution or moved upward without a corresponding downward movement during the study period. The elevational migration of the grizzly bear in the Gallatin Range was observed by

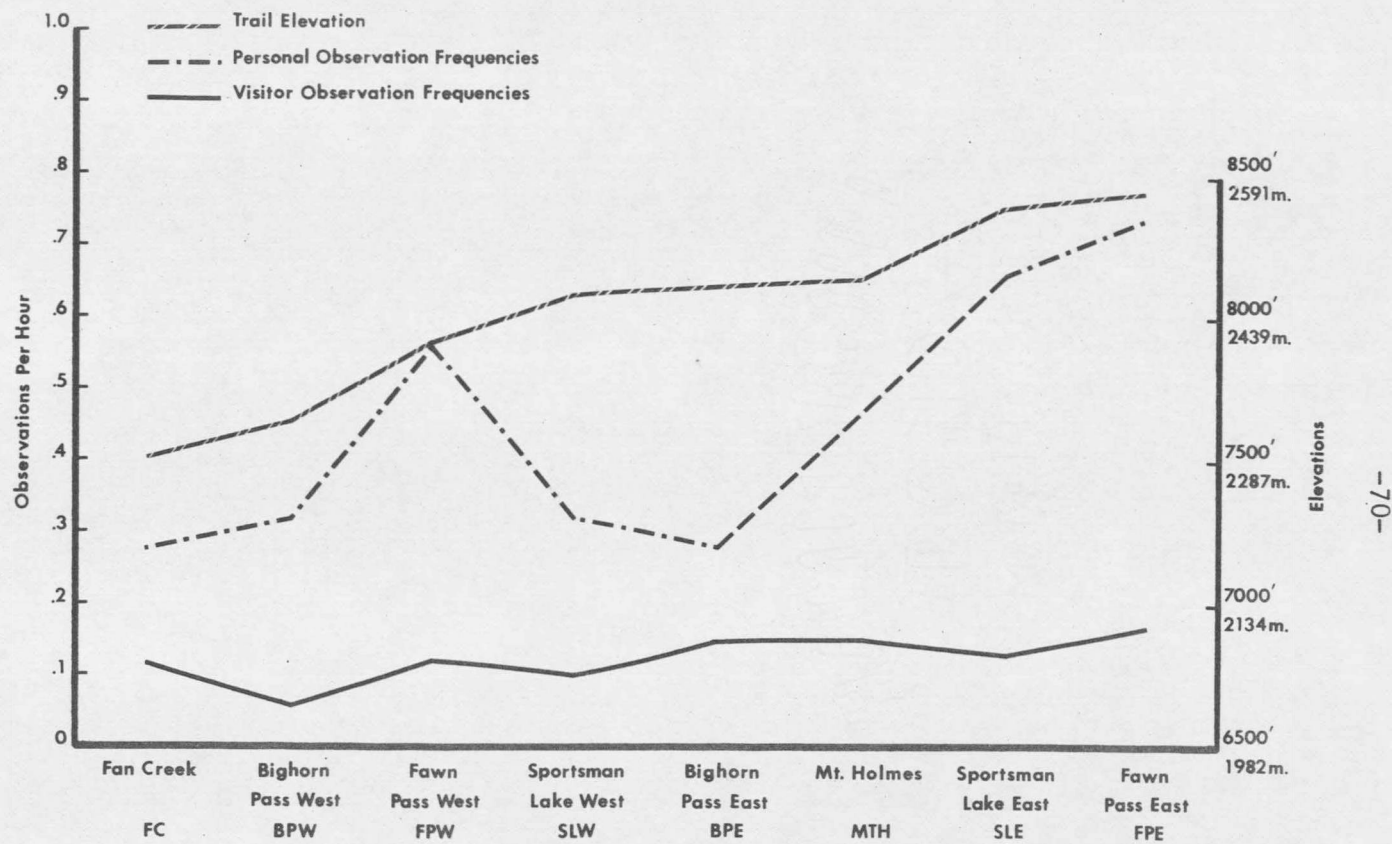


Figure 18. A comparison of the trail elevations of individual areas of the Gallatin Range with the frequencies of wildlife observations in those areas.

TABLE 18. MONTHLY AND SEASONAL AVERAGE OBSERVATION ELEVATIONS FOR EACH SPECIES AND MONTHLY AND SEASONAL AVERAGE SIGN DISCOVERY ELEVATIONS FOR BLACK AND GRIZZLY BEARS.

Species	Average Observation or Discovery Elevations				Season Average
	May-June	July	August	September-October	
Elk	8339'* 2542 m. n=49	9161' 2793 m. n=88	8874' 2705 m. n=103	8398' 2560 m. n=181	8667' 2642 m. n=421
Moose		7660' 2335 m. n=10	7694' 2346 m. n=14	8020' 2445 m. n=18	7826' 2386 m. n=42
Mule Deer	7880' 2402 m. n=2	8495' 2590 m. n=11	8427' 2569 m. n=11	8586' 2618 m. n=22	8496' 2590 m. n=46
Grizzly Bear	9772' 2979 m. n=1	9246' 2819 m. n=5	9336' 2846 m. n=5	8865' 2703 m. n=2	9262' 2824 m. n=13
Grizzly Bear Sign	8404' 2562 m. n=9	9120' 2780 m. n=39	8531' 2601 m. n=45	8398' 2560 m. n=36	8663' 2641 m. n=129
Black Bear	7940' 2421 m. n=2	9080' 2768 m. n=1	8550' 2607 m. n=2	8884' 2709 m. n=5	8648' 2637 m. n=10
Black Bear Sign	8280' 2524 m. n=1	8160' 2488 m. n=15	8361' 2549 m. n=15	8588' 2618 m. n=11	8347' 2545 m. n=42
Bighorn Sheep	9653' 2942 m. n=3	8600' 2622 m. n=1	9200' 2805 m. n=1	9261' 2823 m. n=9	9294' 2833 m. n=14
Coyote		8800' 2683 m. n=1	7913' 2413 m. n=6	8494' 2590 m. n=12	8327' 2539 m. n=19

*Averages are based upon personal ground and aerial observations.

Mealey (1975). Work by Martinka (1972) and Knight (1975) also indicates that grizzlies use a relatively broad range of elevations.

Elevational movements resulted in seasonal variation in the utilization of the study area's vegetation zones. Bighorn Sheep remained in the Spruce-Fir and Alpine Tundra Zones throughout the study period. In mid-summer grizzly bear and elk inhabited the Spruce-Fir and the Alpine Tundra Zones, while in the early and late field season they inhabited the lower Spruce-Fir and upper Lodgepole Pine Zones. Black bear, mule deer, and coyotes tended to utilize the lower Spruce-Fir and upper Lodgepole Pine Zones throughout the season. The moose was invariably observed in the Lodgepole Pine Zone.

Subject to the limitations of small sample size, there appeared to be an inverse relationship between seasonal elevations of elk and grizzly bear and the frequency of backcountry visitor observations of these animals (Figures 19 and 20). This is probably related to the amount of time spent by the backcountry visitor near or above the average elevation being occupied by these species. Mid-summer upward shifts in the distribution of these species accentuates the difference between the average trail elevation and the average elevations at which elk and grizzly bear are to be found. For example, in the May-June and September-October periods, about 84 percent of the trail system lay below the average wildlife observation elevation. This compares with about 90 percent during the mid-summer. Thus, it is

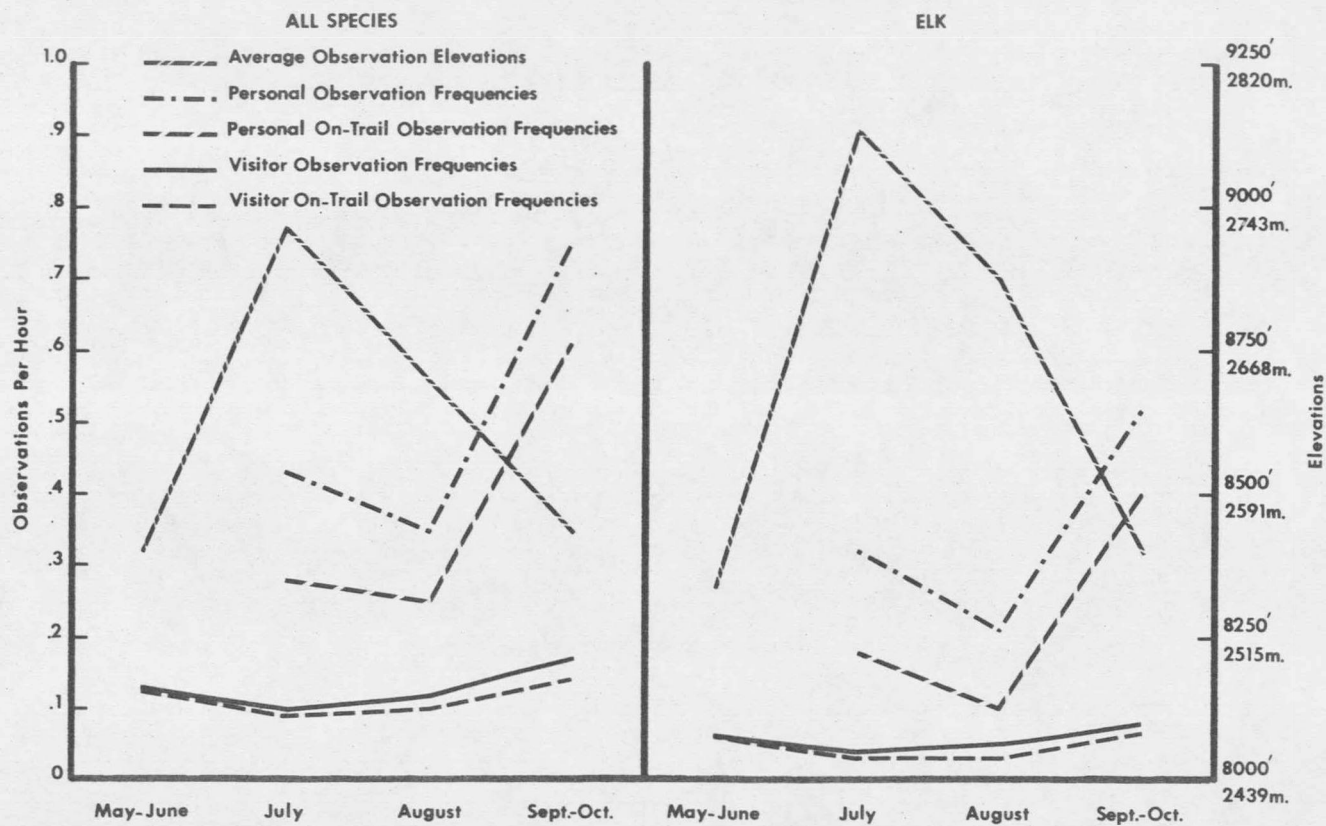


Figure 19. A monthly comparison of the average observation elevations of all species combined and of elk with the frequencies of all observations and on-trail observations of these species.

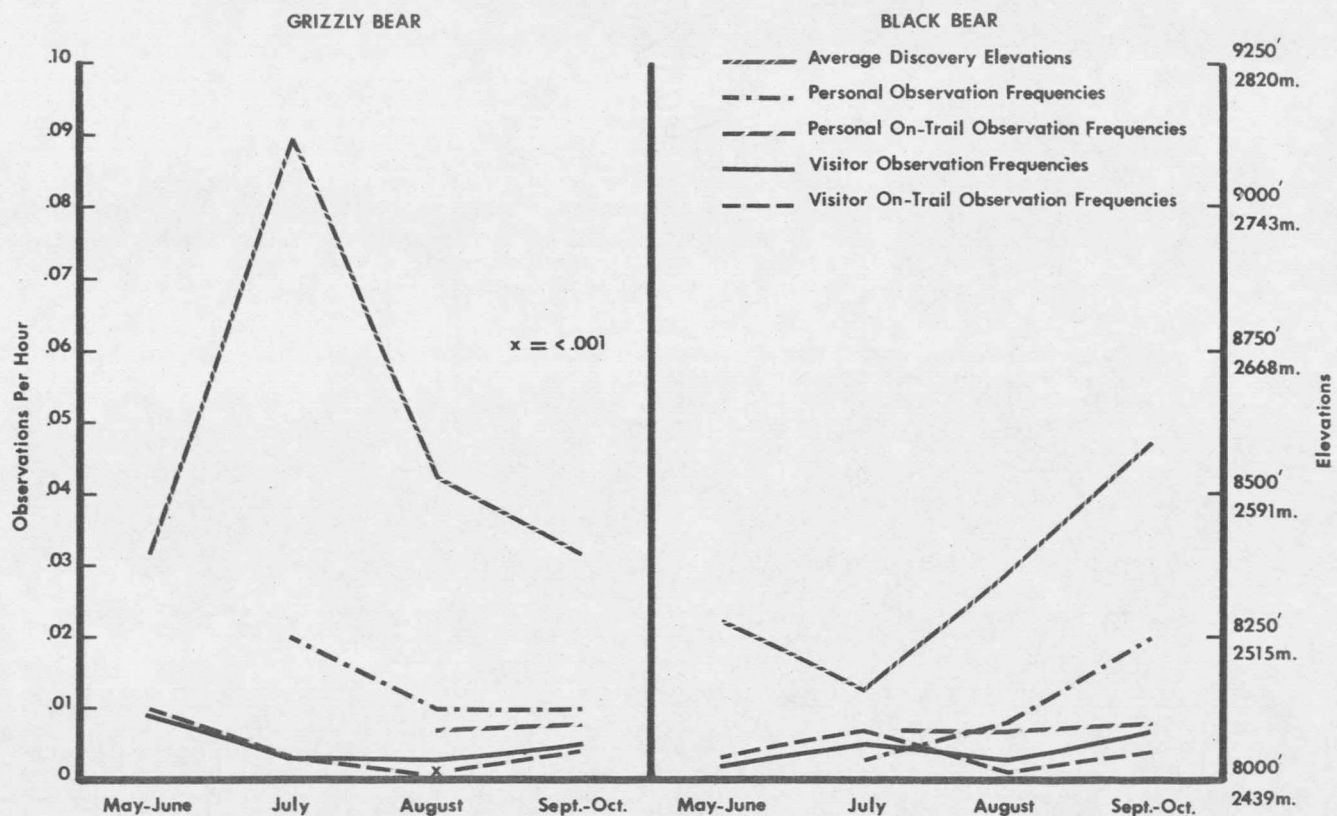


Figure 20. A monthly comparison of the average discovery elevations of black and grizzly bear sign with the frequencies of all observations and on-trail observations of these species.

likely that the amount of time spent by the backcountry visitor near or above occupied elevations would be greatest in early summer and early fall, resulting in high observation frequencies, and least during the mid-summer resulting in low frequencies.

The above relationships for all species, elk, and grizzly bear were not strictly applicable to personal observations as the result of a combination high altitude on- and off-trail and low altitude on-trail travel route (Figures 19 and 20). Mid-summer upward shifts of wildlife resulted in a peak in personal observation frequencies which reflected observations in the high altitude portion of the route while early fall downward shifts also resulted in a peak, this time reflecting observations in the low altitude on-trail portion of the route. In the case of the grizzly bear, the downward movement in August and September-October did not result in increased personal observation frequencies (Figure 20). Nevertheless, sign discovery frequencies increased during this period (Figure 21). Thus, it is likely, especially in light of visitor results (Figure 20), that the potential for increased observation frequencies exists as a result of downward movement. This potential may not be realized as a result of bears being less observable in the lower elevation timbered zones.

Unlike personal results, there was no clear relationship between elevation shifts of black bear, moose, and mule deer and the frequency of backcountry visitor observations (Figures 20, 21, and 22). The

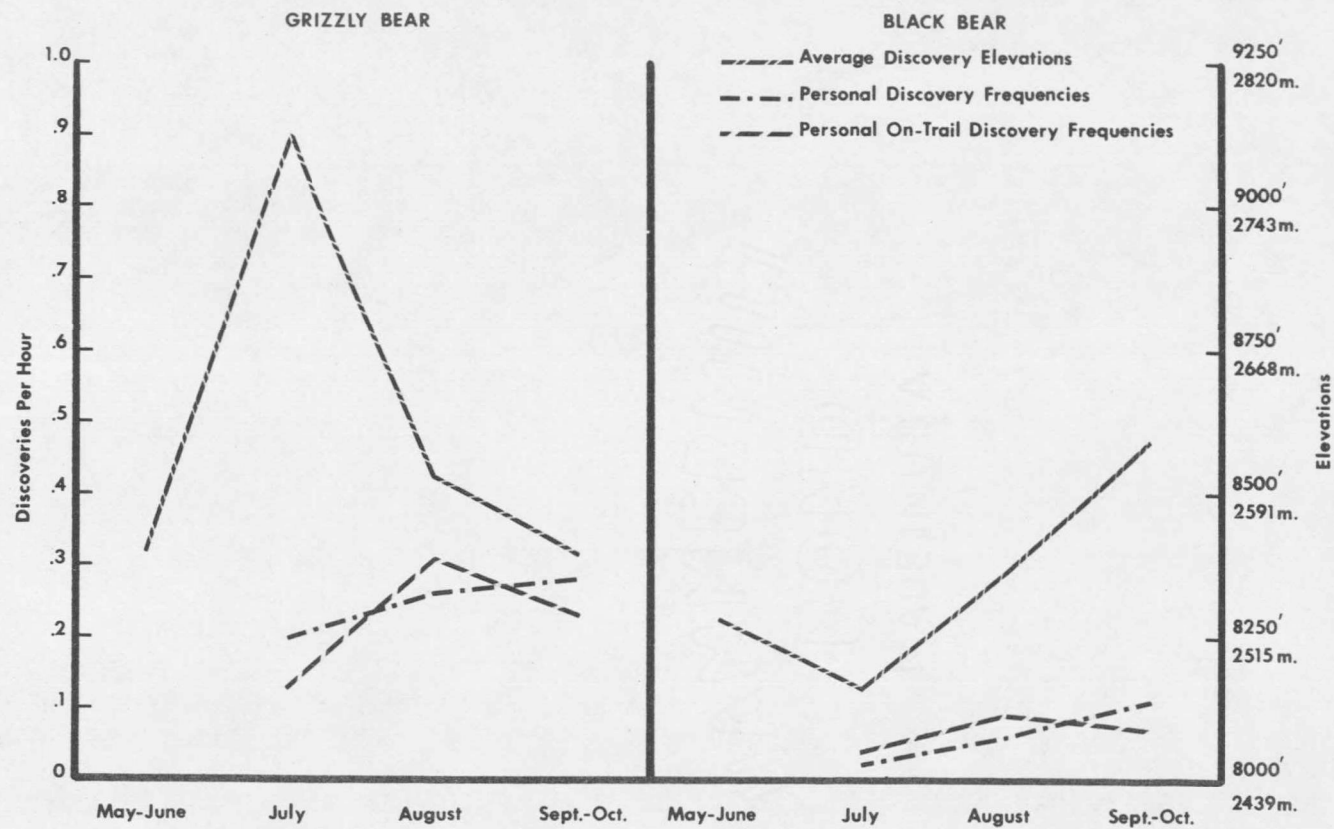


Figure 21. A monthly comparison of the average discovery elevations of black and grizzly bear sign with the frequencies of all sign discoveries and on-trail sign discoveries for each species.

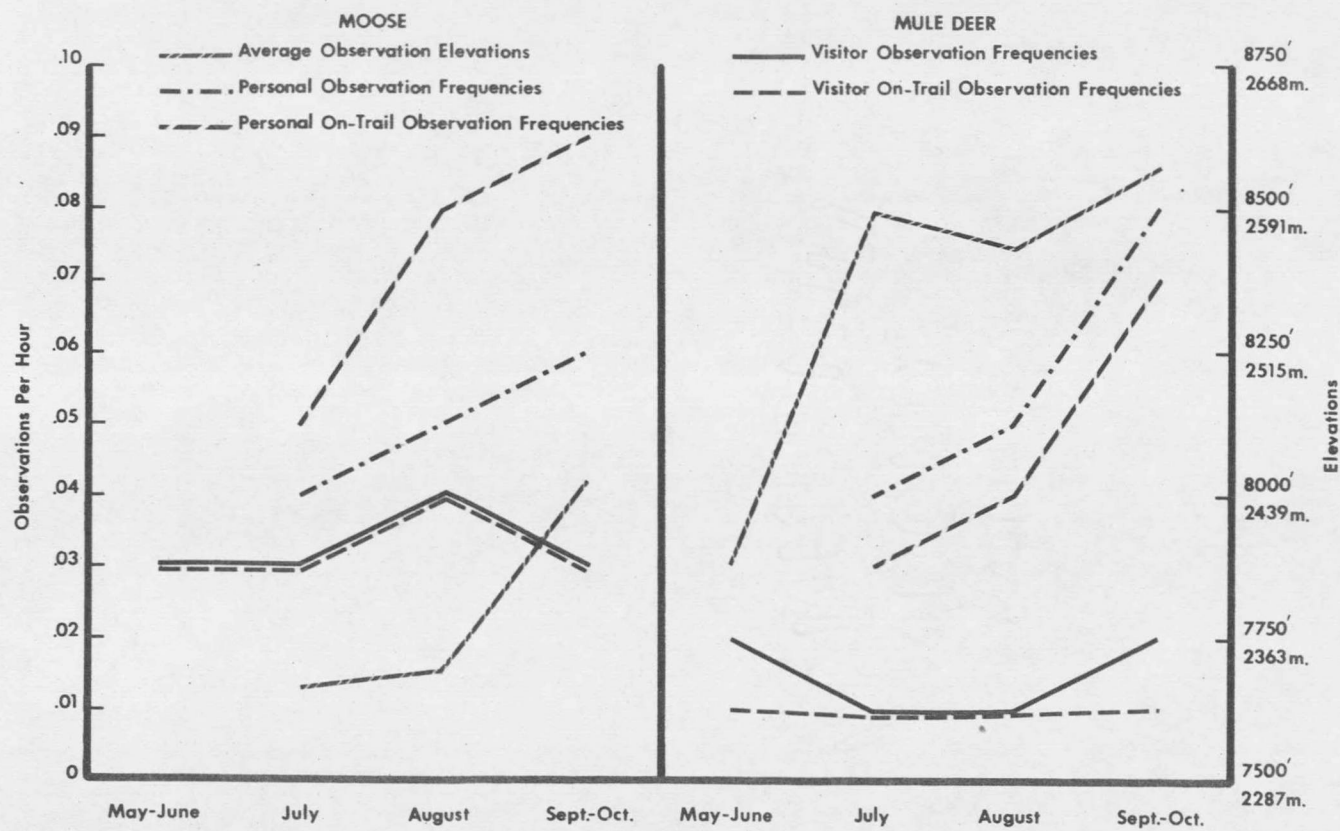


Figure 22. A monthly comparison of the average observation elevations of moose and mule deer with the frequencies of all observations and on-trail observations of these species.

differences between personal and backcountry visitor elevation-observation relationships are again best explained by the differing travel patterns.

A comparison of the different species' on- to off-trail observation frequency ratios show that the ratio tends to increase in those species occupying the lower elevations, (lower Spruce-Fir and Lodgepole Pine Zones), and decrease in those occupying high elevations, (Alpine Tundra and Spruce-Fir Zones), (Tables 7 and 18).

Elevational shifts during the course of the study period also modified the on-trail observability patterns of wildlife. On-trail observation frequencies of all species combined, and elk and grizzly bear tended to peak during periods of relatively low elevation occupancy, i.e., while the species were in the lower Spruce-Fir and Lodgepole Pine Zones (Figures 19 and 20). Discovery frequencies of grizzly sign also followed this pattern (Figure 21). It should be noted though, that a decrease in observation or sign discovery elevations was not invariably followed by an increase in on-trail frequencies. There were no consistent relationships between elevation and visitor on-trail observation frequencies of black bear, moose, and mule deer, while personal results reflected an increase in moose and mule deer on-trail observation frequencies with the upward movement of these species (Figures 20 and 22).

Pellet group transects provided further insight into the relationship between on-trail observations and the elevational movement of elk. As the season progressed from July through September-October, the average number of elk pellet groups per acre on the on-trail transects increased (T test level of significance between July and September-October - $P \leq .30$), (Table 19). Transects divided into altitudinal groups showed that elk use of on-trail transects above 8500 feet (2591 m.) did not vary significantly from mid-summer to fall while elk use of on-trail transects below 8500 feet increased significantly ($P \leq .05$). The increase in on-trail use coincided with decreased observation elevations of elk. Thus, it seems likely that increased on-trail observation frequencies of this species in the early fall are closely related to their downward movement from the Alpine Tundra and Spruce-Fir Zones into the Lodgepole Pine and lower Spruce-Fir Zones.

Visitor Trail and Camp Procedures

A review of trail and camp procedures was made because it was likely that certain activities on the part of the backcountry visitor enhanced or decreased the possibility of human-wildlife interactions.

It has been suggested that numbers provide safety with respect to bear encounters (Herrero, 1970). The administration of Yellowstone National Park has occasionally imposed minimum party sizes on groups entering areas of recent bear activity. The question arises as to

TABLE 19. MONTHLY ELK USE OF ON- AND OFF-TRAIL TRANSECTS OF VARYING ELEVATIONS AS INDICATED BY PELLET GROUPS.

Transects	Pellet Groups Per Acre			Significance Level Between July and September- October Data
	July	August	September- October	
<u>All Elevations</u>				
On-Trail Transects	58.3	62.6	88.7	P _{<} .30
Off-Trail Transects	157.7	157.8	72.6	P _{<} .10
<u>Elevation Groups</u>				
On-Trail Transects <8000' (<2439 m.)	14.2	38.3	55.1	P _{<} .05
On-Trail Transects 8000'-8500' (2439-2591 m.)	0.0	22.5	85.5	P _{<} .05
On-Trail Transects >8500' (>2591 m.)	142.7	112.0	122.2	P _{<} .90
Off-Trail Transects <8000' (<2439 m.)	355.5	175.7	112.0	P _{<} .30
Off-Trail Transects 8000'-8500' (2439-2591 m.)	59.7	117.7	68.8	P _{<} .90
Off-Trail Transects >8500' (>2591 m.)	157.3	164.6	65.6	P _{<} .20

whether the technique of manipulating party size is in fact effective in decreasing the chances of human-wildlife encounters. Table 20 shows

TABLE 20. THE FREQUENCY OF WILDLIFE OBSERVATIONS OF PARTIES OF VARIOUS SIZES.

	Party Size					
	One	Two	Three	Four	Five	>Five
Observations Per Hour	.11	.14	.15	.09	.02	.06
	n=50	n=91	n=27	n=19	n=3	n=6

the relationship between party size and the frequency of wildlife observations. Groups of four or more experienced considerably lower observation frequencies than did groups of one, two, and three. A T test showed that the mean observation frequencies (weighted means) of these two categories of groups were significantly different at the .10 level. Contrary to my expectations, the lowest observation frequencies for parties of 3 or less occurred in single person parties and the second lowest in two man parties. This result could be based upon two factors; the smaller sized parties, i.e. of one and two persons, may have felt more vulnerable to dangerous encounters and thus took greater pains to avoid wildlife encounters, or the frequency of observation may have been a function of the number of potential observers up to an optimum number. The argument for the first is strengthened by the fact that 26 percent of the one man parties used in the Table 20 analysis rated their average noise level at constant and/or repetitive noise for at least part of

their trip, whereas only 23 percent and 15 percent of the two and three man parties did so.

The average size of parties encountering grizzly bears was 2.0 (n=7) persons and black bears 2.5 (n=17). In the case of the grizzly bear, no encounters were reported by parties larger than two persons and only six of seventeen black bear encounters were in this category (Appendix Table 27). All three cases of grizzlies injuring humans in the Gallatin Range in the 70's involved two man parties. It would appear from the above that parties of two or fewer are more prone to encounter grizzlies than are larger sized parties.

Backpacking parties averaged 2.4 persons while all parties averaged 2.8 persons (Table 21). Thus, the average group walking the Gallatin Range is at or near the optimum size for encountering and observing wildlife. Whether or not this is viewed as a desirable situation depends upon the goals of the administration of Yellowstone National Park. In any event, the manipulation of party size would appear to be a useful technique in altering the relationship between humans and wildlife.

A second technique often suggested in the avoidance of wildlife is the use of noise. It has been pointed out that loud noises were not being used immediately prior to any National Park cases of grizzly attack (Herrero, 1970). About 24 percent of the Gallatin backcountry users reported they used continuous and repetitive noises, other than those normally made by travelers, during at least a portion of their

TABLE 21. THE PARTY SIZE DISTRIBUTION OF BACKPACKERS, HORSEBACK RIDERS, AND ALL BACK-COUNTRY VISITOR PARTIES COMBINED, 1973-1974.

	Party Size										
	One	Two	Three	Four	Five	Six	Seven	Eight	Nine	Ten	>Ten
<u>Backpackers</u>											
Numbers of Parties	137	289	76	70	9	12	1	0	0	3	4
Percent of Total	22.8%	48.1%	12.6%	11.6%	1.5%	2.0%	0.2%	0.0%	0.0%	0.5%	0.7%
<u>Horseback</u>											
Numbers of Parties	1	3	4	7	2	6	7	8	4	2	9
Percent of Total	1.9%	5.7%	7.5%	13.2%	3.8%	11.3%	13.2%	15.1%	7.5%	3.8%	17.0%
<u>All</u>											
Numbers of Parties	138	292	80	77	11	18	8	8	4	5	13
Percent of Total	21.1%	44.6%	12.2%	11.8%	1.7%	2.8%	1.2%	1.2%	0.6%	0.8%	2.0%

trip (Table 22). It seems likely that the decreased observation frequencies in party sizes of four or more must be related to the increased disturbance, including a higher noise level, attendant upon larger numbers of people. However, the question arises as to whether artificial noise produced by small parties is really effective in dispersing wildlife. Table 23 shows a comparison of the observation frequencies of parties in the constant and repetitive noise category versus those of parties in the other noise categories. The data do not suggest that noise at the levels commonly used is effective in decreasing the frequency of wildlife observations. Further study with much tighter control on the variables, including odor, is needed.

It is likely that the grouping of the individuals while traveling will affect the noise level of the party and possibly the tendency of a group to encounter wildlife at close range. Table 22 shows the percentages of the parties utilizing various travel configurations. It is interesting to note that 31 percent of the parties were fragmented at least part of their travel time. In addition, over 18 percent of the parties reported they were strung out singly. Data were obtained in 1973 concerning the average distance between members of groups while traveling. The average for 52 of the 57 multiple person parties was 22 feet (6.7 m.) with a range of 0 to 75 feet (0-22.9 m.). Five parties (8.8 percent) reported distances of 200 feet or more (61 m.) between at least one member and the others. One two man group reported a distance of 200 feet (61 m.); two two man parties, 300 feet

TABLE 22. THE DISTRIBUTION OF BACKCOUNTRY VISITOR GROUPS INTO VARIOUS TRAVEL CONFIGURATION, NOISE LEVEL, AND REACTION TO WILDLIFE CATEGORIES.

	Number of Parties	Percent of Total
<u>Travel Configuration</u>		
Group bunched - normal conversation possible	136	69.0%
Group fragmented into small groups of 2 or more	19	9.6%
Strung out singly	37	18.8%
Group fragmented or strung out singly at least part of time	5	2.5%
<u>Noise Level</u>		
Silent	86	33.3%
Periodic conversation at normal levels	95	36.8%
Periodic conversation at normal levels with occasional shouts	16	6.2%
Constant and repetitive noise at least part of the time	61	23.6%
<u>Reaction to Wildlife</u>		
Animals noted - party usually didn't stop	20	8.9%
Animals noted and pointed out - stop occasionally involved	169	75.1%
Animals approached on occasion	20	8.9%
Animals startled or alerted on occasion	16	7.1%

TABLE 23. THE FREQUENCY OF WILDLIFE OBSERVATIONS OF PARTIES OF VARIOUS SIZES UTILIZING CONSTANT AND REPETITIVE NOISE WHILE TRAVELING VERSUS THOSE NOT UTILIZING CONSTANT AND REPETITIVE NOISE.

	Party Size					All Sizes
	One	Two	Three	Four	Five	
<u>Constant and Repetitive Noise</u>						
Observations Per Hour	.12	.12	.11	.13	.05	.12
	n=13	n=22	n=7	n=7	n=1	n=50
<u>Other Noise Categories</u>						
Observations Per Hour	.11	.14	.16	.06	<.04	.12
	n=37	n=69	n=20	n=12	n=2	n=146

(91.5 m.); one five man party over 2000 feet (610 m.); and a second five man party over 1320 feet (402.4 m.). Although minimum party size requirements may be imposed as a measure to lessen the possibility of dangerous encounters, it should be clear from the above that the ultimate effectiveness of this technique depends a great deal upon the travel characteristics of the party.

It is a common occurrence along the roads in Yellowstone National Park to see humans approaching wildlife to dangerously close distances. The reaction of visitors in analogous backcountry situations was of interest. Roughly 9 percent of the parties reporting their actions upon encountering wildlife stated that they did approach wildlife on occasion (Table 22). Another 7.1 percent reported efforts to startle

or alert wildlife. Such actions would seem to represent a considerable potential for detrimental human-wildlife interactions.

In grizzly country, the proper handling of food is of paramount importance. Factors in this regard are the types of food utilized, the ultimate disposition of leftovers and excess food, and the methods used for securing food.

The use of fresh and canned foods, as opposed to dried foods, probably increases the potential for attracting wildlife into camps. Fresh and canned foods, especially the type often used on camping trips, are usually highly odorous and require considerable cooking. The cooking often results in the spattering of food residue around the periphery of the cook site and in the accumulation of food wastes, such as grease and burnt bits of food. Pots and pans so used are difficult to clean. If these are left uncleaned, they become an attractant in themselves. If they are cleaned, food residues are often scattered about the camp, in nearby streams, or burned in the fires. Numerous times during the course of the study I found partially burnt food items in the campfires. Cans present similar cleaning and disposal problems. The fact that nearly 60 percent of those parties returning the questionnaire used fresh or canned foods at one time or another points out a possible problem area (Table 24).

Cleanliness of the backcountry camps also depends upon the disposition of excess food and food containers. Less than 5 percent

TABLE 24. THE DISTRIBUTION OF BACKCOUNTRY VISITOR GROUPS INTO VARIOUS FOOD USE, HANDLING, AND SECURITY CATEGORIES.

	Number of Parties	Percent of Total
<u>Types of Food Utilized</u>		
Dry	101	40.4%
Canned	9	3.6%
Fresh	12	4.8%
Canned or Fresh	9	3.6%
Canned or Fresh on at least part of the trip	117	47.6%
<u>Disposition of Leftovers</u>		
Carried out	82	48.2%
Burned	29	17.1%
Buried	5	2.9%
Dumped	1	0.6%
Burned or carried out	51	30.0%
Buried on at least part of the trip	2	1.2%
<u>Secured Food During Absence From Camp</u>		
Yes	204	82.9%
No	41	16.7%
Sometimes	1	0.4%
<u>Secured Food During Sleep</u>		
Yes	225	90.4%
No	23	9.2%
Sometimes	1	0.4%
<u>Distance From Camp Food Secured</u>		
0'-150' (0 m.- 46 m.)	110	48.9%
150'-300' (46 m.- 92 m.)	75	33.3%
300'-450' (92 m.-137 m.)	23	10.2%
450'-600' (137 m.-183 m.)	12	5.3%
600'-750' (183 m.-229 m.)	3	1.3%
750'-900' (229 m.-274 m.)	1	0.4%
>900' (>274 m.)	1	0.4%

of the parties returning questionnaires reported dumping or burial of excess foods (Table 24). Thus, it would seem that there is general knowledge of the correct procedures for handling leftover food items in bear country. Whether this knowledge is translated into actuality is another question. Many of the Gallatin camps were searched for food and food related items during each trip. A total of 75 searches were made. Appendix Table 26 shows a trip by trip compilation of the discovery of six major categories of refuse in each camp searched. About 58 percent of the cans were found in the fire sites. Food items were found in 21 percent of the searches. These food items were often trace amounts found in or around the fires or small single items such as tea bags, discarded coffee grounds, or fruit rinds and pits. Major food items were discovered in 8 percent of the searches of backcountry campsites. In one other search, a number of highly odiferous food containers were found scattered about the camp. Although the magnitude of the discarded food problem is not yet great, increased use of the Gallatin backcountry, coupled with continuous use of a limited number of sites could result in certain camps being contaminated with enough food residue to begin attracting bears.

On a number of occasions, I encountered parties who either had not secured their food or secured it in or very near their camp. Roughly 90 percent of the groups returning the questionnaire stated that they secured their food during sleep (Table 24). It is interesting to note

that only 83 percent secured food during absences from camp. Although the vast majority of groups were aware of the necessity for securing their food, the distances at which they did so seem to indicate naivete towards the potential danger of bear encounters. Over 82 percent secured their food within 100 yards (91.5 m.) of their camp and over 90 percent within 150 yards (137.2 m.) (Table 24). When the short distance speed of bears is considered (6.8 seconds to cover 100 yards), food cached at these distances may invite problems. Herrero (1970) points out that "Even at 100 yards a person has little time to think or maneuver if a grizzly suddenly finds its' individual distance violated and is startled into making an attack."

SUMMARY AND RECOMMENDATIONS

Human Use of the Gallatin Range

1) The basis of this study is the premise that the human-wildlife interface reflects the kinds and intensity of human use in the study area, and the distribution, behavior, and movements of wildlife in the study area.

2) Deviation from use permits introduced an element of error into human use data collected from National Park Service records. Nevertheless, a distinct trend toward increasing human use of the Gallatin backcountry was apparent from 1972 through 1974.

3) Roughly 60 percent of the parties returning questionnaires deviated from the campsite assignments given on backcountry use permits. This problem could be minimized by better campsite selection by the Park Service; improved camp and trail information and markers; and improved briefings of the permittee.

4) Human use of the study area was not evenly distributed. A few campsites received the bulk of the human use, and camp day use of an area was not strictly related to the number of campsites in the area. The most heavily utilized areas were the Fawn Pass East, Bighorn Pass East and West, and Sportsman Lake East trail complexes. To prevent concentrations of human use in a few areas, four procedures are recommended: establishment of monthly upper limits of use in each

camp; yearly rotation of the campsites; active but not insistent participation by Park Service personnel in the decision as to where a group should go; and a redistribution of the campsites in such a manner that visitors are not literally forced to use a particular area due to lack of facilities in another. A reasonable separation of sites in terms of both travel time and negation of the potential for multiple human-bear interactions is estimated at 2 miles.

5) Backcountry use of the Gallatin Range was greatest during July and August, with all trail complexes receiving their peak use during this period.

Wildlife Observations - Time and Place - All Species

6) The frequency of wildlife observations was used as an index of probable frequencies of human-wildlife interactions per party, for a given area and/or time. All references to frequencies of interactions, or likelihood or probabilities of frequent interactions are on a per party basis. Personal and backcountry visitor observation frequencies were analyzed separately since each reflected a different level of experience with wildlife and a different route and elevation of travel.

7) Based upon the frequency of personal and backcountry visitor wildlife observations, the Fawn Pass East, Sportsman Lake East, and Sportsman Lake West backcountries are units in which high frequencies of human-wildlife interactions per party can be expected. The Bighorn

Pass West, Sportsman Lake West and Gardners Hole trails are units with low probabilities for frequent human-wildlife interactions.

8) Observations occurred with the greatest frequency in the May-June and September-October periods indicating that these periods hold the greatest potential for frequent human-wildlife interactions per party.

9) Observations of wildlife in the Gallatin Range occurred most frequently in off-trail sections of the study area in all periods except May-June. On-trail observation frequencies peaked in the May-June and September-October periods.

Wildlife Observations - Time and Place - Each Species

10) Elk were the most frequently observed study species in the Gallatin Range. Of the remaining species studied, mule deer, moose, and coyotes ranked relatively high in observability while bear and bighorn sheep were the least frequently observed species.

11) Elk were most frequently observed and/or encountered in the northern two-thirds of the study area along the eastern slope and crest of the Gallatin Range. The Sportsman Lake region, particularly its eastern half, and to a lesser extent the east side of the Fawn Pass region, were areas of high observation frequency. The focus of deer activity was similar to that of elk, with the Fawn Pass region being an area of high frequencies of mule deer-human interactions. In both

species, there was a trend toward more frequent observations during the early and late periods of the field season (May-June, September-October). Off-trail observations of elk occurred two to three times as frequently as on-trail observations, while mule deer were observed roughly one and one-half to two times as often off the trail as on it. Greater off-trail observation frequencies persisted throughout the field season, with the single exception of higher backcountry visitor on-trail observation frequencies of elk in June. The peak on-trail observation frequencies of elk tended to occur in early summer and fall. In mule deer, on-trail observation frequencies remained rather constant throughout the season, excepting a sharp increase in personal on-trail observation frequencies in September-October.

12) High observation frequencies of moose primarily occurred in the low elevation trail areas of the East and West Fawn Creek and the Fan Creek drainages. Personal observation frequencies of moose steadily increased as the field season progressed while backcountry visitor observation frequencies remained relatively constant during the same period. The same trend was apparent in on-trail observation frequencies. The moose was the only species observed more frequently from on the trail as compared to off the trail. The predominance of on-trail observability generally persisted throughout the field period.

13) On the basis of personal and visitor observations and sign discovery, the Sportsman Lake region (excepting the east trail) and

the west side of the Bighorn Pass region appear to be areas where high frequencies of human-grizzly interactions per party are probable. The high elevation areas surrounding the passes appear to be particularly critical. Although the Fawn Pass region ranked relatively low under the system used, the area in the vicinity of the pass has considerable potential for frequent human-grizzly interactions as evidenced by high personal observation frequencies of grizzlies in the Fawn Pass West complex. In addition, two of three cases of human injury caused by grizzlies in the Gallatin Range since 1972 occurred in this area. Backcountry visitor observations and personal bear sign discovery occurred most frequently during the May-June and September-October periods. In contrast, personal observation frequencies were highest in July due to differing travel routes. Grizzly bear were observed and/or encountered three to four times more frequently by off-trail travelers than by on-trail travelers. As a result, off-trail travel should be discouraged and groups whose plans include off-trail travel should be made well aware of their increased chances of bear encounters. The predominance of off-trail observability occurred during all months of the study period except May-June. Periods of peak on-trail observation frequencies occurred in May-June and September-October. Park Service briefers should advise early and late season travelers of the increased likelihood of encountering bears while on the trail and at altitudes considerably below those of mid-summer.

14) Black bear observations generally occurred most frequently in the Sportsman Lake region (excepting the West trail) and in the Fawn Pass region. This species was most frequently observed in the September-October period. Off-trail travelers observed black bear two to three times as frequently as on-trail travelers. However, the black bear was most frequently observed from on rather than off the trail in the May-June period and in July.

In order to supplement the above data on black and grizzly bear distribution and movements, the bear monitoring program should be continued and augmented with data from backcountry visitors.

15) The small number of bighorn sheep observations and/or encounters occurred most frequently in the high elevation areas of the Sportsman Lake and Bighorn Pass regions and were made most often by off-trail travelers.

16) The small number of coyote observations were made most frequently in the off-trail portions of the Sportsman Lake and Bighorn Pass regions and in the east side of the Fawn Pass region, with increasing frequencies in early fall.

Factors Relevant to the Nature of the Human-Wildlife Interface

17) Peak observability of elk, moose, and mule deer occurred during early morning and late afternoon or evening (6:00 a.m.-9:00 a.m. or 3:00 p.m.-9:00 p.m.). Grizzly bear, black bear, and bighorn sheep

were most frequently observed in the 6:00-9:00 a.m. period.

18) Over 50 percent of the personal wildlife encounters occurred at distances between 100 and 300 feet (30.5 m.-91.5 m.). Mule deer and moose had the shortest average encounter distances followed by bighorn sheep, elk, coyotes, grizzly bear and black bear. No bears were encountered at less than 100 feet (30.5 m.). However, 60 percent of the black bear encountered occurred at less than 200 feet (61 m.).

19) All individual species except the mule deer and coyote were most commonly feeding when first observed. Deer and coyotes were commonly alert or running. Less than 10 percent of the moose observations or encounters involved initial flight. Thus, one would be likely to encounter a stationary moose at close distances. Only 12.5 percent of the grizzly bear observations involved initial flight. This is probably a reflection of the long distances at which they were first encountered. Black bear were relatively oblivious to the human presence, with just over 15 percent of the observations or encounters involving either initial alert or flight responses.

20) In response to the human presence, the moose was more likely to stand its ground than any other species. Conversely, when aware of humans, bears were the least likely to remain stationary.

21) Aggressive behavior was noted in approximately 3.4 percent of backcountry visitor observations of moose (6 of 176) and black bear (1 of 29). Roughly one percent (3 of 258) of personal observations of

elk, five percent (2 of 40) of moose observations, and ten percent (1 of 10) of the grizzly bear observations involved aggressive reactions. Females with young were involved in many of the aggressive interactions with moose and bears. In stressing the dangers of wildlife to potential backcountry users, the concentration should be upon the dangers posed by bears. However, specific comments should also be directed towards the generally belligerent nature of the moose, females with young and wildlife encounters during the rut.

22) Despite an inverse relationship between the intensity of human use and the frequency of wildlife observations on a monthly basis, it does not appear that the intensity of human use in the study area was generally responsible for shifts in wildlife distribution. However, recurring long period use of limited areas, such as at campsites, appeared to cause limited shifts in elk distribution.

23) Bighorn sheep and grizzly bear were observed at an average elevation of over 9000 feet (2744 m.); in the upper Spruce-Fir and lower Alpine Tundra Zones. In the Gallatin Range, the potential problem of bears entering campsites would probably be substantially reduced by lower elevation camps, i.e., none above 8500 feet (2591 m.). Elk and black bear were most commonly observed in the Spruce-Fir Zone between 8500 feet (2591 m.) and 9000 feet (2744 m.), while the average observation elevations for mule deer and coyotes were between 8000 feet (2439 m.) and 8500 feet (2591 m.), in the upper Lodgepole Pine and

lower Spruce-Fir Zones. The only species observed below the study areas' average trail elevation (7935 feet, 2419 m.) was the moose (7826 feet, 2368 m.). This species was most commonly observed in the Lodgepole Pine Zone. Elk and grizzly bear migrated from low to high elevations and back to low elevations during the course of the field period, (lower Spruce-Fir and Lodgepole Pine Zones to Spruce-Fir and Alpine Tundra Zones and back), while black bear, moose, and mule deer tended to remain static or move upward without a corresponding downward movement during the study period.

24) As a result of the trails in the Gallatin Range being lower in elevation than the average elevations at which most species were observed, there was a trend toward higher frequencies of wildlife observations in those areas with the highest average trail elevations (Spruce-Fir and Alpine Tundra Zones) and the on- to off-trail observation frequency ratio tended to increase in those species occupying lower elevations (Lodgepole Pine and lower Spruce-Fir Zones). Mid-summer upward shifts in elk and grizzly distribution moved them away from the trails resulting in decreased total and on-trail observation frequencies of these species and all species combined by backcountry visitors. Late season downward shifts resulted in increased observation frequencies. This relationship was not strictly applicable to personal observations as the result of a combination high elevation on- and off-trail and low elevation on-trail travel route. In the case

of black bear, moose, and mule deer, general upward elevational movements coincided with increased personal observation frequencies of all three species and increased personal on-trail observation frequencies of moose and mule deer. Movements apparently were not of sufficient magnitude to cause consistent modification of backcountry visitor observation frequencies of these species.

25) Groups of four or more people experienced considerably lower observation frequencies than did groups of three or less. Groups of one and two had lower frequencies of observations than groups of three. This may be related to concerted efforts on the part of small parties to avoid wildlife encounters or to the frequency of observations being a function of the number of potential observers up to an optimum number. Backpacking parties in the Gallatin Range averaged 2.4 persons. Parties of this size are at or near the optimum size for encountering and/or observing wildlife.

26) Parties of two or fewer were the most prone of all party sizes to encounter grizzly bears. A similar but not as pronounced relationship was apparent in black bear.

27) Parties utilizing continuous and repetitive noise during at least a portion of their trip did not consistently report less frequent wildlife observations than parties not putting forth this effort.

28) A considerable number of the backcountry parties reported actions which could increase the possibilities of detrimental encounters

with wildlife, especially bears. Almost one-third of the parties returning the questionnaires reported their groups were fragmented at least a part of their travel time. Since there is an indication that larger sized parties have decreased probabilities of frequent wildlife encounters, briefers should stress that groups remain together while traveling in the backcountry. Roughly 9 percent of the parties stated they approached wildlife upon observation. Seven percent reported efforts to startle or alert wildlife. Slightly less than 5 percent reported dumping or burial of food. Abandoned food items were found in 21 percent of the campsites searched and major food items in 8 percent. Fires were often the principal locality of food contamination. Thus, a critical look should be taken at the use of campfires in bear country. Ten percent of the groups failed to secure their food during sleep, while 17 percent failed to do so during absence from camp. Food was secured very close to camp with 82 percent of the parties securing it within 100 yards (91.5 m.). Briefers should be sure that backcountry users realize the importance of securing food at least a quarter mile from the sleeping area during all absences and during sleep. Nearly 60 percent of the parties returning the questionnaires reported use of high residue fresh or canned foods on their trip. The use of freeze dried and dried foods should be recommended.

29) The mandatory backcountry visitor use permit briefing should be used to inform the public how to camp and travel in bear country.

The information should be uniform and consistent throughout the Park. A pre-season employee seminar should be held to insure that personnel understand bear biology and behavior as well as currently accepted travel and camping procedures. These seminars should be based upon current research.

30) Eighty-three percent of those parties returning questionnaires in 1974 stated that they would be interested in attending a seminar designed to improve their knowledge of the ecology and biology of wildlife. Wildlife problem prevention should receive some emphasis but information promoting the enjoyment of the Park's wildlife resource with minimum impact should form a major part. Backcountry permit holders should be encouraged to attend.

31) The information system should be extended into the backcountry areas by backcountry rangers. These personnel would also monitor bear movements, maintain naturalness and cleanliness of camps and trails, provide law enforcement, and assist in research.

APPENDIX

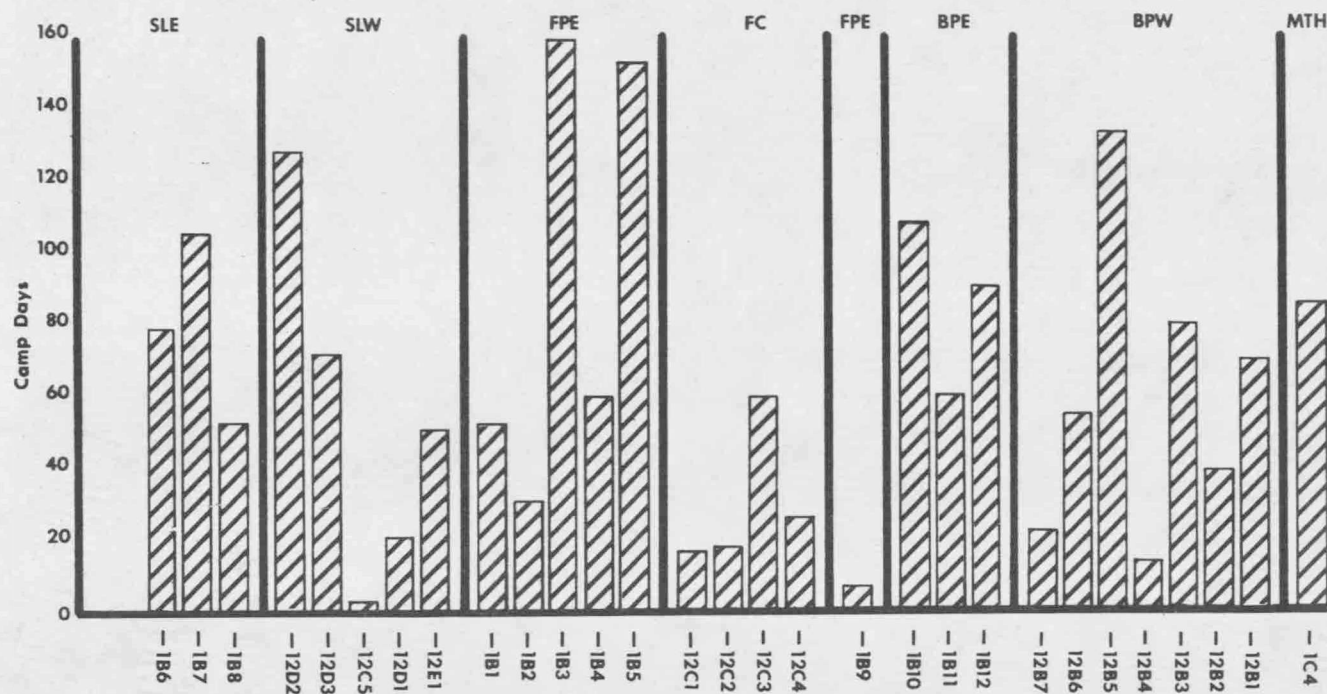


Figure 23. Human use of individual campsites, 1973-1974, as indicated by average yearly camp days.

TABLE 25. THE AVERAGE NUMBER OF DAYS DURING EACH MONTH THAT INDIVIDUAL CAMPSITES WERE OCCUPIED.

Campsite	May	June	July	August	September	October
1B6	2.0	2.0	13.0	10.5	1.5	0.0
1B7	1.0	6.0	12.0	11.5	7.5	3.0
1B8	0.0	2.5	7.5	7.0	1.0	0.0
12D1	0.0	0.5	2.5	3.5	0.0	0.0
12D2	0.0	4.0	8.5	10.0	2.0	1.5
12D3	0.0	1.5	4.5	11.0	2.5	2.0
12C5	0.0	0.0	0.5	1.0	0.5	0.0
12E1	3.0	3.0	4.0	5.5	1.5	0.5
1B1	0.0	5.5	5.5	10.5	2.5	0.5
1B2	0.0	3.0	5.5	5.5	0.0	0.0
1B3	0.0	7.0	9.0	8.5	8.5	5.5
1B4	0.0	3.0	5.5	10.0	4.0	0.5
1B5	0.0	4.5	10.0	16.5	5.0	2.5
12C1	0.0	0.0	1.5	2.5	0.5	0.0
12C2	0.0	0.0	1.5	0.5	1.5	0.0
12C3	0.0	0.0	3.0	4.0	1.0	0.0
12C4	0.0	0.0	1.0	3.5	0.0	0.0
1B9	0.0	0.5	1.5	0.5	0.5	0.0
1B10	0.0	8.0	14.5	13.5	6.0	4.0
1B11	0.0	5.0	8.0	10.5	4.0	2.0
1B12	0.0	5.5	9.5	17.0	7.5	0.5
12B1	0.0	3.0	9.0	11.0	2.5	1.0
12B2	0.0	0.5	4.0	2.0	1.0	1.0
12B3	0.0	1.5	5.0	4.5	0.0	1.5
12B4	0.0	1.0	0.5	3.0	1.0	0.0
12B5	0.0	1.0	6.5	11.5	2.0	0.0
12B6	0.0	1.0	7.0	9.0	1.5	1.5
12B7	0.0	0.0	3.0	1.0	2.5	0.5
1C4	0.0	3.5	18.5	13.0	1.0	1.0

TABLE 26. A COMPILATION OF THE DISCOVERY OF VARIOUS CATEGORIES OF REFUSE IN SELECTED GALLATIN BACKCOUNTRY CAMPSITES, 1974.

Campsite	Trips on Which Items were Found						Trips Not Searched
	Food	Food Packages	Foil	Cooking Supplies: Pots, Soap Pads	Cans and Lids	Misc. Trash	
1B1	2,3	3	2,3,5	4	2	2,3,5	1
1B2		3	1,3,4,5	3,4	1,3,4	1,3,4,5	
1B3	5	2,4	1,2,4,5	2	2,5	1,2,4,5	3
1B4			1,2,4		1,2,4	1,2,3,4	5
1B5		5	1,2,3,4,5		1,2,5	1,2,3,4	
12D2		3,4	2,3,4,5	4	2,3,4	2,3,4,5	1
12D3	2	2,3	2,3	2	2	2,3	1,4,5
1B6	3,4	2	1,2,3,4		1,2	1,2,3,4	5
1B7	2,3	3,4,5	2,3,4,5		2,3,5	3,4,5	1
1B8	1	1,2	2,3,4,5		2,3,5	1,2,3,4,5	
12B1		3	2,3,4,5		4,5	2,3,4,5	1
12B2			2		2,4	2,3,4	1
12B3			2,3,4,5		3,4	2,3,4,5	1
12B4			2,3,4			2,3,4	1
12B5		2	2,4		2,4	2,4	1,3
12B6	3,4	4,5	2,3,4	3	3	2,3,4,5	1
1B10	3	2,3	2,3		3	2,3	1,4
1B11	2,5	4,5	2,3,4,5		3,4,5	2,3,4,5	1
1B12	2,3	3,5	2,3,4,5		2,3,4,5	3,4,5	1

TABLE 27. THE NATURE OF EACH GRIZZLY BEAR OBSERVATION OR ENCOUNTER.

Date	Time	Personal Observations and Encounters					Party Size
		Observer Location	Description	Closest Distance	Encounter or Observation	Reaction	
7/73	11:00	FCB*	1 Unknown	240'	Encounter	Running Flight	1
7/73		FPWB	1 Adult 1 Yearling	660'	Encounter	Running Flight	1
8/73**	20:15	SLWT	1 Adult 2 Two Year Olds	319'	Encounter	Running Flight	1
8/73	20:30	SLWT	1 Adult 2 Two Year Olds	220'	Encounter	Approach Then Flight	1
7/74	13:30	BPWB	1 Adult	700'	Observation	Unaware	1
7/74	14:30	BPWB	1 Two Year Old	545'	Encounter	Running Flight	2
7/74	17:10	BPWB	1 Adult	~1350'	Observation	Unaware	2
8/74	09:30	FPEB	1 Adult	Several Miles	Observation	Unaware	1
9/74	09:35	SLEB	1 Adult	355'	Encounter	Walked Off	1
9/74	13:30	FPWT	1 Adult	~160'	Observation	Unaware	1
Visitor Observations and Encounters							
6/73	10:30	BPWT	1 Adult	600'	Encounter	Trotting Flight	2
7/73	13:00	BPWT	2 Two Year Olds	75'	Encounter	Not Determined	2

TABLE 27. Continued.

Date	Time	Visitor Observations and Encounters					
		Observer Location	Description	Closest Distance	Encounter or Observation	Reaction	Party Size
7/73	13:00	MTHT	1 Adult	1500'	Observation	Unaware	2
9/73	14:00	SLET	Not Given	1800'	Observation	Unaware	2
6/74	09:55	BPWT	1 Adult	900'	Encounter	Flight	2
6/74	20:30	MTHT	1 Adult	60'	Encounter	Running Flight	2
6/74	21:30	GHT	1 Adult	600'	Observation	Unaware	3
7/74		BPEB	1 Unknown	90'	Encounter	Flight	2
7/74	12:00	SLWT	2 Adults	525'	Observation	Unaware	1
8/74	19:00	SLWB	1 Unknown	150'	Encounter	Flight	2
8/74	13:00	SLWB	1 Unknown	90'		Walked Off	2
8/74	14:00		1 Adult	2400'	Observation	Unaware	10
9/74	13:00	SLEB	1 Immature	105'	Encounter	Trotted Off	2
9/74	11:30	FPWT	1 Unknown	750'		Walked Off	2

*The three or four letter location is an abbreviation for the appropriate study area unit. Principal components of the system are as follows: FP = Fawn Pass; SL = Sportsman Lake; BP = Bighorn Pass; MTH = Mt. Holmes; FC = Fan Creek; GH = Gardners Hole; E = East; W = West; T = Trail; and B = Backcountry.

**The bears observed at 20:15 were the same bears that were observed at 20:30-8/73.

TABLE 28. THE NATURE OF EACH BLACK BEAR OBSERVATION OR ENCOUNTER.

Date	Time	Personal Observations and Encounters					Party Size
		Observer Location	Description	Closest Distance	Encounter or Observation	Reaction	
7/73	14:00	FPWT*	1 Adult	1400'	Observation	Unaware	1
8/73	17:20	FPET	1 Adult 1 Cub of Year	275'	Encounter	Running Flight	1
9/73	18:00	FPEB	1 Adult	506'	Observation	Unaware	1
8/74	11:00	FPEB	1 Adult	138'	Encounter	Ran than Walked	1
9/74	07:15	FPWB	1 Adult	~1000'	Observation	Unaware	2
9/74	13:50	FPEB	1 Adult	171'	Observation	Unaware Walked Off	2
9/74	08:45	FPEB	1 Adult	171'	Encounter	Climbed from Tree and Ran	2
9/74	12:45	SLEB	2 Adults 3 Yearlings	104'	Observation	Unaware	1
Visitor Observations and Encounters							
6/73	a.m.	SLWT	1 Adult 1 Yearling	60'	Encounter	Flight	5
7/73	13:30	MTHT	1 Adult	1320'- 2640'	Observation	Unaware	1
8/73	21:00						3
8/73	18:00	Camp 1B3	1 Adult	600'	Observation	Unaware	1

TABLE 28. Continued.

Date	Time	Visitor Observations and Encounters					
		Observer Location	Description	Closest Distance	Encounter or Observation	Reaction	Party Size
8/73	18:00	SLEB	2 Adults	150'	Encounter	Climbed Tree, 2 Came Down, Fled	
8/73	18:50	SLEB	1 Adult	100'	Encounter	Lumbering Flight	2
8/73	19:00	MTHT	1 Adult 1 Yearling	120'	Encounter	Cub Treed, Sow Ran 45'	2
8/73	11:00	BPWT	1 Adult	150'	Encounter	Loped Away	1
6/74	10:00	FPET	1 Adult 2 Immature	900'	Observation	Unaware	3
6/74	11:15	GHT	1 Adult	150'	Encounter	Flight	2
7/74	21:00	Camp 1B12	1 Unknown	300'	Observation	Unaware	2
7/74	10:00	SLET	1 Adult	100'		No Response	2
7/74	18:00	MTHT	1 Adult	900'	Encounter	Flight	4
7/74	18:30	MTHT	1 Adult	90'	Encounter	Walked Off	3
7/74	16:30	BHET	1 Adult	750'	Encounter	Walked Off	2
7/74	12:00	SLEB	1 Adult 2 Cubs of Year	150'	Encounter	Trotting Flight	3
7/74	11:30	SLET	1 Adult	50'	Encounter	Ran into Hikers, then Fled	4

TABLE 28. Continued.

Date	Time	Visitor Observations and Encounters					Party Size
		Observer Location	Description	Closest Distance	Encounter or Observation	Reaction	
8/74	15:00	SLWB	1 Adult	2640'	Encounter	Flight	3
8/74	13:00	GHT	1 Adult	300'		Walked Off	4
8/74	19:00	Camp 1B10	2 Year Old	20'	Encounter	Aggressive Entered Camp Chased Off	2
8/74	11:15		2 Adults	1200'	Observation	Unaware	10
8/74	14:00		1 Adult 2 Cubs of Year	900'	Observation	Unaware	10
8/74	18:00		1 Adult	600'	Encounter	Trotting Flight	2
8/74	24:00	Camp 1B12	1 Adult	600'	Encounter	Trotting Flight	2
8/74	13:00	SLEB	1 Immature	150'	Encounter	Flight	2
8/74	12:00		1 Cub of Year	20'			2
9/74	13:00	FPET	1 Cub of Year	50'		Slowly Walked Off	1
9/74	15:00	SLEB	1 Adult	105'		Slowly Walked Off	2
9/74	12:00	FPEB	4 Unknown	60'	Encounter	Flight	1

*The three or four letter location is an abbreviation for the appropriate study area unit. Principal components of the system are as follows: FP = Fawn Pass; SL = Sportsman Lake; BP = Bighorn Pass; MTH = Mt. Holmes; FC = Fan Creek; GH = Gardners Hole; E = East; W = West; T = Trail; and B = Backcountry.

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