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Bear-livestock interactions Targhee National Forest

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BEAR-LIVESTOCK INTERACTIONS, TARGHEE NATIONAL FOREST

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Black bear (Ursus americanus), grizzly bear (U. arctos), and domestic sheep interactions and competition were investigated using radio telemetry on the Targhee National Forest in Idaho and Wyoming during 1976 and 1977 to better determine the role of bears within Multiple Use (Multiple Use Act, 1964) areas. Black and grizzly bear intra- and interspecific relationships were discussed in terms of habitat utilization and food habits. Radio-monitored movements of seven black bears and one grizzly were compared to movements of sheep herds on selected USFS sheep allotments to investigate bear behavior near sheep herds and determine the extent of competition and interspecific conflicts. Competition between bears and sheep occurred when they utilized the same plants (primarily grasses and forbs) that were limited by either abundance or seasonal availability. Additional conflict, resulting in losses of sheep to bear predation and high bear mortality from real or alleged predation, occurred during concurrent habitat use by bears and sheep. Bear predation was discussed in detail. Areas and seasons of expected bear-sheep interaction were delineated. Management to possibly alleviate some bear-sheep conflict was discussed.

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CHAPTER I

INTRODUCTION

Wild and domestic animals have competed for rangeland for centuries. Wagner, in The Effects of Livestock Grazing and the Livestock Industry on Wildlife (in press), noted that the predator control program is an indirect influence of the livestock industry on wildlife. Cain et al. (1972) and Leopold (1964) questioned the value of predator control programs. Better data on the real role of predator/livestock interactions are being sought. This study deals with one aspect of the predator/livestock relationship, that of range competition and relationships between bears and sheep, but it also recognizes the total impact of predation and the economics or value (cost) of predator control. Because of the threatened status of grizzly bears and the endangered status of Northern Rocky Mountain wolves (*Canis lupus*) under the Endangered Species Act of 1973, the role of predators in the ecosystem balance as "indicator species" of environmental quality, and as highly valued and strongly protected "national" species, is greatly enhanced. Federal agencies, especially, must place a proper value on the bear and its habitat, a level of value which local people, federal and state agencies, and commercial interests do not readily accept.

In total, however, coyote (*Canis latrans*) predation on domestic sheep is the major cause of sheep loss in the western United States and has been studied extensively (Klebenow and McAdoo 1976, Nesse et al. 1976, Anon. 1975, Magleby 1975, Balser 1974, Davenport et al. 1973).

Bear predation has been poorly studied by comparison and is usually reported as minimal or is included in "other predation" (Nass 1977, Dorrance and Roy 1976, Nesse et al. 1976, Nielson and Curle, 1970).

A unique situation exists on the Targhee National Forest (TNF), Idaho-Wyoming. Summer livestock grazing allotments coincide with prime, mountainous black and grizzly bear habitat (Craighead et al. 1974). Bear predation is thought a major cause of sheep losses on the Targhee National Forest (Targhee Annual Use Reports). The Targhee, flanked by Yellowstone (YNP) and Grand Teton (GTNP) national parks, serves as a travel corridor for bears between the parks and also supports a resident population of black bears and possibly of grizzlies.

The U.S. Fish and Wildlife Service (USFWS), as the lead agency in enforcement of the Endangered Species Act, has indicated great concern over known grizzly habitat reduction and suspected dwindling population numbers. To better meet critical habitat determination and delineation requirements specified by the Endangered Species Act of 1973, the U.S. Forest Service (USFS) initiated studies on the TNF to determine general bear use, bear-livestock relationships, and bear habitat requirements.

A 1975 investigation of black and grizzly bear use of the Ashton and Island Park ranger districts resulted in a compilation of bear-livestock problems on the TNF (Jorgensen and Allen 1975). A list of 32 grizzlies killed from 1970 to 1975 was compiled from unpublished reports by Kary (USFS), Jenkins (USFS), Mitchell (USFS), and DeShon (Idaho Fish and Game). Mortality reports lacking necessary information or suspiciously similar to another report were eliminated. The USFS later eliminated as invalid the seven kills reported by Mitchell and six other kills because of their unclear status. The final total accepted by the USFS was 22 grizzlies killed between 1970 and 1975. The majority of those deaths were livestock related. Data are lacking on the numbers of black bears killed on the TNF for the same period, but general observations indicate that the kill was significant (this report).

A number of questions were raised as a result of the Jorgensen and Allen (1975) report, including the character of association between bears and livestock, the amount of interspecific relationships between black bears and grizzlies, and the proper management of bears on livestock allotments. This study is a continuation of that preliminary investigation.

History of Sheep and Predators on the Targhee

Grizzlies, black bears, cougars (*Felis concolor*), wolves, and coyotes were an integral part of the Targhee ecosystem before settlement by Europeans. Farmers and ranchers settled the area en masse when the railroad provided a link to markets in the mid-1800s; conflict between the livestock industry and predators developed soon thereafter.

When the TNF was created in 1905, the livestock industry was already prominent in the local economy, with established livestock ranges on the public domain and a massive economic-political lobby (Voight 1976). By 1933, 240,000 sheep and 24,000 cattle grazed in the summer on the Targhee (unpublished USFS records), numbers that far exceed the carrying capacity specified by present grazing allotment contracts.

In recent years, wiser range management has been practiced. Grazing seasons were shortened to allow adequate plant development and to prevent range destruction or erosion. Range sheep breeds were developed for high weight gain, easier herding, successful reproduction, and resistance to disease. Livestock losses to disease, poisonous plants, and birth mortality decreased with improved breeding and range practices, but losses to predators remained the same or, in some cases, increased (Early and Roetheli 1974).

A nationwide predator control program was initiated in the late 1800s and continued through the early part of this century. Control techniques were highly successful against some species and virtually eliminated the grizzly, cougar, and wolf from many parts of their range (Singer in press, Rutter and Pimlott 1968, Young and Goldman 1949). During this extended effort, the nearby national parks perhaps served as a semi-protected reservoir for predators on the TNF.

Occasional sightings and rare kills of cougars by predator control agents (USFWS records 1969-1977) documented that a small population of cougars resided in or used parts of the TNF. The scarcity of reports indicates that the population is too small or too wary to comprise more than an incidental threat to livestock.

Isolated wolf sightings and tracks have been reported in the TNF and in YNP, but they have not been conclusively verified. If wolves do exist on the TNF or in the adjacent Park back country, they probably have not attained pack status. Sighting reports and predation records to date show no evidence of wolf predation on domestic sheep within the TNF.

Coyotes are commonly reported throughout the TNF and consistently pose a serious threat to domestic sheep. The extent of coyote predation is being investigated in a related study of the TNF.

Bear Predation

Bears were frequently seen and involved in sheep depredations according to FWS and USFS unpublished predator reports. Annual grazing reports have three categories: poisonous plants, predation, and other. Most permittees reported few or no losses in each category, but some permittees consistently reported predator losses of 10 percent or more, with no losses in the other categories (Jorgensen and Allen 1975), suggesting that many of the reported losses were improperly classified as predator losses.

The degree of actual bear predation on allotment livestock is difficult to ascertain. Grazing reports fail to separate coyote, black bear, and grizzly predation. Bears are highly omnivorous and opportunistic feeders. Scavenging is common. Historical records of reported depredations failed to differentiate scavenging from predation. Stampedes, with losses of up to 230 sheep, are often listed as predation, although little predation may have occurred (W. Bodie, pers. comm., Anon. 1972).

Johnson and Gartner (1975), Balser (1974), Wagner (1972), U.S. Senate (1962), Brown (1959), Remington (1955), and Spencer (1955) all questioned the validity of reported predator losses because of reporting biases and lack of verification.

Balser (1974) examined biases in USFS reports. USFS loss records are derived from the difference between the count of adult ewes entering the allotments and the count of adult ewes that leave the allotments in autumn (Wagner 1975). However, losses reported by USFS annual grazing reports include undifferentiated lamb and ewe losses, classified as poisonous plants, predator, and other. A count of only adult ewe losses ignores lamb mortality. The individual annual grazing reports include both adult and lamb losses but fail to provide the total number of sheep using the allotment. Wagner (1972) and Balser (1974) suggested that USFS records are valuable, nonetheless, as an index to losses since they have been routinely compiled for decades.

Bear predation on the study area was briefly examined in the 1975 Grizzly Bear Study (Jorgensen and Allen 1975). Losses of sheep to predators (bears especially) and losses of bears resulting from suspected bear predation on sheep were examined in greater detail in the present study in an attempt to clarify the status of bear populations, the relationship of bears to sheep, and grizzly/black bear habitat needs.

Predator Control

The Forest Service places the burden of predator control on the permittees using Forest Service allotments. They are supported by a USFWS cooperatively supervised predator control program associated with the local Predatory Animal Board (PAB) and the Idaho State Sheep Commission. Sheep owners are assessed \$.40/head/year by state law to support the program. Sixty percent of the assessment is diverted to disease control and research, and the remaining 40 percent is allotted to predator control (Richard Wonnecot pers. comm. 1977). The salary, travel expenses, and miscellaneous expenses of government trappers are provided by the 40 percent PAB levy. The FWS provides traps, snares, and supervision. FWS policy states:

> In historic problem areas, prevention as well as correction is justified for coyote control. . . . On August 16, 1965, the control of mountain lion and bear was placed on a corrective rather than a preventative basis. This policy provides for the removal of problem bear(s) and lion(s) that are killing or destroying private property. . . . (FWS Memo, Jan. 1977, State Supervisor Animal Damage Control, Boise, Idaho.

When an allotment is having predator problems, the government trapper is contacted and, in the case of cougars and bears, asked to remove the offending individual(s). "Preventative" control of coyotes occurs as is compatible with the trapper's other responsibilities. This includes maintaining regular contact with herders throughout the trappers' designated territories. The trapper delegated to my study area during 1976 and 1977 had a territory including 33 sheep bands ranging from the Buffalo River west of YNP to the southern TNF boundary and encompassing more than 90 airline miles from north to south.

Idaho classifies bears as fur bearers. One bear per season is mandated by hunting statute 36-1405. The law further states that

> . . . nothing in this Act shall make it unlawful to trap, kill, or otherwise dispose of bears of any kind, or mountain lions molesting livestock, and it shall not be necessary to obtain from the department of Fish and Game any permit for the killing or taking of such bears or mountain lions. Livestock owners may take steps they deem necessary to protect their livestock.

In Wyoming, black and grizzly bears are classified as trophy game animals (Wyoming law 23.1-1). Law 23.1-5.6 allows that

> . . . specified trophy game animals may be taken in the same manner as predatory animals without a license . . . giving proper regard to the livestock and game industries in those particular areas (23.1-10).

The shooting of free ranging predators and snaring/trapping are the most common summer control techniques used on the TNF, although aerial hunting and denning, as described by Cain et al. (1972), are common winter coyote preventative controls. Traps or snares are often left by the government trapper for the herders to check and sometimes reset while the trapper attends to complaints on other allotments. This practice leads to unskilled personnel handling traps and contributes to the deficient reporting of predator activities, control, and impact.

Range Use

Sheep allotment seasons are determined by plant availability and snow melt. The grazing seasons usually begin the end of June or the first of July and continue through September on allotments within the study area. The number of sheep allotted is determined by regular range use analyses. USFS personnel count only adult ewes, although one or two lambs usually accompany each ewe. Sheep are trailed or trucked along the Reclamation Road. Five hundred to 1,000 ewes are usually permitted on each allotment in the area. Sheep are counted before entering the allotment and again prior to shipping in the fall.

Columbia sheep are run on the Dog Creek-Grizzly Creek allotment by Ball Bros., Inc. Another sheep company, Davis Bros., Inc., runs Targhee-Suffolk cross sheep on the Squirrel Meadows, South Boone, and Middle Boone allotments.

A herder on horseback, a camp tender, and one or two sheep dogs usually accompany each band of sheep. Preestablished campsites are used for 2 to 8 days each. Bedgrounds are degermined by the preference of lead ewes, the desire of the herder to bed near camp, and USFS regulations. Sheep prefer bedding on high ridges free of trees or shrubs if allowed a choice (Bowns 1971). USFS policy specifies one night of use per bedground.

Sheep activity begins with the light of dawn. Feeding and watering continue throughout the morning and may be directed by the herder and his dogs or may be initiated by the sheep. "Shading up," a period of rest and inactivity when the herds seek shady areas, occurs around noon. Bowns (1971) explained that shading is a result of satiation and not a matter of avoiding high temperatures. Grazing resumes by mid-afternoon and continues through the evening until the sheep bed for the night. Grazing time increases on poor range and when the light of a full moon encourages sheep to move or feed at night.

Herding techniques and effectiveness are widely variable and are difficult to describe or typify without judgment and discussion about the personalities of each herder. Herding problems will be discussed in detail in the Results and Discussion section of this paper.

Bear/Livestock Food Competition

According to Mealey (1975), seasonal distribution of Yellowstone grizzlies is influenced primarily by the availability of succulent herbaceous vegetation. Amstrup and Beecham (1976) found that movements of black bears in Idaho follow the phenology of succulent vegetation. The select vegetation necessary to omnivorous bears is also relished by domestic livestock, resulting in competition.

Birch (1957) defined competition as occurring "when two organisms of the same or different species utilize a common resource which is in short supply; or if this resource is not in short supply, competition occurs when organisms seeking this resource nevertheless harm one another in the process." Nelson and Barnell (1976) state that "Regardless of food, cover, and water abundance, if one animal species drives another from the area, thus preventing the second species from utilizing needed resources, competition exists."

Blood (1966) established the following criteria for forage competition between game and livestock under typical range conditions:

1. Species must utilize the same range areas.
2. Species must eat the same forage plants.
3. Food plants eaten are an important food source for either or both species.
4. Food plants are in limited supply or deteriorating in production.

Neither the severity nor the consequences of forage competition between bears and domestic sheep has been investigated. The problem is of greater interest now that grizzlies have been classified as a threatened species by the USFWS. This study attempted to determine the degree and consequences of forage competition by investigating common habitat use and food preference overlap between bears and sheep as a parallel study to direct predation.

Objectives

1. Attempt to determine whether competition for succulent vegetation between bears and sheep on the study area is a significant conflict.
2. Collect information on grizzly and black bear utilization of the study area in relation to habitat, range, seasonal movements, and livestock use.
3. Document any observed interactions between black and grizzly bears.
4. Document observed bear predation and compile available predation information from USFS and USFWS files and other sources.

5. Examine and determine what management practices could reduce bear-livestock interactions and conflicts.

CHAPTER II

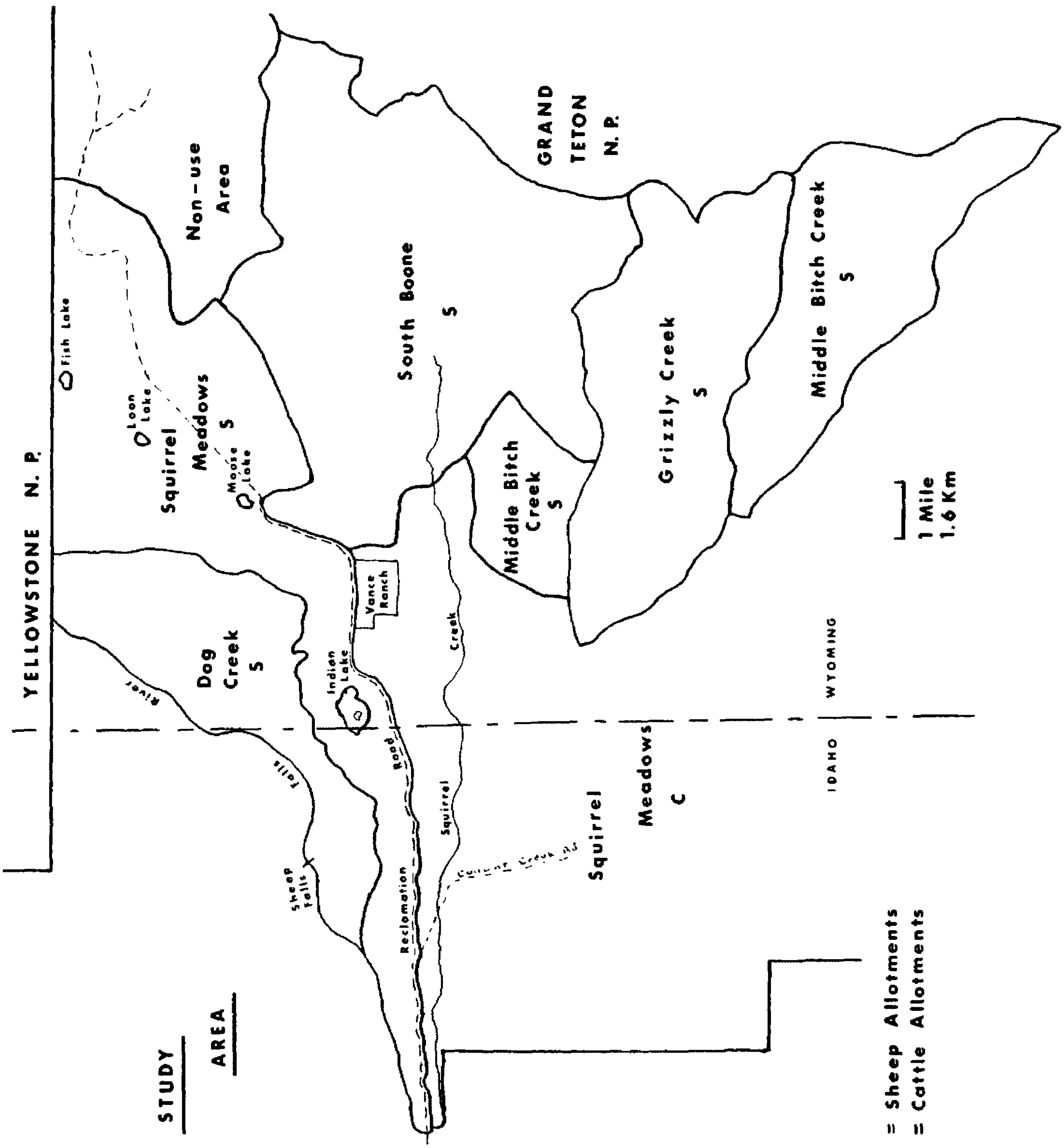
STUDY AREA

My research took place on the Ashton Ranger District (D-3) of the TNF in southeastern Idaho and northwestern Wyoming. The study area is bordered by YNP on the north and the Rockefeller Parkway and Grand Teton National Park on the east. It is divided into several sheep and cattle grazing allotments (Figure 1). Squirrel Meadows, Dog Creek, and South Boone sheep allotments and Squirrel Meadows and Falls River cattle allotments were the primary lease areas investigated.

The area ranges from relatively flat valley bottoms to foothills and mountains. The elvation at the western end of the study area is 1768 m (5800 ft), 2195 m (7200 ft) at the northeast corner, and 2828 m (9277 ft) at the southeastern corner in the foothills of the Grand Teton Mountains.

Most precipitation occurs as rainfall. Annual precipitation averages 45.5 cm (18 in). June is the wettest month, with an average of 5 to 7.5 cm (2-3 in). Annual snowfall averages close to 381 cm (150 in) at mountain elevations above 2133 m (7000 ft), with snowfall at lower elevations averaging 254 cm (100 in) (Wirschborn undated). Summer temperatures range from 0° C (32° F) to 21° C (70° F). Winter temperatures can vary from well below freezing, -40° C (-40° F) to 4.5° C (40° F). Killing frost can be expected any month of the year and can have a major impact on available vegetation (Wirschborn undated). A

Figure 1. The Targhee National Forest study area, delineating major drainages and allotments.


STUDY AREA
YELLOWSTONE N. P.
GRAND TETON N. P.
Non-use Area
South Boone S
Fish Lake
Loon Lake
Squirrel Meadows S
Moose Lake
Dog Creek S
Indian Lake
Vance Ranch
Middle Bitch Creek S
Grizzly Creek S
Middle Bitch Creek S
1 Mile
1.6 Km
WYOMING
IDAHO
Squirrel Meadows C
River
Falls
Sheep Falls
Reclamation Road
Squirrel Creek
S = Sheep Allotments
C = Cattle Allotments

climatic differential caused by the proximity of the Grand Tetons results in a marked increase in precipitation and a decrease in temperatures east of the Idaho-Wyoming state line.

Snow melt is a major factor in determining the grazing period for USFS allotments. Snowfall occurs at higher elevations through June, and the sursequent spring melt results in flooded streams and muddy trails. Snow melt may continue in some areas into July.

The primary study area is a glacial moraine and outwash with fluvial and lacustrine deposits (Nelson 1970). The peripheral study area, consisting of the higher elevation allotments, Middle Boone, Bitch Creek, and parts of South Boone, is typified by mixed metamorphosed and granite rock with sloping beds of limestone, dolomite, and sandstone. The valley lands adjacent to Boone and Conant creeks and Falls River are rhyolite outcrops and colluvial materials on side slopes. The bottom lands are alluvial deposits. The many meadows are glacial driftlands with thick, loamy soils. Higher areas are typically gravelly loams over a heavy loam subsoil (Nelson 1970).

The study area is part of the broadly inclusive Yellowstone ecosystem (Craighead and Craighead 1972). Lodgepole pine (*Pinus contorta*) and aspen (*Populous tremuloides*) are the predominant overstory species of the glacial moraine tablelands found commonly on the Squirrel Meadows cattle and sheep allotments and the Falls River and Dog Creek allotments. Douglas-fir (*Pseudotsuga menziesii*) and subalpine fir (*Abies lasiocarpa*) are present on slopes and the higher elevation allotments. Occasional limber pine (*Pinus flexilis*), juniper (*Juniperus* spp.), and Englemann spruce (*Picea englemanii*) are encountered throughout the study area.

Sedge (Carex spp.) marshes and intermittently wet, tall grass meadows are interspersed with dry sagebrush flats, forests and parklands, and glacial lakes.

Calamagrostis spp., sedge, junegrass (Koeleria cristata), wheatgrass (Agropyron spp.), and brome grass (Bromus spp.) are common grasses in the lodgepole-aspen areas. Meadowrue (Thalictrum spp.), geranium (Geranium spp.), arnica (Arnica spp.), coneflower (Rudbeckia spp.), senecio (Senecio spp.), and clover (Trifolium spp.) are some of many of the forbs found in lodgepole-aspen areas. Huckleberry (Vaccinium spp.), spirea (Spirea betulifolia), serviceberry (Amelanchier alnifolia), rose (Rosa woodsii), cherry (Prunus virginianus), and snowberry (Symphoricarpos spp.) are found in widely varying distributions throughout the lodgepole-aspen areas.

Subalpine fir/Douglas-fir parklands are characterized by elksedge (Carex geyri) and pinegrass (Calamagrostis rubescens), asters (Aster spp. and Erogeron spp.), wildrye (Elymus spp.), a wide variety of umbelliferae, and assorted forbs. Huckleberry, snowberry, spirea, mountain ash (Sorbus canadensis), cherry, serviceberry, and oregon grape (Berberis repens) are common shrubs.

River and creek bottoms are characterized by aspen, birch (Betula spp.), hawthorn (Crategus spp.), willow (Salix spp.), dogwood (Cornus spp.), horsetail (Equisetum arvense), umbellifers, and assorted grasses.

The Reclamation (Flagg Ranch) Road provided the main access to the study area (Figure 1). The Jackass-Conant Creek road provided peripheral access to the South Boone allotment. Unimproved USFS roads provided access to Falls River, Loon Lake, and Fish Lake. Squirrel Meadows cattle and sheep allotments were the most accessible, with most areas near or adjacent to a road. Dog Creek was accessible only by a trail. The South Boone allotment was adjacent to roads for a portion of its northwestern border. The majority of the higher elevation allotments was inaccessible other than by foot or horseback.

Sheep normally graze the Dog Creek allotment through mid-August and then trail to the high mountain Grizzly Creek allotment until mid-September, unless Dog Creek forage conditions will sustain a full season's use. Trailing losses and conflicts with sheep using the Squirrel Meadows allotment often occur when the sheep move from Dog Creek to Grizzly Creek.

The majority of the lodgepole pine in the Targhee National Forest is infested with the pine bark beetle (*Dendroctonus ponderosae*). Lodgepole pine-dominated stands are characterized by extensive downfall and standing dead timber. A salvage logging operation along the Reclamation Road was in progress during 1976 and 1977.

CHAPTER III

METHODS AND MATERIALS

Capture and Tagging Techniques

Black bears were captured in Aldrich footsnares (Aldrich Snare Co., Clallam Bay, WA) or a hinged door culvert trap. Traps were located on livestock allotments where bear activity was known to occur and, if possible, where pre-baiting indicated recent bear activity. The Wyoming Fish and Game Department prohibited the use of snares for this research. With one exception, snares were used exclusively in Idaho. Placement of culvert traps was necessarily limited to locations with adequate vehicular access. The culvert trap was not used during the 1977 field season.

I used cubbies for all successful snare sets following the procedure described by Jonkel (1967), incorporating either a drag log or an anchor tree. The culvert trap was set as described by Piekielek and Burton (1975). Honey, bacon, and fish were initially employed as bait with limited success; the remainder of the time I used meat scraps and sheep carcasses (which were easily obtained at no cost throughout the trapping period) with good success.

I checked all operating traps every 12 hours as required by the Idaho Fish and Game Department. Trapping ran from June through August, 1976, and May through 7 July 1977.

Captured bears were anesthetized with 2.9 mb/lb phencyclidine hydrochloride (Sernylan, Parke-Davis & Co.) or 5 mg/lb ketamine hydrochloride (Ketaset, Bristol Laboratories) administered by a long-range automatic syringe (Palmer Chemical Co., Douglasville, VA) or a 3-6 foot jab stick. I injected a standard dosage of 1 mg/lb Acepromazine, a tranquilizer, only if bears drugged by phencyclidine hydrochloride showed indications of convulsions.

I examined each bear for injuries and external parasites. All wounds were cleaned with alcohol and treated with Nytrosal, an antiseptic. Ampicillin was injected by hand syringe to prevent infection when wounds or extensive exposure were evident.

Each captured bear was tagged with metal cattle eartags, tattooed on one or both upper lips, and measured. Sex and general condition were recorded; weights were taken with a 200-pound spring scale or, when the scale was unavailable, were estimated visually and with a cattle/hog girth/weight tape using Jonkel's (1967) correlation value. I later calculated the age of each bear by tooth wear and general appearance as based on body size, and the lower P-1 was removed from some bears for cementum annuli age determination (Stoneberg and Jonkel 1966).

All but one extremely small bear were radio-collared with 164 mghz transmitters potted in acrylic and beeswax and mounted on fiberglass belting. Transmitters were supplied by Telonics, Inc. (Mesa, AZ) and AVM (Champaign, IL) built and packaged at the University of Montana, except that two prepackaged transmitters were potted by USFS personnel, and one AVM pre-assembled collar was used. The University of Montana collars were activated, soldered, and sealed with epoxy shortly before use. The Telonics prepackaged transmitters were activated by a magnetic switch. Pulses ranged from 60 to 80 beats/minute.

Radio Monitoring

Bears were released at the point of capture. I remained with each bear until it was fully mobile or until recovery was assured. I used an AVM, one-channel, 12-band, 164 mghz receiver incorporating both an internal and external power source, and a two-element, hand-held Yagi-type Telonics antenna. Triangulation bearings were measured with a Silva orientation compass.

The majority of black bear radio locations were obtained from foot or by truck, although I occasionally used a trail bike, horse, snowshoes, or aircraft. Aerial locations were made by a National Park Service (IGBST) fixed-wing aircraft equipped with two three-element Yagi-type antennas mounted on the wing struts and a directional loop antenna coupled to a four-band AVM receiver. Frequent aerial locations of the collared black bears were recorded in 1976, but only occasional flight reports were received from IGBST in 1977.

Maximum signal range for ground observations under ideal conditions was less than 5 km (3 mi). I completed most triangulations within 1 km (0.75 mi) of the bear. IGBST (Knight et al. 1976) reported a maximum aerial range of 17 km (10 mi). There was little discernible difference in signal strength among collars, although a difference of signal clarity and distinctness was apparent at temperatures below 0° C (32° F).

Grizzly Study Methods and Materials

Grizzly bears were captured on the study area by IGBST personnel and the local government predator control agent working in cooperation with the team. The grizzlies were captured in Aldrich foot snares and processed as described by IGBST (Knight et al. 1977, 1976). All grizzly locations were obtained through aerial radio-tracking by the National Park Service.

I attempted to locate each marked black bear daily. Locating collared bears in or near sheep herds, particularly the Squirrel Meadows sheep allotment, was my first priority. I maintained regular contact with the Squirrel Meadows sheep herder and recorded sheep losses, bear problems, bear sightings, and general range herding conditions. Contact with other herders was irregular and dependent upon marked bear activity in their allotments. USFS personnel recorded more extensive sheep loss data in a related study.

Home Range Methods

I calculated home ranges by both the minimum area home range method (Mohr 1947) and the modified minimum home range method (Harvey and Barbour 1965). Mean distances between locations were also calculated to facilitate comparisons with other research results.

Habitat Use

I collected and recorded data on scats, bear observations, tracks, and other bear sign throughout the study area. The seral forest habitat type and a complete plant species list (with general comments on vegetative phenological condition) were determined as possible for each area of bear activity, including capture sites and telemetric locations. Seral habitat determination followed the habitat typing procedures and key adapted from Steele et al. (1977) for eastern Idaho and western Wyoming.

Unknown plants were identified only to the detail allowed by the phenological condition and presence of key identifying characteristics. A comparison of vegetative plots at the lower western and higher eastern ends of the Squirrel Meadows allotment failed to show a measurable difference in phenological development.

Bear Mortality Investigation

I attempted to collect reproductive data, stomach contents, measurements, skulls, and/or general condition information from all bears killed as a result of real or alleged predation on sheep. My success was limited by the isolation and inaccessibility of the higher elevation allotments, vague or neglected reports regarding killed bears, and rapid decay of bear carcasses.

Bear and Sheep Food Competition

Scats were tentatively analyzed and labeled in the field, then air dried at field headquarters for later analysis. A 7 percent loss resulted from rodent depredations and mold caused by inclement weather. I analyzed scats following the laboratory method described by Mealey (1975) and matched plant fragments with positively identified BGP, Idaho Fish and Game, and University of Montana herbarium specimens. Scat contents were classified according to the following categories: I (75-100 percent), II (50-75 percent), III (25-50 percent), IV (5-25 percent), and V (5 percent-trace).

I compiled a list of bear food plants from my food habits analyses and the food habits studies tabulated below, which were grouped by habitat and bear species:

Bear Studies Included in Appendix A

Source	Area	Bear Species
Craighead and Sumner (1975)	Northwestern Montana	Grizzly
Jonkel et al. (1975,76,77)	Northwestern Montana	Grizzly
Schallenberger (1976)	Northwestern Montana	Grizzly
Mealey and Jonkel (1975)	Northwestern Montana	Grizzly
Tisch (1961)	Northwestern Montana	Black
Singer (1976)	Glacier National Park USA	Grizzly
Kelleyhouse (1975)	Northern California	Black
Martinka (1972)	Glacier National Park USA	Grizzly
Hatler (1967)	Alaska	Black
Blanchard (1978)	Yellowstone National Park	Grizzly
IGBT (1976,77)	Yellowstone National Park	Grizzly
Mealey (1975)	Yellowstone National Park	Grizzly
Hamer et al. (1977)	British Columbia	Grizzly
Lloyd and Fleck (1976)	British Columbia	Black-Grizzly
Hamer (1974)	British Columbia	Grizzly
Beecham (1977)	Southern Idaho	Black
Norstrum (1974)	Alberta	Black
This study	Idaho-Wyoming	Black-Grizzly

A list of the most common plants in the study area compiled from my habitat data, Targhee range reports (unpublished) and Richie's plant lists (unpublished data on moose study) were incorporated with the bear foods table. Plants that occurred on both the bear foods list and the study area list were presented in Appendix A.

I assembled a table of plants that occurred on both the bear foods list compiled from the literature and in scats I analyzed.

The total number of times each genus was reported in other bear studies partially indicates that plant's importance as a bear food. The relative importance of some genera, weighted by their frequency and percentage occurrence, will be discussed with the results. Plants that were important bear foods in some areas but were not represented in scats I analyzed were also tabulated.

Sheep use of bear food genera was determined from ratings in

Heady et al. (1947), summer, Bridger Mountains, MT; Hermann (1966), summer, USFS Regions 1 and 6; Sampson (1924), general; Reid (1942), summer, eastern OR and WA; and Anon. (undated), BLM Range Plant Desirability List, Missoula, MT district.

Each bear food was categorized from 1 to 5 for sheep and cattle use:

5-Excellent	2-Poor
4-Good	1-Negligible or none
3-Fair	

Sampson (1924) and Heady et al. (1947) furnished numerical ratings commensurate with those ratings listed above. The BLM list provided three ratings: D-Desirable, I-Intermediate, and L-Least Desirable. I assigned the numerical ratings D=5, I=3, and L=3 to BLM categories, using the categories above. Reid (1942) and Hermann (1966) described, rather than rated, plants used by livestock. To facilitate tabular comparison, I attempted to classify their descriptions into appropriate numerical categories listed above.

Statistics

Chi square tests were used to compare categorized habitat use.

CHAPTER IV

RESULTS AND DISCUSSION

Bear Data

Six black bears and two grizzlies were captured and processed in 1976 (in addition, one grizzly escaped with a snare on his foot before processing). Five black bears were captured in 1977 (Appendix B). All black bears, except for one too small to collar, were monitored with radio telemetry equipment by ground and aerial observation.

Seven of the 11 black bears, or 65 percent, were males. All black bears but No. 5, which was captured west of Yellowstone National Park, were captured on the Squirrel Meadows allotment. Two grizzlies were captured on the Dog Creek allotment and one on the Squirrel Meadows allotment.

Nine of the black bears captured were subadults (2.5 to 3.5 years old) as estimated from measurements, tooth wear and eruption, and general appearance. Two adults were captured. No. 6 was estimated at 7.5 years of age and No. 7 at 5.5 years of age from tooth cementum annuli sections. Grizzly No. 14 was estimated to be 9 years old, and grizzly No. 17 was 2.5 years by cementum annuli sections (Knight et al. 1976).

Eight black bears were initially captured by Aldrich footsnares and three were captured in culvert traps. No. 1, who slipped his collar shortly after culvert trap capture by USFS personnel in June 1976, was recaptured in August 1976 by snaring. All grizzlies were captured by Aldrich foot snares.

Trapping success for 1976 was very low because of a faulty latch on the culvert trap. Trapping success for 1977 was variable from set to set. Success ran from 11 percent at No. 7's capture site to 0.0 percent on the cattle allotment and at the state line. The overall rate for successful sets was six captured per 77 trap nights, or 6.5 percent. Trapping was terminated on 8 July 1977 to allow more time to collect data on collared bears. No attempt was made to determine bear density or population parameters from these trapping data.

Three of the six black bears captured in 1976, Nos. 2, 3, and 4, were captured in Unit 4 of the Squirrel Meadows allotment prior to arrival of the sheep. No. 6 was captured in Unit 1 several weeks after the sheep had passed through that unit. Her collar failed shortly after activation, and she was not relocated. No. 1, initially collared in Unit 1 by USFS personnel, slipped his collar prior to the arrival of the sheep in that unit. He was not relocated until his recapture in Unit 1 in late August. No. 5 was captured adjacent to a sheep allotment west of YNP in August, but vehicle mileage limitations and radio repeater interference kept observations to a minimum.

Two grizzlies were snared by the IGBST in Dog Creek, Unit 2, following depredations on the sheep herd. Grizzly No. 14 was captured in the Squirrel Meadows Unit 4, concurrent with the presence of the Squirrel Meadows herd.

All five black bear captures in 1977 took place on Squirrel Meadows Unit 1 in Idaho. Nos. 7, 8, and 9 were captured prior to the arrival of the sheep on the forest. Nos. 10 and 11 were captured before the sheep reached the respective capture sites. No trapping was attempted in Wyoming in 1977 because of a Fish and Game Department restriction on snares.

Home Range Data

Summer home ranges for seven monitored black bears are listed in Table 1 (Figures 2 and 3). Mean distances between consecutive radio locations or observations are reported in Table 2 to facilitate comparison with data from elsewhere. Home ranges for Nos. 1 and 5 are not included because too few observations were recorded for home range determination. The collar failed immediately after capture of No. 6, and No. 8 was not collared because of his extremely small size.

The most complete home range information was obtained for No. 3. He was located approximately every 1 or 2 days from 16 July to 9 September 1976 and from 23 June to 30 August 1977. He moved outside of aerial and ground tracking range in autumn both years. Prior to the loss of his signal each year, he was heading southwest. His annual home range was probably larger than recorded in Table 1.

In 1976, No. 3 was estimated at 3.5-4.5 years of age. His minimum home range (Mohr 1947) was 34.7 km^2 (13.4 mi^2). The following year an apparent increase in size indicated that he had attained sexual maturity (size difference noted when I observed him while ground tracking in 1977). His 1977 minimum home range was much smaller, 18.0 km^2 (7.0 mi^2). By eliminating "sallies outside the area" (Burt 1943), his modified minimum home range (Harvey and Barbour 1965) for 1977 was 14.8 km^2 (5.7 mi^2), similar to his 1977 home range of 18.0 km^2 (7.0 mi^2). His home range changed slightly from 1976 to 1977 (Figure 4). The

Table 1. Summer home ranges of collared black bears, 1976, 1977.

Bear	Sex	Year	No. of Locations	Home range methods (Mohr 1947)		Harvey and Barbour (1964)	
2	F	1976	55	13.2 km^2	(5.1 mi^2)	11.9 km^2	(4.6 mi^2)
		1977	1				
3	M	1976	42	34.7 km^2	(13.4 mi^2)	14.8 km^2	(5.7 mi^2)
		1977	41	18.0 km^2	(7.0 mi^2)	18.0 km^2	(7.0 mi^2)*
		Combined	83	83.1 km^2	(32.1 mi^2)	25.3 km^2	(9.8 mi^2)
4	M	1976	12	9.8 km^2	(3.8 mi^2)	0.9 km^2	(0.4 mi^2)
7	M	1977	41	22.2 km^2	(8.6 mi^2)	22.2 km^2	(0.4 mi^2)
9	M	1977	34	19.9 km^2	(7.7 mi^2)	8.7 km^2	(0.4 mi^2)*
10	M	July 1977	6	2.9 km^2	(1.1 mi^2)		
		August 1977	6	2.3 km^2	(1.3 mi^2)		
		Combined	12	23.7 km^2	(9.5 mi^2)		
11	F	1977	47	9.5 km^2	(3.7 mi^2)	9.5 km^2	(3.7 mi^2)*
Mean Summer Home Ranges							
All males (No. 3: 1976, 1977)				21.4 km^2	(8.2 mi^2)	12.9 km^2	(5.0 mi^2)**
All males (No. 3: combined)				31.7 km^2	(12.3 mi^2)	14.3 km^2	(5.5 mi^2)**
Adult males (Nos. 7,3-1977)				20.1 km^2	(7.8 mi^2)	20.1 km^2	(7.8 mi^2)*
Subadult males (Nos. 3-1976,4,7,9)				22.0 km^2	(8.5 mi^2)	8.1 km^2	(4.1 mi^2)

*No difference in home ranges computed by either the minimum area home range (Mohr 1947) or the modified minimum method (Harvey and Barbour 1965).

**No. 10 was not included in modified minimum area averages. Too few locations.

Table 2. Mean distances between locations: collared black bears, Targhee National Forest.

Bear	Sex	Year		Number of relocations	Average distance between consecutive relocations: Actual km	Actual mi	Range km	Range mi	Average number of days between consecutive relocations
1	M	1976		5	4.1	(2.6)	0.4 - 16.5	(0.2 - 10.2)	15.6 (1976 only)
		1977		1					
2	F	1976	6/28 - 10/7	54	1.2	(0.8)	0.0 - 10.0	(0.0 - 6.2)	1.8
3	M	1976	7/16 - 9/9	41	2.5	(1.6)	0.0 - 11.6	(0.0 - 7.2)	1.7
		1977	6/23 - 8/30	40	1.4	(0.9)	0.0 - 3.2	(0.0 - 2.2)	1.4
		(Combined)		81	2.0	(1.2)	0.0 - 11.6	(0.0 - 7.2)	
4	M	1976	7/24 - 7/30	11	2.2	(1.4)	0.0 - 18.9	(0.0 - 11.5)	0.6
7	M	1977	6/11 - 11/4	54	2.2	(1.4)	0.0 - 8.7	(0.0 - 5.4)	3.8
9	M	1977	6/23 - 11/10	33	1.8	(1.1)	0.0 - 7.2	(0.0 - 4.5)	4.2
10	M	1977	7/7 - 8/19	11	2.9	(1.8)	0.0 - 8.0	(0.0 - 5.0)	3.8
11	F	1977	7/6 - 11/12	46	1.4	(0.8)	0.0 - 4.2	(0.0 - 2.6)	2.7
			7/6 - 9/19	44	1.4	(0.8)	0.0 - 4.2	(0.0 - 2.6)	1.6

combined home range for 1976 and 1977, 25.3 km^2 (9.8 mi^2) by the modified minimum area method, may be the most accurate approximation of his home range.

No. 7, an adult male, had a home range of 22.2 km^2 (8.6 mi^2) by both the minimum area and modified minimum area home range methods (Table 1, Figure 3). This range was comparable to Jonkel and Cowan's (1971) estimate of 30.8 km^2 (11.9 mi^2) area for adult male black bears in Montana. However, the range was considerably smaller than the 38.8 km^2 (15.0 mi^2) estimate given by Erickson et al. (1964) in Michigan, the 51.5 km^2 (19.9 mi^2) estimate for adult males in Washington (Poelker and Hartwell 1973), and the 112.1 km^2 and 60 km^2 (43.3 mi^2 amd 23.2 mi^2) estimates for adult males in Idaho by Amstrup and Beecham (1976) and Reynolds and Beecham (1977), respectively. Reynolds and Beecham (1977) found a considerably smaller home range, 31 km^2 (12.0 mi^2) for adult males tracked 2 to 8 months, which was more comparable to the 5 month home range data for No. 7.

Data for the other male bears listed were less complete. No. 4 (Figure 2), a subadult male, remained within a 1.0 km^2 (0.4 mi^2) area for 5 days. That night he moved 77.0 km (11.8 mi) in 8 hours to the southwest, was captured in a sheepherder's snare, and was shot the next morning. Including the movements of the last day, his home range was 9.8 km^2 (3.8 mi^2), comparable to estimates of male black bear home ranges by Jonkel and Cowan (1971) in Montana and Kelleyhouse (1975) in California 10.6 km^2 (4.1 mi^2).

No. 9's home range, including one salley and a 3 week period when no locations were recorded, was 19.9 km^2 (7.7 mi^2), not unlike

Figure 2. 1976 summer home ranges of collared Targhee National Forest black bears.

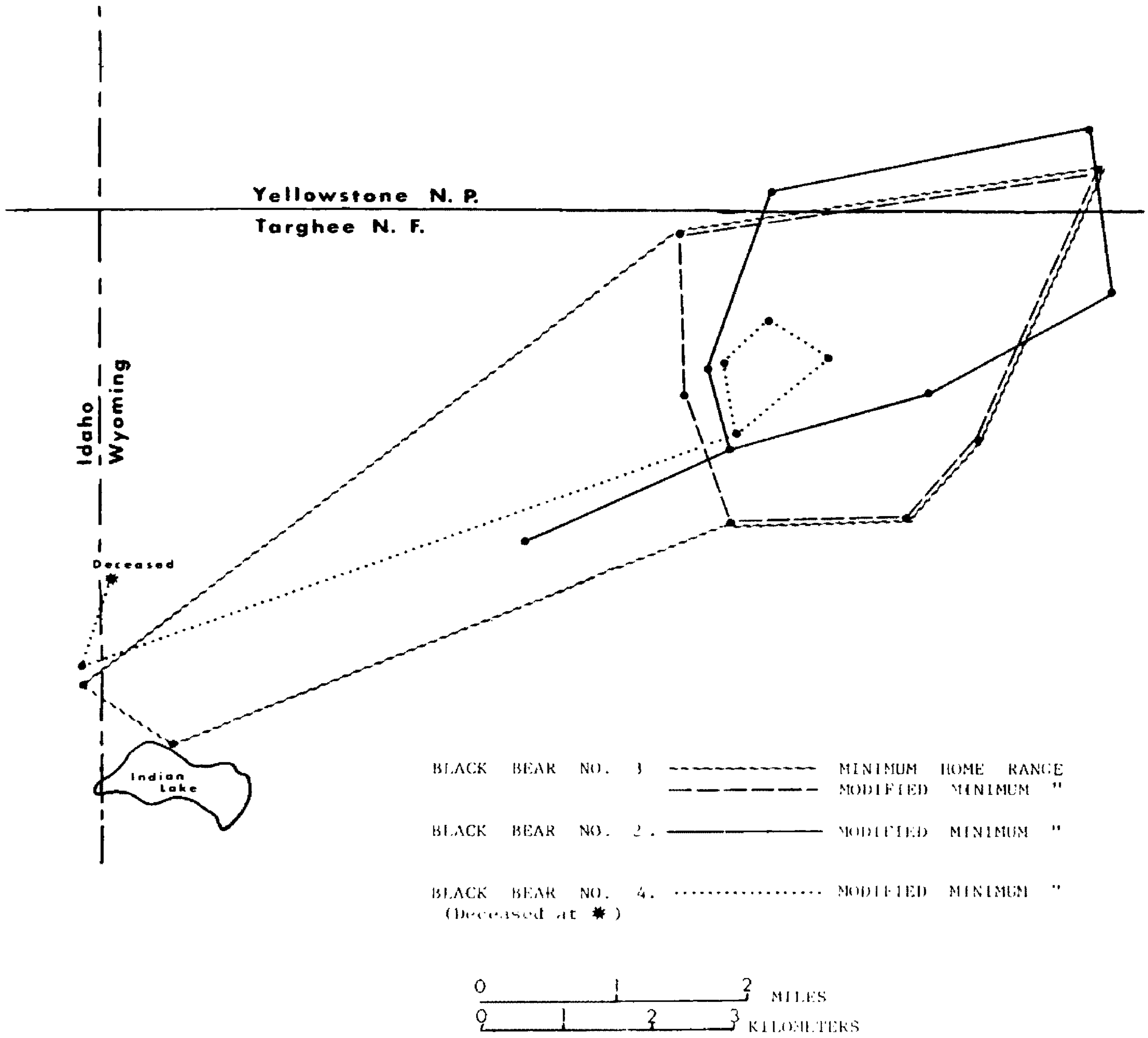
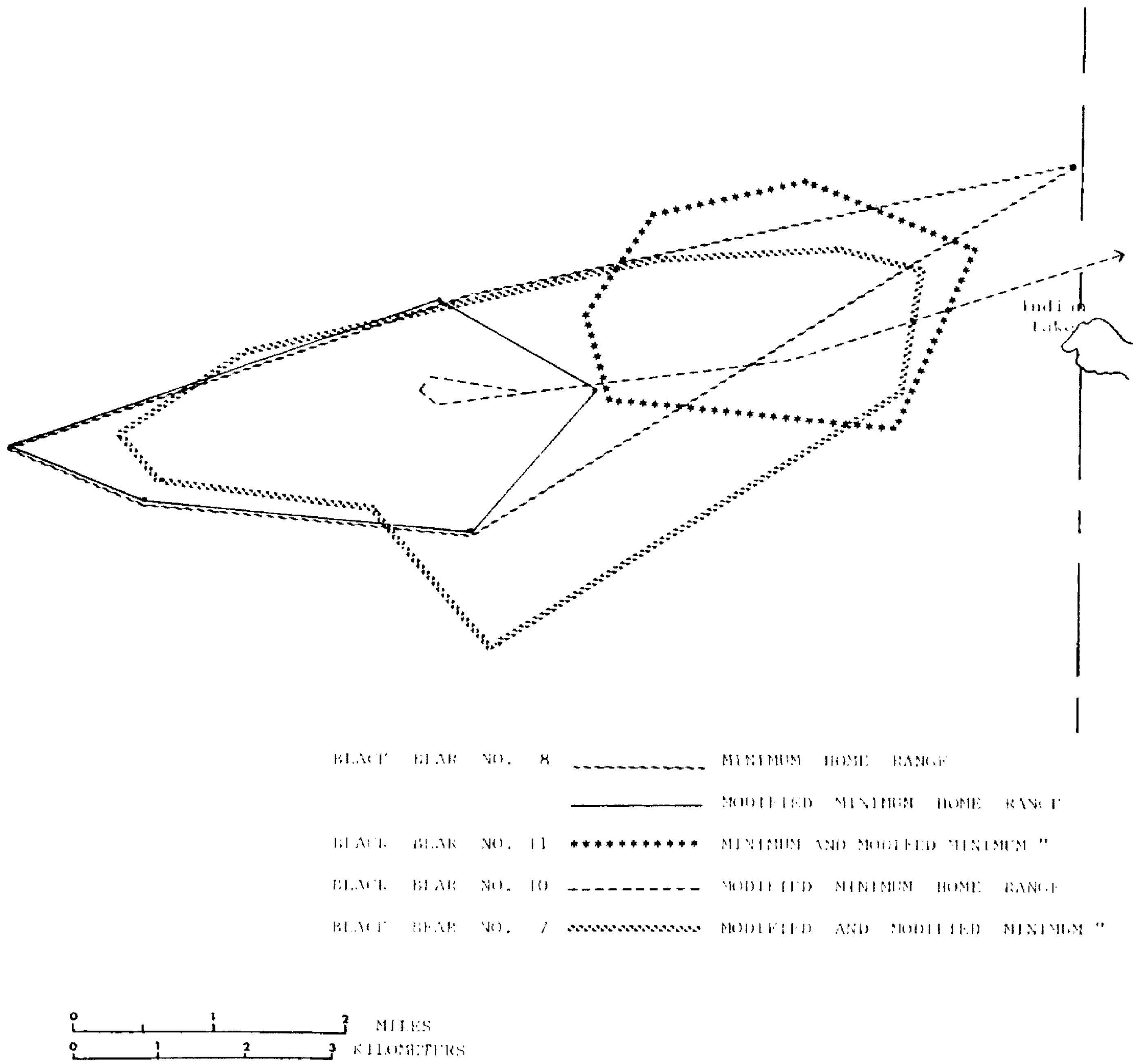
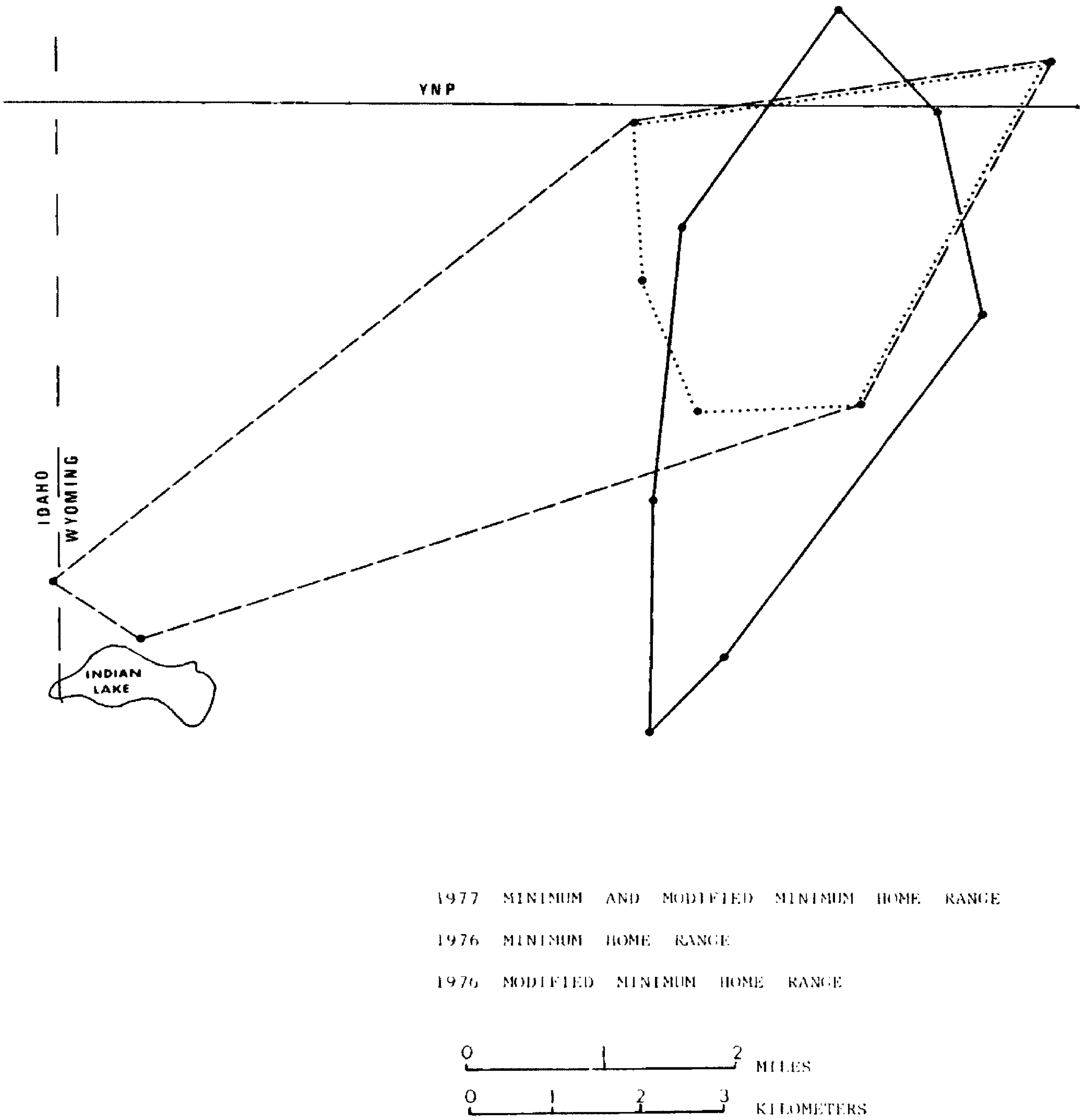

Yellowstone N. P.
Targhee N. F.
Idaho
Wyoming
Deceased
Indian Lake
BLACK BEAR NO. 3 MINIMUM HOME RANGE
MODIFIED MINIMUM "
BLACK BEAR NO. 2. MODIFIED MINIMUM "
BLACK BEAR NO. 4. MODIFIED MINIMUM "
(Deceased at ✱)
0 1 2 MILES
0 1 2 3 KILOMETERS

Figure 3. 1977 summer home ranges of collared Targhee National Forest black bears in Idaho.



Indian
Lake
BLACK BEAR NO. 8 MINIMUM HOME RANGE
MODIFIED MINIMUM HOME RANGE
BLACK BEAR NO. 11 MINIMUM AND MODIFIED MINIMUM "
BLACK BEAR NO. 10 MODIFIED MINIMUM HOME RANGE
BLACK BEAR NO. 7 MODIFIED AND MODIFIED MINIMUM "
0 1 2 MILES
0 1 2 3 KILOMETERS

Figure 4. Black bear No. 3 summer home range overlap: 1976 and 1977.


YNP
IDAHO
WYOMING
INDIAN LAKE
1977 MINIMUM AND MODIFIED MINIMUM HOME RANGE
1976 MINIMUM HOME RANGE
1976 MODIFIED MINIMUM HOME RANGE
0 1 2 MILES
0 1 2 3 KILOMETERS

that of the two adult males monitored (Tables 2 and 3).

No. 1 was monitored intermittently. He slipped his collar within 1.2 km (0.69 mi) of his original capture site. He remained in the area for 6 days after the recapture in August 1976. Four days after I observed him near the capture site, he was located by air 10.1 km (6.3 mi) to the northeast. No further radio locations were obtained. In June 1977, he was shot by an out-of-state hunter 16.5 km (10.3 mi) southwest of his last radio location and 6.4 km (4.0) mi from his recapture site.

Table 3. Bear habitat use in terms of Targhee USFS cover types.

Observation	LPP	DF	AF	Aspen	Sage Grass	Swamp	Bare	Total
Percent Occurrence	80.0	10.0	6.0	2.0	1.5	0.5	1.0	100
Scats	167	54	5	13	17	2	0	258
Sightings	16	6	2	13	5	0	0	42
Radio Observations	140	68	2	19	12	13	1	255
Killed bears	12	4	2	1	1	0	0	20
Grizzly No. 14	9	0	1	0	2	0	0	12
Totals	344	132	12	46	37	15	1	587

No. 10, a subadult male, exhibited two non-overlapping home ranges for July and August before his signal was lost on 19 August 1977. Between 7 July and 19 August 1977, he ranged more than 16.1 km (10.0 mi) from west to east. His combined home range, 23.7 km^2 (19.5 mi^2), was similar to that of adult males.

Minimum area home ranges (Mohr 1947) for Nos. 2 (Figure 2) and 11 (Figure 3), both subadult females, were 13.2 km^2 (5.1 mi^2) and 9.5 km^2 (3.7 mi^2), respectively. The average minimum area home range for female black bears in this study was 11.4 km^2 (4.4 mi^2). Sallies were less common in females than in males, and the average modified minimum home range (Harvey and Barbour 1965) was 10.7 km^2 (4.1 mi^2), similar to the minimum area home range (Mohr 1947).

Intraspecific Behavior

Brown and Orians (1976) defined a home range as "the area in which an animal normally lives, exclusive of migrations, emigrations, or unusual erratic wanderings." They suggested that individuals may display dominance in core areas during the breeding season but display tolerance regarding other activities. Black bears in Idaho (J. Beecham, pers. comm.) demonstrated behavior patterns which fit this rule. Wide tolerance was experienced among Idaho bears outside of the breeding season.

Female black bears in Minnesota exhibited defensive behavior toward strange females but tolerated their own young (Rogers 1977). Jonkel and Cowan (1971) noted mutual avoidance between resident bears and aggressive behavior toward nonresidents. Tolerance of family members was indicated. Reynolds and Beecham (1977) found that black bears in Idaho had extensive home range overlap and little evidence of hostile interaction. However, the overlap of home ranges of adult females in which 75 percent of their locations occurred was minimal. They believed the lack of overlap was a result of mutual avoidance rather than aggressive hierarchy defense. Poelker and Hartwell (1973) found overlapping home ranges among adult females and males, and occasionally other females, but no overlap among home ranges of adult males.

Dispersal usually occurred at 1.5 (Jonkel and Cowan 1971) to 2.5 years (Rogers 1977, Reynolds and Beecham 1977) in subadult males. Rogers (1977) found that dispersal occurred independently of the mother's presence, food abundance or scarcity, or the density of resident adult male bears. Dispersing males were deterred from establishing home ranges in new areas by the presence of local adult males. Subadult females often established home ranges within their mother's range (Rogers 1977, Pearson 1975, Jonkel and Cowan 1971).

The 1976 summer home ranges of collared subadult bears Nos. 2 and 3 overlapped considerably (Figure 2), as did the 1977 ranges of No. 8, 9, 10, and 11 (Figure 3). Males Nos. 3 and 7 utilized different habitats and therefore had no home range overlap. No. 1's movements were within the 1977 home range of adult male no. 7, but without additional data for 1977 it was difficult to determine home range overlap between those two adult males. Much of the home range of subadult female No. 11 concurred with the home range of No. 7, an adult male (Figure 3).

Subadult female No. 2 ranged within the home range of male No. 3 during 1976. Temporal mutual avoidance was observed. Both bears, subadults in 1976, utilized the abundant huckleberries on the hills southeast of Loon and Fish lakes, often within 0.5 km of each other. They were always separated by the apex of the ridge or a drainage. When one bear ascended to the ridge, the other descended. Several times the two bears exchanged places, circling around the site where an encounter would have occurred had they both maintained straight line travel patterns. Although Nos. 2 and 3 often utilized the same habitat less than 0.5 km from each other during 1976, they never roamed on the same side of the drainage or hillside while being monitored. Neither bear demonstrated alpha-dominance or any hierarchical behavior. Rather, mutual avoidance was suggested. I was unable to observe further interactions in 1977 because No. 2's signal was lost in April, presumably to transmitter failure.

One subadult male, No. 10, exhibited the widely ranging habits of a dispersing subadult. His extensive wanderings made consistent ground tracking impossible. He remained out of range from 14 July 1977 to 22 July 1977 and from 23 July 1977 to 9 August 1977. He was last located in the southeastern section of the study area, moving rapidly to the southeast. Further attempts to locate him by foot, horseback, and aircraft were unsuccessful.

The home ranges of adult male No. 7 and subadult male No. 9 were broadly overlapping, especially in autumn 1977. Lindzey and Meslow (1977) found that yearlings were always subordinate to adult males and that subordinate bears utilized home ranges in response to the location of dominant bears. However, Nos. 7 and 9 demonstrated mutual tolerance of each other in their autumn centers of activity, often simultaneously occupying seasonally prime habitat less than 0.3 km apart.

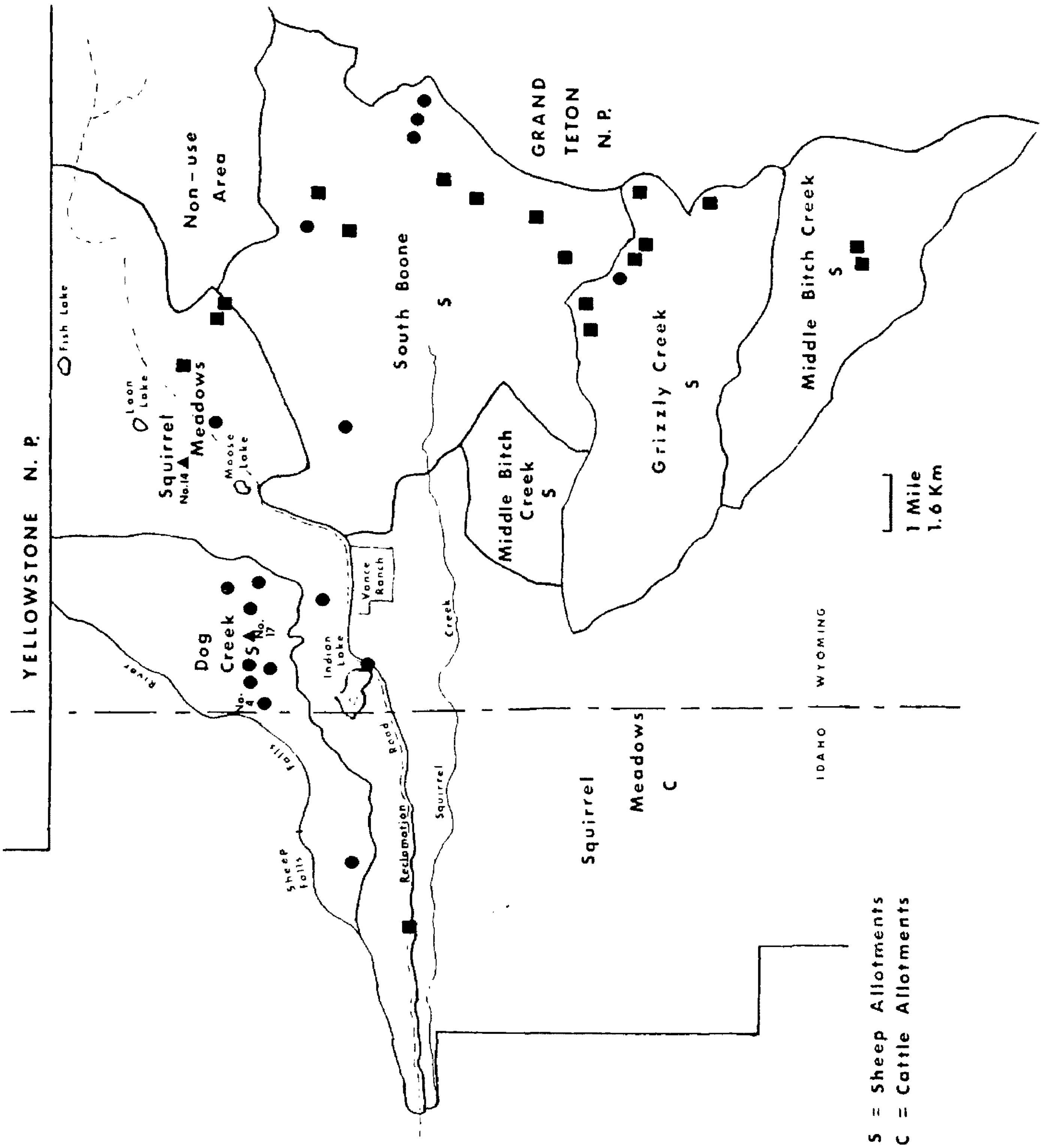
Black Bear Sightings

In addition to the collared bears in the study area, several unmarked bears resided in and/or ranged into the study area. I recorded all reported or personally observed sightings by date and location. Loggers, herdsmen, USFWS personnel, and USFS employees reported sightings irregularly, when reporting was convenient. In most cases, bears were observed crossing the Reclamation Road in Idaho or near a sheep herd in Wyoming.

Many bears moved back and forth between the forested lodgepole and Douglas-fir types along Falls River and the productive hawthorn, serviceberry, rose, and snowberry patches of the western Squirrel Creek drainage (Figure 5) during September, October, and November 1977. At least four females with cub(s) (differentiated by markings and color phase) occupied that habitat in September. Other solitary bears occupied the area, and collared bears Nos. 7 and 9 regularly moved between Falls River and Squirrel Creek that autumn.

A similar aggregation occurred in 1976 at the eastern end of the study area. Two females with cub(s) were sighted within 2 km of each other and near collared bears Nos. 2 and 3. All observed bears were feeding on the abundant huckleberries west of Loon Lake (Figure 5). The number of scats I collected indicated that several other bears were also utilizing the berry patch. Aggregations of bears at clumped food sources were documented by Craighead (1976), Halter (1967), Barnes and Bray (1967), Erickson et al. (1964), and Hornocker (1962) for black bears and/or grizzlies.

Figure 5. Partial delineation of aggregated bear food within the study area, Targhee National Forest.


YELLOWSTONE N. P.
GRAND TETON N. P.
Non-use Area
South Boone
S
Grizzly Creek
S
Middle Bitch Creek
S
Middle Bitch Creek
S
Squirrel Meadows
No.14
Fish Lake
Loon Lake
Moose Lake
Dog Creek
S
No. 17
No. 4
Indian Lake
Vance Ranch
River
Falls
Sheep Falls
Reclamation Road
Squirrel
Creek
Squirrel Meadows
C
WYOMING
IDAHO
1 Mile
1.6 Km
S = Sheep Allotments
C = Cattle Allotments

Grizzly Bear Sightings

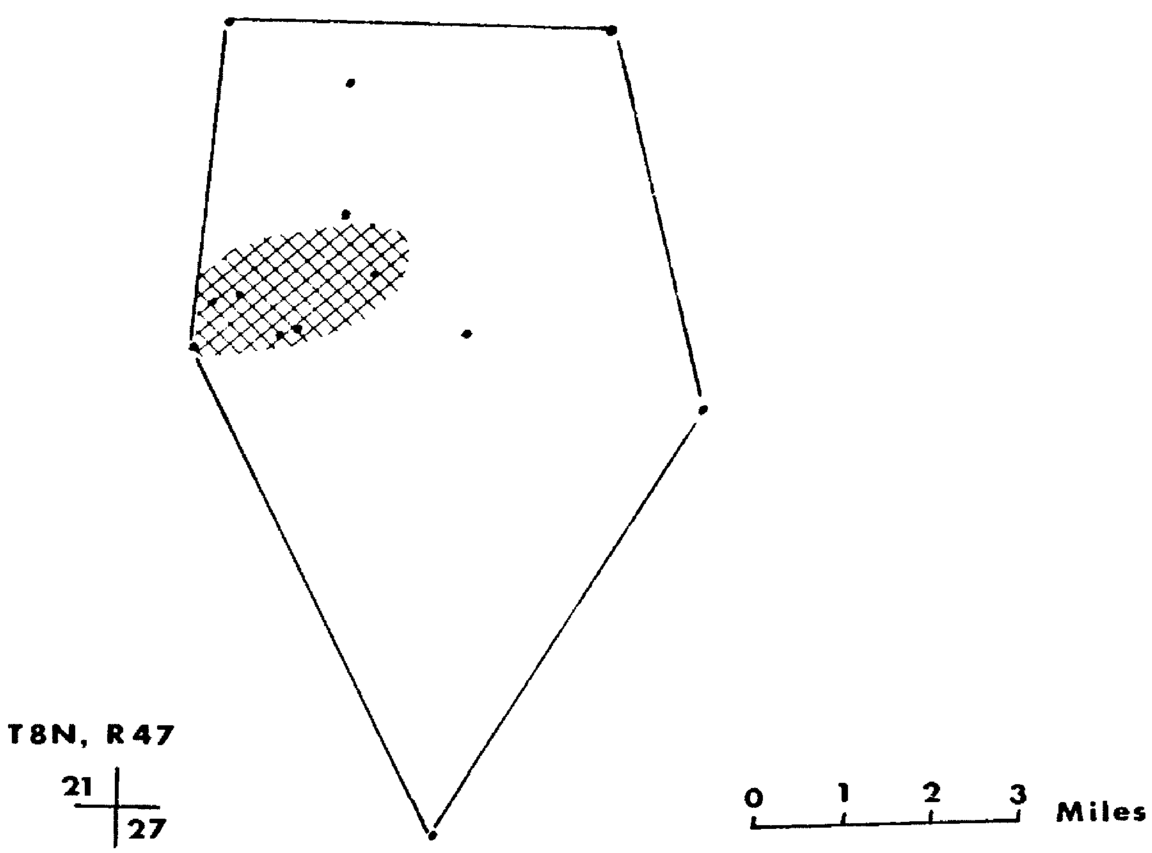
Three non-collared grizzlies were reportedly sighted within the study area in 1976 or 1977. A large grizzly was seen by local residents in June by Fish Lake near the YNP boundary. A sheep camp tender observed a large grizzly wading a stream on the Dog Creek allotment in August 1976. A grizzly reportedly chased a logger across a grass/sagebrush meadow near South Boone Creek in July 1977. It is likely that more grizzlies ranged through the study area than were involved in grizzly/sheep predation incidents, although few sightings of grizzlies not associated with sheep were verified.

Yellowstone Study Team Grizzlies (IGBST)

Only one of the grizzly bears encountered by IGBST in the study area was successfully monitored (Figure 6). No. 14, a 500-pound, 5-year-old male, had a temporary range of 38 mi^2 (98.4 km^2) for 13 September through 15 September with a concentrated area of activity for that period as shown (Figure 6) (Knight et al. 1976). The signal was lost in September 1976, and was presumed to have failed. No. 14 was relocated in 1977. His 1976-77 home range extended from northern YNP to Grand Teton National Park, covering most of the east end of my study area encompassing more than 2590 km^2 (1000 mi^2) (D. Knight, pers. comm.).

No. 17, a 2.5-year-old male grizzly, was captured by the USFWS trapper during a black bear/sheep predation control effort. He was processed and collared by IGBST 21 August 1976 in the Dog Creek allotment and released. He was relocated 6 days later, dead of a drugging injury. An adult grizzly, judged to be extremely large from the canine indentations on a bitten log, was temporarily detained in the Dog Creek

Figure 6. 1976 home range, IGBST grizzly No. 14, with shaded center of activity (Knight et al. 1977)


T8N, R47
21
27
0 1 2 3 Miles

allotment in August 1976. He escaped (by breaking the snare cable) with the snare on his foot. An extensive search was unsuccessful in relocating him. In 1977, an adult male grizzly was captured by YNP personnel with a snare attached to his foot. He died during processing. He traveled more than 20 airline kilometers (12.5 mi) from his initial capture site.

Grizzly Bear Home Ranges

Cole (1972) estimated grizzly densities within the Yellowstone area at 1/17 mi^2 (1/44 km^2) based on an estimated population of 200 animals, of 1/11 mi^2 (1/28 km^2) using an estimated population of 300 bears. Craighead and Craighead (1971) estimated the grizzly density in the Yellowstone ecosystem at 1/29 mi^2 (1/75 km^2), although greater densities were encountered at artificial food supplies. Craighead et al. (1974) estimated Yellowstone grizzly densities to be 1/88 km^2 (1/34 mi^2). Craighead (1976) reported home ranges for adult male grizzlies from 57 km^2 (22 mi^2) to 324 km^2 (125 mi^2). Pearson (1975) calculated the mean minimum home range for adult male grizzlies in the Yukon at 287 km^2 (110 mi^2). Jonkel (1978) reported preliminary minimum home ranges for adult males from 103.6 km^2 (40 mi^2) to 704.7 km^2 (272 mi^2) in Montana. Knight et al. (1976) expressed summer and summer/fall partial home ranges in terms of standard diameters of areas of activity. Assuming approximately circular home ranges, standard diameters for adult males ranged from 6.15 mi (76.6 km^2) to 12.54 mi (101.8 km^2), which are comparable to results from other studies, although recent unpublished data estimates Yellowstone area grizzly home ranges several times those reported in 1976 (Knight, pers. comm.). Heterogeneous habitats, physical barriers, social relationships, and differing individual preferences, in addition to differences in analysis techniques, are a few of the reasons for widely variable home range estimates.

Grizzly Bear/Black Bear Interactions

Documentations of black bear/grizzly bear interactions are scarce. Barnes and Bray (1967) based their results on observations at concentrated feeding spots such as bait stations and garbage dumps. Shaffer (1971) discussed ecological relationships between black bears and grizzlies, documenting the grizzlies' exclusive habitation of high elevation parklands. Herrero (1978) explained the evolutionary adaptations between the forest-dwelling (climbing) black bear and the meadow/parkland/tundra-dwelling (digging) grizzly. He suggested competitive exclusion in open areas and postulated grizzly predation on black bears as a mechanism. Rausch (1961) reported a prevalent belief in Alaska that grizzlies prey on black bears. Jonkel (1967) documented three cases of grizzly predation on black bears.

Barnes and Bray (1967) documented several black bear/grizzly bear encounters at YNP dumps and bait stations. Black bears were dominant in 28.6 percent and submissive in 40.8 percent of 49 encounters with grizzly bears. Black bears and grizzlies were mutually tolerant 15 percent of the time at a minimum allowed distance of 20 yards. Black bears generally avoided concentrations of grizzlies.

Shaffer (1971) reported that grizzlies were primarily active from 0400-1100 hours and from 1530 to after dark, but that black bears were most active in the early morning, throughout the day, and into late evening. Craighead and Craighead (1972) found that grizzlies were active night and day during the spring and fall but were mostly nocturnal in the summer. Grizzly activity in the Yukon Territory, Canada, peaked at dusk (Pearson 1975). Greatest movements occurred after dark, although feeding was common during the day excepting 1100-1500 hours. Reynolds and Beecham (1977) found that southern Idaho black bears were diurnal. Activity peaked at 1000 and 2100 hours, with general inactivity between 0100 and 0400 hours. Minnesota black bears had similar diurnal activity patterns (Rogers 1977). YNP black bears used dumps during the day, and grizzlies used dumps from dusk until pre-dawn (Barnes and Bray 1967). Collared TNF black bears were generally active during the day, with a daytime period of inactivity common between 1300-1500 hours. Nighttime monitorings were few, but night bear movements were minimal in all cases. Bears located after sunset would usually be near that spot at dawn, but dawn to dusk movements were generally greater. Black bears involved in sheep depredations were both diurnal and nocturnal. Grizzly 24-hour activity patterns for the TNF were not known, but they probably approximate grizzly activity patterns reported for YNP (Craighead and Craighead 1972, Barnes and Bray 1967). Competitive and/or aggressive interactions between black bears and grizzlies were probably curtailed by the limited overlap in their peak activity patterns. Bears involved in sheep predation exhibited slightly different patterns (see Predation section).

The dominance relationships at concentrated food supplies discussed above did not necessarily apply to free-ranging animals in the heterogeneous habitat of the study area. Grizzly observations were limited to capture locations, aerial observations by IGBST, and alleged interactions with sheep (Bear Sheep/Interactions section). Parts of the home ranges of black bears Nos. 2 and 3 lay within the range of grizzly No. 14. No. 3 moved within 0.75 km of No. 14 and used that area prior to, during, and after No. 14's initial capture and release without a detectable reaction to the vocalizing, snared grizzly. No. 14 moved through the occupied home ranges of Nos. 2 and 3 several times in 1976. No apparent response was exhibited by either black bear to the presence of the grizzly.

Most predator-prey ecology is based on the predator feeding upon the prey, although other variables are involved in the killing response (Polsky 1975). Kitching and Ebling (1967, in Krebs 1972) proposed the following criteria for determination of predator restrictions on prey distribution:

1. Experimentally transplanted prey will survive in areas outside their normal occurrence if protected from predators.
2. Predators and prey have inversely correlated distributions.
3. The suspected predator is able to kill and has been observed killing the prey.
4. The predator is responsible for the extermination of the experimentally transplanted prey population (No. 1).

Documentation of grizzly predation on black bears is scarce, but verified. The generally accepted theory of food-procuring predation is probably invalid between grizzlies and black bears, although cannibalism is not unknown. Grizzly predation on black bears is better explained by aggressive response. The second criterion may exist to a limited degree if estimated ratios of black bears and grizzlies in areas jointly occupied are accurate (Jonkel and Cowan 1971, Barnes and Bray, 1967). Criteria Nos. 1 and 4 would be extremely difficult to document, particularly when habitat and intraspecific relationships are considered. Strict predation is probably not a limiting factor on black bears in grizzly habitat, based on the criteria expressed above. A more complex relationship develops when niches overlap, and the habitat preferences, activity patterns, and the social relationships among black bears and among grizzlies, as well as the interspecific associations between both species, are considered.

If aggressive grizzly actions commonly occur in grizzly bear/black bear encounters, the black bear could be expected to exhibit a flee response or to hide (Emlen 1973). In several instances, based on responses of collared black bears in areas of known grizzly presence, and on personal comments and observations of sheepmen and predator control agents, black bears responded indifferently to the presence of the grizzlies. Radio-collared bears exhibited no significant changes in their movements when grizzlies were near, even in their concentrated centers of activity. Black bear movements did not differ in areas of known grizzly occurrence (Wyoming) and areas thought to be utilized only by black bears (Idaho), as determined by sign, sightings, and the history of grizzly bear use in the Targhee (Jorgensen and Allen 1975). I conclude, therefore, that grizzly bear/black bear interactions on the TNF are comparable to the mutual avoidance exhibited among bears of the same species.

Habitat Description

Description.

Habitat analyses of representative bear habitat (judged by observation frequencies) were completed throughout the study area. True habitat types are "the aggregation of units of land capable of producing similar plant communities" (Pfister 1971). Habitat types so defined deal with "primary complexes"; non-disturbed plant communities succeeding to climax types. Because of the long history of livestock grazing and logging in the study area, the term habitat type, as used here, will refer to a "disclimax" (Tansley 1935), or seral habitat classification, not to be confused with primary habitat types. The seral descriptions for the categorized types (adapted from Steele et al. 1977) were reasonably similar under field conditions to use as categories of bear habitat use.

Habitat occurrence. Douglas-fir was the most prevalent classification type along the lower elevational units of the Squirrel Meadows and Dog Creek allotments. North facing slopes were predominantly Douglas-fir types interspersed with subalpine fir types in the abundant drainages along Boone Creek and Falls River. Seral stages of Douglas-fir types were typically aspen, lodgepole or limber pine, and Douglas-fir (Steele et al. 1977).

Cooper (1975) was the first to describe lodgepole pine as a climax species. Lodgepole was the most prevalent overstory species in the entire study area, but the presence of occasional Douglas-fir and subalpine fir within lodgepole stands prevented classification as a PICO type in most cases (see Table 4 for habitat abbreviations). Most lodgepole pine types were located on southern slopes and along the Reclamation Road.

One quaking aspen type was classified. It was a minor type in

Table 4. Bear habitat use in terms of habitat types.

Habitat Type	Scats	Sightings	Radio Locations
DOUGLAS-FIR (PSME)	126	15	70
Symphoricarpos albus (Syal)	33	1	29
Vaccinium globulare (Vagl)	34	6	18
Calamagrostis rubescens (Caru)	18	2	7
Physocarpos malvaceus (Phme)	19	5	3
Arnica cordifolia (Arco)	7	0	2
Osmorhiza chilensis (Osch)	3	1	1
Spirea betulifolia (Spbe)	1	0	0
Carex geyeri (Cage)	3	0	0
Acer glabrum (Acgl)	0	0	1
Unspecified grassland	8	0	8
SUBALPINE FIR (ABLA)	69	9	77
Vaccinium globulare (Vagl)	20	1	36
Calamagrostis canadensis (Caca)	18	2	11
Symphoricarpos albus (Syal)	4	2	0
Equisetum arvense (Eqar)	7	0	1
Actea rubra (Acru)	9	0	1
Calamagrostis rubescens (Caru)	5	0	0
Vaccinium scoparium (Vasc)	1	0	2
Streptopus amplexifolius (Stam)	5	0	0
Unspecified ABLA type	0	4	26
LODGEPOLE PINE (PICO)	4	9	19
Calamagrostis rubescens (Caru)	2	0	10
Calamagrostis canadensis (Caca)	0	3	1
Carex geyri (Cage)	0	1	6
Calamagrostis rossii (Caro)	1	0	0
Vaccinium scoparium (Vasc)	0	2	1
Unspecified PICO type	1	5	1
QUAKING ASPEN (Populous)	4	7	11
DISTURBED OR GRASSLAND TYPE (Not keyed in habitat type)	26	0	21

occurrence, but was an important bear habitat, particularly in autumn. Isolated patches of aspen were found near the western Targhee National Forest boundary and on the plateau between Falls River and the mouth of Boone Creek.

Subalpine fir was the dominant climax type of higher elevation units in the Squirrel Meadows, Dog Creek, and South Boone allotments. It often occurred in closed, mature stands and was mixed with Douglas-fir and Englemann spruce (Steele et al. 1977).

USFS cover types. Bear use was also recorded in terms of USFS cover types. These broadly inclusive types were classified according to major commercial timber type species from aerial photos. Lodgepole pine was the most extensive cover type throughout the study area (80 percent), followed by Douglas-fir (10 percent), subalpine fir (6 percent), aspen, a non-commercial type (2 percent), grass/sage (2 percent), and wasteland (1 percent). I categorized 587 observations to USFS cover types (Table 3).

PSME/Syal was characterized by aspen and lodgepole seral overstory species with snowberry (*Symphoricarpos albus* and *S. oreophilus*), oregon grape, and often chokecherry and serviceberry making up the shrub understory. Domestic livestock reportedly had little preference for this habitat type (Stele et al. 1977), although they used the openings within these types extensively. Aspen reportedly regenerates rapidly after disturbance and may retard Douglas-fir regeneration. Lodgepole pine was the dominant seral species of PSME/Vagl types, invading after fire. Plants such as globe huckleberry, spirea, red twinberry (*Lonicera utahensis*), and pinegrass (*Calamagrostis rubescens*) were the most common understory species. Douglas-fir dominated the PSME/Phme type accompanied by limber pine (Pinus flexilis) and aspen. The understory was predominantly ninebark (Physocarpos malvaceus with snowberry and spirea. Livestock find little forage in this habitat type.

ABLA/Vagl occurred within the study area in the ABLA/Vagl-Vagl and ABLA/Vagl-Vasc phases. Lodgepole pine and Englemann spruce were the major seral overstory species. Red twinberry, globe huckleberry, and grouse whortleberry were typical understory dominants. ABLA/Vagl was a moderately productive timber type for Douglas-fir, spruce, and lodgepole. Fire and logging reportedly favor lodgepole and huckleberry regeneration (Steele et al. 1977). ABLA/Caca was common along streams and places with high water tables. Bluejoint was the prevalent ABLA/Caca understory species on the study area. Twinflower (Linnea borealis) mountain ash (Sorbus scopulina), and huckleberry were common.

Use by bears. Bear use of habitat types in the TNF are reported in Table 4. PSME/Syal and ABLA/Caca represented moist areas of their respective habitat series. These types were often interspersed with moist meadow types and stream bottoms and provided succulent vegetation throughout the season. Bears used habitats with huckleberries, buffalo berries (Shepherdia canadensis), chokecherries, serviceberries, mountain ash berries, and hawthorn fruit as the fruit became seasonally available (Figure 5). The types with greatest berry production were generally found on northerly, steep slopes with subalpine fir or Douglas-fir overstory. Greatest diversity was found on the relatively undisturbed types along the steep slopes south of Boone Creek on the Squirrel Meadows sheep allotment and along the Falls River Canal near the western TNF boundary on the Falls River and Squirrel Meadows sheep allotments.

Bears, in general, utilized swampy areas around lakes and streams in the spring and early summer, the diversified, grass-forb understory of mesic plateaus and parklands in summer, drier (and often higher) types with huckleberry, serviceberry, and buffaloberry understories in late summer, and hawthorn and mountain ash habitats in autumn. Bears in Idaho congregated in the aspen-sagebrush (Artemesia tridentata) types, especially along stream banks of Squirrel Creek and Falls River, where a narrow patch of riparian habitat produced bumper crops of mountain ash and hawthorn fruit in autumn 1977.

Differences in black bear and grizzly bear habitat use. The types of foods eaten by grizzly bears and the observations of grizzly bears in TNF suggest that they utilize open types more than do black bears. Barnes and Bray (1967) reported a black bear/grizzly bear observation ratio of 67:113 in backcountry areas of YNP. They interpreted this ratio to mean that more grizzlies than black bears utilized the semi-open, spruce-fir backcountry. Shaffer (1971) made a similar conclusion for Glacier National Park bears. Jonkel and Cowan (1971) estimated a black bear/grizzly bear ratio of approximately 15:1 in the southern Whitefish Range in Montana. They further interpreted their observations to mean that grizzly bear activities were more concentrated than that of black bears in higher elevations uring summer and atumn. In the northern Whitefish Range, they found a lower black bear to grizzly atio. They attributed the greater percentage of grizzly scats found on their northern study area to greater grizzly use of the extensive treeless burns produced by forest fires in the northern area.

Locations of grizzlies on the study area were skewed toward swampy grass and meadow types but were too few to be representative.

The food habits of grizzly bears from studies reported in Appendix A show a high proportion of roots, tuberous plants, meadow/ alpine vegetation and rodents/carrion. In contrast, the black bear food habit studies from similar habitats indicate that black bears utilize a high proportion of fruit crops from forested and riparian habitats, suggesting a significant difference in habitat utilization by black bears.

Table 5 compares black bear observations from this study with IGBST grizzly observations in the Yellowstone area. Habitat preferences between the two species were highly significant (x^2=121.9, p<.001, 2DF), substantiating the hypothesis of grizzly preference for non- or semi-forested habitat.

Table 5. Comparison of Targhee National Forest black bear and Yellowstone National Park grizzly bear (Knight et al. 1976) habitat use.

Observations	LPP	Spruce/Fir	Open*	Rock	Barren	
325	68	114	97	3	43	GRIZZLY BEAR
445	49	364	31	None	None	BLACK BEAR

*Includes mountain meadow, stream, and sagebrush.

Bear food habits. I collected 238 scats from the study area. IGBST (Knight et al. 1976) classified all scats with diameters greater than 5.0 cm as grizzly scats, but I collected known black bear scats larger than 5.0 cm and known grizzly scats smaller than 2.5 cm. Therefore, I did not attempt to differentiate between black and grizzly bear scats. Scats were classified by food species, frequency (percent) occurrence, and average percent content. Results are presented in Table 6. Approximate season of use, indicated by scat contents and availability, was included when known.

Succulent vegetation utilized by bears in order of greatest frequency of occurrence were common horsetail (Equisetum arvense), dandelion (Taraxacum spp.), lomatium (Lomatium spp.), clover (Trifolium spp.) salsify (Tragopogon spp.), baneberry (Actea rubra), unknown Umbelliferae, sweet cicily (Osmorhiza spp.), false-dandelion (Agoseris spp.), Indian paintbrush (Castilleja spp.), licorice root (Ligusticum spp.), water leaf (Hydrophyllum spp.), and meadowrue (Thalictrum spp.). One or more of these plants were present in one third of all scats collected. Grass and grass-like plants, including Agropyron spp., Poa spp., Bromus spp., Agrostis spp., Phleum spp., Calamagrostis spp., and Carex spp. was the single greatest category, occurring in over one third of all scats analyzed. Eighty percent of the scats containing succulent vegetation were deposited from May to mid-August. Seventy-one percent were deposited prior to mid-July.

Fruit crops in order of greatest to least incidence of occurrence in the diet for 1976 and 1977 are as follows: huckleberries, hawthorn fruit, buffaloberries, twin berries (Lonicera involucrata, L. utahensis), serviceberries, dogwood berries (Cornus stolonifera), mountain ash berries, and chokecherries were most important from mid-August to mid-September.

Table 6. Scat analysis, 1976-77, Targhee National Forest.

CONTENT	IN DIET No.	IN DIET % Occurrence	IN DIET % Content	IN HABITAT No.	IN HABITAT % Occurrence	IN HABITAT Ave. % coverage
SUCCULENT VEGETATION						
Graminae-Cyperaceae	91	35.0	36.1	99	100	54.4
Agropyron spp.						
Poa spp.						
Bromus spp.						
Phleum spp.						
Calamagrostis spp.						
Carex spp.						
Equisetum arvense	27	(10.0)	34.7	9	(9.0)	17.5
Taraxacum spp.	11	(4.0)	34.9	37	(37.0)	2.6
Lomatium spp.	10	(4.0)	48.4	17	(17.0)	6.0
Tragopogon spp.	8	(3.0)	52.5	16	(16.0)	4.2
Trifolium spp.	8	(3.0)	28.3	12	(12.0)	4.0
Cirsium spp.	7	(3.0)	2.5	10	(10.0)	6.5
Actaea rubra	5	(2.0)	30.9	7	(7.0)	5.0
Unk. Umbelliferae	5	(2.0)	38.6	36	(36.0)	11.1
Osmorhiza spp.	4	(1.0)	14.5	44	(44.0)	5.1
Agoseris spp.	1	(0.4)	15.0	9	(9.0)	3.6
Castilleja spp.	1	(0.4)	15.0	10	(10.0)	5.0
Hydrophyllum spp.	1	(0.4)	2.5	12	(12.0)	3.8
Labiateae	1	(0.4)	15.0	2	(2.0)	7.5
Ligusticum spp.	1	(0.4)	38.0	3	(3.0)	4.2
Thalictrum spp.	1	(0.4)	2.5	36	(36.0)	7.3
FRUIT						
Crateagus spp. Hawthorn	77	30.0	63.0	8	(8.0)	14.0
Vaccinium spp. Huckleberry	72	28.0	54.7	42	(42.0)	29.0
Amelanchier alnifolia Serviceberry	48	19.0	22.5	72	(72.0)	8.0
Shepherdia canadensis Buffaloberry	26	10.0	19.0	15	(15.0)	17.0

CONTINUED

Table 6. Scat analysis, 1976-77, Targhee National Forest (continued).

CONTENT	No.	IN DIET % Occurrence	IN DIET % Content	IN HABITAT No.	IN HABITAT % Occurrence	IN HABITAT Ave. % Coverage
FRUIT (continued)						
Lonicera spp. Red and black twinberry	23	9.0	12.0	40	(40.0)	7.0
Cornus stolonifera Dogwood	13	5.0	40.0	4	(4.0)	9.0
Rosa woodsii Wild rose	13	5.0	16.0	13	(13.0)	11.0
Sorbus scopulina Mountain ash	12	5.0	35.0	43	(43.0)	8.0
Ceanothus velutinus Ceanothus	9	3.0	13.0	5	(5.0)	4.0
Ribes spp. Gooseberry	8	3.0	16.6	16	(8.0)	14.0
Prunus virginianus Chokecherry	6	2.0	9.0	8	(8.0)	9.0
Berberis repens Oregon grape	5	2.0	5.0	38	(38.0)	6.0
Symphoricarpos albus	3	1.0	T	56	(56.0)	10.5
MISCELLANEOUS						
Ants	72	(28.0)	43.3			
Rodent/Cervidae/Bovidae	9	(3.0)	68.3			
Sheep/Bait	14	(5.0)	32.6			
Undetermined	10	(4.0)	41.0			
Eggs	5	(2.0)	T			
Garbage	3	(1.0)	39.1			
Erethizon dorsatum Porcupine (quills)	1	(0.4)	100.0			

Ants were present in 25 percent of the scats analyzed, with the greatest occurrence in June-July. Meat was present in only 12 percent of the scats. An inherent bias resulted from scat collection near sheep herds and in trapping areas. Verified sheep and undetermined meat scats provided 8.5 percent of the total, some of which no doubt were obtained from my baits, and some as the result of scavenging (coyote scats, which were noted for sheep content but were not collected, were especially prevalent along the Sheep Bridge trail to Dog Creek allotment, the Idaho-Wyoming state line road, South Boone trail, and the area adjacent to the Dog Creek trail north of Squirrel Meadows).

Stomach contents. Seven stomachs were sampled and analyzed for food contents. They are reported with information on the bears involved (Table 7), all of which were killed as a result of real or alleged sheep depredations. Four stomach samples contained more than 40 percent sheep meat and wool remains; ants were present in three, huckleberries in two, grass in two, and serviceberries in one. Two of the seven stomachs analyzed had no sheep or meat contents.

Seasonal food utilization. The seasonal use of fruit reflected the availability of preferred berry crops during 1976 and 1977. In 1976, the berry crop was sporadic. A late cold period at the critical blossom-fruit forming stage of development destroyed much of the huckleberry, chokecherry, and serviceberry production, particularly in the lower elevations along Falls River and Dog and Squirrel creeks. Berry development at the eastern end of the Squirrel Meadows and South Boone allotments, slightly retarded by the higher elevation, was not affected

Table 7. Summary of stomach contents of examined bears killed for alleged depredations.

Date	Age	Sex	Allotment	Stomach Contents
21 July 1976	A	M	D.C.	100% sheep
27 July 1976	1.5	F	S.M.	65% huckleberry 35% ants
28 July 1976	A	M	D.C.	95% sheep 5% grass
30 July 1976*	3.5	M	D.C.	65% ants 25% huckleberry 10% sheep
31 July 1976	3.5	M	D.C.	100% sheep
08 August 1976	9.5	M	D.C.	65% sheep 35% ants T grass
July 1977	A	M	S.M.	45% sheep 45% huckleberry 10% wool T serviceberry

*Radio-collared black bear No. 4.

as severely by the cold. Crops there were reasonably abundant, based on subjective estimates. Consequently, the majority of the 1976 scats containing huckleberries came from the northeast section of the study area. At the lower elevations in 1976, bears used a wider variety of fruit (and continued using grass and forbs throughout the summer) than bears on the east end of the study area. In 1977, plots with good huckleberry production (subjective estimate and opinions of resident berry pickers) were scarce. Huckleberries were available but widely scattered. Chokecherry bushes, common throughout the lower study area, were nearly non-productive in 1977 (one of six habitat plots containing chokecherry bushes was productive). Serviceberries were affected by the 1976 cold period to a limited extent but produced a well dispersed, abundant berry crop in 1977. Buffaloberries were available in clumped patches during the mid-summers of both years.

Hawthorn fruit was very abundant in 1977. Hawthorn was used almost exclusively from mid-September through November in 1977 at lower elevations. All post-sheep sightings were in or adjacent to the hawthorn-rich habitat along Squirrel Creek of Falls River Canal. Rose hips and snowberries were common in this habitat but were utilized to a lesser degree. The condition of the hawthorn crop for 1976 was unknown, but was poorly represented in scats from 1976 (collected primarily on the east end of the study area).

An indication of the dispersion and availability of bear food species is provided by the number (percent occurrence) of important bear food plants in the complete species lists and the average percent coverage of bear food species per habitat plot (Table 6).

Sheep use of habitat. Sheep allotments were divided into units. The order of unit use was determined prior to the grazing season based on USFS range analyses and varied from year to year. Sheep habitat was highly variable. The actual use of each allotment depended upon the herder's diligence in following range use plans. Although USFS policy specified one night per bedground, compliance and enforcement were often lax.

An excellent description of herding practices and management of sheep ranges is provided by Heady et al. (1947) for a comparable range in Montana. A description of standard range practices on herded sheep allotments will not be repeated here.

In 1977, the Squirrel Meadows herder largely ignored the unit grazing schedule, preferring instead to utilize the early summer vegetation on Unit 1 meadows. The grazing schedule specified 31 days on Unit 1, but actual use exceeded 40 days, with greatest use concentrated around Paddy Lake and the trail to the Sheep Bridge. Unit 2 was underutilized, and meadows on Unit 1 were heavily overgrazed. The herder used dogs extensively. The sheep, therefore, grazed in tight bands which prevented free forage selection. Plants, or parts of plants, that would normally be left under an open-herding system (Heady et al. 1947) were eaten under such a tight herding system: Bear foods in the overutilized areas were nearly eliminated for the remainder of the season. Bear observations for the Sheep Bridge area were fewer in the late summer of 1977 than 1976, possibly due to the lack of available bear foods there in 1977.

Herders within my study area preferred to graze their sheep in open areas within timbered habitats rather than in heavily timbered ranges, partially because surveillance of herds in meadows was easier and because sheep preferred the open areas (H. Bell, B. Ferguson, pers. comm. 1977). According to my habitat analysis, grassland and weeded ranges provide a greater quantity and variety of livestock forage than timbered ranges. Heady et al. (1947) in the similar habitat of the Bridger Mountains, Montana, found that quality and production of open ranges were superior to the same acreages of timbered range. The possible superior quality of open ranges may also be a factor on the study area, but I did not investigate this aspect.

Sheep on a tall forb range in southwestern Montana used succulent grasses early in the season, but use decreases as the summer progresses (Buchanan et al. 1972). Other researchers suggest that late summer rainfall in 1967 may have caused a longer period of grass preference than in 1966. Blaisdell (1958) classified the developmental stages of grasses. Using his terminology, decreased grass preference in late July would correspond with the "Bloom-over/Seed ripe" developmental stages of grasses (or the curing stage). Jensen et al. (1972) found that grass preference decreases following seed maturity in late June-July. Forbs were found most important throughout the grazing season, but relative palatability was seasonally variable for most species (Buchanan 1972, Jensen et al. 1972, Cook et al. 1948). Grass use was noted to increase in the fall when re-growth occurs (in some species) (Cook et al. 1968), and it was most important late in the season on alpine ranges (Strasia et al. 1970). Browse preference increased as the season progressed (Cook 1954).

Sheep utilization of palatable species is proportional to plant abundance (Buchanan et al. 1972, Strasia et al. 1970, Cook et al. 1948). Leaves are selected before stems in all seasons (Buchanan et al. 1972), Cook et al. 1948). Palatability varies between ranges. Selectivity is greater on lightly grazed ranges with abundant forage than on heavily grazed ranges (Cook et al. 1948). Confirming this, the tightly herded 1977 Squirrel Meadows herd ate species such as wyethia (*Wyethia* spp.) and plant parts such as serviceberry and snowberry twigs that were left untouched in 1976. Wyethia (*Wyethia amplexicaulis*) and coneflower, two species that were easily identified and are considered to be relatively unpalatable to sheep (Jensen et al. 1972, Heady et al. 1947), were heavily utilized by the Squirrel Meadows herd in 1977. Snowberry and serviceberry shrubs adjacent to the heavily grazed meadows of Unit 1 were stripped of all leaves and buds up to the maximum grazing height of sheep.

Jardine et al. (1927) found that herded sheep gained 5-8 lbs less than unherded sheep on mountain ranges in Oregon because the non-herded sheep bedded when night fell, while herded sheep were trailed to bedgrounds. Free-ranging sheep grazed during the early morning and late evening hours when herded sheep were near camp; grazed and bedded on open ridges rather than the canyons preferred by herders; and grazed quietly and well dispersed instead of tightly together, creating disruption and trampling the grass.

Bear and Sheep Food Competition Index

Table 8 compares the importance values of plants found in analyzed bear scats from the study area. The frequency (and therefore relative utilization) of those species are in the bear food studies tabulated in Appendix A. It also tabulates bear use of the plants in question from scat analyses and sheep preferences determined from ratings given in or adapted from the literature. An index to food use overlap is provided. Table 9 provides a competition index for important bear foods found in the study area that were not found in scats analysis from the study area.

Bear food importance greater than 0.5 indicate that those species are readily utilized, palatable, and therefore important to bears. Values greater than 1.0 would indicate that the bear chooses those species and uses them with greater frequency than their availability in the habitat would suggest.

Sheep use ratings. Values greater than 2.0 would indicate use but not selection. Values greater than 2.5 would indicate some preference for those species. As with bear foods, seasonal development and the availability of other, possibly more preferred, species affects the palatability and use of particular sheep foods.

Utilization by bears (derived from the literature). Totals indicated by the bear literature indicate only that the particular plant in question is utilized by bears. Ratings were not possible due to different rating systems provided from other studies and by habitat differences. However, the plants used more than one or two times are usually plants commonly consumed by bears, with importance varying with season and availability of other possibly more preferred species. In general, the starred species from Appendix A are palatable to bears

Table 8. Bear/sheep food importance values (I.V.) and competition index of plants found in scat analysis.

Plant	Bear I.V.[a] TNF	Bear utilization[b]	Sheep rating[c]	Competition index[d]
SUCCULENTS				
Gramineae[e]	0.3	14	0-5	X
Equisetum arvense	0.4	14	1.0	0
Taraxacum spp.[e]	1.6	7	4.0	X
Lomatium spp.	1.9	9	2.8	0
Tragopogon spp.[e]	2.6	1	unknown	unknown
Trifolium spp.	2.0	5	5.0	X
Cirsium spp.[e]	0.1	7	1.7	0
Actaea rubra	1.9	2	unknown	unknown
Umbelliferae	0.2	2	4.5	X
Osmorhiza spp.[e]	0.1	4	4.8	0
Agoseris spp.[e]	0.2	2	4.5	X
Castilleja spp.[e]	0.1	4	3.2	X
Hydrophyllum spp.	0.0	2	4.0	XE
Labiatae	0.4	unknown	unknown	unknown
Ligusticum spp.[e]	1.2	unknown	unknown	unknown
Thalictrum spp.	0.0	unknown	unknown	unknown
FRUIT SPECIES[f]				
Crataegus douglasii	18.0	4	1.0	0
Vaccinium spp.	1.3	11	2.2	X
Amelanchier alnifolia	0.8	10	4.8	X
Shepherdia canadensis	0.8	6	2.0	X?
Lonicera spp.	0.4	6	2.0	X?
Cornus stolonifera	6.1	7	1.0	0
Rosa woodsii	0.6	6	3.2	X
Sorbus scopulina	0.6	5	unknown	unknown
Ceanothus spp.	0.2	1	1.9	0
Ribes spp.	2.3	9	2.8	X
Prunus virginiana[g]	0.3	2	2.3	0
Berberis repens	0.0	1	unknown	unknown
Symphoricarpos spp.	0.0	2	3.5	0

[a]Mean adjusted content = $\frac{\text{Frequency of occurrence in scats X average content X 100}}{\text{Total number of scats}}$

Mean adjusted coverage = $\frac{\text{Frequency of occurrence in habitat plots X average coverage X 100}}{\text{Total number of habitat plots}}$

Importance value of TNF bear foods (I.V.) = $\frac{\text{Mean adjusted content (scats)}}{\text{Total habitat plots (habitat)}}$

Importance values greater than 0.5 indicate bear use and importance. Values greater than 1.0 indicate plants preferred and selected by bears.

[b]Expressed as the number of times the plant was reported as a bear food in food habit studies from Appendix A.

[c]Sheep ratings (0=non-use to 5=excellent) from literature reported in Appendix A were averaged. Ratings greater than 2.0 indicate use. Values greater than 2.0 indicate selection.

[d]X means that the species is important to bears and is utilized by sheep. Basis for competition exists.

0 means that the species is unimportant to bears and/or to sheep or is not utilized to a great enough degree to provide a basis for comparison.

X? means that the values indicate competition may occur under certain circumstances, such as a food failure of more important or more palatable species.

XE means that competition is likely only during early phenological stages of the plant, usually occurring prior to the arrival of the sheep on the forest.

[e]Importance values (I.V.) may not reflect the limited seasonal utilization of these species. They were used only at a particular phenological stage (i.e. early-bloom or pre flower or pre fruit). Actual I.V.s and competition indices are probably greater than shown.

[f]Bears generally utilize the fruit. Livestock usually utilize the vegetation.

[g]Prunus virginiana is probably a more important species than indicated. A low importance value probably occurred due to poor production in 1976 and 1977. In the eastern United States, chokecherry is a very important bear food in areas of occurrence.

Table 9. Bear/sheep food competition index (of important bear food plants not reported in Table 8).

Plant	Utilization by bears[a]	Sheep rating[b]	Competition index[c]
FORBS			
Achillea spp.	1	3.4	X
Allium spp.	3	4.5	X
Angelica spp.	6	4.7	X
Aster spp.	2	2.8	X
Astragalus spp.	3	1.5	0
Claytonia spp.	5	5.0	XE
Erythronium spp.	6	5.0	X
Fragaria spp.	6	2.2	X
Hedysarum spp.	2	5.0	X
Heracleum spp.	8	5.0	X
Hieracium spp.	3	3.8	X
Lupinus spp.	2	2.8	X
Mertensia cililata	1	4.4	X
Pastinaca sativa	1	4.0	X
Perideridia spp.	6	unknown	unknown
Ranunculus spp.	4	1.5	0
Senecio spp.	3	4.7	X
Smilacina spp.	7	unknown	unknown
Streptopus spp.	3	unknown	unknown

- Continued -

[a]Expressed as the number of times the plant was reported as a bear food in food habit studies from Appendix A.

[b]Sheep ratings (0, non-use to 5, excellent) from literature reported in Appendix A were averaged. Ratings greater than 2.0 indicate use. Values greater than 2.5 indicate selection.

[c]X means that the species is important to bears and is utilized by sheep. Basis for competition exists.

0 means that the species is unimportant to bears and/or to sheep or is not utilized to a great enough degree to provide a basis for competition.

X? means that the values indicate competition may occur under certain circumstances, such as a food failure of more important or more palatable sources.

XE means that competition is likely only during early phenological stages of the plant, usually occurring prior to the arrival of the sheep on the forest.

Table 9. Bear/sheep food competition index (of important bear food plants not reported in Table 8) (continued).

Plant	Utilization by bears[a]	Sheep rating[b]	Competition index[c]
FORBS (continued)			
Urtica spp.	1	2.0	0
Valeriana spp.	3	4.3	X
Vicia spp.	3	4.8	X
Zizia spp.	1	5.0	X
SHRUBS/TREES[d]			
Arctostaphylos spp.	8	1.0	X
Pinus spp.	9	unknown	unknown
Populous tremuloides	3	4.0	X
Quercus spp.	1	4.0	X
Rhamnus alnifolia	4	3.0	X
Rubus spp.	7	2.0	X?
Salix spp.	1	4.3	X?
Sambucus racemosa	3	4.5	X

[a]Expressed as the number of times the plant was reported as a bear food in food habit studies from Appendix A.

[b]Sheep ratings (0, non-use to 5, excellent) from literature reported in Appendix A were averaged. Ratings greater than 2.0 indicate use. Values greater than 2.5 indicate selection.

[c]X means that the species is important to bears and is utilized by sheep. Basis for competition exists.

0 means that the species is unimportant to bears and/or to sheep or is not utilized to a great enough degree to provide a basis for competition.

X? means that the values indicate competition may occur under certain circumstances, such as a food failure of more important or more palatable sources.

XE means that competition is likely only during early phenological stages of the plant, usually occurring prior to the arrival of the sheep on the forest.

[d]Bears generally utilize the fruit. Livestock usually utilize the vegetation.

at some time of the year, given average food availability.

Predation

Bear depredations have been widely documented in the literature for damage to crops (Spencer 1955, Davenport 1953), trees (Poelker and Hartwell 1973, Glover 1955, Merill 1953), apiaries (Cardoza 1976, Gilbert and Roy 1977, Gunson 1974, Nelson 1974), and nuisance depredation (Barnes and Bray 1967, Erickson et al. 1964, Trippensee 1948). Jorgensen et al. (in press), Cardoza (1976), Spencer (1955), and Davenport (1953) have discussed the extent and economic impacts of bear depredations.

Bear predation on big game has also received attention in the literature. Investigations of bear predation on big game indicate that black, brown, and/or grizzly bears may have more serious effects on herbivore populations such as mose (LaResch 1968, Chatelain 1950) and elk (Franzmenn and Bailey 1977, Leege et al. 1976) than is commonly accepted (Pearson et al. 1974, Cole 1972, Murie 1951, Cahalane 1947). Black bears, as well as the larger and more aggressive brown and grizzly bears (Herrero 1978), are capable of preying upon big game under certain circumstances (Barmore and Stradley 1971, King 1967, Howell 1921). The effects of black bear depredations on big game populations are currently being investigated in Idaho (Leege et al. 1976) and Alaska (Franzmann and Bailey 1977), and the importance of black bear predation on game may be revised as new data become available.

Livestock losses from bears are economically significant to individual producers, although insignificant to total livestock production in some cases (Mystrud 1977, Davenport 1953). The occurrence of bear depredation on livestock has been documented in the literature. Details of the predation, the extent and effect of predation on production, and the sex and age characteristics of the bears involved are lacking (Jorgensen et al. in press).

Davenport (1953) reported that 90 percent of black bear depredations in Virginia were on sheep, comprising an average loss of 0.09 percent of the 1950 sheep production in counties paying bear damages. Bears were also responsible for localized hog depredation in the isolated Dismal Swamp area where hogs were allowed to roam free. Of 1,384 bear complaints made in Wisconsin from 1939 to 1956, more than one half were sheep incidents and approximately one sixth involved attacks on cattle. During those years, Wisconsin paid $84,057 in bear depredation damages (Bersing 1956). Spencer (1955) found that bears usually killed sheep in remote areas where unprotected flocks grazed in or near the woods. Brown (1960) reported that bears were claimed responsible for 21.3 percent of total predator losses based on results of a questionnaire sent to Montana livestock owners. He demonstrated that verified predator losses in relation to total livestock were of minor significance, with only one cow killed by bears per 1,000 cattle produced and 2.4 sheep killed by bears per 100 sheep produced, based on field investigations. Mystrud (in prep. 1974) noted extensive European brown bear predation upon sheep in Norway.

Silver (1957), cited in Cardoza (1976), Erickson et al. (1964), Brown (1960), Remington (1955), Spencer (1955), Davenport (1953), and Gilbert (1953) documented black bear predation on cattle, although sheep were most often preyed upon. Murie (1948) investigated grizzly predation on cattle in Wyoming and found that grizzlies were responsible for ten deaths or 0.6 percent of the 1,648 cattle using the allotments studied. Eide (1965) documented that Kodiak bears were effective predators on cattle in Alaska. Thirty-three of 1,350 cattle, or 2.4 percent, were preyed upon by Kodiak bears. Lentfer et al. (1969) reported limited brown bear predation on cattle in Alaska.

In many cases depredations were difficult to differentiate from scavenger feeding on animals dead from other causes (Nass 1977, Terrill 1976, Balser 1974). In attempts to verify reported stock losses, Lenfter et al. (1968), in Alaska, found only 10 of 22 reported cattle deaths were due to bears in 1967. Murie (1948) documented that only 10 of 25 cattle casualties in Wyoming were grizzly kills. Four deaths were undetermined. Gilbert (1951) found that bear depredation claims were exaggerated. Only 7 percent of the claims he examined were valid bear depredations, 43 percent were questionable, and 50 percent were invalid. Brown (1960) found that only 25 percent of the 16 investigated bear predation cases on cattle were valid during 1959 and 1960 and that 23 percent of the 39 bears killed for depredations were unjustified (Brown 1959). He reported that predator losses were minor when compared to losses from disease, poisonous plants, or accidents. Spencer (1966) reported a similar incidence of fraudulent claims in Maine.

Table 10, adapted from Jorgensen et al. (in press), presents a review of sheep predation statistics derived from recent research and questionnaires. Some of the data in the table were calculated from raw data supplied in the literature to facilitate standardized comparisons; in other cases, the necessary data were provided. Averages were used

Table 10. Categorized sheep losses derived from questionnaires (Q) or field research (R).

Study	Year of study	Location	Livestock class	No. sheep lost to all causes	% of total lost to all causes	% of sheep losses to: bears	coyotes	non-predators	Source
Anonymous (1975)	1973	Wyoming	E & L	462,000	[a]	0.7	23.2	70.3	Q
	1974	Wyoming	E & L	342,000	3.9	0.9	35.9	55.5	Q
Dorrance and Roy (1976)	1974	Alberta	E	784	6.6[b]	2.0[c]	21.0	76.0	Q
	1974	Alberta	L	2,137	15.5	1.0	16.0	82.0	Q
Early and Roetheli (1974)[d]	1972	Idaho	E	10,203	8.6	3.0	12.0	73.0	Q
	1973	Idaho	L	23,782	15.5	2.0	18.0		
McAdoo and Klebenow (1978)	1976	California	E & L	69	4.4	0.0	77.0	0.6	R
McAdoo and Klebenow (1976)[a]	1977	Nevada	E & L	351	[d]	0.0	31.0	66.0	R
Magleby (1975)[a]	1974	15 western states	L	940,000[e]	12.0	14.0	54.0	32.0	Q
Nesse et al. (1976)[d]	1974	California	E	21,885	8.0	0.0	10.0	74.0	Q
	1974	California	L	28,095	10.0	0.0	23.0		

[a]Unable to determine from furnished data.

- Continued -

[b]Discrepancy in publication: total lambs, Table 1, was 153,092; total lambs, Table 5, was 143,787. No percent differences in losses.

[c]Includes bears, wolves, and mountain lions. [d]Values calculated from data in publication for comparison.

[e]Of docked lambs.

Table 10. Categorized sheep losses derived from questionnaires (Q) or field research (R).

Study	Year of study	Location	Livestock class	No. sheep lost to all causes	% of total lost to all causes	% of sheep losses to:			Source
						bears	coyotes	nonpredators	
Nass (1977)	1973-1975	Idaho	E & L	30,071	10.6	0.2	5.6	94.0	R
Neilson and Curle (1970)	1969	Utah	E & L	9,607	6.1	2.2	78.1	2.4[a]	Q
Tigner and Larsen (1977)	1973-1975	Wyoming	E & L	4,440	[b]	2.5	17.7	77.0[c]	R
Johnson et al. (in press)	1976-1977	TNF	E & L	220	3.4	57.8	5.0	27.2	R
USFS Grazing Reports	1970-1973	TNF	E & L	768	1.3				

[a]Combined predators' losses (percentages for cougar, bobcat, eagle, and dog =

$$\frac{868 + 131 + 338 + 424}{9607} = 36.0\%.$$

[b]Unable to determine from furnished data.

[c]Eagles were responsible for 2.1%.

when studies included more than one year's data. Data from a related TNF study (Johnson et al. in press) in which sheep deaths were investigated are included in Table 10. Sheep losses as reported by herders and permittees for Dog Creek 1976, Squirrel Meadows 1976 and 1977, and South Boone 1976 and 1977 are also reported for comparison.

Determination of predation by bears. Animals merely fed upon by bears can often be identified as such. Determination of actual predation by bears is much more difficult and is usually inconclusive. Predation is often differentiated from carrion feeding by the presence of subcutaneous hemorrhages around wounds and by attack characteristics.

Verification of bear predation was often impossible because many carcasses were too completely consumed for identification re. cause of death. Not all carcasses were located by herders or USFS employees. Nass (1977) and Wagner (1972) discussed incomplete reports of livestock losses, but had no solution to the problem.

Davenport (1953), Murie (1948), and Seton (1909) described bear kills characterized by bites to the back of the neck and spine, especially the thoracic region, often accompanied by dorsal clawing. Spencer (1955) documented bear attacks by powerful blows of the bear's forepaw. The majority of sheep I encountered that could be identified as bear kills were swatted down and/or grabbed, as determined by the presence of claw marks, hemorrhaging, and standard necropsy investigation. In some cases evidence indicated that the sheep had been fed upon prior to its death. Permittees and predator control agents also classified carcasses as to cause of death. Their explained difference in the characteristic bear kills they had observed are of interest. B. Enget (pers. comm.) described the appearance of kills as resulting from bears "straddling and clawing the backs of sheep" on his TNF allotment west of YNP on the Island Park Ranger District (D-2). R. Wonnecot, regional predator control agent, reported that most of the bear predation on sheep he had observed resulted from clawing and "batting" (pers. comm.). S. Davis (Pers. comm.), of Davis Bros., Inc., described sheep that had been killed by bites to the back of the neck. R. Phillips (pers. comm.), predator control agent for my study area, observed sheep that had been killed by powerful blows that failed to break the skin. He found that subcutaneous hemorrhaging, often accompanied by a broken neck, was characteristic. He reported that sheep which had been apparently killed by bites to the back of the neck were also encountered, but less frequently than sheep killed by swatting.

Spencer (1955) suggested that the bite attack was more common in one-on-one encounters, whereas mass killings were characterized by forepaw blows. He reported that all cattle that were verified as bear kills were characterized by severe head and neck lacerations and bruises, and that all had died from broken necks. M. Schlegal (pers. comm.), while investigating elk calves killed by black bears in Idaho, found subcutaneous hemorrhages charactistically located on the hindquarters of elk if the calves were killed in open areas, but hemorrhaging of calves killed in dense habitats was most common on the withers. He observed an adult bear kill a spike bull by jumping on the elk's back from a log, biting the neck and clawing the sides of the elk. J. Beecham (pers. comm.), working with Schlegel on the bear-elk predation study in Idaho, noted that bites to the neck of prey were typcial on older elk calves, but extensive clawing of the shoulders was more common on younger animals.

A third attack pattern deserves mention. Murie (1948) documented a grizzly bear killing a yearling calf by a bite to the face. Mystrud (1977) observed the same pattern in European brown bear predation and theorized that it occurs more often than published reports would suggest. The nasal bite is a method of attack used by bobcats and coyotes as well (M. Schlegel pers. comm., R. Phillips pers. comm.) and can result in the temporary paralysis of prey (Murie 1948). Documentation of this for the black bear is lacking.

Carcasses of sheep killed in the TNF were often dragged or carried to secluded areas for feeding. Most kills in an Idaho study (where coyotes accounted for 97 percent of predator killed sheep) took place on hillsides and draw bottoms and were found in remote areas or in dense vegetation (Nass 1977). Bears in Virginia carried carcasses in their mouths with the weight of the carcass over one shoulder or "in their mouths while walking erect" (Davenport 1953).

In both sheep and cattle, udders were typically selected, followed by breast fat, brisket, and internal organs (California F&G 1965, Spencer 1955, Davenport 1953). TNF black bears, like those in Virginia (Davenport 1953), consumed an entire carcass if left undisturbed and returned within 24-36 hours to finish carcasses too large to be consumed at one time. For example, one or more black bears, determined by sign, fed on a yearling calf for more than two weeks. The carcass was typically skinned back and was cached in a large bearexcavated depression that measured more than 2 m^2. In contrast to their cattle-feeding habits, bears partially consumed most sheep immediately after killing them. Grizzlies were more cautious, often returning to kill again, leaving previously killed sheep untouched. In 1978, however, both species were reportedly cautious in returning to kills, making the capture of depredating bears more difficult than during 1976 and 1977 (R. Phillips pers. comm.).

With multiple kills the bear (or bears) responsible usually returned to the kill site to finish feeding, but trapping that occurred more than two or three days after a kill was likely to capture innocent bears that were merely attracted to the carcass (see discussion on Bear-Sheep Interactions, and Remington 1955). Because grizzlies were less likely to return to kills than black bears, trapping for grizzly depredators was more likely to result in the capture of innocent black bears attracted to the baited snare, rather than the grizzly responsible.

Davenport et al. (1973) described the characteristics of coyote kills as typified by attacks to the throat. On the TNF, an area heavily hunted and trapped by predator control agents, herders, and fur hunters, coyotes seldom return to a kill. Coyotes in south central Idaho did not feed at all on 25 percent of their kills (Nass 1977).

Examinations of carcasses were often biased. Griffel (unpubl. 1977), in a related TNF study, thought bears were responsible for many of the sheep losses I attributed to coyotes or natural causes. Bear predation or scavenging, for example, are more difficult to determine from carcass remains than is coyote depredation (Nesse et al. 1976, Henne 1975, Davenport et al. 1973) because usually little of the carcass remains. Feeding and scavenging often destroy characteristic marks. Canine puncture wounds made by bears were similar to the punctures made by coyotes, and in cases of bites to the neck, throat, or head, predation was difficult to attribute to either species unless claw marks were evident. Bear sign in the area also influence determination. Permittees subjectively estimated the bear/coyote predation loss ratio at 60/40. R. Davis (pers. comm.) and W. Jenkins (pers. comm.) suggested that bears were responsible for approximately 80 percent of the losses reported in annual grazing reports.

Herders and USFWS personnel based many of their cause-of-death and predation documentations on tracks, scats, and sign in the area and on the examination of carcass remains. USFWS predator control agents were required to file justification reports for bears trapped as livestock killers since 1975. Selective bear removal was also based on the tendency of a bear to return to his kill. Successful capture of a problem bear was indicated if depredations decreased or stopped following its death. The high degree of concurrent habitat use by bears and sheep, including bears not associating with the sheep, also led to presumptions of guilt.

Justification Based on Stomach Contents

Unfortunately, the innocence of a scavenging bear usually was not determined until after its death. Even if the captured bear was identified as a scavenger, herders and predator control agents lacked the equipment to drug and release the bear unharmed.

Stomach contents alone were a poor indicator of predation. The presence of sheep in a stomach indicated only that the bear had fed upon sheep. Sheep remains in the contents did not establish whether that bear preyed on the sheep, or if it merely fed on carrion; conversely, the absence of sheep in stomach contents indicated only that the bear in question had not recently fed upon sheep (recently is defined as the unknown, but apparently rapid digestive rate of fresh meat and carrion eaten by bears of variable physiological condition and dietary habits). The presence of maggots in the contents of a stomach did not necessarily identify a bear as a scavenger either. Bears characteristically return to their kills one or more days later. The bear in question could just as easily be the depredator returning to its kill as a scavenger.

Scats were usually deposited within 305 m (100 ft) of a carcass in Virginia (Davenport 1953). Bears on the TNF were also likely to deposit meat scats near a bait or the site of an isolated carcass, but were less likely to deposit scats in open areas occupied by sheep or herders. Scats were usually near carcasses that were dragged from bedgrounds into adjacent sheltered timbered areas. Burghardt and Burghardt (1972) noted that young bears in captivity defecated within ten minutes after eating.

I found that scats with meat were located closer to baits or feeding sites than scats containing predominantly succulent vegetation. I compared important bear foods (Table 7) with complete plant lists from vegetation plots (located within 0.25 km^2 of the scat sites) to determine if scats were deposited in the habitats where feeding took place. With the exception of grass (which was found in every habitat type), little overlap occurred. In comparison, scats with meat were found within 0.25 km^2 of baits, cached carcasses, or bedgrounds where sheep losses had occurred. Fruit scats, too, were usually deposited near food sources.

Davenport (1953) reported that bears ingest little hair or wool from carcasses. Both scat and stomach analyses from this study showed very little wool or hair content. The greatest wool content was in the stomachs of bears killed during verified sheep predation incidents. Scats containing wool were, as expected, found near sheep kills (or sheep dead of other causes), but the overall proportion of scats containing wool and/or meat was small when compared to the incidence of predation. Schlegal (pers. comm.) found the percentage of elk hair to be very low even in areas of high predation. The occurrence of hair in scats, therefore, is probably a poor indicator of the occurrence or intensity of bear predation.

Herders as a Factor in Bear Depredation and Mortality

There are inconsistent data regarding activity patterns of bears involved in depredations. General activity patterns of black bears and grizzlies were previously discussed in the section on grizzly bear/black bear interactions. Black bears in the TNF reportedly killed sheep at night on the bedgrounds, but also killed sheep during the day while they were bedded. All grizzlies trapped on the study area in 1976 were captured at night, as were most black bears captured as the result of depredation activities. Two of the 11 black bears tagged and released for this study were captured between 0700 and 1900 hours. All depredations that sheep herders and predator control agents could attribute to grizzlies occurred at night. Both species were sighted during daylight hours. However, survival rates of bears seen by herders and permittees were extremely small. Possibly, bears in the TNF have learned to avoid sheep activities during the daylight hours in much the same way nuisance bears in parks have learned to time their begging to peak visitor hours (Garshelis 1978, Tate-Eager 1978).

Marksmanship varies greatly among herders, as does their awareness of the presence of bears and/or coyotes in the area. Although observers have reported seeing bears and livestock grazing peacefully together where bears have shown no apparent interest in the livestock (Griffel pers. comm., Remington 1955, Smith 1946), some herders shot at all bears seen on the allotment. Others shot only at bears actually molesting sheep. Grizzlies received protection from the shoot-on-sight policy of many sheep herders by a token of the grizzlies' classification as a threatened species in 1975.

The Squirrel Meadows allotment had the least topographic relief and the greatest vehicular access of all allotments in the study area, allowing a trailer camp to be located near the bedgrounds. The amount of time required for routine camp chores (supposedly the responsibility of the camp tender) was therefore reduced and the herder was free to spend more time with his sheep. The Dog Creek and South Boone allotments demanded tee pe camps. The greater topographic relief and more primitive camps resulted in less sheep surveillance and more sheep losses to predation, wandering, and stampede. The habitat differences and greater predator density on the higher elevational allotments required more surveillance for proper herding.

Herders who spent the majority of their time with their sheep, including sleeping on the bedgrounds, reduced losses to straying, stampeding, and predation. R. Davis (pers. comm.) believes that better herder techniques were responsible for a decrease in sheep losses on an allotment outside the study area in two consecutive years. The negligent herder had serious and heavy bear predation throughout the season. The following season the herder remained with the sheep constantly and bedded his sheep between the camp and his bedroll. His reported loss was reduced to one sheep that had been killed by a coyote and fed upon by a yearling bear.

The 1977 Squirrel Meadows herder spent more time with his sheep than the average herder associated with my study. He reported 32 sheep lost to bears and coyotes, compared with 47 to bears and 15 to coyotes by the 1976 herder for the same allotment. One bear was killed on the Squirrel Meadows allotment in 1977, and three bears were killed in 1976. However, as mentioned previously, range use in 1977 was excessive in places on the Squirrel Meadows allotment (Tigner and Larsen 1977 also mentioned the conflict resulting from close herding and increased range damage). Difficulty in finding qualified herders was one of the greatest problems expressed by sheep owners in several surveys (Gee et al. 1977, Nesse et al. 1976). In total, difference in herder technique was probably the most important variable affecting sheep losses and bear mortality from alleged depredations in this study.

Sheep Losses

The total number of ewe and lamb losses to all causes on the Ashton (D-3) District allotments is reported in Table 11. Data were

Table 11. Ewe and lamb losses (expressed as percentages of the total number of ewes and lambs grazing Ashton (D-3) District allotments) to all causes (including predators, poisonous plants, and other) for 1970-73.

YEAR	IDAHO		WYOMING		COMBINED	
1973	$\frac{26}{14,389}$	(0.2%)	$\frac{15}{5,344}$	(0.3%)	$\frac{41}{19,958}$	(0.2%)
1972	$\frac{134}{12,992}$	(1.0%)	$\frac{24}{3,537}$	(0.7%)	$\frac{158}{16,528}$	(0.8%)
1971	$\frac{202}{9,272}$	(2.2%)	$\frac{162}{5,486}$	(3.0%)	$\frac{364}{14,758}$	(2.2%)
1970	$\frac{140}{11,322}$	(1.2%)	$\frac{241}{7,427}$	(3.2%)	$\frac{381}{18,749}$	(2.1%)

NOTE: Loss records include losses of both lambs and ewes. Totals in this table were increased by 125% to include total lambs and ewes using D-3 allotments.

derived from USFS allotment grazing reports and compiled by USFS personnel for the Ashton District.

Table 12 presents percentages of sheep lost to all causes on allotments on the study area for the years 1970-1977 compiled from individual USFS allotment grazing reports. Table 12 also incorporates a 125 percent increase in total sheep using the allotments to provide for lambs not normally included in USFS allotment counts.

Actual numbers of sheep (including both lambs and ewes) lost to all causes for the Squirrel Meadows, South Boone, Dog Creek and Middle Bitch allotments on the study area, compiled from USFS grazing reports, are reported in Table 13 for 1970-1977.

USFWS bear mortality. USFWS records for 1970 through 1977 document the taking of 125 black bears and nine grizzlies (four of which were captured in cooperation with the IGBST, marked with radio collars, and released) by predator control agents in southern Idaho. Bears killed by herders, permittees, and hunters were not included in that tabulation. Forty-two of the 134 bears (including three of the seven known-sex grizzlies) were females (32 percent).

USFWS justification reports listed only the general location and/or the name of the permittee, making allotment determination difficult. Thirty-one black bears and four grizzlies (two radio-collared and released) were taken from Davis or Ball Brothers allotments. Nine of the 31 black bears, or 29 percent, were females, similar to the percentage of females taken region-wide.

USFWS justification reports did not necessarily reflect the

Table 12. Sheep lost to all causes for 1970-1977 on the South Boone (SB), Squirrel Meadows (SM), Dog Creek (DC), and Middle Bitch (MB) allotments expressed as actual losses and percentage lost of total number of sheep grazing each allotment.

Year	Total	% of Total	SB	SM	DC	MB
Percentages of sheep lost to all causes 1970-1977[a]						
1977	1985 (97)	4.9	980 (65)	1005 (32)	Non-use	Unk. (94)
1976	2935 (169)	5.8	1000 (21)	950 (62)	985 (86)	---
1975	2040 (40)	2.0	1020 (25)	1020 (15)	Non-use	---
1974	4132 (143)	3.5	1025 (30)	1044 (29)	1050 (40)	1013 (44)
1973	2906 (93)	3.2	1000 (50)	990 (28)	916 (15)	Unk. (139)
1972	6822 (147)	2.2	999 (56)	999 (30)	890 (50)	999 (11)
1971	3085 (40)	1.3	1020 (9)	1045 (17)	Non-use	1020 (14)
1970	2652 (39)	1.5	860 (5)	851 (29)	Non-use	851 (5)
Adjusted percentage sheep losses to all causes[a] (totals increased by 125 percent to include ewe and lamb totals. Losses already include E & L						
1977	4466 (97)	2.2	2205 (65)	2261 (32)	Non-use	---
1976	6604 (169)	2.6	2250 (21)	2138 (62)	2216 (86)	---
1975	4590 (40)	0.9	2295 (25)	2295 (15)	Non-use	---
1974	9297 (143)	1.5	2306 (30)	2349 (29)	2362 (40)	2279 (44)
1973	6538 (93)	1.4	2250 (50)	2228 (28)	2061 (15)	Unk. (139)
1972	15350 (142)	0.9	2248 (56)	2248 (30)	2002 (50)	2248 (11)
1971	6941 (40)	0.6	2295 (9)	2351 (17)	Non-use	2295 (14)

[a]Actual loss in parentheses.

Table 13. Sheep losses by season (1970-1977) for the Squirrel Meadows (SM), South Boone (SB), and Middle Bitch (MB) allotments as recorded in USFS annual grazing reports.

Year	Herd	6/15-8/4	8/5-8/20	8/21-9/8	Total
1977	SM	15	5	12	32
	SB	36	16	13	65
	MB	29	29	36	94
	Total	80	50	61	191
1976	SM	33	18	11	62
	SB	10	7	4	21
	DC	32	27	27	86
	Total	75	52	42	169
1975	SM	7	6	2	15
	SB	5	5	0	10
	Total	12	11	2	25
1974	SM	9	20	0	29
	MB	16	15	13	44
	Total	25	35	13	73
1973	SM	19	9	0	28
1972	MB	3	6	2	11
1971	SM	7	8	2	17
	MB	8	6	0	14
	Total	15	14	2	31
1970	SM	7	20	1	28
TOTAL		236	197	123	555

actual extent of predation or indicate the actual number of bears killed as the result of alleged depredation activities. Predator control agents responded to requests during the summer. Accessible allotments were more likely to have regular contact with the outside, and therefore herders were able to report depredations more regularly than herders on allotments accessible only by trail. Some permittees depended heavily on predator control agents and requested assistance often, while other permittees (for a variety of reasons) chose to handle depredations themselves. A biased representation of depredations in each allotment therefore resulted.

Salvage of Bears

Herders and government trappers are required by Idaho law to turn in claws, skulls, and salvable hides to the Fish and Game Department. I attempted to trace the few hides and skulls that had been turned in according to USFWS justification reports. Nineteen of the 40 black bears killed by predator control agents from 1974 through 1977 were partially salvaged. The low salvage rate was due to several factors. Herders often check traps set by predator control agents and, upon finding a bear, shoot it (usually in the head, destroying the skull), leaving the snared bear for the agent to recover one or more days later. Summer temperatures and insects make the salvage of hides of many bears impossible, and skull salvage difficult and offensive. In fact, summer hides are usually of poor quality and not salvable. The situation is further complicated by poor access and lack of storage facilities, even if parts are salvaged.

All salvaged bear parts, including skulls, hides, and claws, were eventually shipped to J. Beecham, Idaho game biologist in Boise, who supervises bear research for the Department. Claws were sometimes turned in by predator control agents as required by USFWS policy, but disappeared between the regional predator control agent in Pocatello and Boise. The claws have minimal, if any, scientific value, although they have value as jewelry and fetishes on the consumer market. The majority of the skulls were unlabeled or lacked essential information such as the location, sex, and date by the time they were examined in Boise (J. Beecham pers. comm.) and were disposed of. In total, salvage of specimens as listed in the salvage law was so unenforceable and obscure that the value of salvaging either specimens or hides is questionable. Collection of reproductive tracts, one complete tooth, stomach contents, and labeling the sex and location of mortality, could furnish valuable information about the bear population in general and, possibly, from "verified" depredators.

Summary of Bear Mortality by Sheepmen

The number of bears killed by permittees and herders on the allotments was difficult to determine accurately. USFS policy specifies that permittees comply with the game regulations of the state in which their allotment is located, including salvage law, but enforcement is lax and compliance difficult.

Herders and permittees often shoot at bears without confirming their deaths. Killed bears often are not examined for sex or general condition. Locations of the kills are seldom recorded, or are noted in terms of allotment landmarks. The majority of bear mortality was reported too late for verification, but the reported totals probably closely approximated actual bear losses for 1976 and 1977 on the allotments studied.

Of the 17 bears killed (Figure 7) as alleged depredators on the Dog Creek, Squirrel Meadows, and South Boone sheep allotments, ten were killed by permittees and herders (one of the bears killed by the USFWS may have been from the Middle Bitch allotment). Of the 18 bears killed (Figure 7) on the South Boone, Middle Boone, and Squirrel Meadows allotments in 1977, at least 15 were killed by herders and permittees (information on one bear was ambiguous). Less than one half (41 percent, 1976; 17 percent, 1977) of known bears kills were reported through USFWS justification reports. Herder mortalities were usually reported as sex unknown.

Assuming that twice as many bears were killed in alleged depredations than were reflected in USFWS justification reports, a minimum estimated black bear mortality for the Dog and Grizzly creeks, Squirrel Meadows, and South Boone and Middle Boone sheep allotments for 1970 through 1977, inclusively, would be 62 black bears.

Figure 7 shows the locations of known livestock-related bear mortality for 1976 and 1977, including IGBST collar-marked and released grizzly bears No. 14 and No. 17.

Bear mortality from a variety of sources is compared to sheep mortality (to all causes) within the study area for an 8-year period (Figure 8). The relationship between livestock-related bear mortality and reported sheep losses to all causes is represented, showing similar

Figure 7. Livestock related bear mortality 1977 (●), 1977 (■), and grizzly bear capture and release 1976 (▲) on the study area Targhee National Forest.

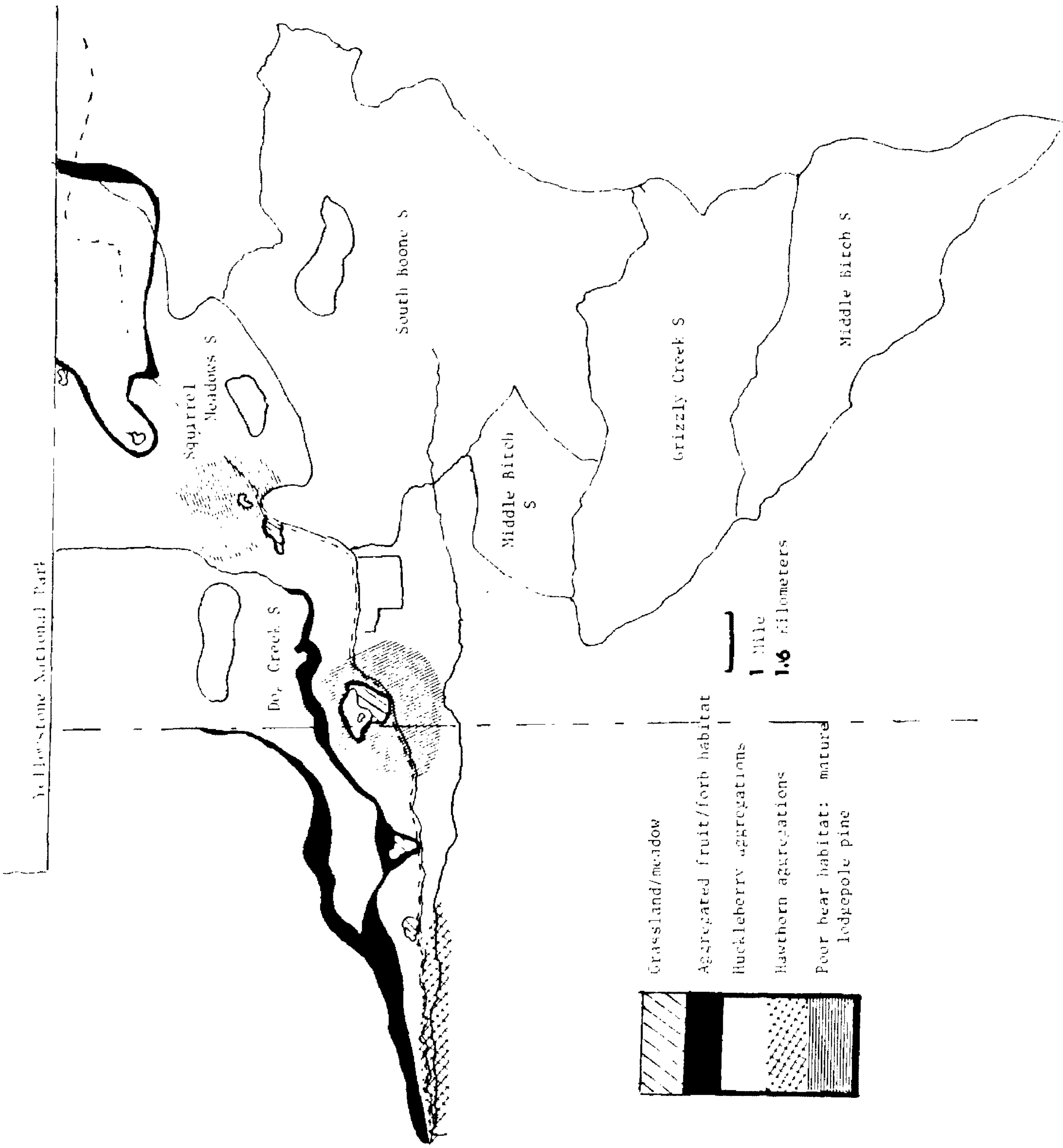
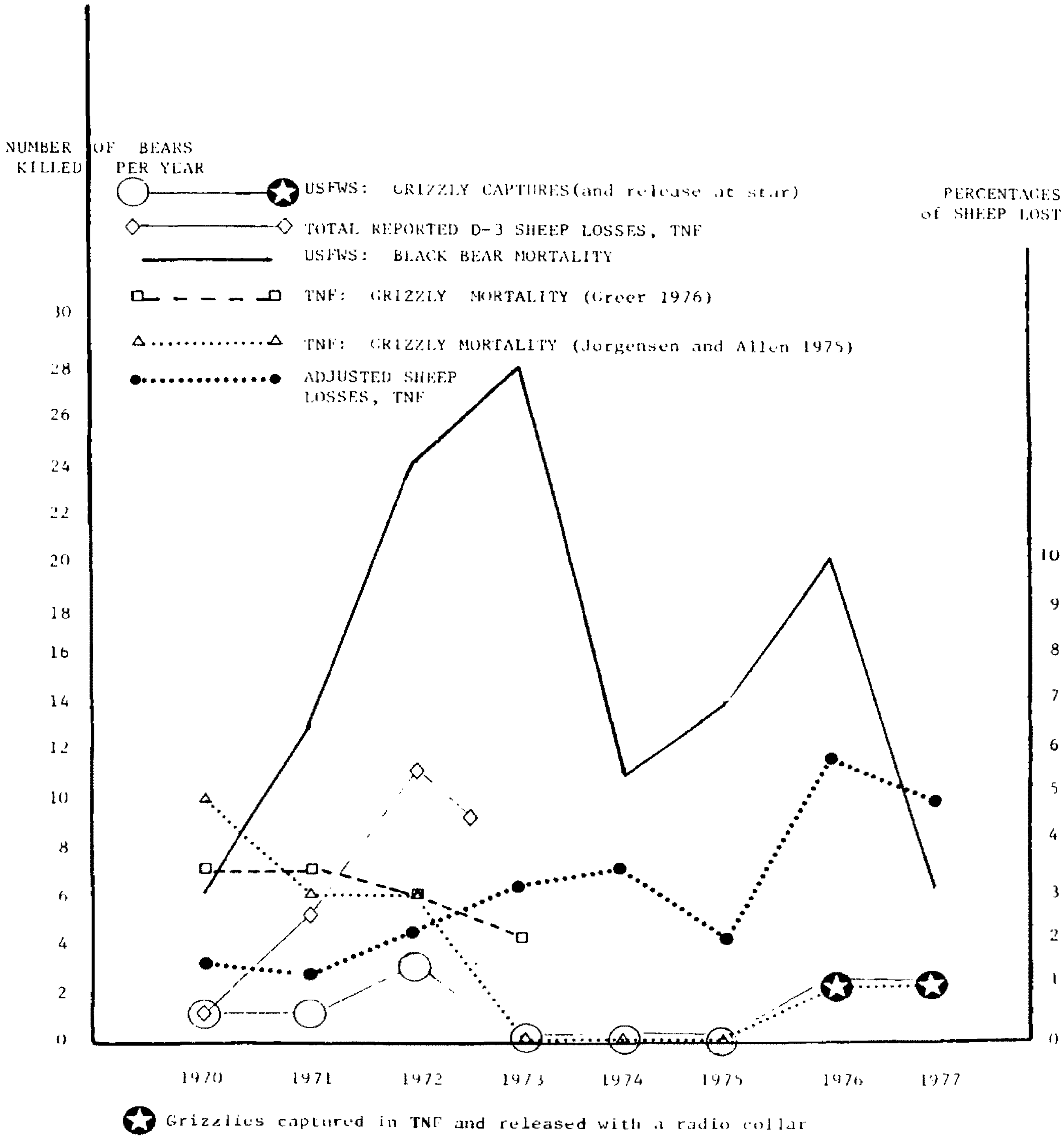

Yellowstone National Park
South Boone S
Squirrel Meadows S
Dog Creek S
Middle Birch S
Grizzly Creek S
Middle Birch S
1 Mile
1.6 Kilometers
Grassland/meadow
Aggregated fruit/forb habitat
Huckleberry aggregations
Hawthorn aggregations
Poor bear habitat: mature lodgepole pine

Figure 8. Bear and sheep mortality 1970-1977.


NUMBER OF BEARS
KILLED PER YEAR
USFWS: GRIZZLY CAPTURES (and release at star)
TOTAL REPORTED D-3 SHEEP LOSSES, TNF
USFWS: BLACK BEAR MORTALITY
TNF: GRIZZLY MORTALITY (Greer 1976)
TNF: GRIZZLY MORTALITY (Jorgensen and Allen 1975)
ADJUSTED SHEEP LOSSES, TNF
PERCENTAGES of SHEEP LOST
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0
10
9
8
7
6
5
4
3
2
1
0
1970
1971
1972
1973
1974
1975
1976
1977
Grizzlies captured in TNF and released with a radio collar

fluctuations.

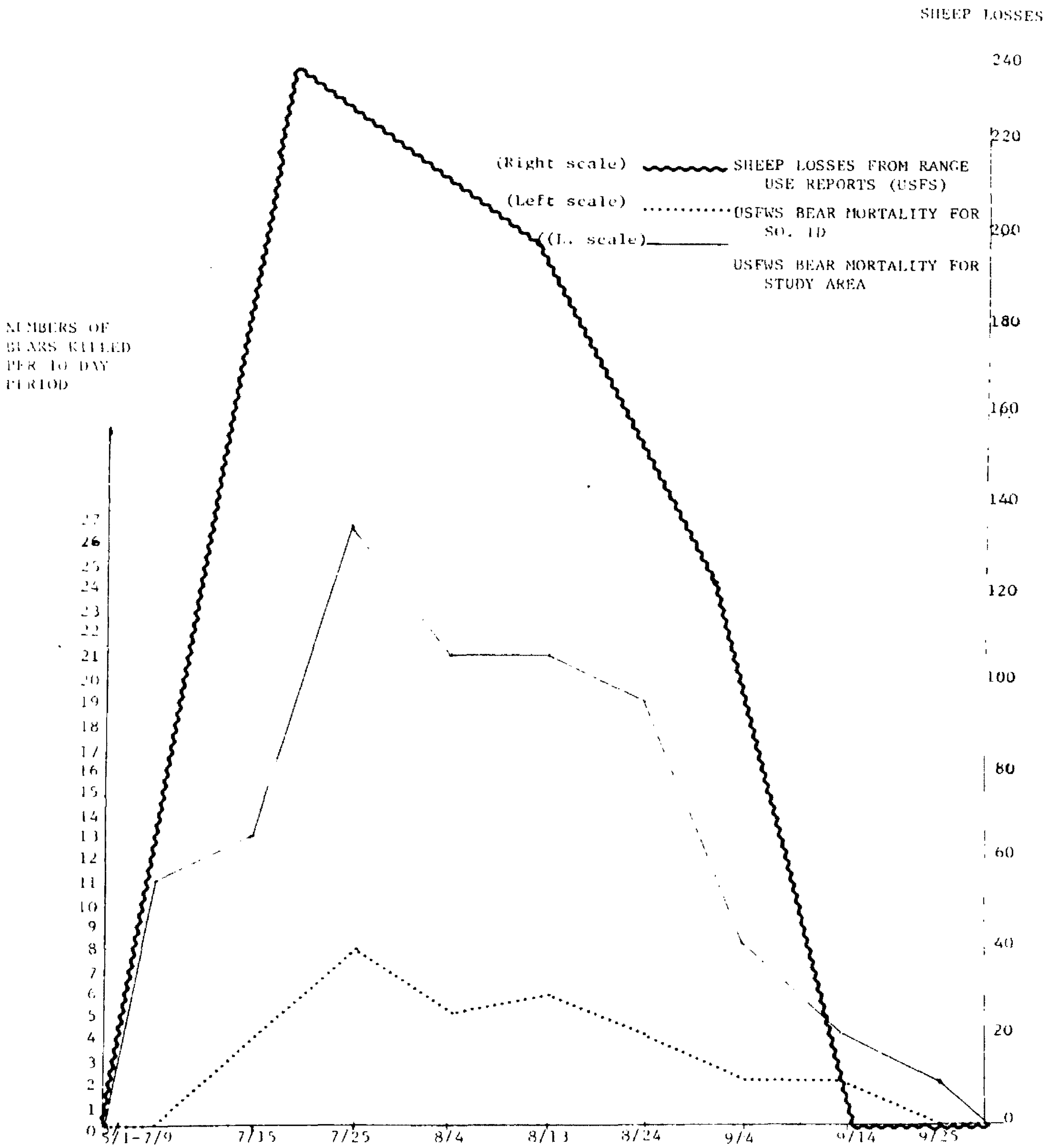
Figure 9 illustrates seasonal bear and sheep mortality. The graph indicates that the USFWS seasonal bear mortality for the study area approximates USFWS seasonal bear mortality for southern Idaho. Sheep mortality peaks in mid-July and livestock related bear mortality, as expected, peaks shortly afterward.

Bear/Sheep Interactions

The bears collared on the study area provided information on the responses of bears to sheep herds, as indicated by bear movements. Of the eight bears collared on the allotments studied, only one (No. 3), was a verified sheep killer. Two bears (Nos. 1 and 10) were monitored intermittently, so complete seasonal data on their interactions with sheep were not collected, although they were not involved in depredations during monitored periods. Two bears (Nos. 7 and 11) were captured in snares baited with sheep carcasses. Neither was found to be involved in any depredations. Bears Nos. 2, 4, 7, 8 and 11 moved near to sheep and exhibited various responses. No. 4 was killed in a herder's snare, and No. 7 was shot at by herders, although neither incident was justified based on available evidence. Figures 10 through 18 represent coded bear and sheep movements during concurrent habitat use. Numbers followed by a letter represent days when more than one location for either bears or sheep was recorded. Only representative bear locations were mapped to prevent confusion (complete home ranges were reported in Figures 2, 3, and 4).

No. 1 (not mapped), an adult male, was captured prior to the

Figure 9. Seasonal bear and sheep mortality 1970-1977.



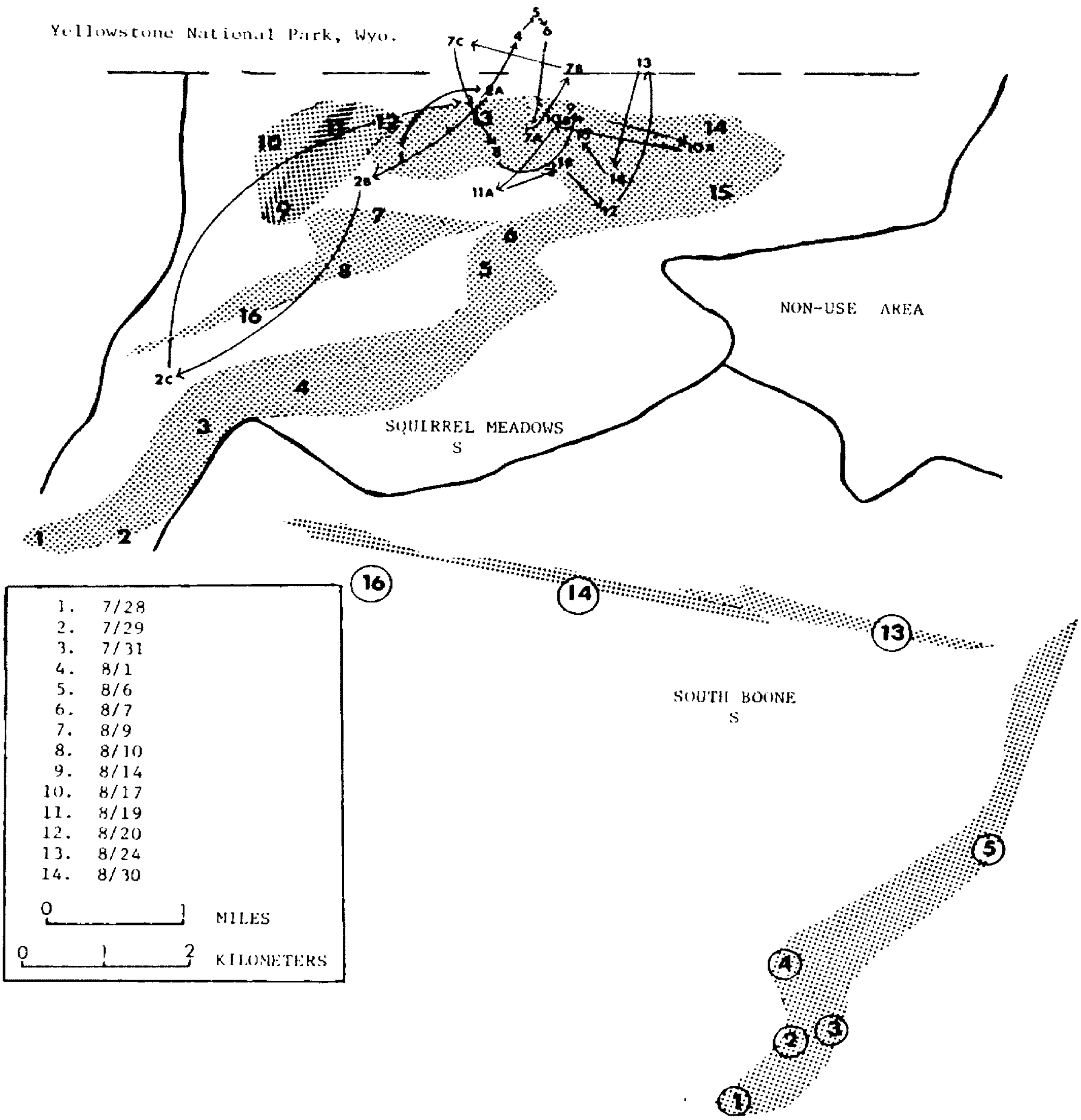
10 DAY PERIODS OF TIME (* GROUPED FOR GRAPHING) THROUGHOUT THE GRAZING SEASON

arrival of the sheep on the TNF in 1976, but slipped his collar. I recaptured him in August near the first capture site and obtained several radio observations before he moved out of the study area. He was killed by a hunter in June 1977, approximately 8 km south of his August 1976 range, on the Squirrel Meadows cattle allotment. He was not monitored while sheep were in the area.

No. 2, a subadult female, was captured prior to the arrival of the Squirrel Meadows herd on Unit 3. The Squirrel Meadows herd grazed within her 1976 summer home range from approximately 30 July to 1 September (Figure 10). On July 29 she moved from Fish Lake to west of Moose Lake, near the Squirrel Meadows herd (2A, 2B, 2C, Figure 10), and returned a day later (3, Figure 10), Several sheep were reportedly killed from 26 July-1 August on the Dog Creek and Squirrel Meadows allotments west of Moose Lake. Because the killing occurred prior to and after the visit of No. 2, and because she returned within 24 hours to her usual habitat, it is doubtful that she killed any sheep.

Although No. 2 was in close proximity to the sheep for more than a month, she avoided contact with them in much the same way that she avoided contact with bear No. 3. When the sheep grazed the huckleberry-rich hill where the majority of her locations occurred (10 and 11, Figure 10), she left the TNF for the swampy YNP parklands to the north. After the sheep moved west of Loon Lake she returned to the berry habitat. She again left the hill when the sheep returned on 24 August. No. 2's August center of activity was the extensive huckleberry patches on the hills above Loon Lake and Fish Lake. Her only major departure from that habitat corresponded with the proximity of

Figure 10. Movements of bear No. 2 (small numbers) and shaded representation of movements of the Squirrel Meadows (large numbers) and South Boone herds (circled).



Yellowstone National Park, Wyo.
NON-USE AREA
SQUIRREL MEADOWS
S
SOUTH BOONE
S
1. 7/28
2. 7/29
3. 7/31
4. 8/1
5. 8/6
6. 8/7
7. 8/9
8. 8/10
9. 8/14
10. 8/17
11. 8/19
12. 8/20
13. 8/24
14. 8/30
0 1 MILES
0 1 2 KILOMETERS

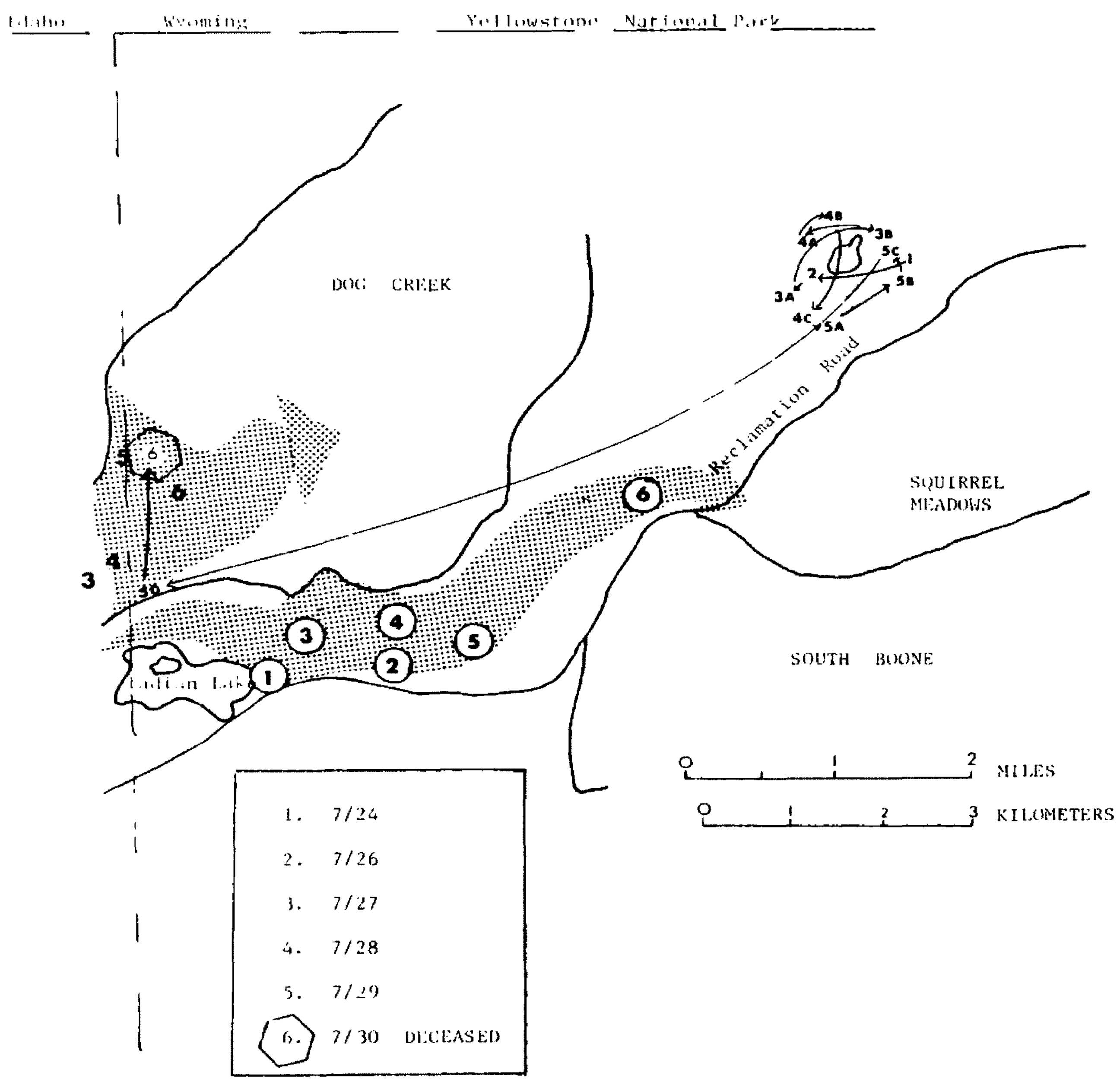
the sheep, leading me to conclude that her movements were a negative reaction to the presence of the sheep, herders, and/or dogs.

No. 4, a subadult male, was monitored from 24 July through 30 July (Figure 11). From 24 July until 1800 hours on 29 July, he remained within 1 km of his capture site east of Loon Lake. That evening he moved rapidly southwest. At 2100 hours I located him north of Indian Lake (5D, Figure 11). I rode into the Dog Creek allotment at 1000 hours on 30 July and found that he had just been shot in a herder's snare.

Stomach contents (Table 7) indicated that No. 4 had fed upon sheep. The amount of time spent on the allotment suggested that he had fed on carrion. Furthermore, it would seem illogical for a bear that had just killed a sheep to feed on a several-days-old, partially consumed carcass in a trap site instead. No. 4 was, therefore, probably killed as a result of depredations by another bear. The herder admitted that he had baited the snare for a large bear thought responsible for sheep losses during the preceding week, and that tracks and sign indicated that a bear much larger than No. 4 was responsible. Several adult black bears were killed within 3.5 km of the site within the next several days.

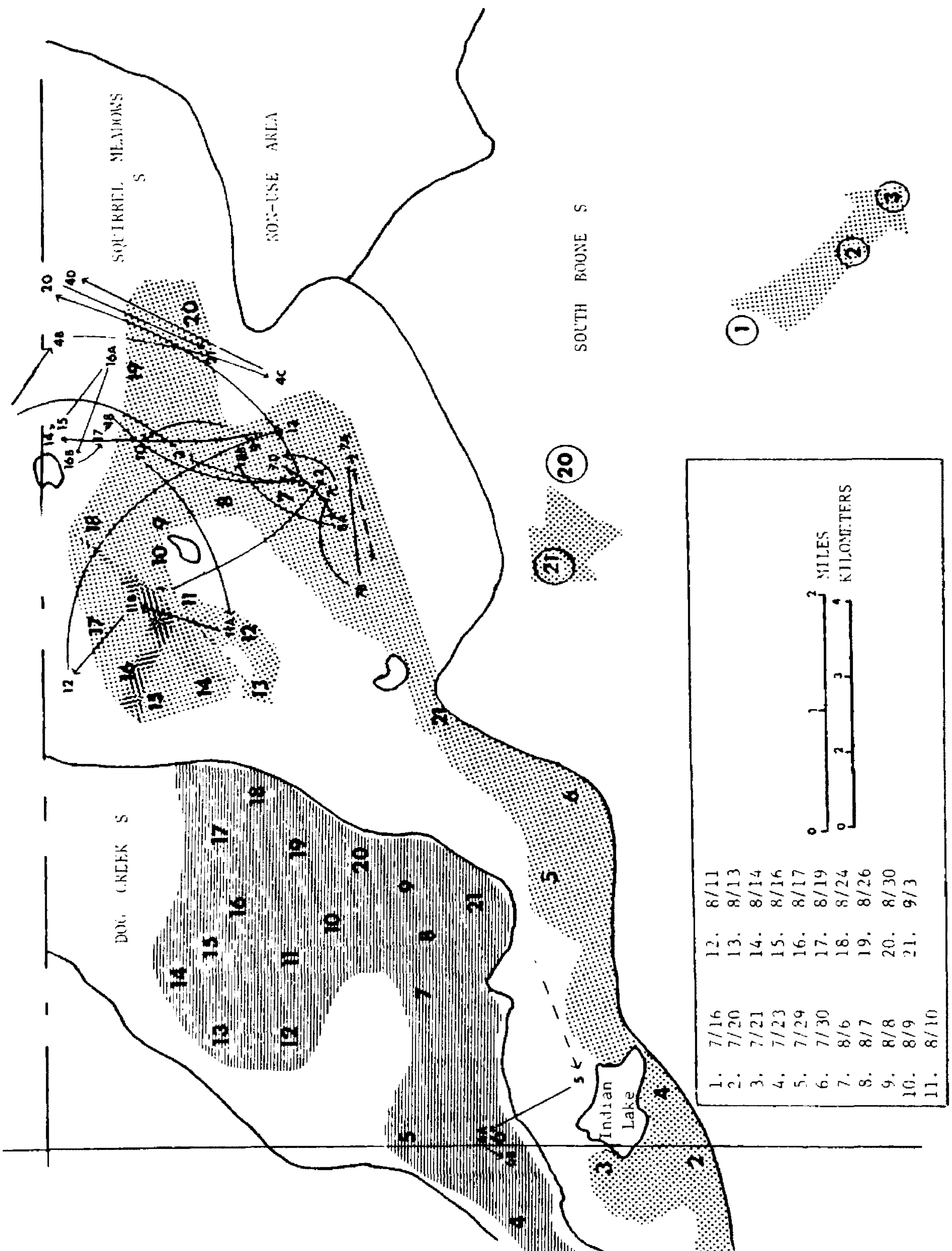
No. 3 was the only monitored bear known to kill sheep (Figures 12 and 13). His 1977 depredations were possibly related to his 1976 experiences as a scavenger. He was obviously a subadult male in 1976, but he was a considerably larger adult in 1977. No. 3's movements (1-4D, Figure 12) prior to his 1976 contact with the sheep were concentrated in the huckleberry patches around Loon Lake and Fish Lake and

Figure 11. 1976 movements of bear No. 4 (small numbers) and the shaded representative movements of the Squirrel Meadows (large numbers) and Dog Creek (circled large numbers) herds.



Idaho
Wyoming
Yellowstone National Park
DOG CREEK
Reclamation Road
SQUIRREL MEADOWS
SOUTH BOONE
Indian Lake
0 1 2 MILES
0 1 2 3 KILOMETERS
1. 7/24
2. 7/26
3. 7/27
4. 7/28
5. 7/29
6. 7/30 DECEASED

Figure 12. 1976 movements of bear No. 3 (small numbers) and the Squirrel Meadows (large numbers, dots), Dog Creek (large numbers, stripes) and South Boone (large numbers, circled) herds.

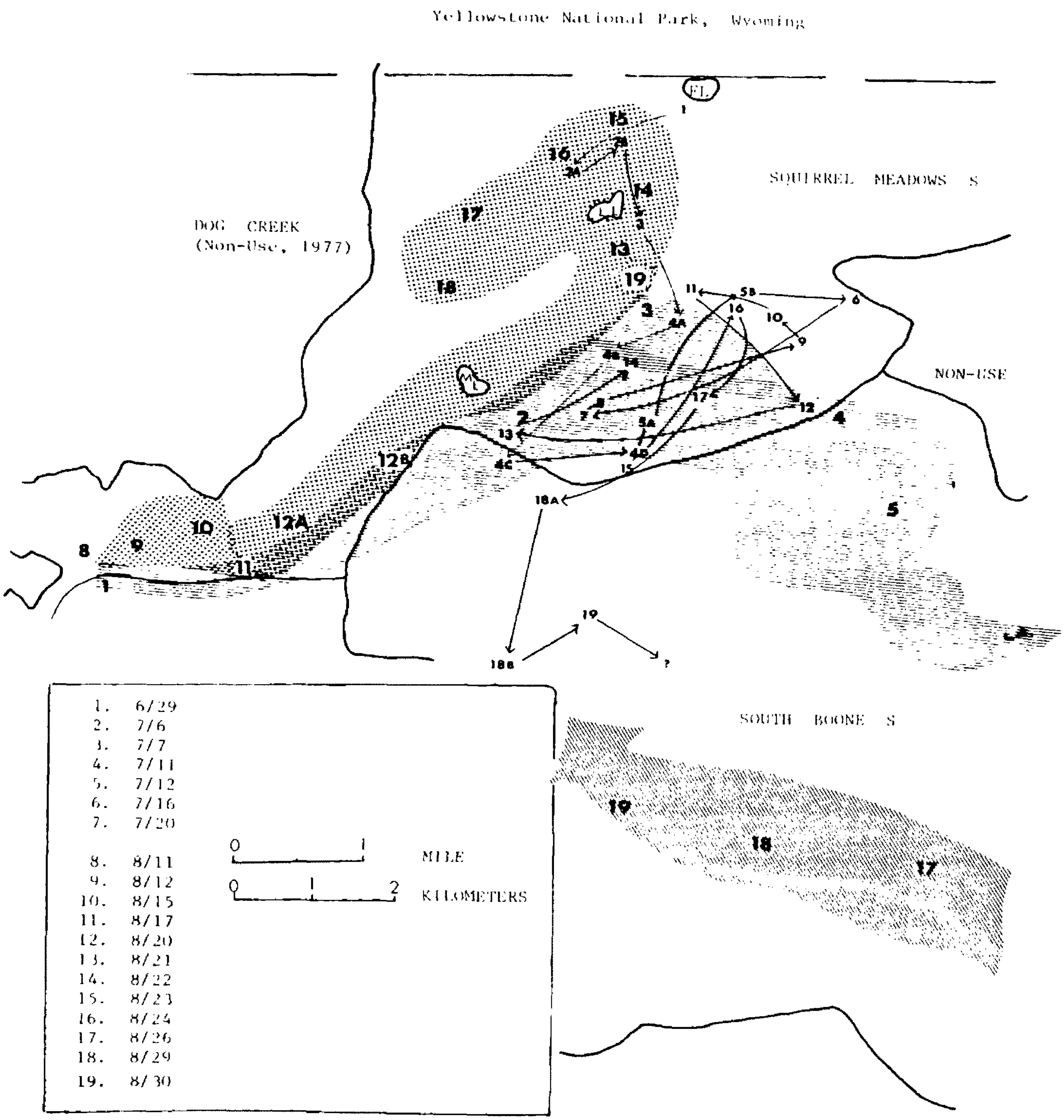

SQUIRREL MEADOWS S
NON-USE AREA
SOUTH BOONE S
DOG CREEK S
Indian Lake
1. 7/16
2. 7/20
3. 7/21
4. 7/23
5. 7/29
6. 7/30
7. 8/6
8. 8/7
9. 8/8
10. 8/9
11. 8/10
12. 8/11
13. 8/13
14. 8/14
15. 8/16
16. 8/17
17. 8/19
18. 8/24
19. 8/26
20. 8/30
21. 9/3
MILES
KILOMETERS

North Boone Creek. On 29 July I located him north of Indian Lake. He spent at least two days near the Dog Creek herd until he moved out of receiver range. I relocated him a week later east of Moose Lake, southwest of the Squirrel Meadows herd. He presumably moved through (or near) both herds at least twice during his unmonitored wanderings.

At approximately 2050 hours on 6 July, while I was closely monitoring No. 3, I saw a large, unmarked adult black bear at the edge of a clearing. After photographing the bear, I moved closer, chasing it into the woods. I heard another bear, which I assumed to be No. 3, crashing through the woods behind the large bear. No. 3 moved rapidly out of range in the same direction. The first bear was feeding and had consumed 75 percent of a fresh lamb carcass. I was unable to determine the cause of the lamb's death from the remains. The Squirrel Meadows herd had grazed that meadow four or five days earlier and had experienced predation losses on the bedgrounds. The herder also reported leaving a lame lamb near there.

I returned the next morning to find the carcass completely consumed and the hide characteristically peeled by bears. Several trees around the meadow had their bark stripped, peeled to a height of 2.5 m, typeical of bear cambium feeding (Poelker and Hartwell 1973). No scats were found nearby. No. 3 had returned and remained in the area that morning. He moved toward the Squirrel Meadows herd that afternoon and passed just below the timbered ridge they were grazing. He continued to move with the her, traveling downslope and ahead of the lead ewes, maintaining a distance of approximately 0.3 km (7-8B, Figure 12). The sheep moved north of the Reclamation Road late on 7 August. No. 3

Figure 13. 1977 movements of bear No. 3 (small numbers) and the Squirrel Meadows (large numbers, dots) and South Boone (large numbers, stripes) herds.


Yellowstone National Park, Wyoming
SQUIRREL MEADOWS S
DOG CREEK
(Non-Use, 1977)
NON-USE
SOUTH BOONE S
1. 6/29
2. 7/6
3. 7/7
4. 7/11
5. 7/12
6. 7/16
7. 7/20
8. 8/11
9. 8/12
10. 8/15
11. 8/17
12. 8/20
13. 8/21
14. 8/22
15. 8/23
16. 8/24
17. 8/26
18. 8/29
19. 8/30
MILE
KILOMETERS

moved slightly southeast, remaining in the north Boone Creek drainage which had patchy, but fair huckleberry and buffaloberry production. He again interacted with the sheep (and grizzly No. 14) from 8 August to 13 August (9-13, Figure 12), moving with the herd until they left his home range on 3 September.

Other bears were thought responsible for some of the sheep losses that occurred during No. 3's proximity to the sheep. Grizzly No. 14 was responsible for many of the losses reported by the herder from 9 August to 11 August. Scats and large tracks indicated that, in addition, at least one large black bear, and probably more, were also killing sheep, and continued to kill sheep after the grizzly left.

No. 3 spent considerable time southwest of Moose Lake where the Dog Creek and Squirrel Meadows herds experienced heavy 1976 predation. USFS investigators reported that at least nine sheep were lost on the Squirrel Meadows allotment from 26 July to 30 July, and 22 sheep were lost on the adjacent area of Dog Creek allotment from 28 July to 3 August (Griffel, unpubl. USFS rpt. 1977). Although some of those carcasses were used to bait snares, most sheep were left at the site of the kill. Two bears were killed on the Squirrel Meadows allotment and four bears were killed on the Dog Creek allotment, including collared bear No. 4. No. 3 could not conclusively be eliminated as a sheep killer in 1976, but his monitored movements, plus other evidence, indicated that he was scavenging on the kills of other bears. The numerous, partially consumed carcasses were probably a strong attractant to bears using the nearby high quality habitat.

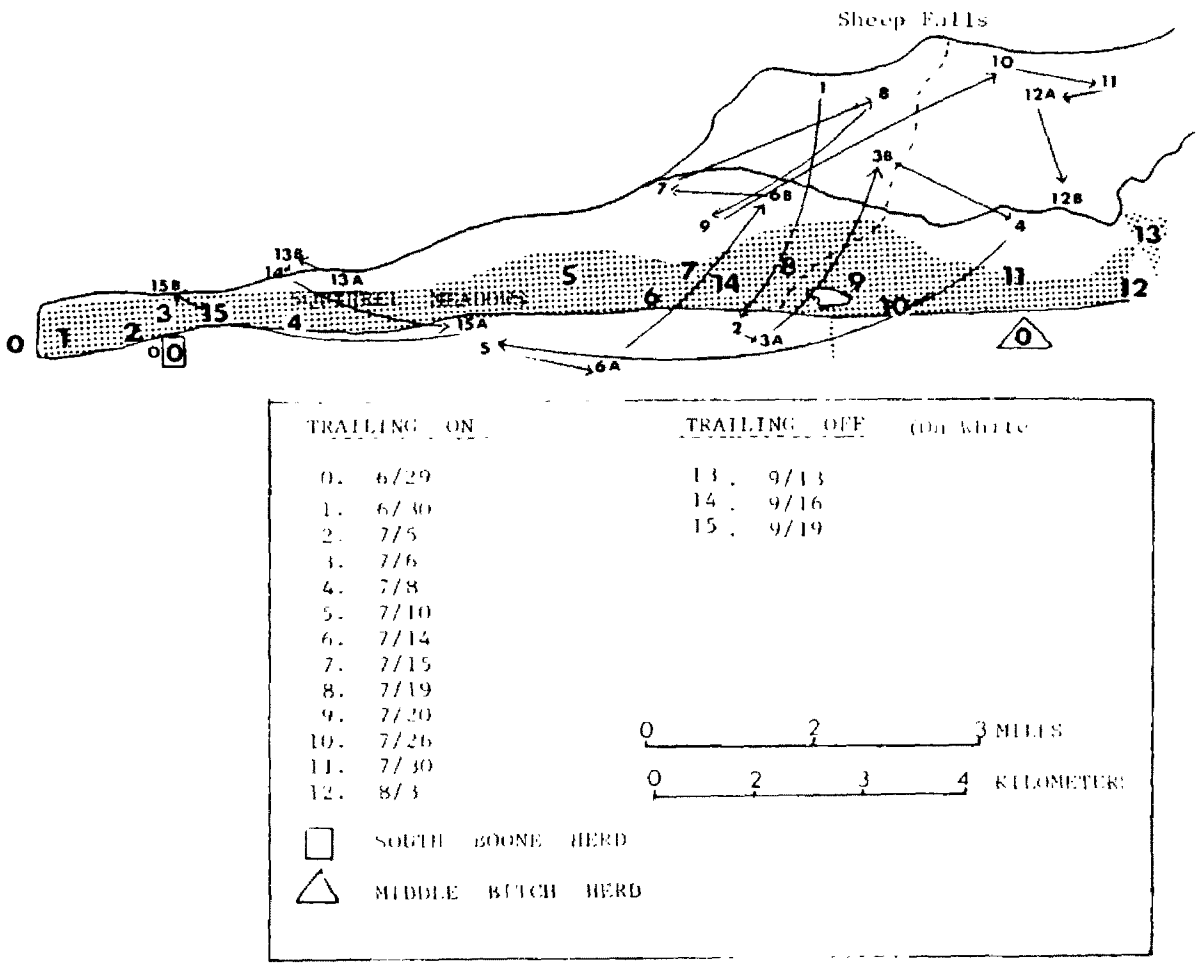
In 1977 No. 3 was close to sheep from 7 July to 12 July (Figure

13), but evidence indicated that his interactions with the South Boone herd involved more than scavenging. He chased sheep and was seen with two other bears near a kill on 10 July. All three bears reportedly came from the same direction within several yeards of each other. The herder shot at all three bears, but apparently missed.

No. 3 was not deterred by the shooting and spent 11 July to 12 July (4 and 5, Figure 13) moving near to and with the sheep. On the evening of 12 July he moved away from the herd toward the North Boone drainage and I lost contact. The sheep continued in a southeasterly direction as represented in Figure 13, and out of range by 12 July to 13 July. He continued to confine his activities on his summer range until the end of August, then moved out of the study area. He was not located again by foot, air, or horseback, neither was he within range of the South Boone herd from 30 August until the sheep left the allotment. Although No. 3 was close to the Squirrel Meadows herd on 20 August to 21 August (12 and 13, Figure 13), no known interaction occurred.

No. 7, an adult male, had the largest home range of any known black bear on my study area. The Squirrel Meadows herd grazed his home range from 30 June through 9 August (0-13, Figure 14). The South and Middle Boone herds trailed the Reclamation Road en route to their respective allotments. No. 7's home range included parts of the Dog Creek and Squirrel Meadows cattle and sheep allotments north and south of the Reclamation Road. He was seen by the South Boone herder on 29 June (0, Figure 14). The herder shot at him and missed, although no sheep losses or attempted predation had occurred. No. 7 moved through the Squirrel Meadows herd regularly during 1977. No depredations occurred during

Figure 14. 1977 movements of bear No. 7 (small numbers) and the shaded representative movements of the Squirrel Meadows herd (large numbers).


Sheep Falls
TRAILING ON
0. 6/29
1. 6/30
2. 7/5
3. 7/6
4. 7/8
5. 7/10
6. 7/14
7. 7/15
8. 7/19
9. 7/20
10. 7/26
11. 7/30
12. 8/3
TRAILING OFF
13. 9/13
14. 9/16
15. 9/19
0 2 3 MILES
0 2 3 4 KILOMETERS
SOUTH BOONE HERD
MIDDLE BUTCH HERD

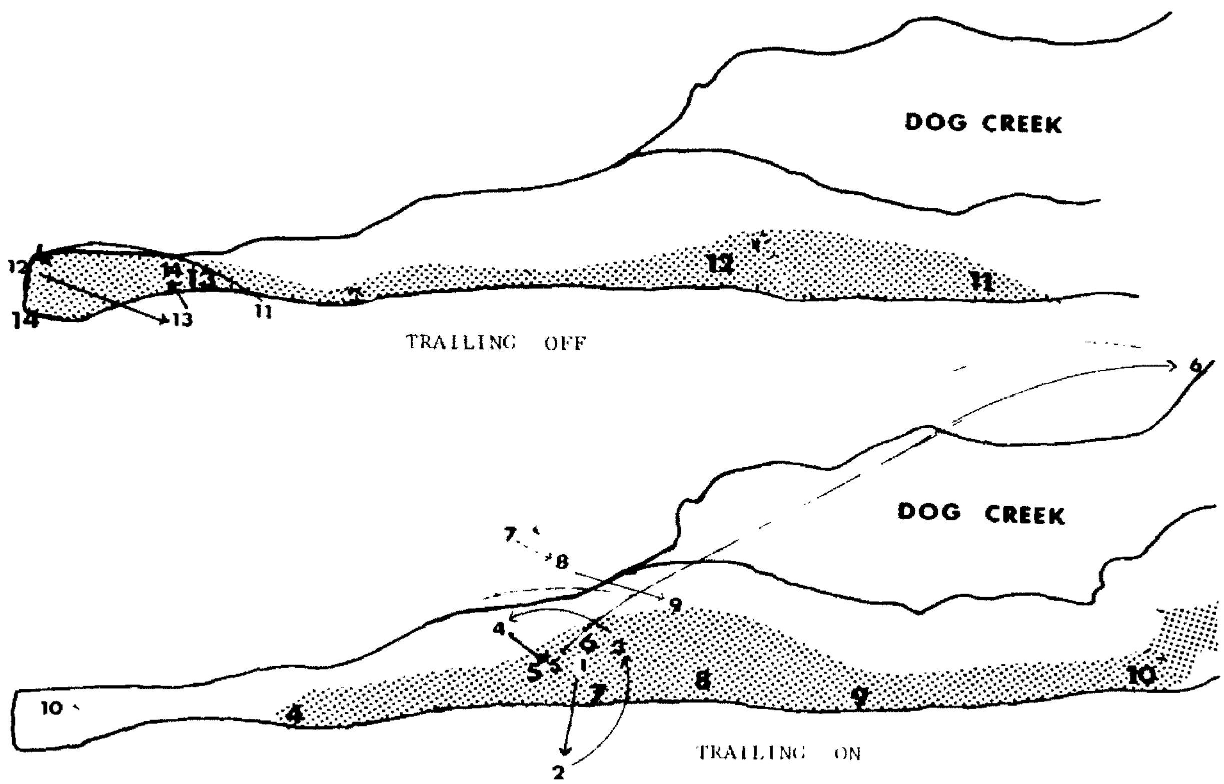
those monitored interactions, and no association with the sheep was known to occur after 29 June. His centers of activity corresponded with areas of quality seasonal bear habitat.

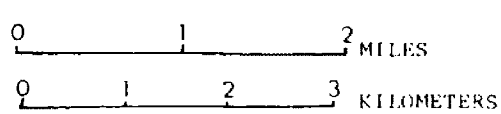
No. 9 moved through the Squirrel Meadows herd from 8 July to 26 July (4-9, Figure 15) and from 12 September to 20 September. As with bear No. 7, large parts of No. 9's occupied range concurred with areas grazed by sheep, but his temporal activities reduced the chances of direct contact with the sheep. Like No. 7, his activities were also related to seasonal bear food sources.

No. 10 was monitored intermittently, but he was not located near any sheep herds during those periods (Figure 16). His movements were more erratic than those of other bears monitored, and he fit the description of a dispersing subadult male (Rogers 1977). Most of his locations occurred in substandard bear habitat dominated by lodgepole pine, elk sedge, and pinegrass.

No. 11 was captured on the Squirrel Meadows allotment in 1977. Most of her seasonal home range lay within the Dog Creek allotment (non-use 1977). She moved north and south between the two allotments throughout the summer, but remained on the north facing slopes of Boone Creek, or on the Falls River ridge, when the Squirrel Meadows herd was proximal (Figure 17). Much vegetation on Squirrel Meadows Unit 1 was depleted by overgrazing in 1977; this may have been a factor in her consistent use of the berry-rich habitat on the Dog Creek allotment. No losses to bears occurred during her limited movements south of Falls River.

Figure 15. 1977 movements of bear No. 9 (small numbers) and Squirrel Meadows herd (large numbers, dots).





TRAILING ON	TRAILING OFF
1. 6/30	11. 9/14
2. 7/5	12. 9/16
3. 7/8	13. 9/19
4. 7/9	14. 9/20
5. 7/10	
6. 7/11	
7. 7/14	
8. 7/16	
9. 7/26	
0. 8/22	

Figure 16. 1977 movements of bear No. 10 (small numbers) and Squirrel Meadows herd (large numbers).

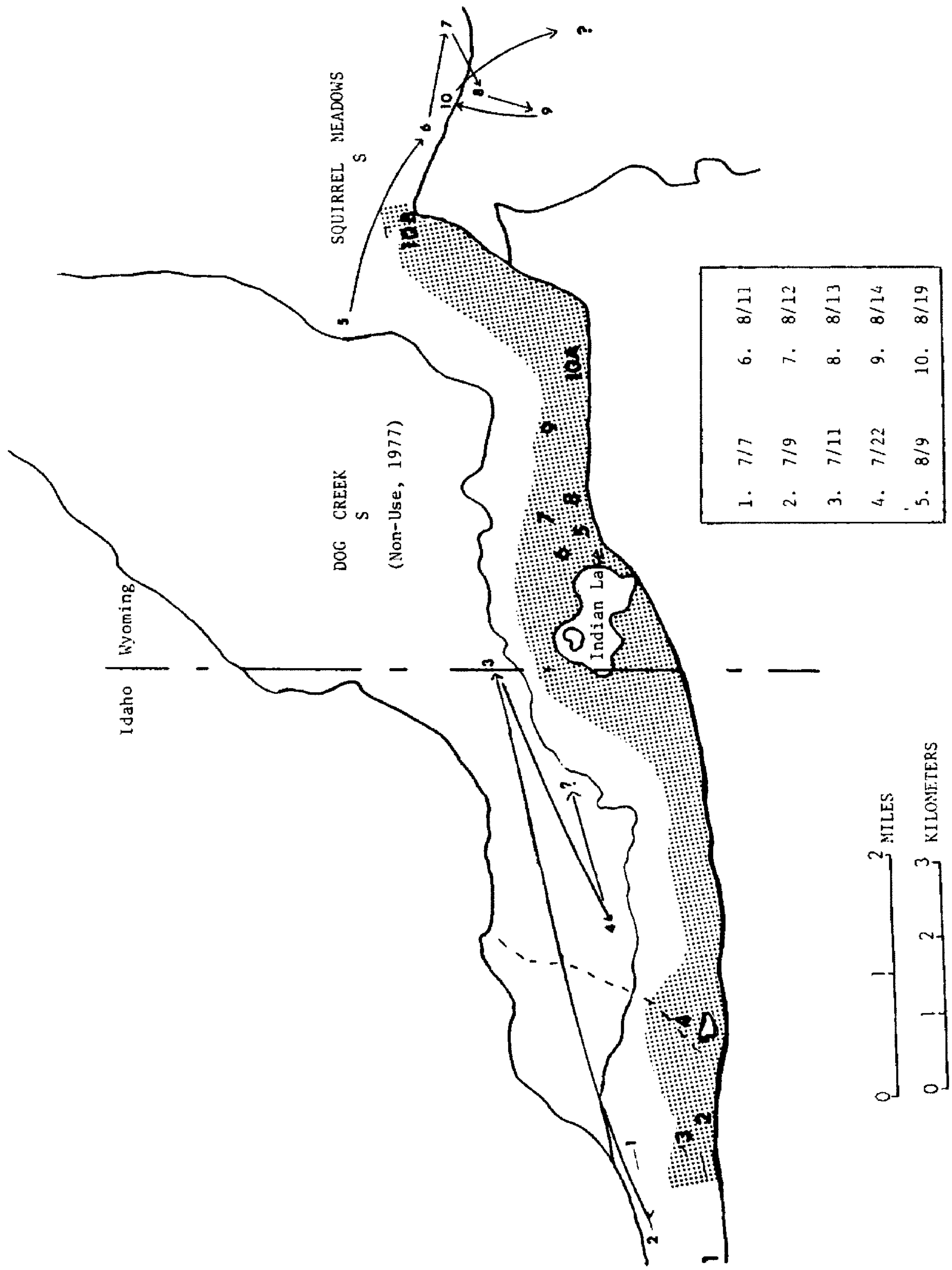
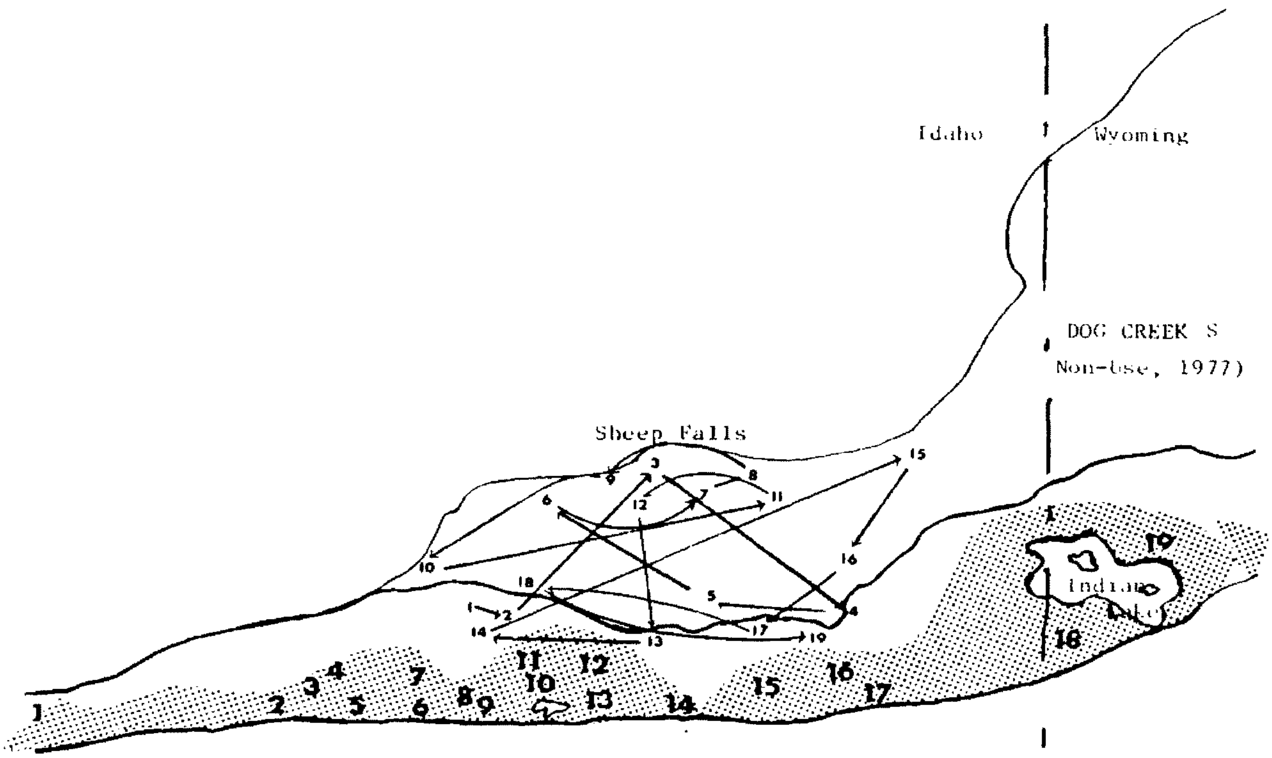

SQUIRREL MEADOWS
S
DOG CREEK
S
(Non-Use, 1977)
Idaho
Wyoming
Indian La
1. 7/7
2. 7/9
3. 7/11
4. 7/22
5. 8/9
6. 8/11
7. 8/12
8. 8/13
9. 8/14
10. 8/19
0 1 2 MILES
0 1 2 3 KILOMETERS

Figure 17. 1977 movements of bear No. 11 (small numbers) and the shaded representative movements of the Squirrel Meadows herd (large numbers).



1.	7/8	11.	7/22
2.	7/9	12.	7/23
3.	7/10	13.	7/26
4.	7/11	14.	7/28
5.	7/14	15.	7/30
6.	7/16	16.	8/2
7.	7/17	17.	8/3
8.	7/18	18.	8/5
9.	7/19	19.	8/7
10.	7/20		

0 1 2 MILES

0 1 2 3 KILOMETERS

Movements of IGBST grizzly No. 14 and several sheep herds are depicted in Figures 18 and 19. Grizzly No. 14 was captured in a blind set less than 0.75 km from the Squirrel Meadows sheep camp in 1976. He had been killing sheep for several nights preceding his capture. After his capture, he was not suspected of further depredations in 1976.

In 1977, his wide-ranging movements showed regular contact with the sheep (Figure 19). No. 14 was monitored exclusively by air so daily locations were not possible. Herders reported probable grizzly depredations on 27 July and 26 August. No. 14 may have been involved although sign indicated other grizzlies were also in the area. As in 1976, No. 14's movements within the sheep allotments were limited to a few weeks. No. 14's movements within these sheep allotments constituted only a small portion of his 2590 km^2 (1000 mi^2) home range (D. Knight, pers. comm.).

Discussion. My data indicate that the presence of sheep did not influence any collared bear to leave its established home range either to follow or avoid the sheep. One possible exception occurred on 29 July 1976. Three bears (Nos. 2, 3, and 4) exhibited unusual "sallies" or wanderings (Burt 1943) outside their established home ranges for 1 to 10 days. All bears began their departure in the evening and moved southwesterly to lower elevations (toward the Dog Creek and Squirrel Meadows sheep herds). I was unable to determine the cause of this simultaneous movement; nor was I able to find mention of similar movements in the literature. A massive electrical storm moved in rapidly from the east, coincidentally, but the actual storm was short-lived (though highly charged). Radio monitoring was nearly impossible after 1900 hours. When the weather cleared the following afternoon, No. 2 had returned

Figure 18. 1976 movements of Grizzly bear No. 14 (small numbers), and the Squirrel Meadows (large numbers), Dog Creek (large numbers, circled), South Boone (large numbers, squares) herds.

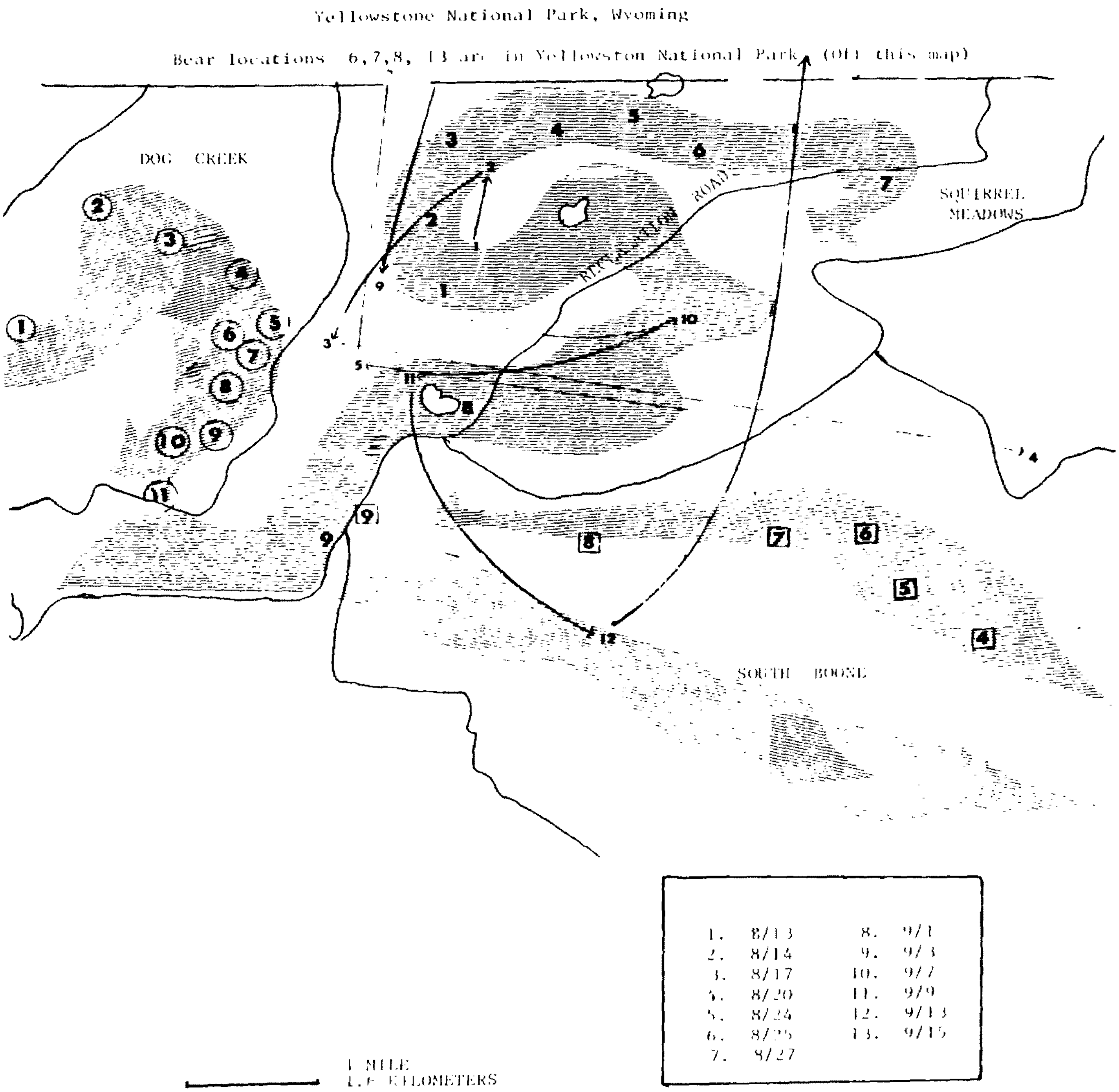
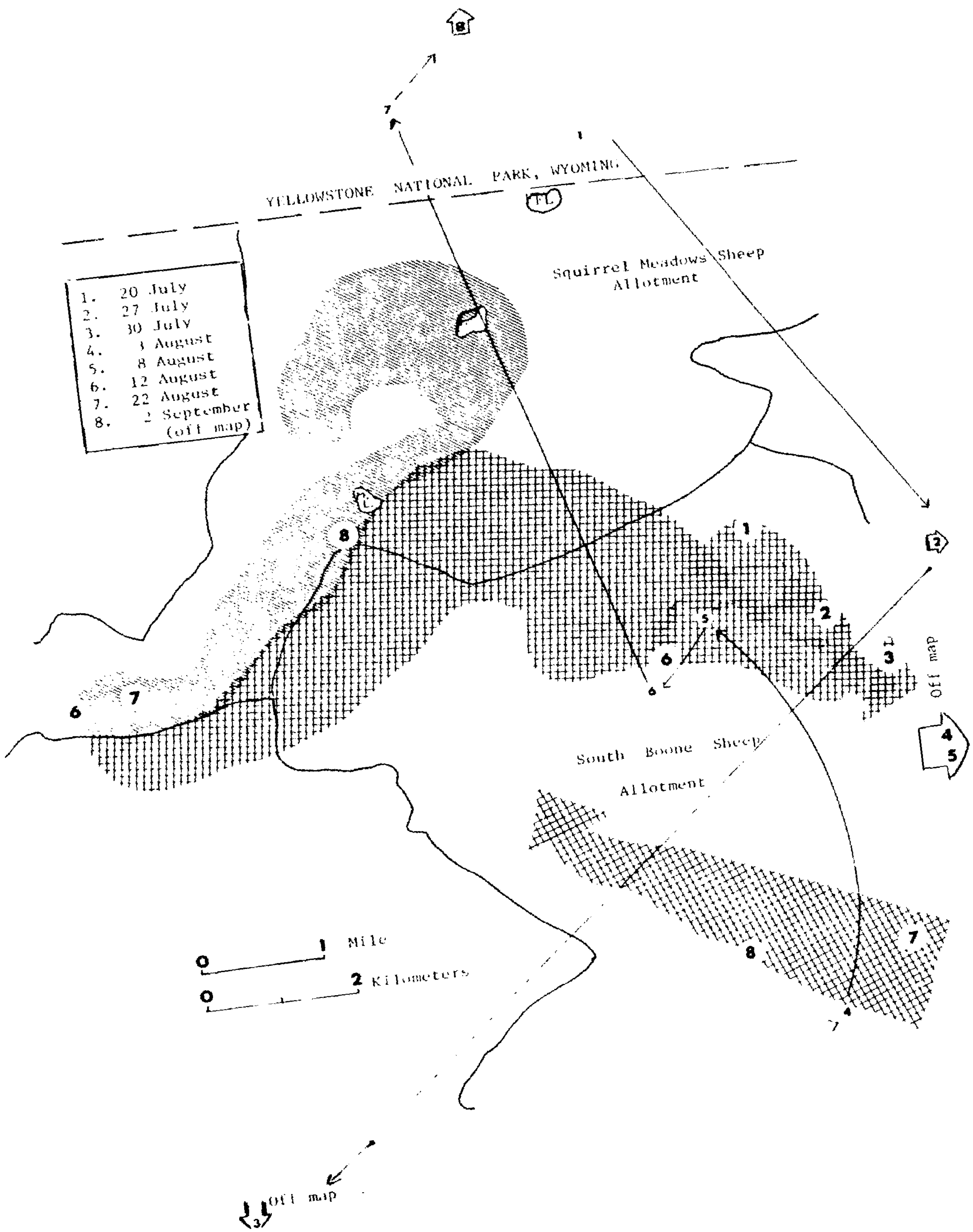

Yellowstone National Park, Wyoming
Bear locations 6,7,8, 13 are in Yellowston National Park (Off this map)
DOG CREEK
SQUIRREL MEADOWS
RECLAMATION ROAD
SOUTH BOONE
1. 8/13
2. 8/14
3. 8/17
4. 8/20
5. 8/24
6. 8/25
7. 8/27
8. 9/1
9. 9/3
10. 9/7
11. 9/9
12. 9/13
13. 9/15
1 MILE
1.6 KILOMETERS

Figure 19. 1977 movements of grizzly bear No. 14 (small numbers) and the shaded representative movements of the Squirrel Meadows (large numbers, striped) and South Boone (large numbers squared) allotments.


YELLOWSTONE NATIONAL PARK, WYOMING
Squirrel Meadows Sheep Allotment
South Boone Sheep Allotment
1. 20 July
2. 27 July
3. 30 July
4. 3 August
5. 8 August
6. 12 August
7. 22 August
8. 2 September (off map)
Off map
0 1 Mile
0 2 Kilometers
Off map

to her home range, No. 3 remained out of range, and No. 4 was dead on a sheep bedground.

The movements of the monitored resident bears were generally related to the seasonal food availability in their respective areas and did not seem to vary as a result of interactions with the sheep. The mean seasonal distance between radio-collared bears and sheep herds ranged from 2.0 km (N = 49) between No. 2 and the Dog Creek herd to 14.4 km (N = 23) between No. 7 and the Dog Creek herd in 1977. In most cases, rather than the bears following the sheep, the sheep moved close to established centers of bear activity. Bears and sheep utilized the same home range and occasionally interacted (Nos. 3, 4, and 7), but the association ended when the sheep moved out of the bears' home range.

Intraspecific Relationships Among Depredating Bears

Perhaps a greater intraspecific tolerance occurs among bears involved in depredations than between other free ranging bears. By viewing a sheep herd as a clumped food source, a loose association of bears, such as those seen on 10 July 1977, and others documented in USFWS reports or by sheepmen, would not be unusual. Craighead (1976), Egbert and Stokes (1976), Stonorov and Stokes (1972), Barnes and Bray (1967), and Erickson et al. (1964) all have documented aggregations of bears that occurred at concentrated feeding sources and have studied the social hierarchy that develops among bears with consistently clumped food sources. Observations of bear interactions in TNF sheep herds were usually short-lived (as were the bears involved). It was doubtful that an established hierarchy was involved, because the sheep were a dynamic variable, utilized as a food source by only certain bears and ignored or avoided by others. They moved rapidly through the home ranges of many different bears, constantly changing habitat. The changing conditions and severe selective pressure on bears seen near sheep herds probably kept the innate social mechanisms that cause the formation of hierarchies to a minimum, but a greater incidence of temporary association seemed apparent.

Speculation, therefore, led me to consider the advantages of greater than normal tolerance among depredating bears (I define normal to be the free ranging minimum tolerance distance between bears in heterogeneous environments, or 0.3-0.5 km from my data). Killing is considered to be a learned behavior in some species (Polsky 1975), and bears have a demonstrated learning ability (Burghardt and Burghardt 1972). Pearson (1975) discussed mothers teaching their young foraging strategy and habitat utilization. Cowan (1972 in Herrero ed. 1972) suggested that killing requires experience and in bears, localized, specialized predation techniques may spread through a population via learning behavior. Therefore some bears may learn the technique of killing livestock and big game from other bears. Greater association with experienced stock killers would lead to greater skill and greater rewards from scavenging the remains of kills made by experienced depredators. Because one herder is unable to pursue more than one bear at a time, chances of killing either bear are reduced.

This speculation does not imply that bears openly cooperate to kill and share the spoils, but rather that certain bears may benefit from greater intraspecific tolerance in some circumstances. Monitored bear No. 3 may have benefitted from the experience of the larger bear sighted on 6 August 1976, utilizing the abandoned carcasses. His depredation activities in 1977 suggested that he expanded his interests from scavenging to preying on sheep, possibly as a result of learned behavior.

Competition: Bears and Sheep

Competition for food is defined as occurring if two species utilize the same forage plants on the same range, the plants eaten are an important food source for either or both species, and such plants are somehow limited (Blood 1966). The plants that bears and sheep utilize and which meet Blood's (1966) criteria are presented in Table 1. Parts of sheep allotments coincided with the home ranges of one or more bears, meeting the second criterion. Scat content analysis and widespread documentation of feeding indicated the importance of Tables 8 and 9 plants as bear foods. The importance of the same plants to sheep on my particular study area was less conclusively determined, but by averaging the ratings of sheep preference for those plants from the literature, the plants most consistently preferred were identified. Some of the plants were in limited abundance, and nearly all were seasonally limited regarding palatability and nutrient content.

While actual concurrent use of habitat may be decreased by spatial and temporal movements, or through mutual avoidance by both bears and sheep, the basis for range use conflict exists. Both species prefer certain plants that serve as important food sources for them. When these are the same plants at the same season, the conflict could be serious. However, the true importance of such plants is obscured by the availability of alternate, nonoverlapping food sources, and slight differences in season of use. In most years, habitat diversity provides adequate alternative food sources should one or more of the important foods fail. However, the most severe consequences of the potentially limiting, competitive situation described above will occur when alternate food supplies fail and survival (or growth/reproduction) is dependent upon nutrition provided by plant species simultaneously important to bears and sheep (Table 1).

Important bear food failures have been documented in the literature, and they usually coincided with increased bear depredations (Rogers 1976, Piekielek and Burton 1975, Hatler 1967, Shorger 1946, Babcock 1929). More importantly, a poor nutritional level affects the reproduction and survival of bear young (Rogers 1977). Resultant mortality would be detrimental to dangerously low or decreasing bear populations.

Competition, as defined by Birch (1957) and Nelson and Barnell (1976), occurs between two species when the presence of one prevents the other from utilizing a needed resource, or if harm comes to either as a result of common use. Instances of sheep "spooking" at the presence of a bear are well documented in livestock journals and USFWS justification reports. Straying losses, stampede injuries, and decreased contentment are possible additional results, but difficult to quantify. Observations of collared bears on the study area indicate that certain bears also avoid preferred (and possibly required) areas when sheep herds are present. The percentage of sheep killed bears, and the number of bears killed as a result of real or alleged depredations, definitely meet the requirement specified by Birch (1957).

The <u>effects</u> of competition in terms of losses of sheep on the sheep population (or herd in this situation) are minor when compared to losses from other causes (Table 10). Many producers claim that predation losses preclude annual profits. Gee et al. (1977) and Nesse et al. (1976) reported survey results claiming predation as a major problem faced by sheep operators and a major reason for the decline in the sheep industry. To sheep operators, and to many of their neighbors who depend upon the economic contributions of the sheep industry to their communities, the effects of bear/sheep competition may be greater than percentage losses indicate. Indirect losses are also real, but are difficult to evaluate.

CHAPTER V

CONCLUSIONS

The consistently heavy mortality on bear populations within my relatively small study area would be expected to have the following effects on resident bear populations: a high subadult/adult population ratio (Beecham 1977), decreased bear density, and decreased annual hunter/herder bear kill.

Unfortunately, no such information is collected from bear hunters in the study area or in adjacent Idaho areas. Skulls collected from bears killed by herders and USFWS personnel, if labeled with sex, date, location of the kill, reproductive condition, and the circumstances of the mortality, could provide additional data on the general bear population structure and stability. In Wyoming, where most bear mortality on the study area occurs, there is no requirement for information on killed bears to be furnished the Game Department. Therefore data from only the Idaho side of the study area could, at best, be expected, and this could provide a biased representation of predation.

Kemp (1976) felt that high mortality stimulated production in a bear population. If the heavily exploited black bear population exhibits a predominance of subadults similar to that found in an exploited population in Idaho (Beecham 1977), the social structure and behavior characteristics of the population could be expected to reflect that deviation. Some researchers have postulated that subadults, because of their lack of experience in efficent foraging, plus less familiarity with newly established home ranges, are more likely to be involved in depredations than adults (Pelton and Beeman, 1975). Other researchers think an old age structure of bears may lead to high depredation rates, but I was unable to investigate that aspect.

Rogers (1977) documented a high incidence of subadult mortality due to starvation. Starvation, and a related reduced reproduction rate caused by inadequate food supplies, could be serious in a bear population dependent upon foods also selected by domestic livestock.

The effects of competition on the TNF bear population are obscured by the influence of the adjacent national parks. Allotments consistently having the greatest bear depredation problem (and consistently high coyote predation) are Dog Creek, South Boone, and Middle Boone, all bordering either YNP or GTNP. The Squirrel Meadows allotment, insulated from YNP by the Dog Creek allotment (except for a short northern boundary in Unit 4) had consistently lower bear predation losses (Table 10) and lower bear mortality resulting from depredation activities than the other allotments. Although other factors such as habitat and food availability are considerations in the greater incidence of bear/sheep conflicts in the first three allotments, the proximity of the parks must not be disregarded. GTNP and YNP may also serve as a temporary sanctuary for bears whose home range overlaps the boundary (e.g., collared bear No. 2).

Bears dispersing from their mothers' home range in a park could probably find an unoccupied niche created by the deaths of the 10-20 bears removed yearly from my 400 km^2 study area (including Dog Creek, South Boone, Middle Boone, and Squirrel Meadows allotments). Cowan

However, chances of capturing a scavenging or innocent bear rather than a sheep killer increases as time elapses between the incident and capture. At best, careful examination of all the evidence (e.g., sign, changes in the predation rate, stomach contents, characteristics of the kill) may prove predation, but it cannot prove innocence.

Bear locations were largely centered in quality bear habitat. Bear food use (Appendix A, Tables 6 and 7), scats, radio locations, sightings, and kill locations were keyed to habitat (Tables 3 and 5). Douglas-fir seral habitat types adapted from Steele et al. (1977) were the preferred black bear habitat. Grizzlies used significantly greater proportions of open habitat types than did black bears. Sheep also preferred nontimbered types, although sheep habitat use was greatly influenced by the herder.

Increased contact with bears can be expected in areas of prime berry and fruit availability, such as the north slopes of Falls River and Boone Creek, and in the habitat types with an abundance of huckleberries along North and Middle Boone Creeks. Buffaloberries, chokecherries, and serviceberries appear to be the most essential bear foods throughout the summer, especially along the gentle slopes near creeks and rivers and in aspen types. Huckleberries as a food are most essential in July through early August (or slightly later at the highest elevations in each allotment). Mountain ash and hawthorn fruits become most important in the fall. These sites, in general, are not good sheep range, and excessive browsing, "trailing in," and trampling of bear food species in such areas should be avoided, both to prevent bear/sheep encounters and to prevent the loss of essential bear foods.

Many of the berry/fruit crops are most abundant on steep, north facing slopes, and in disturbed areas logged for salvage in recent years and, in fact, herders usually avoid steep, brushy areas to decrease sheep injuries. Chances of bear/sheep interactions are greater on north facing slopes from mid-July through August than would be expected on dry ridge tops or mature lodgepole pine/Douglas-fir habitat types and south facing slopes (Figure 5).

The most critical competition between sheep and bears for essential, succulent vegetation can be avoided by keeping sheep off the forest until late June. In fact, arrival dates should be delayed further in years of poor forage production. This practice may also be compatible with wise range management. In short, sheep have a greater ability to digest and utilize cellulose than bears. Therefore, herders should try to direct sheep away from food species most essential to bears during the early summer season, or at least to graze lightly the areas of prime bear habitat to minimize competition.

Tight herding results in fewer predator losses, but greater range damage. Excessively loose herding results in greater losses to peripheral predators and wandering, but the range is more prudently utilized. A closely guarded, but free ranging herd, is the best compromise.

One of the greatest losses experienced by owners is due to wandering or stampeding. The cause of stampedes may or may not be predators. "Spooking" is a common and easily invoked response in domestic sheep. Sheep, injured or not accounted for because of wandering or stampeding,are often unjustly classified as predator losses or can lead to predation. Diligent herder surveillance can keep such losses to a minimum.

Grazing and herding practices on the TNF have changed little since 1900. Herders' wages have increased, but not enough to attract adequate numbers of qualified herders into the business. Herding practices (such as portable corrals), Komondorok dogs (being investigated at the Sheep Experimental Station in Dubois, Idaho), toxic collars (Brawley 1977), and the proper disposal of sheep carcasses, have not been implemented partially because lax enforcement and livestock economics favor the destruction of real and alleged predators. By allowing indiscriminate killing of coyotes and bears, and not penalizing owners for their lack of compliance with Fish and Game regulations, the USFS is at present encouraging antiquated sheep management.

Predator losses, within reason, should be expected and accepted by permittees on USFS land. The U.S. Multiple Use Act of 1964 provides that grazing is only one of many uses of public domain.

The practice of shooting at bears without positive identification is reprehensible, and the 'look-alike' status of grizzlies and black bears could cause unnecessary grizzly mortality. Notifying enforcement personnel, and the firing of warning shots should normally be adequate. Voluntary cooperation by herders in the killing of only positively identified bear depredators may be an ultimate solution because enforcement will always be difficult if not impossible.

As long as sheep and grizzlies are known to inhabit the same ranges and to utilize concurrent habitat, USFS inspections of grazing techniques and predator control should be required to deter unjustified bear removal.

CHAPTER VI

SUMMARY

1. Eleven black bears and two grizzlies were captured in the Targhee National Forest, Idaho-Wyoming, during 1976 and 1977. Seven black bears, collared with telemetric transmitters, were monitored to determine habitat use and interspecific/intraspecific relationships among and between bears and domestic sheep. Movements of the two radio-collared grizzlies using the study area were provided by the Interagency Grizzly Bear Study Team for inclusion in the bear/sheep interaction aspect of this study.
2. Sixty-five percent of the black bears captured were males, and nine black bears were subadults (2.5 to 3.5 years old). Annual summer home ranges of seven monitored black bears ranged from 0.9 km^2 (0.4 mi^2) to 22.2 km^2 (0.4 mi^2) by the minimum area home range method (Harvey and Barbour 1965).
3. Considerable home-range overlap existed among bears utilizing the same habitat. Both monitored female black bears utilized home ranged concurrently with one or more monitored males. Temporal mutual avoidance was observed.
4. The relationship between monitored black bears and grizzlies was similar to the intrarelationship among black bears. Mutual temporal avoidance was suggested (although not directly observed). Black and grizzly bears were observed within 0.75 km

of each other with no apparent response.

5. Bears were most often observed in Douglas-fir/snowberry, Douglas-fir/globe huckleberry, and subalpine fir/globe huckleberry types.

6. Black and grizzly bears showed a significant difference in habitat utilization ($X^2 = 121.9$, p .001, 2 DF) in similar habitats, suggesting grizzly preference of nonforested or semi-forested habitat types.

7. Analyses of 238 scats collected from the study area showed that grass and grasslike plants were the foods utilized most often; common horsetail, dandelion, lomatium, salsify, and clover were the succulent vegetation species most often encountered in the scats; 71 percent of the scats containing grass and succulent vegetation were deposited prior to mid-July. Huckleberries, hawthorn fruit, and serviceberries were the most common fruits and were used in autumn. Ants were present in 25 percent of the scats with the greatest occurrence in June-July. Sheep and undetermined meat appeared in 8.5 percent of the scats, and meat was present in 12 percent of the total number of scats.

8. The analysis of the stomachs of seven bears killed as the result of alleged depredations showed that four contained more than 40 percent sheep and two contained no meat or sheep. Vegetation, berries, and ants were also present in most stomachs.

9. Sheep use of habitat was observed. Tightly herded sheep herds experienced lower predation losses but caused greater range damage than herds allowed to graze in loose groups. Herding

technique was probably the greatest factor in reducing sheep mortality to all causes.

10. Vegetation found on the study area that was used by bears and sheep was tabulated. A bear food importance value, a sheep utilization rating, and a competition index were assigned to plants found in scats that were important to both bears and sheep.

11. Bear predation was discussed in detail. Sheep losses on the Targhee National Forest were compared to sheep losses reported in other studies. Bear mortality on the study area was compared to reported sheep losses during the same period.

12. Determination of the guilt or innocence of a bear suspected of depredations was difficult. In at least one case, a bear (monitored) was erroneously killed for depredations. The extent of unjustified bear removal is probably greater than commonly thought, although documentation would be difficult.

13. U.S. Fish and Wildlife Service records provided the most reliable information on bears killed as the result of alleged depredations. Bears killed by herders normally go unreported on U.S. Forest Service allotments. Herders and permittees cooperated in providing me with the normally unreported bear mortality. In 1976, 10 of the 17 bears (59 percent) killed on the study area were killed by sheepmen. Assuming that twice as many bears were killed in alleged depredations as were reflected in U.S. Fish and Wildlife Service reports, a minimum estimated black bear mortality for Dog and Grizzly Creeks, Squirrel

Meadows, South Boone, and Middle Boone allotments for 1970-1977 would be 62 bears.

14. The movements of monitored bears were plotted against the movements of sheep herds in their home ranges. Bears exhibited a variety of responses. Two bears showed interest in, two exhibited aversion to, and two demonstrated neutrality toward sheep herds and/or related activities in their home ranges.
15. Only one monitored black bear was verified as a sheep killer. His movements suggest his 1977 predatory behavior may have developed from scavenging and close contact with larger bears who were involved in depredations during 1976.
16. My data indicate that the presence of sheep did not influence any collared bear to leave its established home range either to follow or avoid the sheep and/or related activities.

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	YNP			N.W. Montana					Canada			GNP		Other					Sheep Use						Cattle Use				
	Blanchard (1978)	Knight et al. (1977,1976)	Mealey (1975)	Jonkel et al. (1977,1976,1975)	Schallenberger (1976)	Mealey and Jonkel (1975)	Sumner and Craighead (1973)	Tisch (1961)	Hamer et al. (1977), Hamer (1974)	Lloyd and Fleck (1976)	Korstrum (1974)	Singer (1976)	Martinka (1972)	Beecham (1977)	Hatler (1975)	Kelleyhouse (1975)	TOTAL	THIS STUDY	Anonymous (undated) BLM	Hermann (1966)	Heady et al. (1947)	Reid (1942)	Sampson (1924)	SHEEP RATING	Anonymous (undated) BLM	Hermann (1966)	Reid (1924)	Sampson (1924)	CATTLE RATING
FORBS																													
Achillea spp.									x								1		3.0	3.0	3.0	1.0	[illegible]	3.4	1.0	2.0	1.0	4.0	2.0
Agoseris spp.			x						x								2	x		4.0	5.0	4.0	5.0	4.5		3.0	3.0	4.0	3.3
Allium spp.		x										x		x			3		5.0			5.0		5.0	5.0		4.0		4.5
Angelica spp.		x	x	x				x		x		x					6			4.0		5.0	5.0	4.7		4.0	4.0	3.0	3.7
Aralia spp.				x													1												
Aster spp.			x						x								2			2.0	3.5	3.0		2.8		1.0	1.0		1.0
Astragalus spp.				x					x			x					3		1.0	2.0				2.5	1.0	2.0			
Castilleja spp.				x	x	x		x									4	x	5.0	3.0	3.0	3.0	2.0	3.2	3.0	3.0	3.0	1.0	2.5
Cirsium spp.	x	x	x	x			x							x		x	7	x	1.0	2.0 W	2.0			1.7	1.0	1.0			1.0
Claytonia spp.	x	x	x	x			x										5							E					E
Clematis spp.				x													1												
Disporum spp.			x	x	x												3												
Equisetum arvense	x	x	x	x	x	x	x	x	x	x		x		x	x	x	14	x	1.0					1.0	1.0				1.0
Erigeron spp.				x													1		1.0	1.5	2.0	2.0		1.6	1.0	1.0	1.0		1.0
Erythronium spp.				x	x		x	x		x		x					6				5.0 E	5.0 E		5.0			E		E
Fragaria spp.			x	x			x		x					x		x	6		3.0	2.0	2.0	2.0		2.2	1.0	2.0	2.0		1.7
Galium boreale															x		1												
Gentiana spp.									x								1			1.0				1.0		1.0			1.0
Hedysarum spp.									x	x							2			5.0	5.0			5.0		5.0			5.0
Heracleum spp.			x	x	x	x	x	x				x	x				8									5.0	5.0	3.0	4.3
Habenaria spp.														x			1												
Hieracium spp.				x	x		x										3		3.0	4.5		4.0	4.0	3.8	3.0	3.0	3.0	4.0	3.2
Hydrophyllum spp.							x							x			2		3.0	5.0 E				4.0 E	1.0	2.0			1.5 E
Labiatae																		x											
Ligusticum spp.																		x		4.0		3.0	5.0	4.7		3.0	5.0		4.0
Lomatium spp.	x	x	x	x	x	x	x	x						x			9	x		3.5		2.0		2.8		3.0	2.0		2.5
Lupinus spp.				x											x		2		1.0	4.0		1.0	3.0	2.8	1.0	3.0	1.0	1.0	1.5
Melica spp.	x	x	x		x	x	x										6				2.0	2.0		2.0			3.0	3.0	3.0
Mertensia ciliata			x														1		5.0	4.0	5.0	4/2	5.0	4.4	3.0	1.0	3/1	4.0	3.0
Oplopanax horridum				x				x									2												
Osmorhiza spp.				x	x	x		x									4			4.0	5.0	5.0	5.0	4.8	3.0	5.0	5.0	3.0	3.8
Pastinaca sativa			x														1			4.0				4.0					
Perideridia spp.	x	x	x		x	x	x										6												
Polygonum spp.		x													x		2					2.0	1.5	1.8			5.0	1.5	3.2

	YNP			N.W. Montana					Canada			GNP		Other					Sheep Use						Cattle Use				
	Blanchard (1978)	Knight et al. (1977,1976)	Mealey (1975)	Jonkel et al. (1977,1976,1975)	Schallenberger (1976)	Mealey and Jonkel (1975)	Sumner and Craighead (1973)	Tisch (1961)	Hamer (1974), Hamer et al. (1977)	Lloyd and Fleck (1976)	Norstrum (1974)	Singer (1976)	Martinka (1972)	Beecham (1977)	Hadler (1975)	Kelleyhouse (1975)	TOTAL	THIS STUDY	Anonymous (undated) BLM	Hermann (1966)	Heady et al. (1947)	Reid (1942)	Sampson (1924)	SHEEP RATING	Anonymous (undated) BLM	Hermann (1966)	Reid (1924)	Sampson (1924)	CATTLE RATING
FORBS (Continued)																													
Ranunculus spp.		x	x						x							x	4		1.0				2.0	1.5	1.0			1.0	1.0
Rumex spp.								x	x								2												
Senecio spp.				x					x			x					3		5.0	3.5	5.0	5.0	5.0	4.7	5.0	3.0	5.0	4.0	4.2
Smilacina spp.			x	x	x	x		x		x			x				7												
Streptopus spp.				x	x			x									3												
Taraxacum spp.			x	x		x		x			x	x				x	7	x	5.0	4.0		4.0	3.0	4.0	1.0	3.0	3.0	3.0	2.5
Trifolium spp.		x	x	x				x			x						5	x	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Tragopogon spp.														x			1	x											
Umbelliferae			x	x													2	x		4.0			5.0	4.5		3.0		3.0	3.0
Urtica spp.									x								1		3.0		1.0			2.0	1.0				1.0
Valeriana spp.					x	x				x							3			5.0	5.0		3.0	4.3		3.0		2.0	2.5
Vicia spp.								x		x				x			3		5.0	4.0	5.0	5.0	5.0	4.8	4.0	5.0	5.0	5.0	4.8
Veratrum spp.				x													1				2.0	3.0	3.0	2.7	2.0		2.0	2.0	2.0
Zizia spp.										x							1			5.0				5.0		4.0			4.0
BUSHES/SHRUBS																													
Aralia nudicaulis				x													1												
Artea rubra								x			x						2												
Abies lasiocarpa																x	1												
Amelanchier alnifolia				x	x	x	x	x		x	x		x		x	x	10	x	5.0		5.0	4.0	5.0	4.8	5.0		4.0	5.0	4.7
Arctostaphylos spp.				x		x	x	x	x			x			x	x	8		1.0		1.0	1.0		1.0	1.0		1.0		1.0
Avena fatua																x	1												
Berberis repens								x									1	x											
Ceanothus spp.																x	1	x	1.0		1.0	1.0	4.5	1.9	1.0		1.0	4.0	2.0
Eleagnus spp.								x									1												
Cornus spp.				x	x	x		x			x		x	x			7	x				1.0		1.0			1.0		1.0
Crataegus spp.					x			x					x	x			4	x		1.0				1.0		1.0			1.0
Juniperus spp.		x															1		1.0		1.0			1.0	1.0				1.0
Ledum glandulosum														x		x	2												
Lonicera involucrata				x	x	x	x	x						x			6	x				2.0		2.0			2.0		2.0
Lonicera utahensis				x	x	x		x						x			5	x											
Manziesia glabella				x													1		1.0					1.0	1.0				1.0
Pinus albicaulis		x	x	x	x		x	x									6												
Pinus flexilis	x						x										2												

	YNP			N.W. Montana					Canada		GNP		Other					Sheep Use						Cattle Use				
	Blanchard (1978)	Knight et al. (1977,1978)	Mealey (1975)	Jonkel et al. (1977,1976,1975)	Schallenberger (1976)	Mealey and Jonkel (1975)	Sumner and Craighead (1975)	Tisch (1961)	Hamer et al. (1977), Hamer (1974)	Lloyd and Fleck (1976)	Norstrum (1974)	Singer (1976)	Martinka (1972)	Beecham (1977)	Hetler (1975)	Kelleyhouse (1975)	TOTAL	THIS STUDY	Anonymous (undated) BLM	Hermann (1966)	Heady et al. (1947)	Reid (1942)	Sampson (1924)	SHEEP RATING	Anonymous (undated) BLM	Hermann (1966)	Reid (1924)	Sampson (1924)	CATTLE RATING
BUSHES/SHRUBS (Continued)																													
Pinus spp.		x														x	2												
Populous tremuloides									x	x	x						3					4.0		4.0			3.0		3.0
Prunus virginiana								x						x			2	x	1.0		3.0	3.0		2.3	1.0		2.0		1.5
Pyrus malus				x										x			2												
Quercus spp.																x	1						4.0	4.0				4.0	4.0
Rhamnus alnifolia				x		x		x								x	4						3.0	3.0				1.0	1.0
Ribes spp.			x	x	x	x	x	x	x		x			x			9	x	3.0		2.0	3.0	3.0	2.8	1.0		3.0	3.0	2.3
Rosa woodsii			x	x	x			x			x				x		6	x	3.0		3.0	3.0	4.0	3.2	1.0		3.0	3.0	2.3
Rubus spp.				x	x	x	x	x			x					x	7		3.0		1.0			2.0	1.0				1.0
Salix spp.									x								1				5.0	4.0	4.0	4.3			4.0	2.0	3.0
Sambucus racemosa				x				x						x			3		5.0		4.0	4.0	5.0	4.5	3.0		3.0	5.0	3.7
Shepherdia canadensis				x	x		x		x	x				x			6	x	3.0			1.0		2.0	1.0		1.0		1.0
Sorbus scopulina				x	x			x					x		x		5	x											
Symphoricarpos albus								x			x						2	x	3.0		2.0	4.0	5.0	3.5			3.0	4.0	3.5
Vaccinium spp.			x	x	x		x	x	x	x	x		x		x	x	11	x	1.0		2.0	2.0	4.0	2.2	1.0		2.0	2.0	1.7
V. caespitosum				x	x												2	x			1.0			1.0					
V. globulare				x	x												2	x											
V. membranaceum			x	x	x		x		x	x			x				7	x			2.0	3.0	4.0	3.0			1.0	3.0	2.0
V. myrtillus				x	x												2	x				2.0		2.0					
V. scoparium				x																		3.0	3.0	3.0			2.0	2.0	2.0
GRASSES/SEDGES																													
General grass	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		15	x											
Cyperacea			x					x									2				2.0			2.0					
Graminae			x					x									2												
Juncaceae		x		x		x		x	x	x							5				1.0			1.0					
Agropyron caninum		x															1						4.0	4.0				4.0	4.0
Agropyron spicatum				x								x					2		5.0		1.0	3.0	5.0	3.5	5.0		5.0	5.0	5.0
Agropyron smithii												x					1		3.0				4.0	3.5	5.0			5.0	5.0
Agropyron spp.									x								1		3.0		4.0	3.0	5.0	3.8	5.0		4.0	5.0	4.7
Bromus spp.		x			x	x			x								4		3.0		4P 2A	2.0	4.0	3.0	5.0		2.0	3.0	3.3
Calamagrostis spp.				x	x	x											3		3.0		4.0	2.0	1.0	2.5	3.0		3.0		3.0
Dactylis glomerata												x					1		3.0					3.0	5.0				5.0
Deschampsia spp.				x													1		5.0			3.0		4.0	5.0		3.0		4.0
Elymus glauca													x				1												
Elymus spp.	x																1				1.0	1.0	2.0	1.3			2.0	4.0	3.0
Festuca idahoensis				x	x												2		5.0		4.0	3.0	4.0	4.0	5.0		4.0	4.0	4.3

	YNP			N.W. Montana				Canada				GNP		Other					Sheep Use						Cattle Use				
	Blanchard (1978)	Knight et al. (1977, 1978)	Mealey (1975)	Jonkel et al. (1977,1976,1975)	Schallenberger (1976)	Mealey and Jonkel (1975)	Sumner and Craighead (1975)	Tisch (1961)	Hamer et al. (1977), Hamer (1974)	Lloyd and Fleck (1976)	Norstrum (1974)	Singer (1976)	Martinka (1972)	Beecham (1977)	Hatler (1975)	Kellevhouse (1975)	TOTAL	THIS STUDY	Anonymous (undated) BLM	Hermann (1966)	Heady et al. (1947)	Reid (1942)	Sampson (1924)	SHEEP RATING	Anonymous (undated) BLM	Hermann (1966)	Reid (1924)	Sampson (1924)	CATTLE RATING
GRASSES/SEDGES (Continued)																													
Festuca ovina						x											1												
Festuca scabrella					x												1		3.0					3.0	5.0				5.0
Festuca spp.				x	x	x	x										4					3.0	4.0	3.5			3.0	4.0	3.5
Melica spectabilis	x				x												2				4.0	2.0	2.0	2.7		3.0		3.0	3.0
Melica subulata																													
Phleum pratense	x											x					2		3.0	5.0	5.0		3.0	4.0	5.0		4.0	4.0	4.3
Poa spp.												x					1												
Carex geyeri			x	x													2			2.0	3.0			2.5			4.0		4.0
Carex spp.		x		x	x				x				x				6			2.0	3.0			4.5			3.0		3.0
Juncus drummondii					x												1		1.0					1.0	1.0				1.0
Juncus parryi				x	x												2		1.0					1.0	1.0				1.0
Juncus spp.													x				1				1.0	3.0		2.0					
Luzula campestris					x												1												

APPENDIX B

BLACK BEAR TRAPPING SUMMARY, 1976-1977

TARGHEE NATIONAL FOREST

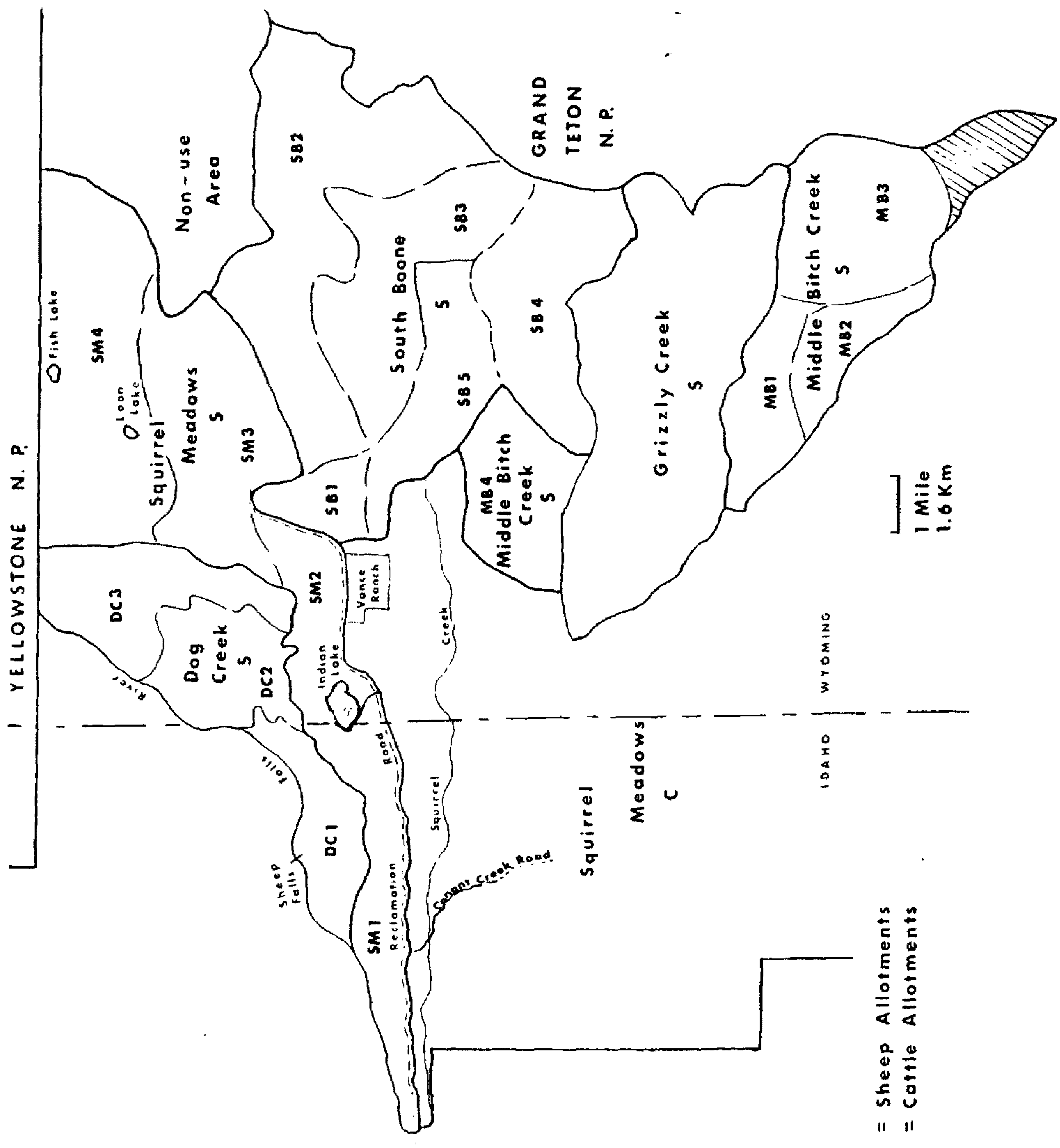
Bear no. & name	Date	Location of capture	Sex	Id. F&G eartag	Tattoo	Collar, #	Color
1. Charlie (S)	8/29/76	Boone Creek, ID	M	L-1644	1697	213 (UM)	Black and white
2. Lady Ebony (S)	2/2/76	Boone Creek, ID	F	R-1640	1690	202 (UM)	Black and white
3. O.D. (C)	7/16/76	Loon Lake, WY	M	L-1641	1692	219 (UM)	Black and white
4. Saturday Mourning (C)	7/24/76-7/30/76	Loon Lake, WY	M	R-1642	1693	3802 AVM	Black and white
5. Coy (S)	8/28/76	Warm River, ID	F	L-1646	1696	3802 AVM	Black and white
6. Ma Beecham (S)	9/2/76	Boone Creek, ID	F	L-1648	1698	USFS	Black and white
7. Strawberry (S)	6/15/77	Boone Creek, ID	M	R&L U-176	0176	210 (UM)	Red
8. Bert (S)	6/23/77	Boone Creek, ID	M	R&L U-177	0177	None	
9. Clover (S)	6/24/77	Boone Creek, ID	M	R&L U-178	0178	221 (UM)	Green
10. 7-UP (S)	7/7/77	Boone Creek, ID	M	R&L U-179	0179	220 (UM)	Blue
11. Herbie (S)	7/7/77	Boone Creek, ID	F	R&L U-180	0180	USFS	Black and white

Unless otherwise indicated, Telonics transmitters were used:

(UM) = collar furnished by University of Montana
(S) = snare
(C) = culvert trap
(FS) = collar furnished by Forest Service

APPENDIX C

ALLOTMENT UNIT BOUNDARIES


YELLOWSTONE N. P.
GRAND TETON N. P.
Non-use Area
SB2
SB3
South Boone
S
SB4
SB5
SB1
Fish Lake
Loon Lake
SM4
Squirrel Meadows
S
SM3
DC3
Dog Creek
S
DC2
SM2
Vance Ranch
Indian Lake
River
Falls
DC1
Sheep Falls
SM1
Reclamation Road
Squirrel Creek
Conant Creek Road
Squirrel Meadows
C
IDAHO
WYOMING
MB4
Middle Bitch Creek
S
Grizzly Creek
S
MB1
Middle
MB2
Bitch Creek
S
MB3
1 Mile
1.6 Km
S = Sheep Allotments
C = Cattle Allotments