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Seasonal movements and migrations of the Spotted Bear elk herd

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SEASONAL MOVEMENTS AND MIGRATIONS OF THE SPOTTED BEAR ELK HERD

By

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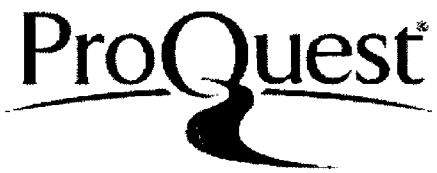

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CHAPTER I

INTRODUCTION

The past decade has seen a sharp increase in the size of the hunting population, and this number is likely to increase even more in the future. Increasing demands on the wildlife resource require more intensive management programs. For large animals such as deer and elk, this not only requires accurate life history information but also reliable information concerning population sex and age structure, habitat use, seasonal movement patterns and migration habits.

The Rocky Mountain elk (Cervus canadensis nelsoni Bailey) is widely distributed in western Montana and is generally considered the most prized big game animal in terms of hunter interest (Rognrud and Janson 1971). Elk herds of the South Fork of the Flathead River gave that area a reputation as an outstanding big game area (Pengelly 1960). The U.S. Forest Service conducted winter game surveys in that area from 1933-1937. In 1941, the Montana Fish and Game Department initiated winter surveys similar to the earlier Forest Service work. Those early studies resulted in considerable information concerning elk populations, winter range conditions, and gross movement patterns.

Recently a possible management problem occurred in the Spotted Bear Ranger District along the lower South Fork. Road construction for timber harvest caused concern that roads might bisect natural elk migration routes and either interfere with migration or make migrating segments of the population more vulnerable to hunting pressure. To evaluate this possibility required more precise data concerning elk movements that were available from the early Forest Service and Fish and Game investigations. With this in mind, a program of trapping and marking was proposed for the herd segment wintering along the South Fork between Brush Creek and Spotted Bear Ranger Station.

The primary objective of the study was, through use of radio-telemetry and marked animals, to document elk movements to and from the winter range including:

1. distance and directions of dispersal from winter range;
2. probable migration routes; and
3. time span of migration period.

Secondary objectives included determining:

1. whether animals from different parts of the winter range utilize separate areas of the summer range;
2. location, use, and size of seasonal areas;
3. seasonal habitat utilization; and
4. winter population estimates and herd composition.

Full-time field work commenced in March 1973 and continued through March 1974.

Early elk studies relied primarily on direct observations of groups of animals. Those studies were conducted mainly in the Yellowstone Park-Jackson Hole areas where large numbers of elk could be readily observed (Skinner 1925, Murie 1951, Altmann 1952, 1956). Such studies revealed information concerning social behavior, food habits, general habitat use, and gross migration patterns. However, identification of individual animals was rarely possible.

Later studies utilized neckbanded and eartagged elk to aid observation and make identification of individuals possible. Brazda (1953) worked with marked elk in the Gallatin River drainage. Picton (1960) and Knight (1970) made use of neckbanded elk in studying the Sun River elk herd. Craighead et al. (1972) used 1,448 individually marked elk in studying the Northern Yellowstone herd. By using marked animals, dispersal and movement information could be obtained from hunter kills, but for most studies the bulk of the data still depended on direct observation of the marked individual. The information provided was often limited unless large numbers of marked animals were involved or the study extended over a long period of time.

More recently, a number of elk studies have involved use of radiotelemetry in addition to marked animals. Judd (1971) and

McLean (1972) used radiotelemetry in studying the Lochsa elk herd in northern Idaho. In western Montana, Ream et al. (1971, 1972) radio-tagged elk on the Three Mile Game Range, and Zahn (1974) worked with radio-instrumented elk in the Fish Creek area near the Idaho-Montana border. Craighead et al. (1973) determined home ranges and activity patterns of nonmigratory elk in the Madison drainage of Yellowstone Park through use of radio-instrumented individuals.

The perfection of radiotelemetry systems provided wildlife researchers and managers with a tool of tremendous value in obtaining large quantities of data in a relatively short time. Direct observations of individuals are enhanced but no longer necessary to obtain a wide variety of data. Habitat utilization and movements can be reliably documented without actually observing the animal.

Most radiotracking systems were originally designed to gather movements data for small to medium sized animals with relatively small home ranges and living on flat terrain (Seidensticker et al. 1970). Using radiotracking techniques in mountainous terrain, such as that utilized by elk in western Montana, presents a variety of problems. Mountains and ridges act as barriers to signals and may cause signal bounce. Also, when working with large mobile animals such as elk, long movements over a short period are often involved. These problems are often compounded by relative inaccessibility of

large portions of study areas which makes aerial radiotracking the easiest and most efficient method of collecting the desired information.

CHAPTER II

STUDY AREA

Location

The study was conducted in northwestern Montana in the mountainous region lying south of Glacier National Park and west of the Continental Divide (Fig. 1). The area is part of the Spotted Bear Ranger District of the Flathead National Forest. During summer and fall, definite boundaries were not observed as the radio-instrumented elk dispersed over a wide area. Portions of both the South Fork and Middle Fork of the Flathead River drainages were involved. During winter and spring, elk winter range along the South Fork of the Flathead above Hungry Horse Reservoir was the area of particular interest. Winter work was conducted along the South Fork from Brush Creek to Harrison Creek and along the Spotted Bear River from the mouth upstream as far as Beaver Creek (Fig. 2).

Access to the area is provided by gravel roads running on either side of the South Fork from the town of Hungry Horse to Spotted Bear Ranger Station. The eastside road parallels the major elk wintering area. Snow generally closes these roads to traffic by mid-December. Most major drainages on the west side of the South Fork

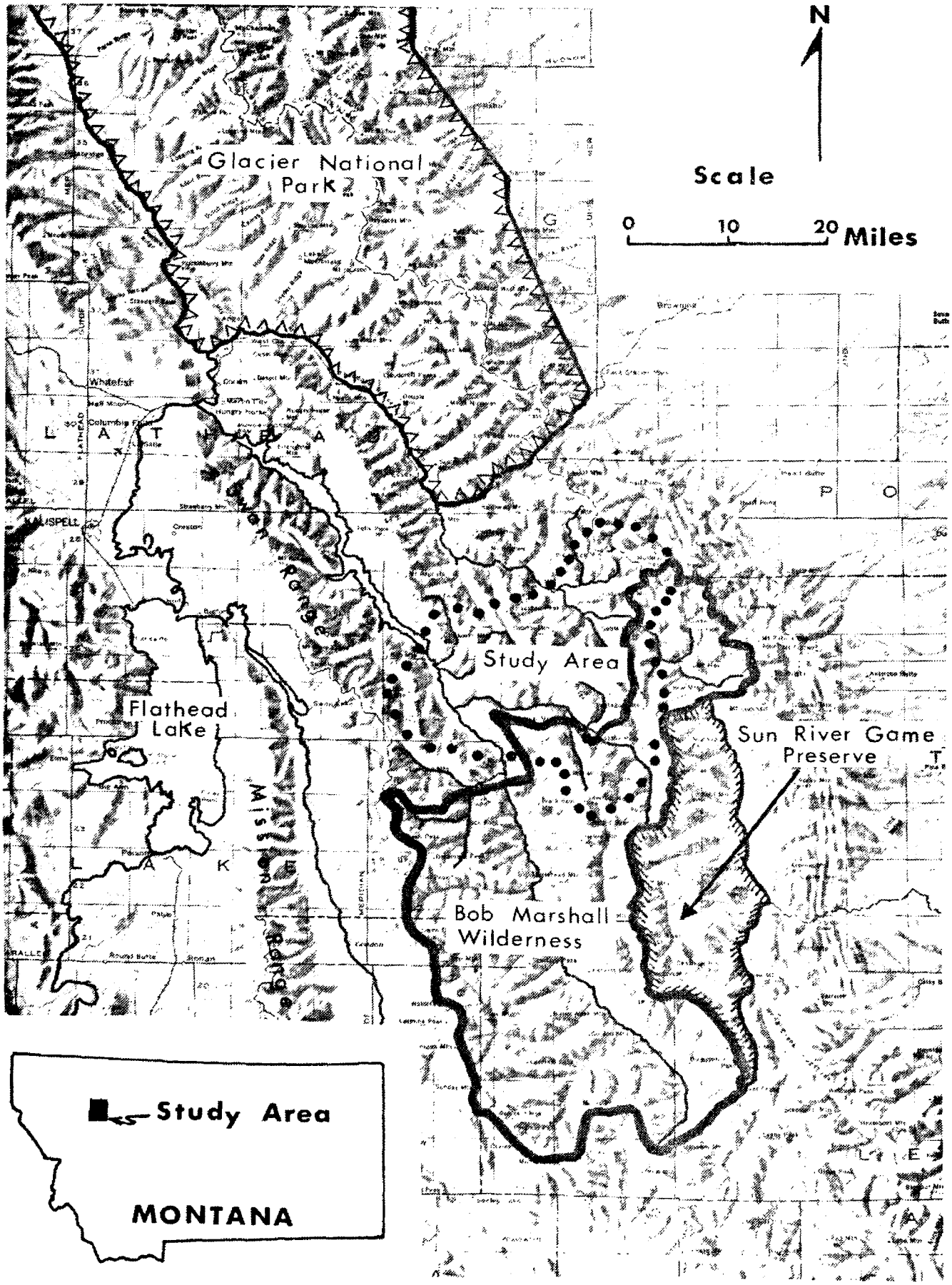

Fig. 1. Location of study area.

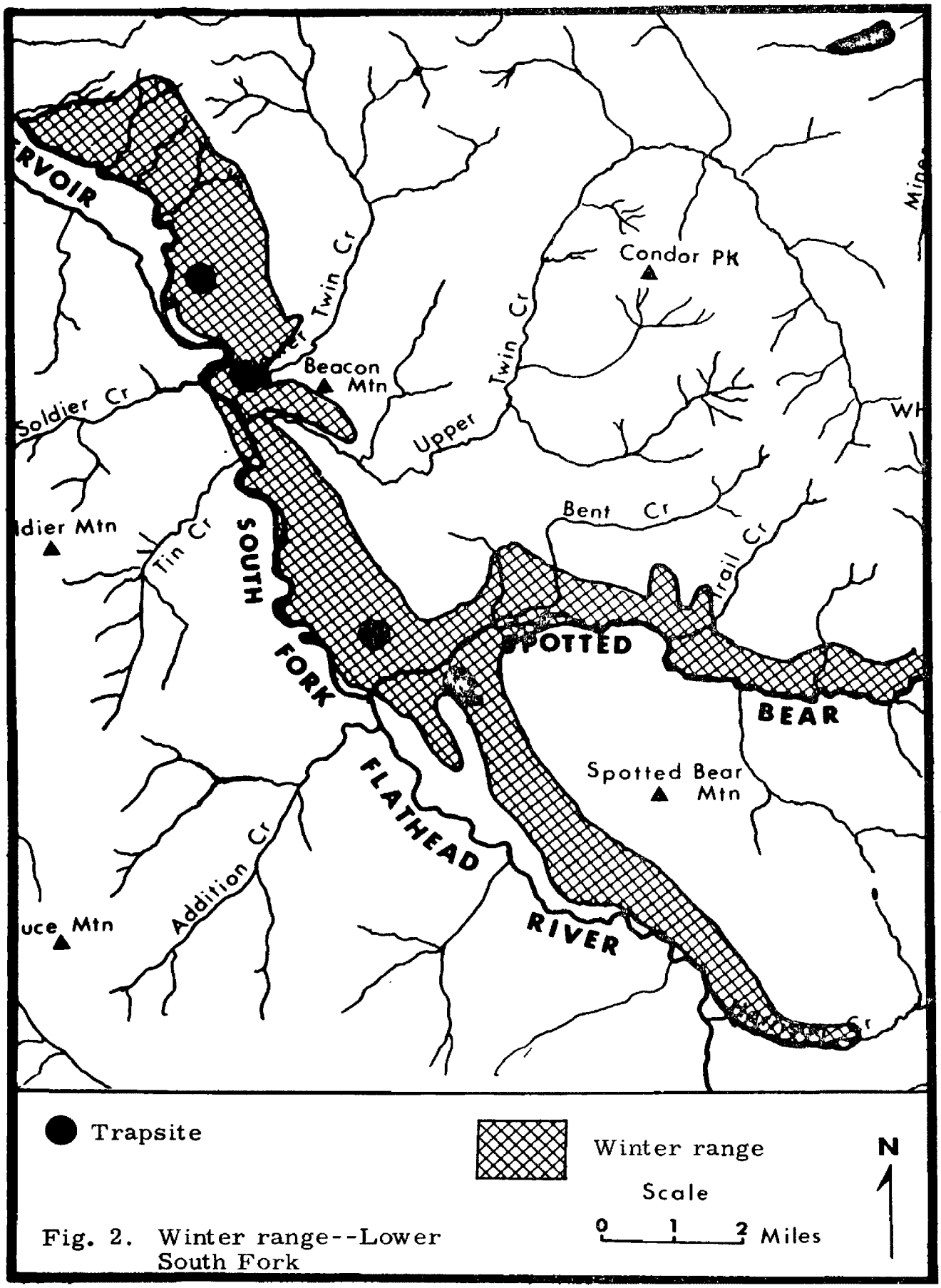

Fig. 2. Winter range--Lower South Fork

upstream to the Bob Marshall Wilderness boundary have logging roads. Areas east and northeast of the winter range are essentially nonroaded.

Physiography

Johns (1970) has described the geology of the area. The major bedrock groups are Cambrian, Devonian and Mississippian limestones and Precambrian argillite and quartzite. Most of the area was subjected to mountain glacial activity, and soils and landforms reflect this glaciation. Glacial morainal and fluvial deposits are found in the river valleys. Scoured cliffs, rock outcrops and thin glacial till over bedrock characterize the steeper slopes and ridges. Elevations range from the 3,560-foot normal pool level of Hungry Horse Reservoir to over 8,000 feet on some mountain peaks.

Climate

Elevational and geographic differences cause considerable climatic variation in the study area. Average annual precipitation varies from as little as 30 inches along the South Fork to 80 inches or more along the Continental Divide. Snow provides approximately 50 percent of the annual precipitation at lower elevations and 80 percent, or more, at the higher elevations (Martinson et al. 1973). Maximum snow accumulation generally occurs in late March. Most areas are snow-free by late May, although snow may persist until late August on north slopes at high elevations.

The weather station at Hungry Horse Dam, some 50 miles northwest of Spotted Bear Ranger Station, provided monthly temperatures for the period 1950-1973. July and August were the hottest months with mean monthly temperatures of 65.2 and 64.3°F, respectively. January was the coldest month with mean monthly temperatures of 21.5°F. Temperature extremes varied from a high of 102°F in 1960 to a -40°F in January 1950. Year-round temperatures for the Spotted Bear area were probably lower for all months than those recorded at Hungry Horse Dam. During the 1973-74 winter, daily maximum and minimum temperatures were recorded at Spotted Bear Ranger Station. The results are summarized in Table 1.

TABLE 1. Temperature records for the Spotted Bear area, January-April 1974 (all temperatures in °F)

Month	Mean Max.	Mean Min.	Max. for month	Lowest temp.	No. days ≤ 0°F	No. days ≤ 32°F
Jan.[a]	31.6	16.4	48	-27	7	21
Feb.	38.8	20.8	50	4	0	28
March	41.4	19.0	59	-4	4	29
April[b]	52.8	28.8	74	21	0	21

[a]No records for first 6 days of January.

[b]No records for last 4 days of April.

Vegetation

Habitat types were described according to the method of Pfister et al. (1972). Plant nomenclature was according to Hitchcock and Cronquist (1973). In summer, elk dispersed over a wide area utilizing a variety of vegetation types. No attempt was made in this study to intensively sample or describe summer areas. For convenience, the winter range was divided into three segments: 1) Horse Ridge/Dry Parks; 2) Spotted Bear Lake-Harrison Creek; and 3) Lower Spotted Bear River. The vegetative characteristics of each area are described in the following paragraphs.

Horse Ridge/Dry Parks. This area may be divided into three general vegetation types: 1) timber; 2) browse; and 3) open glacier-scoured areas. Timbered areas are combinations of Douglas fir (Pseudotsuga menziesii) and alpine fir (Abies lasiocarpa) habitat types. As a result of past wildfires, portions of the timbered areas are dominated by stands of lodgepole pine (Pinus contorta). These stands vary in composition from the relatively pure "dog-hair" stands to mixtures with western larch (Larix occidentalis), Douglas fir and alpine fir. The lower slopes of Horse Ridge and Crossover Mountain and flats along the South Fork support such stands, some of which have been thinned by the Forest Service.

The Douglas fir/snowberry (Pseudotsuga menziesii/ Symphoricarpos albus) habitat type (Symphoricarpos albus phase) is

the most common timber type and is found on S-W aspects mostly below 4800 feet. Tree species include mature Douglas fir and western larch with pole and sapling size lodgepole pine. Some open, drier sites have Douglas fir mixed with ponderosa pine (Pinus ponderosa). Common understory plants are snowberry (Symphoricarpos albus), shiny-leaf spirea (Spiraea betulifolia), mountain maple (Acer glabrum), serviceberry (Amelanchier alnifolia), and rose (Rosa spp.), with pinegrass (Calamagrostis rubescens) the most common grass. The more open stands often have good mixtures of browse species including willow (Salix spp.), redstem ceanothus (Ceanothus sanguineus), mountain maple and serviceberry.

The Douglas fir/beargrass (Pseudotsuga menziesii/ Xerophyllum tenax) habitat type is found on W-NW aspects above 4500 feet. This type is not well represented. The understory is dominated by grouseberry (Vaccinium scoparium), big huckleberry (Vaccinium membranaceum) and beargrass (Xerophyllum tenax).

The alpine fir/beargrass habitat type (Xerophyllum tenax phase) is found on upper S-W slopes and on top of Horse Ridge. Lodgepole pine is the dominant overstory species with alpine fir represented as seedling and sapling size trees. Beargrass, big huckleberry, and/or grouseberry dominate the understory. Other species encountered in this type are prince's-pine (Chimaphila umbellata), twinflower (Linnaea borealis), shiny-leaf spirea, and mountain-lover

(Pachistima myrsinites).

The alpine fir/Queen's cup (Abies lasiocarpa/Clintonia uniflora) habitat type (Menziesia ferruginea phase) is found on N-NE aspects near the top of Horse Ridge. Tree species represented are alpine fir, Engelmann spruce (Picea engelmannii), and lodgepole pine. Understory species include wavy-leaved alder (Alnus sinuata), fool's huckleberry (Menziesia ferruginea), and big huckleberry along with mountain arnica (Arnica latifolia), heart-leaf arnica (A. cordifolia), and beargrass.

The browse type covers fairly extensive areas on the Horse Ridge/Dry Parks wintering area. Browse areas on the mid-upper end of Horse Ridge are generally associated with scattered Douglas fir and/or lodgepole pine of sapling to pole size. The lower end of Horse Ridge and large areas in the Crossover Mountain-Dry Park area are mostly without tree overstory. The most important browse species are mountain maple, serviceberry, evergreen ceanothus (Ceanothus velutinus), redstem ceanothus, willow and chokecherry (Prunus virginiana). These occur in mixed stands, with several species being represented in a given area. Redstem ceanothus and willow are more common in the Crossover-Dry Park area than on Horse Ridge. Generally speaking, browse plants are taller and more vigorous on Dry Park than on Horse Ridge. In fact, willow and mountain maple are growing out of reach in some areas along Crossover-Dry Park.

Other species common to the browse areas are snowberry, shiny-leaf spirea, penstemon (Penstemon spp.), yarrow (Achillea millefolium), strawberry (Fragaria spp.), and fireweed (Epilobium angustifolium). In the Crossover-Dry Park area, paper birch (Betula papyrifera) and water birch (B. occidentalis) are often mixed with other browse species, especially, on lower slopes and along the reservoir.

Open, glacier-scoured areas are most evident on Horse Ridge and the small finger ridges of Crossover and Dry Park Mountains. Rock and bare ground make up a large percentage of the ground cover on these areas. Trees are mostly lacking, except for a few scattered ponderosa pine, Douglas fir, and/or Rocky Mountain juniper (Juniperus scopulorum). Browse plants are present but not abundant. Shrubs include bittercherry (Prunus emarginata), choke-cherry, serviceberry, and snowberry. The browse species all show evidence of heavy use. Most are less than 3 feet tall. Bunchgrasses, including bluebunch wheatgrass (Agropyron spicatum), Idaho fescue (Festuca idahoensis), and Sandberg's bluegrass (Poa sandbergii), are well represented in some of the open areas. Other species commonly found on these areas are spreading dogbane (Apocynum androsaemi-folium), sulfurflower (Eriogonum umbellatum), biscuit-root (Lomatium spp.), roundleaf alumroot (Heuchera cylindrica), Alberta penstemon (Penstemon albertinus), cheatgrass (Bromus tectorum), bluegrasses (Poa spp.), onespike oatgrass (Danthonia unispicata), and

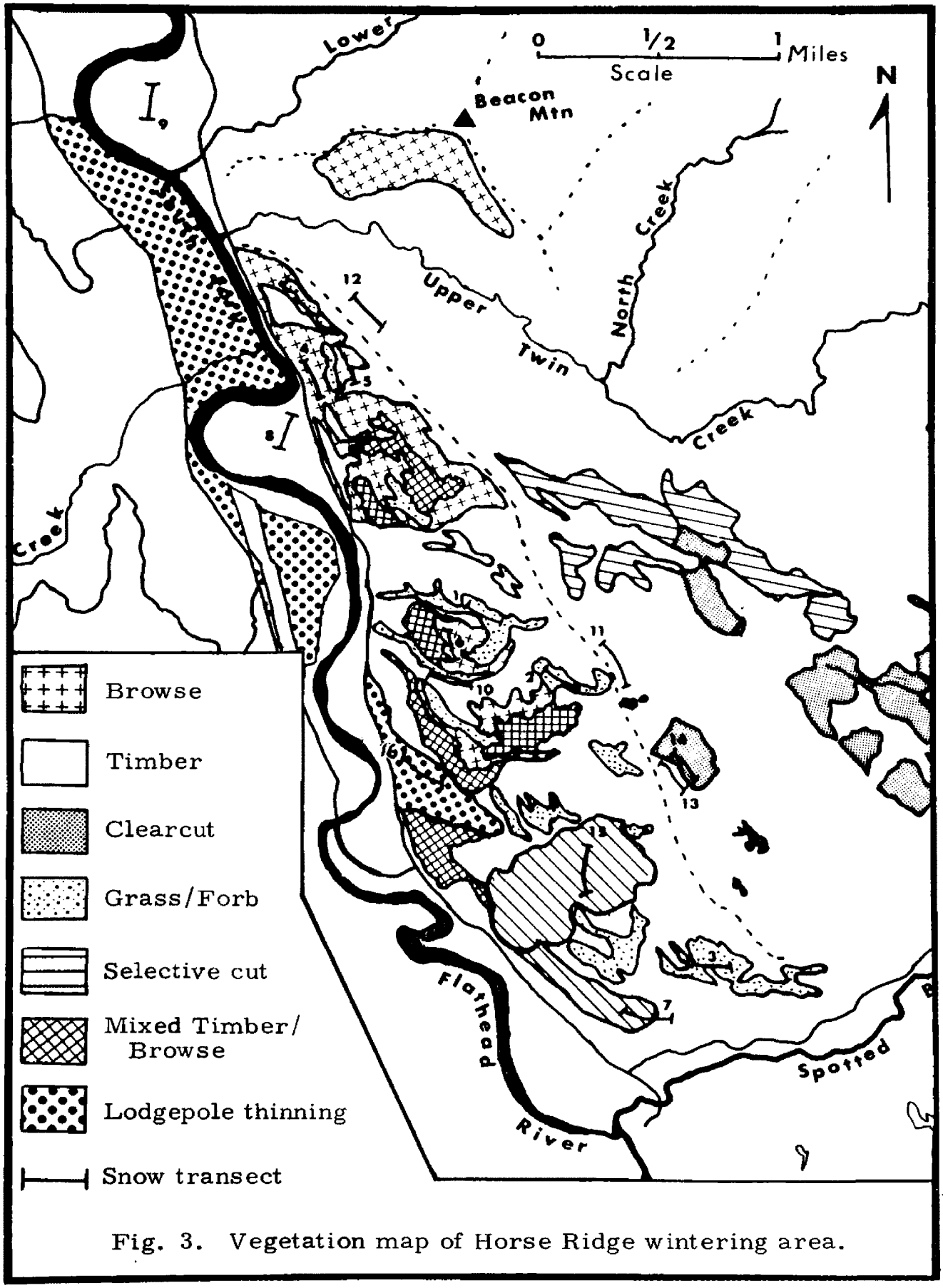

Fig. 3. Vegetation map of Horse Ridge wintering area.

elk sedge (Carex geyeri). In past years, these areas received heavy use by horses during summer-fall months.

Spotted Bear Lake-Harrison Creek. This area is almost completely covered by coniferous forest with few openings. There are several small wet meadows and a few open slopes but nothing to compare with the mosaic of timber, browse, and open areas of Horse Ridge. Aspects are very similar to Horse Ridge being predominantly SW, but slopes are generally more moderate. Much of the area has slopes of 40 percent or less.

Three habitat types are found on this area: 1) Douglas fir/ snowberry (Symphoricarpos albus phase); 2) alpine fir/beargrass; and 3) alpine fir/Queen's cup (both Xerophyllum tenax and Clintonia uniflora phase). Overstory species in the Douglas fir habitat type include sawtimber size Douglas fir, western larch, and ponderosa pine with pole size lodgepole pine. Characteristic understory species for this type have already been mentioned.

Overstory species in both alpine fir habitat types include some Engelmann spruce and western larch sawtimber, but primarily pole and sapling size lodgepole pine and alpine fir. Beargrass, grouseberry, and big huckleberry are the most common understory plants. Other species often present are wavy-leaved alder, russet buffaloberry (Shepherdia canadensis), snowberry, bunchberry (Cornus canadensis), and red-osier dogwood (Cornus stolonifera) in the

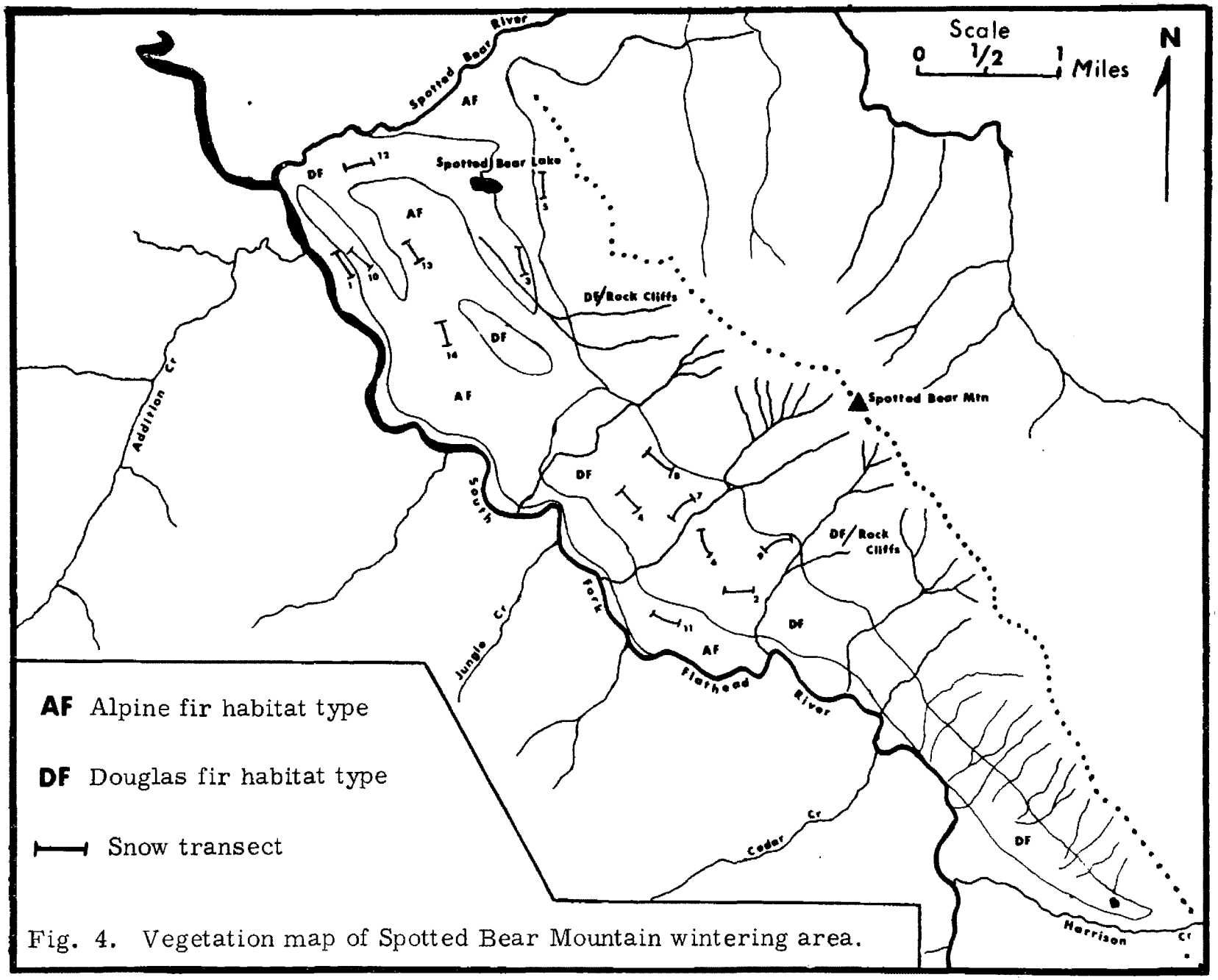

Fig. 4. Vegetation map of Spotted Bear Mountain wintering area.

moister areas.

Lower Spotted Bear River. This portion of the winter range is also heavily timbered. Alpine fir/Queen's cup is the principal habitat type with some areas of Douglas fir/snowberry. Most of the area supports sawtimber size western larch, Douglas fir, ponderosa pine, and Engelmann spruce. Some of this timber, especially in the Flat Creek-Bent Creek area, was removed by regeneration cuts during recent years.

History

Elk populations in the South Fork originated from native stock. There are few mentions of elk in the South Fork prior to 1900, but apparently elk were present long before the first settlers arrived. At Big Prairie in the Bob Marshall Wilderness, a shed elk antler was found buried 18 inches in the ground, and another was found buried 3 feet underground along the river bank (USFS 1936). Flathead Indians reportedly made annual hunting trips into the South Fork for elk (Gaffney 1941). Gaffney (1941) reported that, in 1876, a Colonel Sievers killed an elk near Mud Lake while on a trip through the South Fork and reported that elk were plentiful in the area.

Rognrud (1950) and Pengelly (1960) presented historical data suggesting elk populations in the South Fork were lowest during the early 1900's. In 1913, the Sun River Game Preserve was created,

and in 1923 the Spotted Bear Preserve was established adjoining the Sun River Preserve on the west side of the Continental Divide.

Wildfires burned large portions of the South Fork during the early 1900's, creating prime elk winter range in some areas. In the Lower South Fork, the Dry Park-Twin Creeks area was burned by fires in 1903, 1910, 1919, and again in 1929 (Flathead National Forest fire records). The 1919 and 1929 fires also burned the Horse Ridge area. With the exception of the Meadow Creek-Harrison Creek area which burned in 1889, the Spotted Bear Mountain area has not been burned by a large fire for over 85 years.

Following the wildfires, elk increased and reached a peak in the late 1930's. Winter ranges became badly overused, and the severe winters of 1933 and 1935 resulted in very heavy winter losses. Increased harvests were recommended, and the Spotted Bear Preserve was abolished in 1936. This led to increased harvests, but not enough to ease the pressure on the overbrowsed winter ranges.

There was a general decline in elk numbers from the late 1930's to the late 1950's. In 1937, the South Fork elk population was estimated at 3,700 but was down to an estimated 2,450 by 1949 (Rognrud 1950). The 1960 estimate was 1,950 for the South Fork and Middle Fork combined (Pengelly 1960). Complete counts are no longer attempted, but harvest data suggests a fairly stable population. South Fork checking station records show an average annual harvest

of 246 elk for the period 1962-1972 (Weckwerth and Cross 1973).

Livestock Grazing

The Lower South Fork has not been grazed by sheep or cattle, but the more suitable areas have been grazed by horses and mules in conjunction with the operation of resorts and outfitter camps. Such use dates back as far as 1928 when the first resort started operating. Most use has been on the Horse Ridge area with a small amount in the Flat Creek-Bent Creek area. Forest Service records show an average use of 124 animal (horse) months for the period 1960-71. Prior to 1960, use may have been higher. Pederson (1966) reported that brood mares and colts were also run on Horse Ridge in addition to pack and saddle stock. Periods of use varied, but horses were often put on the area in May and left through October.

The open, grassy areas on Horse Ridge received the heaviest use. Observations indicate that these same areas are very important to elk during both winter and early spring. Summer-fall grazing by domestic stock undoubtedly reduced the amount of forage available for elk during winter. In 1973, in an attempt to relieve grazing pressure on the winter range, the Forest Service cancelled the grazing allotment for the Horse Ridge area.

CHAPTER III

METHODS AND MATERIALS

Trapping and Marking

Trapping was conducted during winter and spring while elk were concentrated on the winter range. Three corral-type traps were set up in the fall of 1972; one on the southern end of Horse Ridge at the end of the Horse Ridge patrol road; a second near the mouth of Lower Twin Creek; and the third on a brushy flat below Crossover Mountain (Fig. 2). In the summer of 1973, the Crossover trap was moved to an opening near Spotted Bear Lake for the 1974 trapping season. This was done in an attempt to sample a different segment of the wintering elk population.

Traps were baited with hay and salt blocks. Hay proved most effective during winter months. Elk use of hay decreased rapidly with spring snow-melt and green-up. In contrast, salt blocks were used sparingly during the winter months but received increasingly heavy use as green forage became available.

In 1973, traps were operated for an 8-day period in February and from 20 March through May. In 1974, traps were operated sporadically in January and on a more regular basis from

February through May.

All trapped elk were eartagged with numbered, metal Fish and Game Department eartags and neckbanded with collars color-coded to the individual trapsites. These neckbands were not designed to allow identification of individuals although in some cases individual elk could be recognized. Color patterns were varied between 1973 and 1974 to allow differentiation between trap years. Neckbands were made of either 5-inch wide strips of colored vinyl or 4-inch wide strips of cloth conveyor belting with colored vinyl strips sewed on. Information concerning sex, age and general condition was recorded for each trapped animal. Aging was done by tooth replacement and wear (Quimby and Gaab 1957) and inspection of the canines (Greer and Yaeger 1967).

Ten radio transmitters were provided for each trapping season. The information summarized in this report is the result of data collected on the elk radioed in 1973. Elk instrumented in 1974 will be discussed in another paper. In 1973, radio collars were of two types: 1) a solid acrylic collar as described by Denton (1973) and 2) a PVC irrigation pipe collar of the type described by Zahn (1974). In 1974 all radio collars were of the pipe-collar type.

Location of Radioed Elk

During winter and spring, while elk were still on or near the

winter range, location was by on-the-ground triangulation using a hand-held, three-element Yagi antenna and portable receiver (Stehn 1973, Denton 1973). Beginning in May and continuing through November, radioed elk were located primarily from the air using a 150 Super Cub with two, three-element Yagi antennas attached to the wings and tracking gear as described by Denton (1973). Weather limited the number and regularity of these flights, and where possible, aerial locations were supplemented by on-the-ground locations. Sightings of marked, nonradioed elk provided additional information on distribution and fidelity to seasonal ranges.

Locations of instrumented elk were plotted on USGS topographic maps (scale 1:24,000). Elevation to the nearest 100 feet and aspect for each location were taken from the topographic map. Information concerning position on slope, general habitat type, and apparent activity (if the animal was sighted) was also recorded at the time of location and was used to describe each location more precisely. The same information was collected for all unmarked elk observed in the field.

Locations of radioed elk were classified by season. These locations were then used to determine a seasonal range. Seasonal ranges were designated as spring, summer, fall, and winter. Spring included the period 1 April through 31 May; summer, 1 June through 31 August; fall, 1 September through 30 November; and winter,

1 December through 31 March. Size of seasonal ranges were determined using the method of Dalke and Sime (1938) and Mohr (1947). Lines were drawn connecting outermost locations, and areas of polygons thus formed were determined by using a polar planimeter. Locations representing movements between seasonal areas were not included.

Winter Studies

Snow-depth transects were established on Horse Ridge and the Spotted Bear Lake-Harrison Creek area (Figs. 3 and 4). These transects were read at the end of each month from January to March. The transects were located in a variety of vegetation types and at various elevations and aspects. Sixteen transects were established on Horse Ridge and 14 on the Spotted Bear Lake-Harrison Creek area. Twenty points were sampled along each transect.

Elk use of the winter range was determined through location of radioed elk, elk observations, and signs of elk use (tracks, beds, etc.). Elk observations were aided by 7x35 binoculars and a 15-60 variable power spotting scope. Observations were broken into the following sex and age classes: cows (adults and yearlings); calves; spike bulls; and branch antlered bulls (BAB). Numbers of elk using various segments of the winter range were estimated from observations and signs of use. Composition counts were

discontinued at the end of March. By that time calves had attained a size that made separation from cows difficult and of questionable accuracy.

CHAPTER IV

RESULTS AND DISCUSSION

Trapping and Marking

A total of 106 elk were marked--39 in 1973 and 67 in 1974. Two elk, one adult cow and one adult bull, were eartagged but not neckbanded. All others were both eartagged and neckbanded. Table 2 summarizes trapping for the 2 years.

Ten elk, all mature cows, were radioed in 1973 (Table 3). The radioed elk were each designated by a letter from the alphabet--thus in 1973, elk A-J. Three elk were instrumented from each of the Horse Ridge and Crossover traps and four from the Lower Twin Creek trap. Eleven elk were instrumented in 1974. Only elk instrumented in 1973 are discussed here. Those radioed in 1974 will be considered in another paper.

Locations of Radioed Elk

The radio of elk A failed early in April after operating less than 2 months. During that period she was located only 3 times. The remaining nine radios, three from each trapsite, continued to function throughout the summer and into fall. From late April through

TABLE 2. Summary of elk trapped on Spotted Bear winter range, 1973 and 1974

	Cows						Calves				Bulls			Two yr. trap total	Calves:100 cows	Bulls:100 cows
	$1\frac{1}{2}$	$2\frac{1}{2}$	$3\frac{1}{2}$-8	8+	Uk[a]	Total	M	F	Uk[a]	Total	Y♂	BAB	Total			
Horse Ridge	9	0	32	3	2	46	7	4	2	13	4	3	7	66		
Lower Twin Creek	0	1	9	0	3	13	4	0	2	6	1	0	1	20		
Crossover[b]	0	0	5	1	0	6	0	1	0	1	1	1	2	9		
Spotted Bear Lake[c]	1	0	12	3	0	16	2	1	0	3	2	3	5	24		
Total	10	1	58	7	5	81	13	6	4	23	8	7	15	119[d]	28.4	18.5
Percentage						68.1				19.3	6.7	5.9	12.6	100.0		

[a]Sex of calves and age of cows not determined.

[b]Trap operated only in 1973.

[c]Trap operated only in 1974.

[d]This total includes 13 elk that were trapped but not marked--three cows, three calves, and three BAB were released due to problems involved in handling them; two cows, one calf, and one spike jumped out of the Lower Twin Creek trap before they could be marked.

TABLE 3. Radio-instrumented cow elk, 1973

Elk	Age	Trap date	Trap[a]	Total locations	Observation period	Calf	Max. movement
A	3½	2/12	LTC	4 (4)[b]	3/28-3/30/73, 4/5/74[c]	?	?
B	6½	2/12	LTC	61(13)	3/29/73-4/5/74	Yes	5.1
C	4½	2/16	C	37 (9)	4/7-11/23/73[c]	Yes	13.5
D	3½	3/22	LTC	39 (8)	4/7-11/2/73[d]	Yes	25.4
E	3½	3/26	C	43(11)	4/13/73-3/21/74	Yes	23.7
F	6½	4/ 7	HR	54(16)	4/8/73-3/23/74	No	3.7
G	3½	4/ 8	HR	42(13)	4/11/73-4/2/74	No	17.8
H	3½	4/10	C	85(27)	4/12/73-4/2/74	Yes[e]	4.3
I	6½	4/16	HR	31 (3)	4/20-11/2/73[c]	No	16.2
J	2½	4/29	LTC	38(11)	5/3/73-3/21/74	No	20.8

[a]HR = Horse Ridge, LTC = Lower Twin Creek, C = Crossover.

[b]Number in parentheses indicates number of times radioed elk was sighted.

[c]Radio ceased operating; all others still functioning as of date shown.

[d]Killed on 11/2/73 during hunting season; radio was recovered.

[e]Seen with calf several times in June; lost calf late in June (found remains).

November these nine elk were located 337 times. A total of 26 flights accounted for 188 locations. The remainder were the result of on-the-ground triangulation. During this period, 19.9 percent of all locations resulted in sightings of instrumented elk.

Between October and December, two radios failed and one instrumented elk was killed during hunting season. The remaining six radios continued to function throughout winter. From mid-January through March 1974, these six elk were located 89 times. One flight was made in December. Thereafter, all winter locations were the result of on-the-ground triangulation. Forty-six percent of all winter locations resulted in sightings of instrumented elk.

Dispersal from Winter Range

Elk radioed in 1973 may be divided into four broad groups based on their dispersal from the winter range: 1) resident elk--those summering on or near the winter range; 2) those moving east up Spotted Bear River toward the Continental Divide; 3) those moving in a northeast direction to summer in the Middle Fork of the Flathead drainage or moving beyond the Middle Fork to the Continental Divide; and 4) those moving in a westerly direction from the winter range. Maximum displacement from trapsites varied from less than 4 to over 25 airline miles (Table 3). Fig. 5 illustrates dispersal of radioed and marked elk from their trapsites to summering areas.

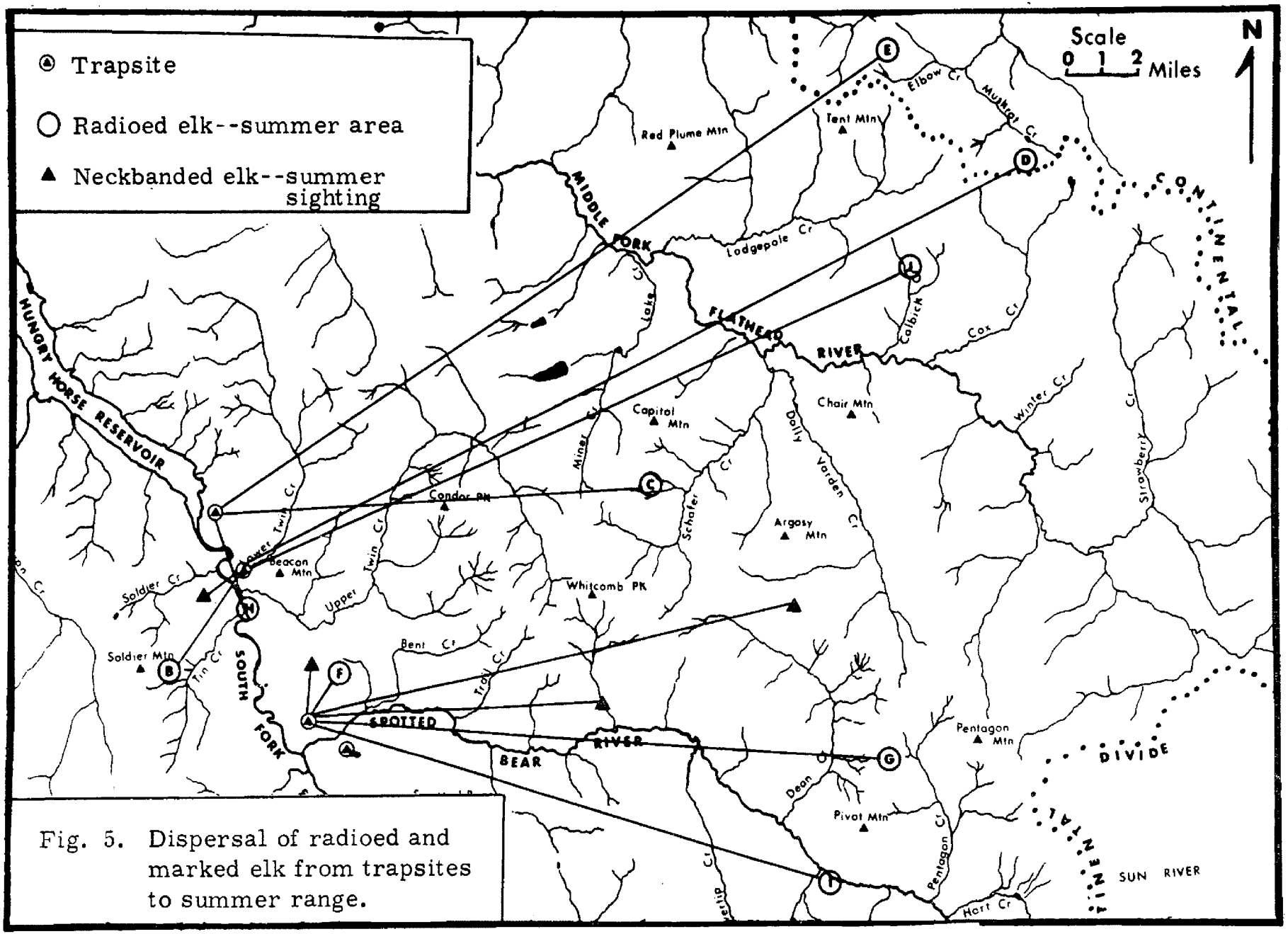

Fig. 5. Dispersal of radioed and marked elk from trapsites to summer range.

The resident population was represented by two instrumented elk, one each from the Crossover and Horse Ridge traps, and one neckbanded individual from the Horse Ridge trap. From summer observations, I estimate 20 elk were summer residents of the Horse Ridge area.

Two radioed elk and two neckbanded elk, all from the Horse Ridge trap, moved east to summer in areas up Spotted Bear River. Early game surveys (USFS 1936, Montana Fish and Game Commission 1942, Rognrud 1950) indicated movement of elk across the Continental Divide over the Lick Creek-Hart Creek pass between the Upper Spotted Bear River and the Sun River. The extent of such movement was not known at that time. In 1973, none of the radioed elk crossed the divide in that area. However, during the summer months elk were commonly seen in Hart Basin just west of the Divide, and it is probable that movement across the Divide still occurs. Knight (1970) noted that some Sun River elk summer in Hart Basin.

Dispersal to the northeast from the winter range was exhibited by four radioed and one neckbanded elk. These elk were from either the Lower Twin Creek or Crossover traps. Each trapsite was represented by two radioed elk. Of this group, elk C and J crossed the Flathead Range and summered in tributaries of the Middle Fork of the Flathead. Elk D and E continued across the Middle Fork valley and summered just east of the Continental Divide (Fig. 5).

The western movement was represented by only one radioed elk. Elk B, trapped at the Lower Twin Creek site, crossed the South Fork and summered in the Tin Creek-Soldier Creek area. In this case, maximum displacement was less than 5 miles which was small compared to other nonresident elk.

Seasonal Movement Patterns

Movement on winter range. On the winter range, elk movements were limited by forage availability, snow depth, and weather. From January through March, movements of individual elk were usually confined to small areas on the winter range. Day to day movements were generally restricted to travel between feeding and bedding sites. Weather fluctuations resulted in some elevational movement, but there was little lateral movement along the winter range. One radioed elk traversed approximately 5 miles of winter range along the Spotted Bear River in a 2-month period.

There were short periods in both January and February when a combination of warm winds and rain caused some of the steep, open areas to become snowfree. During such periods, elk in the Crossover-Dry Park area were sometimes observed feeding and bedding at elevations approaching 6,000 feet. Normally, however, winter use was restricted to that portion of the winter range between 3,600 and 5,000 feet elevation. The mean elevation of radioed elk for January

through March was approximately 4,000 feet.

The South Fork of the Flathead and the Spotted Bear River were partially frozen early in January 1974. Warmer weather in mid-January caused the ice to break up, and the rivers remained open the rest of the winter. There was very little evidence of elk crossing the South Fork from January through March. However, elk were observed crossing the Spotted Bear River several times. Once in 1973 and again in 1974, elk wearing Horse Ridge neckbands were observed crossing from the Horse Ridge side to the Spotted Bear Lake side. On three occasions in 1974, elk neckbanded at the Horse Ridge trap were observed on the south side of the Spotted Bear River in the vicinity of Spotted Bear Lake. On two different occasions elk neckbanded at Spotted Bear Lake were seen feeding on the upper end of Horse Ridge. Locations of radioed elk G also illustrate this crossing movement.

Tracks suggest that movement back and forth across the Spotted Bear River was common throughout winter. Most crossings occurred on that section of the River from the Spotted Bear bridge upstream to Bent Creek. This indicates an exchange of elk between the southern end of Horse Ridge (Spotted Bear Face) and the Spotted Bear Lake area.

Spring movements. In 1974, following a moderately severe winter, elk movements were restricted to a small wintering area

until about mid-April. At that time, most of the winter range was snowfree. However, in 1973 the winter was very mild in terms of snow accumulation. Most of the winter range and much of the surrounding area was snowfree by the end of March. In 1973, spring movements traversed large portions of the winter range and surrounding areas. The area utilized during spring was an extension of the area utilized in winter rather than a definite area apart from the winter range.

There was a general shift to higher elevations and different aspects as new forage became available. With snow no longer a barrier, there was an increase in lateral movements. Several instrumented elk moved 6-8 miles along the winter range in the course of a week. There was a sharp increase in use of clearcuts in the Flat Creek-Bent Creek area and along Spotted Bear River.

During April and May, there was considerable elk movement back and forth across the South Fork. Four radioed elk demonstrated this movement. In 1973, as a result of light snowpack, rivers of the area did not reach normal spring levels. Random crossing and recrossing may not be observed as extensively in a year with a normal or above average snowpack.

Increased lateral movements of elk during spring resulted in some mixing of elk from different segments of the winter range. During April and May, radioed and neckbanded individuals from the

Crossover and Lower Twin Creek traps were regularly seen on Horse Ridge. Elk C (from the Crossover trap) moved as far as Bent Creek. However, elk from the Horse Ridge trap were never observed below the lower end of Horse Ridge (toward Crossover and Dry Park). All observations of marked elk from the Horse Ridge trap were either on Horse Ridge or up Spotted Bear River.

Movement to summer range. Instrumented elk which migrated made rather abrupt moves from winter-spring areas to summer areas. This was in contrast to slow, progressional movements back to the winter range in the fall. Elk I illustrated this abrupt movement. On 11 May, she was located along Spotted Bear River about 5 miles above Spotted Bear Ranger Station. On 14 May, she was some 15 miles up the Spotted Bear River. Less than 72 hours were involved, and the move was probably made in a fraction of the time.

Instrumented elk began leaving winter-spring areas about the second week in May. Elk G was an exception. She left her winter-spring range in mid-April. All radioed elk were on their summer ranges by the first week in June. Variations in winter severity and snow accumulation probably cause considerable year-to-year variations in time of dispersal from the winter-spring areas.

Calving. The first evidence of calving in 1973 occurred on

26 May when a Forest Service employee reported seeing a calf believed to be less than 2 days old (W. Armstrong, pers. comm.). The first cow-calf groups were observed on 21 June. At that time, the calves were estimated to be 2-3 weeks old. From then on, cow-calf groups were observed on nearly all flights during summer.

In 1973, calving took place on summer range. This may not normally be the case. In winters with average or above average snow accumulation, many summering areas remain snow-covered until mid-late June; however, in 1973 most summering areas were snowfree by late May. Definite calving areas were not discovered, but areas where cow-calf groups were first observed were noted (Fig. 6).

Movement on summer range. During summer, movements of radioed elk were confined to definite areas. Within those areas, some parts were used more heavily than others. Summer movements were more predictable than the erratic wanderings of spring. A sudden move out of the normal summer area was noted for one radioed elk. On 4 August, elk C moved approximately 3 miles outside of Soakem Basin, her normal summering area. When next located on 12 August, she was back in Soakem Basin, and she remained there until early September. For 2 days prior to the sudden move, I was in the Soakem Basin area, and my presence may

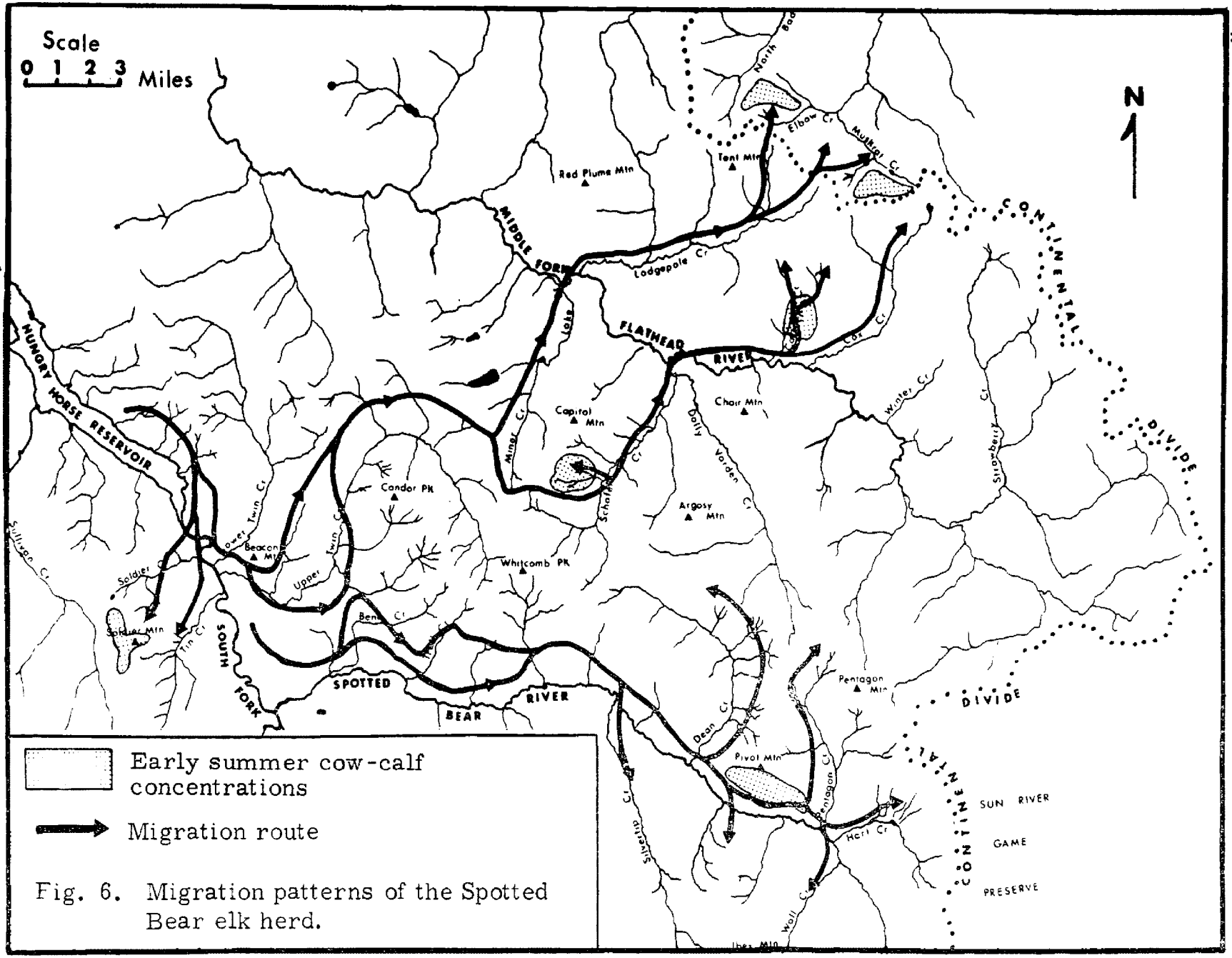

Fig. 6. Migration patterns of the Spotted Bear elk herd.

have caused the movement.

Late summer-fall activity. Beginning in late August and continuing through October, some instrumented elk exhibited increased activity. Four radioed elk, C, E, H, and J, shifted to adjacent, more heavily timbered areas that were not used earlier. Elk E and J did not show increased movement after the initial shift, but they used different aspects and vegetation types. Elk C and H not only shifted their centers of activity, but also showed increased movements in the new area. Elk F did not shift to another area, but she did greatly extend her movements around her summering area.

Shifts to timbered areas and increased movements during late summer-fall have been noted by others. Kirsch (1962), Stevens (1965), and Knight (1970) suggested that such movements were in response to elk seeking succulent forage in timbered areas after vegetation on more exposed types became desiccated. In my study, the shift was most noticeable in instrumented elk which summered on open ridges and basins. Instrumented elk which used timbered areas more extensively throughout summer did not exhibit noticeable shifts to other areas. McLean (1972) and Craighead et al. (1973) suggested that increased movements and movements away from summering areas were related to breeding activity. Increased movements during late October-early November, after the peak of the rut, were

probably related to the beginning of fall migration.

Migration to winter range. The winter of 1973-74 was more severe than the previous winter in terms of snow accumulation. By mid-October, there was some snow at higher elevations. The month of November was characterized by heavy snows and low temperatures early in the month. Some elk began moving back toward winter range at that time. Radioed elk D, E, and J moved from their summer-fall areas in the Middle Fork drainage back into the South Fork drainage. Elk D was shot after moving more than 11 airline miles toward its winter range. During this period, elk concentrated in the timber around Web Lake and in the South Creek-Bent Creek area. In a 5-day period between 5 and 9 November, at least 13 elk were killed by hunters in that vicinity. Elk moving back to winter range from the Middle Fork via Upper Twin Creek and from the Spotted Bear River drainage apparently concentrate in that area.

Not all elk began moving during this early November period. Elk G remained on her summer-fall range up the Spotted Bear River until early December. The cold and snow of early November was followed by increased temperatures and rain which removed much of the snow. Alternate periods of rain and snow from mid-November through mid-December resulted in only light snow accumulations at lower elevations and probably slowed movements to winter range. A

flight on 19 December showed all radioed elk were on or near the winter range. However, tracks and sightings indicated that most elk were not yet concentrated on the winter range proper but remained rather widely dispersed in areas surrounding the winter range. Elk were found on a variety of aspects and on both sides of the South Fork.

By the end of December, most elk were established on the winter range proper on S-W slopes east of the South Fork. There was 18-20 inches of snow on the ground at Spotted Bear Ranger Station at that time.

In 1973, movements to winter range involved a 6-7 week period from late October-early November to late December. Migration back to the winter range involved a slow progression of short movements. Usually several areas were utilized along the way, but none for any extended period until the wintering area was reached. Elk apparently drift back singly or in small groups. There was no indication of large numbers moving together toward the winter range.

Size of Seasonal Areas

Seasonal areas utilized by radio-instrumented elk are summarized in Table 4. Nine radioed elk provided information concerning size of summer range. Six of the nine also provided similar information concerning size of winter range. Data pertaining to fall and spring ranges were collected for three and eight of the radioed

TABLE 4. Size of seasonal areas utilized by radioed elk

Season	Instrumented elk									Mean
	B	C	D	E	F	G	H	I	J	
Spring 1973										
No. locations	23	14	23	15	15	3	24	10	7	
Area (sq. mi.)	15.8	11.3	2.6	2.3	4.7	*	7.6	6.5	3.2	6.75
Summer 1973										
No. locations	19	15	12	12	17	19	23	17	14	
Area (sq. mi.)	2.9	1.4	2.6	4.3	2.3	10.2	5.0	2.4	2.4	3.7
Fall 1973										
No. locations	9	6	4	5	9	5	11	3	4	
Area (sq. mi.)	2.3	*	*	*	5.5	*	11.8	*	*	6.5
Winter 1974										
No. locations	10	2	**	11	13	15	27	1	13	
Area (sq. mi.)	2.4	*	**	0.4	1.5	2.1	1.5	*	1.2	1.5

*Not enough locations to delimit a seasonal area.

**Killed 11/2/73 before she returned to the winter range.

elk, respectively.

In general, winter ranges were smallest, ranging in size from 0.4 to 2.4 square miles. Size of spring ranges varied from 2.3 to 15.8 square miles. In summer, areas utilized varied from as little as 1.4 to over 10 square miles. The largest summering area was that utilized by elk G, a cow without a calf. I believe five of the radioed elk had calves. One of these, elk H, lost her calf in late June. The average summering area of the remaining four cows with calves was 2.8 square miles. The average summer range for cows without calves (including elk H) was 4.5 square miles.

The fall range was usually larger than the summer range. Possible explanations for this have been discussed previously. Fall ranges varied from 2.3 to 11.8 square miles.

Fidelity to Seasonal Areas

Previous studies utilizing marked and/or radio-instrumented elk indicated that elk tend to return to the same summer and/or winter ranges (Brazda 1953, Picton 1960, Knight 1970, Craighead et al. 1972, McLean 1972). In this study, fidelity to winter range was demonstrated by nine radioed elk and at least nine marked elk.

Of the 10 elk radioed in 1973, nine returned to the Spotted Bear winter range in 1974. Elk D moved more than 11 airline miles back toward the winter range before she was shot. If she had not been

shot, she probably would have returned also.

Unlike the radioed elk, neckbanded elk were not all individually recognizable. There were a number of animals from each trapsite marked with identical neckbands (e.g., 5 elk with red and white striped collars, 10 with plain red, 4 with plain white, and 3 with plain yellow). Some of these individuals (usually bulls) could be recognized, but there was usually no way to differentiate between identically marked cows. Five neckbanded elk, individually recognizable because of antler characteristics or unique neckbands, are known to have returned to the Spotted Bear winter range in 1974. In addition, cows representing the four most common neckband colors (red, red/white stripe, white, and yellow) were sighted 1 to several times between January and April 1974. Thus, a minimum of nine marked elk (five individually recognizable and at least four not recognizable as individuals) returned to the Spotted Bear winter range in addition to the nine radioed elk.

By late June 1974, only four of the original 10 radioed elk were still being monitored (other radios were inoperable). By the end of June, these four elk (B, F, G, and H) had returned to areas that were part of their summer ranges in 1973.

Seasonal Habitat Use

In this study, no attempt was made to intensively sample or

describe the various habitats that elk used throughout the year. However, locations of radioed elk and elk observations provided general information concerning seasonal habitat use.

By late December, most elk were established on the winter range proper. During January-March, elk showed a decided preference for S-W aspects (Table 5), with most use occurring in old burns, open grass types, and Douglas fir timber types. Locations of radioed elk for the January-March period ranged from elevations of 3,600 to 4,900 feet, averaging approximately 4,000 feet (Table 6).

Beginning in April, there was a definite shift to use of higher elevations. Extremes varied from 3,600 to 6,400 feet with the average location of radioed elk showing an increase of about 400 feet from March. The S-W aspects continued to receive the most use due to green-up, but some use of N and E aspects began at this time also. From mid-April through May, there was little change in elevation, but use of NE and E aspects increased sharply, accompanied by an equally sharp decrease in use of SW and W aspects. At this time, use of clearcuts and other cutover areas reached its peak. Use of logged areas dropped sharply in June and decreased to almost none by July. It must be noted, however, that by mid-June migratory elk had moved to summer ranges where, in most cases, cutover areas did not exist. Resident elk of the Spotted Bear area did have access to cutover areas and some use was noted throughout summer months.

TABLE 5. Monthly distribution of radioed elk with respect to aspect, April 1973-March 1974

Month	n[a]	N	NE	E	SE	S	SW	W	NW	Ridgetop	Bottom
January	5	0[b]	20	20	0	0	0	60	0	0	0
February	35	0	0	2.9	2.9	20	28.5	34.3	11.4	0	0
March	44	0	0	0	6.8	22.7	25	36.4	9.1	0	0
April	71	2.8	5.6	12.7	11.3	12.7	21.1	25.3	8.5	0	0
May	73	4.1	19.2	20.5	12.3	15.1	12.3	6.9	6.9	2.7	0
June	62	6.5	8.1	22.6	16.1	4.8	12.9	16.1	9.7	0	3.2
July	49	8.2	16.3	14.3	20.4	6.1	6.1	18.4	8.2	0	2.0
August	27	18.5	11.1	7.4	3.7	3.7	11.1	18.5	18.5	7.4	0
September	11	0	9.1	27.3	9.1	18.2	0	18.2	18.2	0	0
October	19	15.8	5.3	10.5	15.8	10.5	15.8	10.5	15.8	0	0
November	26	3.8	11.5	19.3	7.8	11.5	11.5	23.1	11.5	0	0
December	8	0	12.5	0	25	12.5	25	25	0	0	0

[a]n = total locations of radioed elk for given month.

[b]Percentage of total monthly locations that occurred on a given aspect.

TABLE 6. Elevational distribution of radioed elk by month, April 1973-March 1974

Month	Elevation (feet)							
	No. locations		Minimum		Maximum		Mean	
December	8		3,900		4,900		4,313	
January	5		3,600		4,300		3,740	
February	35		3,600		4,900		4,111	
March	44		3,600		4,700		4,048	
April	71		3,600		6,400		4,444	
May	73		3,600		6,000		4,566	
	Resident	Migratory	Resident	Migratory	Resident	Migratory	Resident	Migratory
June*	18	44	3,800	4,500	4,800	7,100	4,250	5,629
July	14	35	3,600	5,000	4,300	7,300	3,993	5,991
August	8	19	4,300	4,700	4,800	7,000	4,425	5,810
September	3	8	4,100	4,700	4,900	6,100	4,400	5,388
October	5	14	4,000	4,300	4,800	7,000	4,500	5,800
November	12	14	3,800	4,600	5,400	6,200	4,650	5,336

*Beginning in June there was sufficient elevational difference between resident and migratory segments of the population to warrant separation.

By early June, most elk were established on summer ranges. Throughout June and July, E, NE, and SE aspects were used extensively. Some elk made use of timbered areas throughout the summer. Elk F spent most of her time in strips of mature timber between clearcuts in the Flat Creek area and utilized the cuts themselves to some extent. Roads to these clearcuts had been closed to vehicular traffic. Elk J used large, open meadows in the Calbick Creek drainage throughout most of June before moving into a timbered area (mostly lodgepole pine) in July. Natural openings were utilized extensively, especially seep areas that were lush with forbs and grasses.

Elk I spent the summer in a heavily timbered area with few natural openings. Like J, she was frequently located near seep areas, and appeared to make use of vegetation on snowslide areas. Elk were frequently observed using snowslide areas throughout June and July.

Other radioed elk used high open ridges and high basins extensively from mid-June through early August. Those elk were associated with cow-calf groups of 12-25 animals. Parts of those areas were open grass/forb types while other areas were open-canopy alpine fir/beargrass. As a reflection of this use of open areas, numbers of observable elk reached a peak for the summer in July.

Use of high elevations reached a peak in July. For the migratory segment of the population, elevations up to 7,300 feet were

recorded with a mean of almost 6,000 feet for radioed elk (Table 6). The resident portion of the population summered at elevations ranging from less than 4,000 to near 4,800 feet.

There was little elevational change during August, but there was an increased use of N and NW aspects. Elk were seen less often in the open, and more locations were in dense timber and open-canopy alpine fir types. This may have been in response to desiccation of forage on the more open areas. The summer of 1973 was very dry. During August, elk were often seen near small ponds, seeps, or wet meadows. Availability of water may significantly affect elk habitat selection during late summer, especially in dry years.

There was little change in vegetation use in September except for a more pronounced use of timbered areas. Very few elk were seen on flights during September or October. The mean elevation of radioed elk decreased more than 400 feet during September, but in October elk returned to levels approaching those of August. Timber types continued to receive heaviest use with relatively uniform use of all aspects.

Heavy snows of early November pushed elk out of the higher areas. The mean elevation of radioed elk during November was approximately 5,300 feet. Elk continued to use timber types predominantly throughout November. Heavy snows early in November could concentrate elk in timbered areas near the winter range. In view of this fact, timbered areas along migration routes should be evaluated

in terms of importance as escape cover. Cutting these areas could increase elk vulnerability to hunting in years of early, heavy snows.

Throughout November, elk showed little preference for any particular aspect, but by mid-December there was a definite shift to SE, SW, and W aspects. By that time elk were again concentrating on the winter range.

Snow Depth Measurements

While the 1972-73 winter was mild with below average snow accumulations, the 1973-74 winter had above average snow accumulation. Some areas at the higher elevations recorded record snowpacks. At lower elevations, including the winter range, rain in January and February kept snow depths near normal. Snow depth transects on Horse Ridge and along Spotted Bear Mountain (Figs. 3 and 4) were measured at the end of January, February, and March. Table 7 summarizes the results of these measurements.

On Horse Ridge, the least snow accumulation occurred on glacier-scoured, open S-W slopes. Snow depths were usually less than 15 inches on those areas, and the steeper parts were snowfree during some period of each month. By early April, those areas were all snowfree except where large drifts had accumulated.

Browse types, on the average, held about 11 inches more snow than the open, windblown areas. Maximum accumulation on

TABLE 7. Snow depth measurements, 1974

Transect No.	Location[a]	Aspect	Slope	Elev.	Mean monthly depth[b]		
					Jan.	Feb.	Mar.
		Horse Ridge					
1	Open--grass/forb	187	60-70+	4,500	15.6	15.6	5.3
2	Open--grass/forb	235	35-40	4,800	11.3	8.4	9.5
3	Open--grass/forb	225	30-40	4,900	17.9	22.0	16.3
4	Browse	245	40-50	3,900	26.3	25.2	18.8
5	Browse	220	35-45	4,200	27.9	29.5	25.9
6	Browse	280	45-55	4,400	25.7	24.9	20.9
7	Timber--DF, PP-S	220	25-35	4,100	22.5	25.5	18.6
8	Timber--LP-P	260	0-10	3,600	34.0	37.7	34.8
9	Timber--DF, L-S	300	0-10	3,600	40.6	49.7	44.9
10	Timber--DF, LP-P	310	50-60	4,300	31.4	32.6	35.7
11	Timber--LP-P	Ridgetop	-	4,900	39.7	38.7	46.9
12	Timber--LP, DF, L-P, Sp	35	35-40	4,100	42.1	49.6	48.7
13	Timber--LP-P	25	0-10	5,000	42.5	45.4	42.0
14	Clearcut	25	35-45	4,900	52.7	50.3	52.8
15	Selective cut	275	35-45	4,600	39.2	42.0	35.5
16	Lodgepole thinning	280	25-30	3,900	36.9	34.8	37.4

TABLE 7. (Continued)

Transect No.	Location[a]	Aspect	Slope	Elev.	Mean monthly depth[b]		
					Jan.	Feb.	Mar.
	Spotted Bear Mountain						
1	Open timber--LP, PP, DF-S	230	5-10	3,900	24.6	34.9	27.8
2	Timber--DF-S	160	30-40	4,200	16.4	22.7	12.5
3	Timber--DF-S	240	30-35	4,300	15.9	23.8	16.5
4	Timber--DF, PP-S	235	40-50	4,300	12.9	19.3	9.6
5	Timber--DF, L-P, S	260	20-30	4,400	18.0	27.4	21.9
6	Timber--DF, PP-P, S	230	35-45	4,400	15.3	20.1	16.6
7	Open timber--DF-S	170	40-60	4,500	14.2	19.3	11.8
8	Timber--DF, LP-P, S	240	20-30	4,700	21.0	24.2	22.0
9	Timber--DF, L-S	165	25-35	4,700	24.3	30.6	30.3
10	Timber--LP-P	300	0- 5	3,800	28.4	36.7	33.6
11	Timber--DF, L, LP-P	210	0-10	3,900	24.4	32.3	27.1
12	Timber--LP-P	110	0-10	3,900	21.6	34.0	24.2
13	Timber--DF, LP-P, S	245	20-30	4,000	19.5	32.5	29.3
14	Timber--LP, DF-P	220	0-10	4,100	20.6	34.1	26.4

[a]Abbreviations used: DF = Douglas fir; L = western larch; LP = lodgepole pine; PP = ponderosa pine; P = pole-size timber; S = sawtimber; Sp = sapling-size timber.

[b]Depth measured in inches; each transect measured at the end of each month, January-March.

browse areas averaged nearly 27 inches. Those areas were mostly snowfree by mid-late April.

Snow depths in timbered areas varied with elevation, slope, aspect, and habitat type. Snow depths were least under Douglas fir habitat types and greatest under alpine fir types, with February measurements averaging 27.5 and 37.9 inches respectively for all slopes, elevations, and aspects. Measurements in browse and open areas were mostly taken on S-W aspects. Transects measured under timber on S-W aspects showed February averages of 23.7 for Douglas fir types compared to 34.2 inches for alpine fir types.

Where aspects were similar, snow depths under Douglas fir types averaged nearly 8 inches more than on open, glacier-scoured areas and 3 inches less than for browse types. It might be expected that a large open area would accumulate more snow than a timbered area where the canopy intercepts some of the snow. However, in this case the open areas were on steeper slopes than most timbered areas, and wind action on the open areas was much greater than under timber.

For timbered areas, the greatest depths were recorded for north aspects, upper slopes and ridgetops, where snow depths approached 50 inches. In the timbered areas, most snow was gone by early May.

Use of the Winter Range

Horse Ridge/Dry Park area. This area supports the largest winter concentration of elk in the lower South Fork. Snow accumulation was light on the steep, open areas (Table 7) which were extremely important feeding grounds from January through March. On the open areas, elk fed primarily on grasses, but browse was heavily used when present. Serviceberry, chokecherry, and maple plants on these areas have been very heavily utilized. Many plants are low in vigor and most are less than 3 feet tall (many chokecherry plants are less than 2 feet tall). In some areas, snowberry and bittercherry also showed high levels of use. Conifers, especially Douglas fir and Rocky Mountain juniper, were commonly browsed as high as elk could reach.

Areas of concentrated use were always associated with timber or mixed timber/browse. During periods of normal weather, elk fed in the open and bedded at the edge of adjacent timber. During periods of extreme cold, strong winds, or heavy snows, elk were rarely seen in the open. At such times, timber became important for both feeding and bedding. Timbered areas with a good browse understory received the most use. In those areas, elk could feed and bed with a minimum of movement and exposure to the weather. In the Dry Park area, patches of tall browse (mountain maple, willow, and birch) mixed with birch and Douglas fir seemed to be the counterpart of the mixed

timber/browse types of Horse Ridge. "Dog-hair" and thinned stands of lodgepole did not receive much use except on edges where they bordered on another type.

Browse types were used as feeding areas throughout winter with most use being observed in mixed timber/browse or small browse areas adjacent to timber. The most extensive browse area on Horse Ridge was used very little during January-March. This area supported the best browse on Horse Ridge in terms of vigor and availability, and snow depths were not restrictive to elk use. However, there was little interspersion of cover (either timber or tall browse). This same area received fairly heavy use in spring. There are similar areas on Crossover-Dry Park that have adequate forage but lack cover. These areas receive light use during winter but are used more heavily in spring.

During spring, there was continued heavy use of open areas on Horse Ridge due to green-up. Finger ridges and rocky/grass areas of Crossover-Dry Park also received heavy use at that time. Such use continued for approximately 1 month (late March-late April in 1973). During that period, there was a general shift to higher elevations. Timbered flats along the River and the lower slopes of Crossover-Dry Parks received proportionately less use. By late April 1973, most elk had moved high up on Crossover-Dry Park and very few were still using the S-W slopes of Horse Ridge. At that time, elk also used the

east facing slopes of Crossover Mountain up Lower Twin Creek and the area behind Beacon Mountain.

Spotted Bear Lake-Harrison Creek area. During winter, elk primarily use the Douglas fir types of this area where slopes are commonly in excess of 40 percent. The gently-sloping alpine fir types receive little winter use. The main reasons for this distribution are snow depth and forage availability. Snow depth in the Douglas fir types is generally less than 24 inches. Some of the steeper slopes with mixtures of Douglas fir and ponderosa pine sawtimber hold less than 18 inches of snow. Mountain maple and serviceberry are the most common of the preferred browse species with some chokecherry being found on the more open slopes and red-osier dogwood occurring along streams and on the moister sites.

Much of the mountain maple and serviceberry has been intensively utilized. Plants are generally less than 4 feet tall and many are low in vigor. During April 1974, I hiked through much of the area and estimated leader use on much of the maple, serviceberry and chokecherry as over 80 percent. The only shoots that escaped browsing were those buried beneath the snow or the few that have grown out of reach. In some areas, browsing on russet buffaloberry, snowberry, and rose, species not generally considered to be important browse plants, was evident.

The alpine fir type has very little available winter forage. Beargrass, grouse whortleberry and snowberry are common, but snow depths in excess of 30 inches make most low-growing vegetation unavailable during winter. Following snowmelt in spring, elk use the entire area more uniformly. The alpine fir type receives more use at this time.

Lower Spotted Bear River. During the winter of 1973-74, elk were found scattered along the Spotted Bear River as far upstream as the road closure above Beaver Creek campground. I did not investigate above that point. Elk were confined mainly to the north side of Spotted Bear River in a strip varying from about 0.5 to 1.0 mile in width. Within this strip, elk use was concentrated primarily in three areas: 1) Spotted Bear Face (southern end of Horse Ridge) to Flat Creek; 2) about 0.5 mile above Bent Creek to Trail Creek; and 3) from Big Bill Creek to just beyond the road closure above Beaver Creek campground. These are all timbered Douglas fir habitat types.

Following snowmelt in spring, clearcuts in the Flat Creek-Bent Creek area and cuts along Spotted Bear River receive moderately heavy use for a 2-3 week period. This is about the same time that fewer elk are being observed on Horse Ridge. Apparently, elk drift from the Horse Ridge wintering area and use the new growth of grasses and forbs in the cutover areas before moving on to summering areas up

the Spotted Bear River. Locations of radioed elk G and I and observations of Horse Ridge marked elk corroborate this.

Population Data

Summer population. Beginning 1 July, elk observations were broken into sex and age categories whenever it was possible to classify all individuals in a group. By that time most calves were at least 2-3 weeks old and observable in cow-calf groups. Quantitative summer composition data were only collected in conjunction with aerial or on-the-ground attempts to locate radioed elk. Many observations involved repeated counts of several cow-calf groups with which radioed elk frequently associated. Since only cows were instrumented, these figures probably do not accurately represent the bull segment of the population. Table 8 summarizes elk classified for the period 1 July-20 October.

TABLE 8. Elk observations, summer-fall 1973

	No.	Percent
Cows	245	63.8
Calves	103	26.8
Spikes	12	3.1
BAB	24	6.3
Total	384	100.0

Summer observations indicated a calf:cow ratio of 42:100 and a bull (spike and BAB):cow ratio of 14.7:100. In the White River elk herd of Colorado, pre-hunting season calf:cow ratios averaged 63:100 over a 6-year period (Boyd 1970). Knight (1970), working with the Sun River elk herd of Montana, found a calf:cow ratio or approximately 30:100 for 2 summers.

Winter population. From mid-December 1973 through March 1974, 1,961 elk were classified according to sex and age. Counts during February and March accounted for 1,711 or 87.2 percent of the total. Table 9 summarizes the monthly composition counts. The calf:cow ratio, calculated from monthly totals, was 39:100. Table 10 shows composition counts based on the largest 1-day counts of each month. Those counts classified 781 elk (40 percent of the total). The calf:cow ratio calculated from those counts was 44.6:100. Cow-calf groups ranging in size from 10 to 50 animals made up the bulk of the 1-day count totals. However, the total winter count included many observations of single animals or small groups (2-10) in which calves were absent or few in number. This may account for some of the difference between the two calf:cow ratios.

The ratio of 39 calves:100 cows represents a considerable increase over the 1973 spring composition count of 28:100 made by the Fish and Game Department on the lower South and Middle Fork winter

TABLE 9. Winter 1974, composition counts--monthly summary

Month	Cows	Calves	Y♂	BAB	Uncl.*	Total	Calves: 100 cows
Dec. 1973	41	17	2	3	29	92	41.5
Jan. 1974	120	49	9	9	22	209	40.8
Feb. 1974	565	209	37	25	54	890	37.0
March 1974	585	240	28	22	37	912	41.0
Total	1,311	515	76	59	142	2,103	39.3
Percent	66.9	26.3	3.9	3.0			

*Unclassified animals--usually cows and calves that could not be separated.

TABLE 10. Best 1-day composition counts by month, winter 1974

Month	Cows	Calves	Y♂	BAB	Uncl.*	Total	Calves: 100 cows
Dec. 1973	34	15	2	1	11	63	44.1
Jan. 1973	36	21	3	1	0	61	58.3
	33	8	4	2	7	54	24.2
Feb. 1974	99	41	7	4	0	151	41.1
	77	34	7	4	10	132	44.2
March 1974	89	38	5	0	0	132	42.7
	65	35	8	3	6	117	53.8
	67	31	4	3	9	114	46.3
Total	500	223	40	18	43	824	44.6
Percent	64.0	28.6	5.1	2.3			

*Unclassified animals--usually cows and calves that could not be separated.

ranges (Weckwerth and Cross 1973). Calf production in the Flathead elk herds has consistently been classed as poor. Over a 16-year period from 1958 to 1973, the calf:cow ratio for the South and Middle Forks of the Flathead ranged from 17 to 32:100 with an average of 25:100 (Weckwerth and Cross 1973).

The large increase over the 1973 count may reflect the extremely mild winter of 1972-73. Snow accumulation was below normal, elk movements were less restricted, and forage was more readily available. Over-winter survival of calves was apparently better than usual as the spring calf:cow ratio of 28:100 is higher than the 16-year average and substantially higher than the previous spring count of 17:100 following a moderately severe winter. Examination of elk trapped during spring 1973 indicated that most animals were in good condition. Pregnant cows in good condition supposedly produce large, strong calves resulting in high calf survival.

Part of the apparent increase may also be attributed to the difference in methods used to obtain the two counts. With the exception of one flight made in December, my counts were all ground counts involving careful examination of animals using 7x35 binoculars or, more commonly, a 15-60 variable power spotting scope. There was usually sufficient time to examine each animal in a group. The Fish and Game figures were based on spring "green-grass" counts gathered from helicopter flights. On such flights it is often impossible to make

a careful examination of every animal, and it is probable that some of the larger calves were classed as cows. Helicopter counts are valuable in determining trends, but they may not reflect actual conditions as accurately as ground counts.

Table 11 summarizes sex and age composition of the population based on data collected by four methods. Calves made up over 26 percent of the population for all methods except for the trap sample which indicated calves as only 19.3 percent of the total. All four methods showed the cow segment to be well over 60 percent of the population, with the summer-fall count being lowest at 63.8 percent and the trap sample highest at 68.1 percent. Branch antlered bulls made up 6.3 percent of the summer-fall count but only 3.0 percent of the total winter count. Harris (1963) and Murie (1951) commented on the tendency of adult bulls to winter in areas apart from cows and calves. Considering this, my winter composition counts probably underestimated adult bulls. Those counts were usually taken in areas where it was most likely to see large numbers of elk. The higher, more remote and heavily timbered portions of the winter range were not sampled as often nor as thoroughly. Small groups of bulls or individuals could easily have been overlooked.

Winter range population estimates. The number of elk using the Spotted Bear winter range was estimated from observations of elk

TABLE 11. Comparison of population sex and age composition calculated from four sample methods

Method*	Cows		Calves		Y♂		BAB		Calves: 100 ♀	Total
	No.	Percent	No.	Percent	No.	Percent	No.	Percent		
A	245	63.8	103	26.8	12	3.1	24	6.3	42.0	384
B	81	68.1	23	19.3	8	6.7	7	5.9	28.4	119
C	500	64.0	223	28.6	40	5.1	18	2.3	44.6	781
D	1,311	66.9	515	26.3	76	3.9	59	3.0	39.3	1,961

*A = 1973 summer-fall counts.

B = Trap sample, 1973 and 1974.

C = 1974 winter, largest 1-day counts (50 or more elk classified).

D = Total elk classified, winter 1974.

and elk sign (tracks, beds, etc.). Many of the areas are timbered, making it very difficult to actually count animals. Very few animals were actually sighted along the lower Spotted Bear River and along Spotted Bear Mountain. In those areas, numbers were based primarily on elk sign and evidence of use. For the winter of 1973-74, an estimated 560 elk wintered in the Spotted Bear area. Table 12 shows the estimated number of elk using the different segments of the winter range compared to the 1949 winter estimate (Rognrud 1950).

TABLE 12. Number of elk using the Spotted Bear winter range--comparison of 1949 and 1974 winter estimates

Wintering area	Total elk	
	1949	1974
Horse Ridge	190	200
Upper Twin Creek-Brush Creek	360	250
Spotted Bear R.S. -Harrison Creek	115	75
Lower Spotted Bear River	30	35
Total	695	560

The above figures indicate a slight decrease in elk numbers in the Spotted Bear Mountain-Harrison Creek area and a substantial decrease in the area from Twin Creeks to Brush Creek. This decrease is possibly a result of winter range deterioration due to conifer invasion and decreasing forage quantity and quality.

CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

Winter range is generally considered the limiting factor of deer and elk populations in the Rocky Mountain region (Dasmann 1971, Boyd 1970). The Spotted Bear winter range is an extremely important area. It supports the largest wintering population of elk in the lower South Fork of the Flathead. This study demonstrated that at least some of the elk that summer in the Middle Fork of the Flathead make annual migrations of over 25 miles to winter in the Spotted Bear area. These same elk could winter in the Middle Fork drainage by moving 10 miles or less from their summering areas.

Observations of marked elk and locations of radioed elk indicate at least two distinct segments of the winter population. 1) those wintering below Upper Twin Creek (the Crossover-Dry Park area) and 2) those wintering above Upper Twin Creek (the Horse Ridge-lower Spotted Bear River area). During winter, elk from these respective areas seldom mix. Some elk marked at the Lower Twin Creek trap apparently wintered on the lower end of Horse Ridge. However, this trap was located near the margin of both areas and could sample elk from the lower end of Horse Ridge as well as the

upper end of the Crossover area. One radioed elk (elk H) was captured in the Crossover trap in 1973 but wintered on the lower end of Horse Ridge in 1974. Since she was trapped in spring when elk tend to wander over large areas of the winter range, it is possible that she was captured out of her normal wintering area. Over 56 percent of all elk marked in 1973 were from the Horse Ridge trap, yet not one Horse Ridge animal was ever sighted below Upper Twin Creek. All sightings of Horse Ridge elk were made either on Horse Ridge or up the Spotted Bear River with the exception of a spike which was sighted in Bruce Meadows (about 1.5 miles SW of Spotted Bear Ranger Station) in May 1973.

Some mixing of elk from the different wintering areas occurs during spring green-up, but there was no indication of mixing on summer ranges. Horse Ridge and lower Spotted Bear River elk tend to move east to summering areas up the Spotted Bear River. Animals from the Crossover-Dry Park area show a tendency to move into summering areas in the Middle Fork of the Flathead (some also summer on the west side of the South Fork). Sufficient evidence has not yet been collected to make any firm conclusions concerning herd segmentation.

If the trapping and marking program is continued, elk should be sampled from nearer the center of each area. The Lower Twin Creek trap should be moved to the site of the original Crossover trap

or farther down toward Dry Park. Elk from the Dry Park end of the winter range may show different dispersal patterns than have been indicated in this study.

Elk wintering along Spotted Bear Mountain between Spotted Bear Lake and Harrison Creek may be a third distinct wintering unit. However, the trap at Spotted Bear Lake does not appear to adequately sample that area. Evidence points to a considerable exchange of animals between the upper end of Horse Ridge and the Spotted Bear Lake area; consequently, elk marked at that trap may show little difference in dispersal from Horse Ridge animals. Elk marked in an area nearer Harrison Creek would probably more accurately represent movements of animals wintering in the Spotted Bear Mountain area.

Migration routes were difficult to document as elk moved long distances in a short time. Often, only the end points of a migration could be established. Additional data are needed to accurately establish these routes; however, elk moving up the Spotted Bear River appear to move parallel to the River with little increase in elevation until the summering area is reached. Elk migrating to the Middle Fork moved up Upper Twin Creek, crossing the divide into either Miner or Schafer creeks and thence down those drainages to the Middle Fork valley. Fall migration appears to be the reverse of the spring migration.

Significantly higher calf:cow ratios following a mild winter in 1973 may indicate poor range conditions. There will probably always be some elk wintering in the Spotted Bear area regardless of how the area is managed. However, to maintain or increase the present population, a management program should be initiated aimed toward improvement or at least maintenance of existing winter range.

Most of the existing winter range resulted from multiple wildfires in the early 1900's. These areas have not been reburned for over 45 years. Quality of the winter range is deteriorating as a result of natural changes in vegetation which will eventually result in coniferous forest replacing much of the brush areas. Conifer invasion is already evident along the lower slopes of the Crossover-Dry Park area, Horse Ridge and flats along the River. The Spotted Bear Mountain area, which has not been burned for over 85 years, supports stands of mature timber. The quantity of forage being produced there is limited by the shading effect of conifers. Consequently the area is currently wintering only a small number of elk.

The elk winter ranges of the upper South and Middle Forks of the Flathead lie within the boundaries of the Bob Marshall Wilderness where manipulation of the vegetation is not possible. However, the Spotted Bear winter ranges are open to a number of management practices including logging, prescribed burning and reseeding. The area involved is small enough to make an intensive management

program practical.

Logging may provide a means for improvement of the winter range along Spotted Bear Mountain. The Forest Service is currently examining that area to determine current elk use, browse production, and site potential. A carefully planned program of cutting and burning might provide long term benefits to elk wintering in the area.

Prescribed burning is one method of improving wildlife habitat (Lyon 1971). In northern Idaho, prescribed burning has been used to improve elk winter range (Leege 1968, 1969), and I believe this method could be used successfully in the Spotted Bear area. Conifer invasion is the main problem on the Horse Ridge area, but there are areas along the reservoir and lower slopes of the Crossover-Dry Park area where the problem is complicated by browse plants growing out of reach of the elk. These areas already support good mixtures of willow, mountain maple, serviceberry, and redstem ceanothus. Leege (1969) found that these species sprout profusely from root crowns following spring burning. Prescribed burning would serve to: 1) increase the amount of forage available by reducing plant height and causing resprouting; 2) kill conifer reproduction; and 3) stimulate seedling establishment of browse plants, especially redstem ceanothus.

Observations during this study indicated that mixed browse/timber areas are very important to elk for cover as well as food.

Considering this, burning small scattered areas each year for a number of years would probably be better than burning a large area in any given year. Small patches of timber that are already well established could be left for cover and bedding areas. In some areas on Horse Ridge where burning may not be practical, conifer reproduction could be eliminated by hand cutting methods, and natural forest openings enlarged to encourage improvement of existing browse plants.

The open, grass areas on Horse Ridge are very important to elk wintering there. The Forest Service should continue to prohibit all summer-fall horse use on the winter range. Some small cage exclosures should be established on the grass areas to measure elk use of the grasses and determine whether grasses and forbs are re-establishing themselves after past overuse by domestic stock. If grass production does not respond, a program of hand seeding might be considered.

CHAPTER VI

SUMMARY

Using radiotelemetry and marked animals, seasonal movements and migration patterns of the Spotted Bear elk herd were studied from March 1973 to March 1974. In two trapping seasons, 119 elk were trapped in corral bait-type traps, and 106 were neckbanded and/or eartagged. Ten adult females were instrumented with radio collars in 1973, and an additional 11 elk were radioed in 1974. Elk instrumented in 1973 provided the data for this report. A total of 426 locations of radioed elk and sightings of neckbanded elk provided information on movements, distribution, and fidelity to seasonal areas.

Movements of radioed elk indicate that a small portion of the wintering elk herd are year-round residents of the Spotted Bear area, but most animals are migratory. Movements from winter to summer ranges varied from less than 4 to over 25 airline miles. Dispersal was primarily toward the east and northeast with only one radioed elk summering on the west side of the South Fork.

Based on dispersal from the winter range and movements of radioed and neckbanded elk on the winter range, the wintering population appears to be divided into two major herd segments. Elk

wintering below Upper Twin Creek in the Crossover-Dry Park area tend to move in a northeast direction to summering areas in the Middle Fork of the Flathead. Some elk from that area also move to the west side of the South Fork. Elk wintering above Upper Twin Creek on Horse Ridge and along the lower Spotted Bear River move east to summering areas in the Spotted Bear River drainage. In this study there was no evidence of mixing of the two herd segments on summer ranges.

On winter range, elk movements were confined to small areas during January-March. In 1973, following a mild winter, elk began moving off the winter range in mid-May and were established on summering areas by early June. Movements from winter-spring areas to summer areas were rather abrupt with most movements taking place in a 2-3 week period. Calving took place on the summer range. Each radioed elk used a fairly well-defined summering area. In late August and early September, several radioed elk moved off their summering areas into adjacent, more heavily timbered areas. Two instrumented elk greatly increased their movements beginning in late August and continuing through October. Possibly those movements were correlated with search for succulent forage and/or the effects of the mating season.

Elk began drifting back toward the winter range as early as the end of October. Snow appeared to be the main factor initiating

movement toward the winter range. Migration to the winter range was a slow progression of short movements involving a 6-8 week period. By late December, elk were established on the winter range.

Sizes of seasonal areas varied with the individual elk, but in general, winter ranges were smallest and spring and fall areas largest. Sizes of seasonal ranges in square miles varied as follows: winter, 0.4-2.4; spring, 2.6-15.8; summer, 1.4-10.2; and fall, 2.3-11.8.

In this study, fidelity to winter range was demonstrated by nine radioed and at least nine neckbanded elk. Four of the original 10 radioed elk returned to the same summer areas again in 1974 (the others could not be checked due to transmitter failures).

On Horse Ridge and the Crossover-Dry Park area, mixed timber/browse and open grass areas were heavily used throughout winter. On timbered portions of the winter range, Douglas fir types received the most use with very little use recorded in alpine fir habitat types.

Population data were collected during the summer and early fall 1973 and winter 1974. Summer observations resulted in a calf:cow ratio of 42:100 and indicated a herd composition of 63.8 percent cows, 26.8 percent calves, 3.1 percent spikes, and 6.3 percent adult bulls. Winter composition counts collected from December to March resulted in a calf:cow ratio of 39:100 and a herd composition of 66.9 percent cows, 26.3 percent calves, 3.9 percent spikes, and 3.0 percent adult

bulls.

Based on observations of elk and elk sign, an estimated 560 elk wintered in the Spotted Bear area during winter 1973-74. About 80 percent of the total wintered in the Horse Ridge/Dry Park area.

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APPENDIX A

MOVEMENTS OF INDIVIDUAL RADIOED ELK

Elk A, a 3.5-year-old cow, was instrumented at the Lower Twin Creek trap in mid-February 1973. She was located 3 times in March, but the radio became inoperable in early April. She was not located again until April 1974, when she was sighted several times on the lower end of Horse Ridge less than 1 mile from the Lower Twin Creek trap.

Elk B, a 6.5-year-old cow, was also trapped and instrumented at the Lower Twin Creek trap in February 1973. From late March through May, she moved widely over the winter range and surrounding area, crossing the South Fork several times and utilizing an area of 15.8 square miles. Beginning in late May, her movements were restricted to the Tin Creek-Soldier Creek drainages on the west side of the South Fork. I believe she calved in the Soldier Creek drainage. She was sighted several times in June and July, always in the company of other cows and calves ranging from 2 to 12 in number. During summer, she utilized an area of 2.9 square miles with most locations occurring above 5,000 feet elevation along Bruce Ridge and near Soldier Mountain.

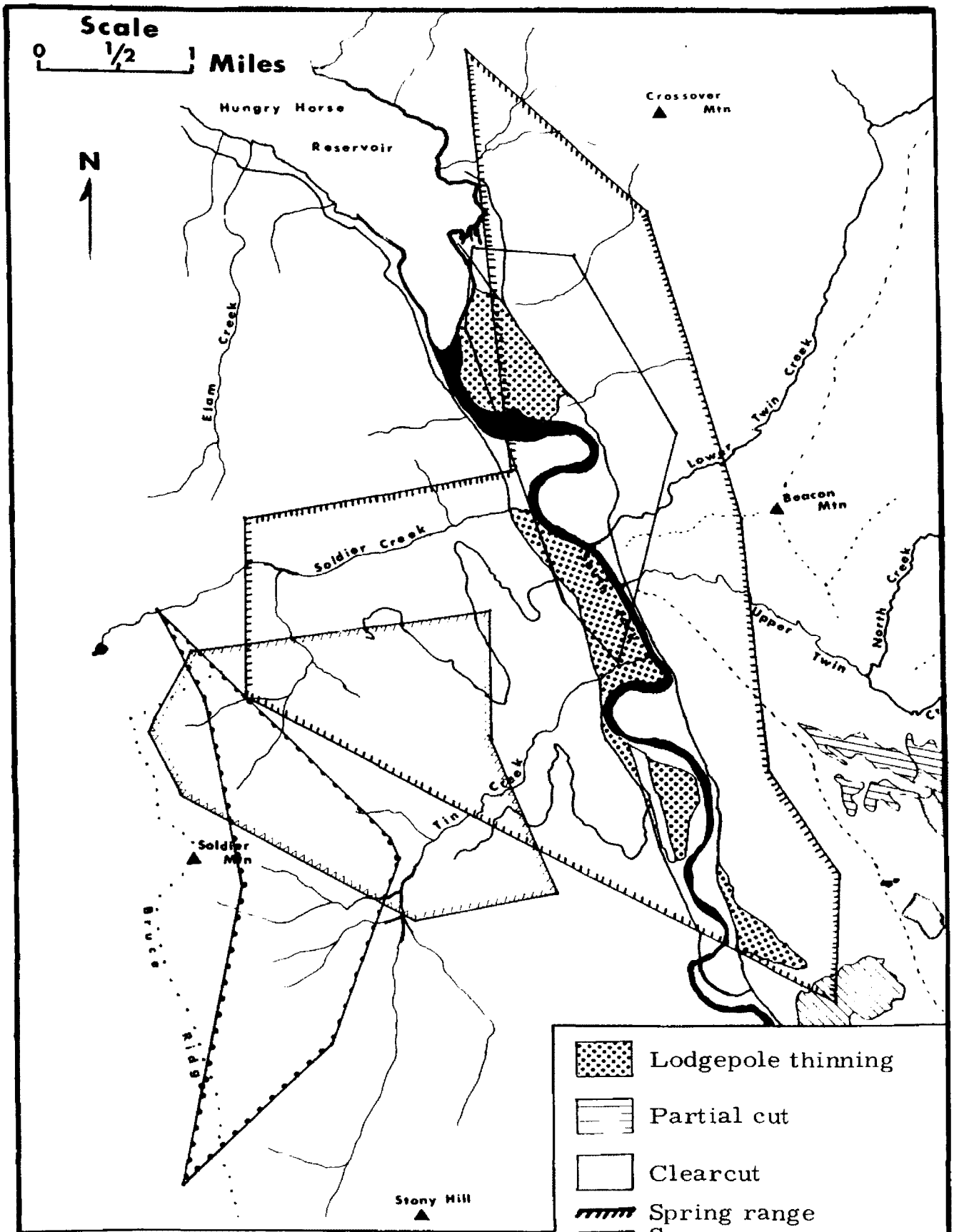

Fig. 7. Seasonal movements of elk B.

During fall, elk B moved farther into the Tin Creek basin with most locations occurring in thick lodgepole. She was first located back on the winter range on 19 December.

Elk C was trapped at the Crossover trap on 12 February 1973. She had a calf with her when she was caught, and her actions while I eartagged and neckbanded the calf led me to believe that the calf was hers. During spring, elk C ranged over an area of 11.3 square miles, moving from the Crossover area to the South Creek-Bent Creek area northeast of Horse Ridge. On 6 May she was located near Spotted Bear Lake, but flights on 11 and 14 May failed to locate her anywhere in the South Fork drainage. She was next located on 4 June in Schafer Creek, a drainage of the Middle Fork of the Flathead. This involved a move of approximately 13 airline miles from her last known location.

Elk C was located regularly throughout the summer in Soakem Basin with a cow-calf group of approximately 26 animals. Another neckbanded elk was occasionally seen in this group. The color of this neckband leads me to believe that this was the same calf (now a yearling cow) that had been trapped with elk C in February. Elk C utilized a summer area of 1.4 square miles, smallest of any of the radioed elk.

On 4 August, she made an abrupt move of about 3 miles out of her normal summering area to a point near the head of Miner Creek.

I had been in the Soakem Basin area for 2 days prior to this move, and it is possible that my presence initiated the move. On 12 August, she was located back in Soakem Basin. She remained there until mid-September, when she left her summering area and began movement back toward the winter range. This movement toward winter range was the earliest recorded for any of the radioed elk. From 27 September to 2 November, she made gradual moves toward the winter range. Movement was directed down Upper Twin Creeks. Points utilized along the way included Grouse Creek, mouth of Nanny Creek, and South Creek (Fig. 8). Her radio failed in early December; however, she was sighted twice during the winter. Both sightings were in the Crossover area within 1.5 miles of the trap where she had been caught the previous winter.

Elk D was a 3.5-year-old cow instrumented at the Lower Twin Creek trap on 22 March 1973. During April and May, she utilized an area of 2.6 square miles. She crossed the South Fork several times during this period, utilizing the area between Soldier Creek and Omega Creek most heavily. A flight on 27 May failed to locate her anywhere within the South Fork drainage. On 10 June, she was located east of the Continental Divide near Beaver Lake at the head of Muskrat Creek. This involved a move of over 25 airline miles from her last known location.

She summered in the Blue Lake-Beaver Lake area, with most

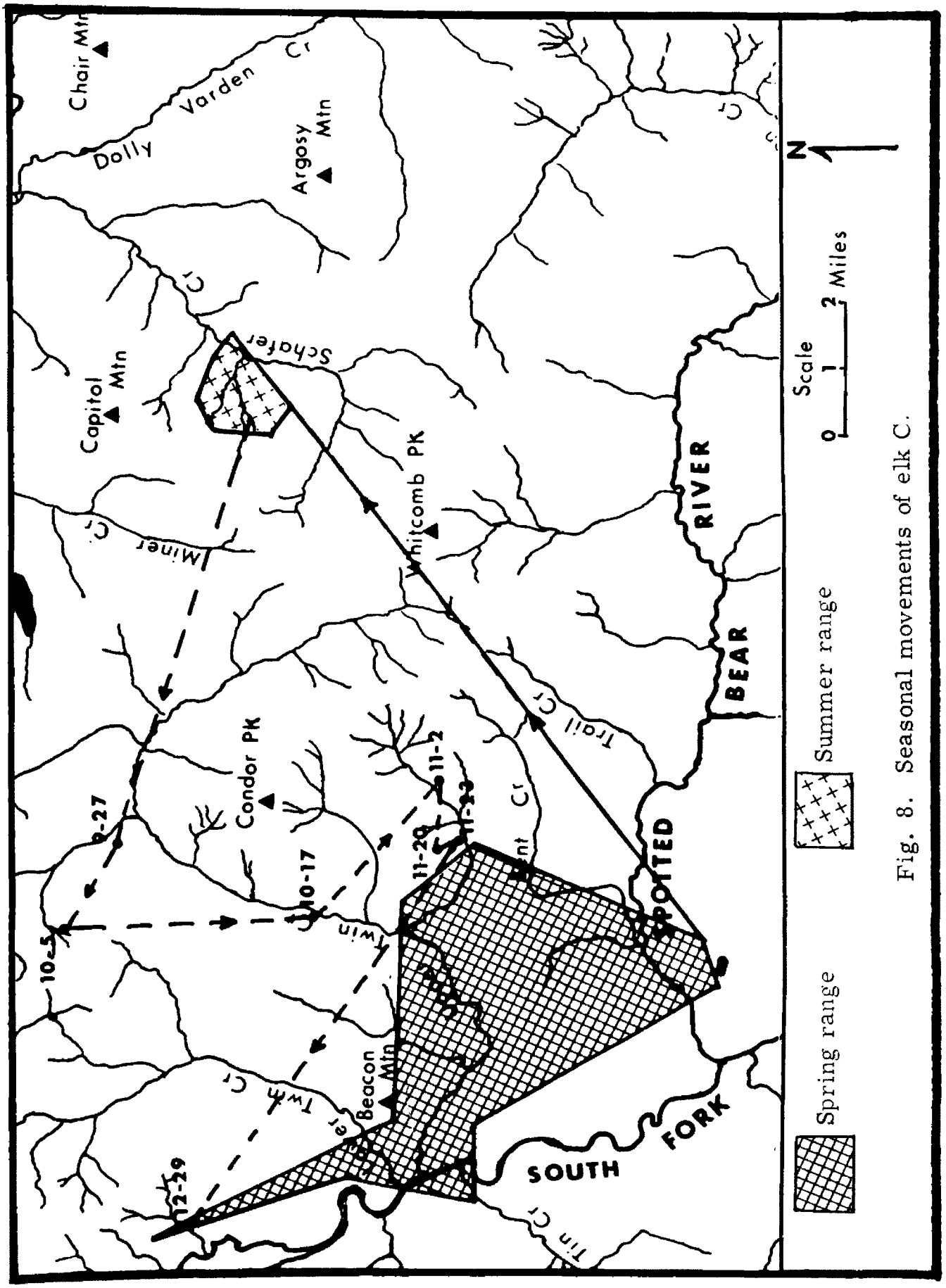

Fig. 8. Seasonal movements of elk C.

locations occurring in small drainage heads just east of the Divide. She was associated with a cow-calf group numbering up to 15 animals. In September and October she began using an area west of the Divide near the head of Lodgepole Creek. She had not used this area previously. On 2 November, she was killed near the head of Guard Creek on the Miner Creek-Upper Twin Creek divide (Fig. 9). At this time, she had moved over 11 airline miles back toward the winter range. Her radio was recovered and used again in 1974.

Elk E was caught in the Crossover trap 26 March 1973. She was estimated to be 3.5 years old. Compared to the other radioed elk, her spring movements were relatively restricted. She utilized an area of only 2.3 square miles. All spring locations were in the vicinity of Crossover Mountain with most occurring above 5,500 feet elevation. On 16 May, she moved to the east side of Crossover Mountain; on 19 May, she could not be located anywhere in the South Fork drainage. She was not located again until 10 June, when a flight placed her east of the Continental Divide at the junction of Muskrat and Elbow creeks (Fig. 10). This involved a move of over 24 airline miles. Throughout the summer she was attached to a cow-calf group of up to 22 elk which utilized the area near the head of Elbow Creek.

In late September, elk E moved into the head of Lodgepole and Drumming creeks on the west side of the Divide. This move was

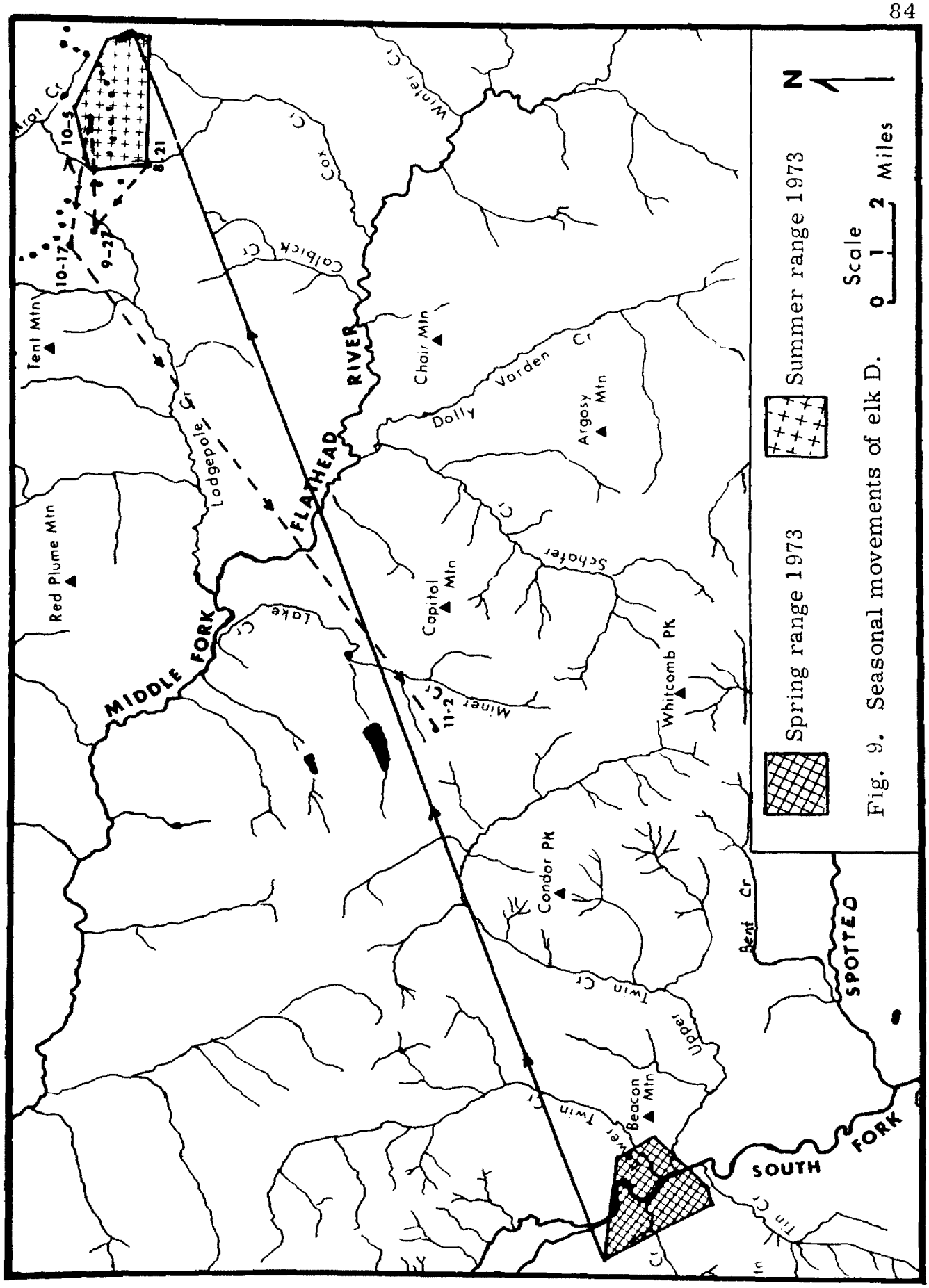

Fig. 9. Seasonal movements of elk D.

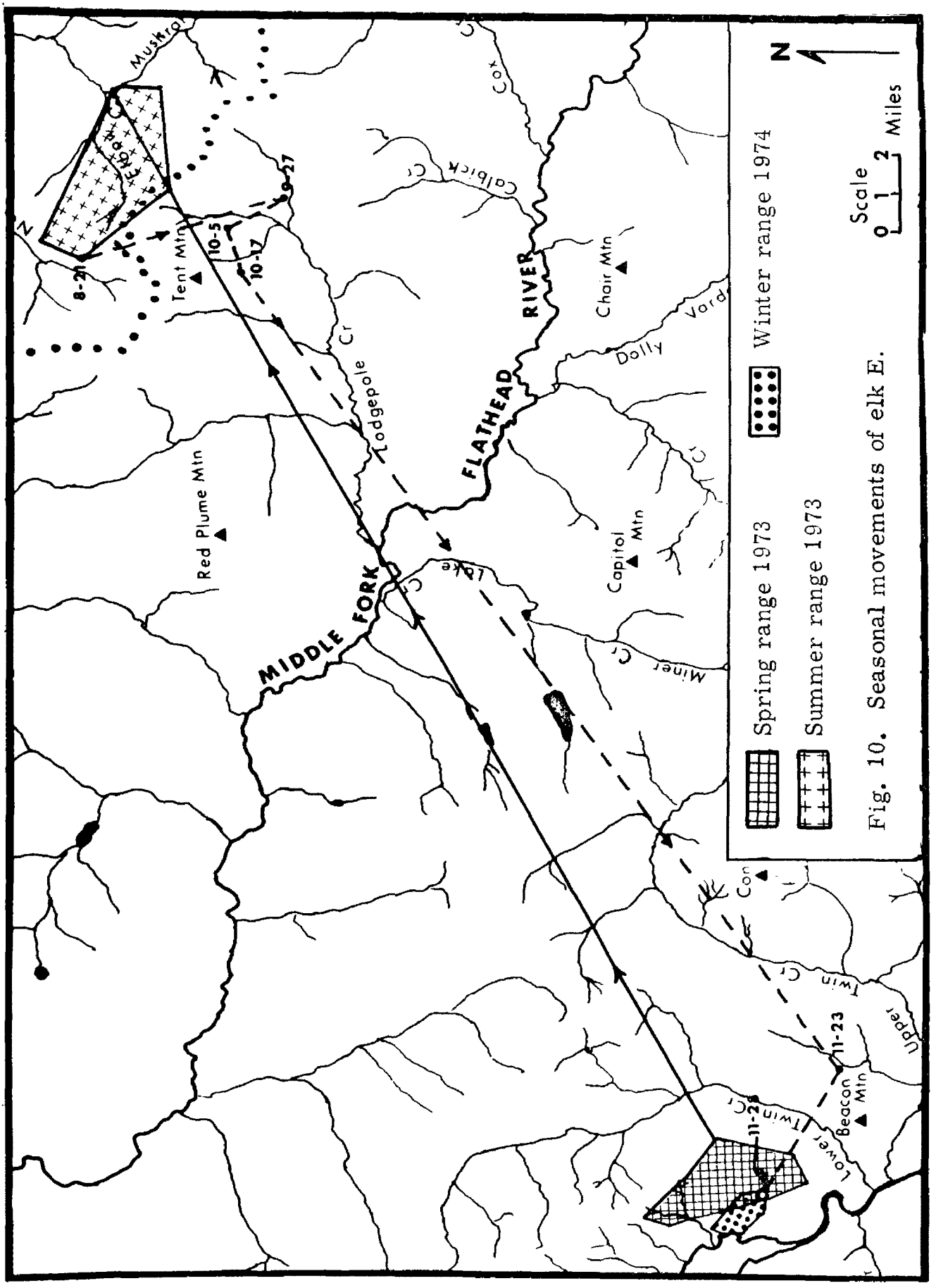

Fig. 10. Seasonal movements of elk E.

very similar to the shift noted for elk D. She remained in this area throughout October. By 23 November, she was back in the South Fork drainage in the area behind Beacon Mountain. On 28 November, she was located on the winter range very near the point of her capture the previous spring. She remained in this area throughout the winter, utilizing an area of only 0.4 square miles.

Elk F represents the resident segment of the Spotted Bear elk herd. She was captured in early April 1973 in the Horse Ridge trap. She was estimated to be 6 years old. In spring she ranged over 4.7 square miles in the Flat Creek-Bent Creek area. Her movements were more restricted in summer as she utilized an area of only 2.3 square miles. Her summering area centered around the large clearcuts in the Flat Creek area. She was usually located in uncut strips of timber between the clearcuts. Twice she was seen feeding in the cuts themselves, and it is probable that she used these cuts regularly throughout the summer. All roads leading to these cuts were closed to vehicular traffic. Elk F appeared to be very solitary. She did not have a calf and was not associated with a cow-calf group.

The fall range of elk F was over twice the size of her summering area. Increased movement in September and early October was probably associated with the mating season. However, this area was particularly accessible to hunters, and from late

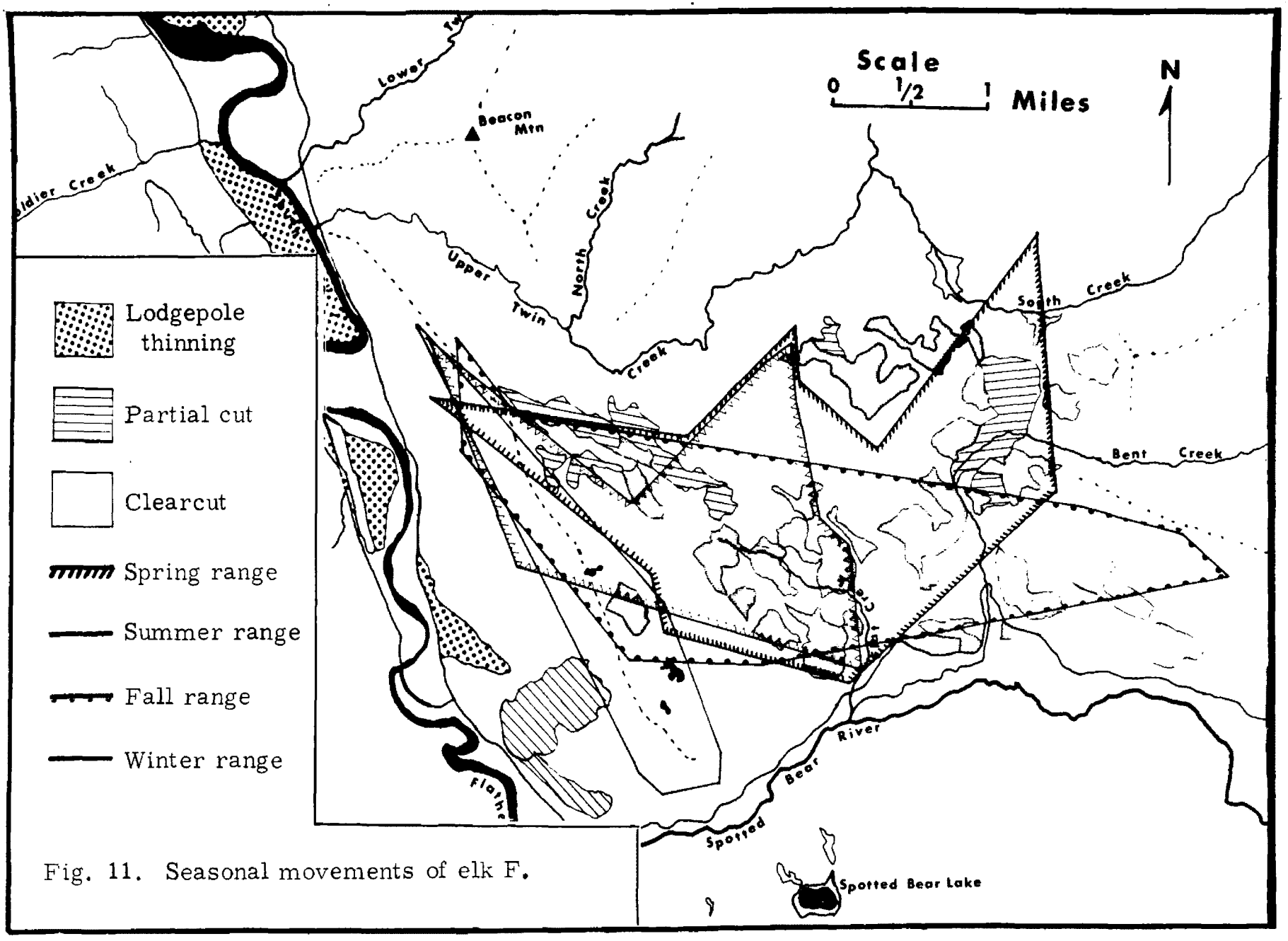

Fig. 11. Seasonal movements of elk F.

October through November, hunting pressure could also have contributed to this increased movement. Elk F wintered on the southern end of Horse Ridge. From January through March, most locations were in the vicinity of the Horse Ridge trap. In fact, she was recaptured there twice during the 1974 winter.

Elk G, a 3-year-old cow, was instrumented at the Horse Ridge trap on 8 April 1973. Following her capture, she moved up the Spotted Bear River to the area between Trail Creek and Big Bill Road. She remained in this area about a week. For the next 4 weeks she could not be located using ground-tracking methods. However, the second attempt at aerial location on 14 May, placed her on Pivot Mountain about 15 miles up the Spotted Bear River. She remained on Pivot Mountain through May, then moved laterally away from the River. She ranged widely throughout the summer, utilizing an area of over 10 square miles between Dean and Pentagon creeks. This was the largest summering area of any of the radioed elk.

Elk G did not have a calf and was not associated with any particular cow-calf group. She was seen with several different small cow-calf groups in the course of the summer, and was twice seen in the company of groups of large branch antlered bulls. She continued to use her summering area throughout the fall with no noticeable change in areas of use. Elk G remained on her summer-fall area until early December. She was first located on the winter range on

19 December. Her wintering area covered 2.1 square miles along the lower Spotted Bear River (Fig. 12).

Elk H was instrumented at the Crossover trap in mid-April 1973. Like elk F, she too remained near the winter range year-round. For much of the spring, she stayed on the west side of the South Fork in the vicinity of Omega and Soldier creeks. I believe she calved near Omega Creek early in June, then moved back to Horse Ridge in mid-June. She remained in a small area on Horse Ridge between 19 June and 20 July and was twice seen with a calf. After 20 July, she began ranging over a much larger area. She was sighted 4 times in August, but no calf was seen. In late July, I examined the area on Horse Ridge which she had used most heavily and found the remains of an elk calf. I suspect that this calf belonged to elk H and that she increased her activity following the loss of her calf.

She spent most of the September-November period on the west side of the South Fork using lodgepole stands in Elam and Tin creeks. On 23 November, she was located back on the winter range. She wintered on the lower end of Horse Ridge, using an area of 1.5 square miles.

Elk I was caught in the Horse Ridge trap on 16 April. For nearly a month following her capture, she stayed along the lower Spotted Bear River in the Bent Creek area (Fig. 14). Then she made an abrupt move up the Spotted Bear River to Pivot Mountain. She

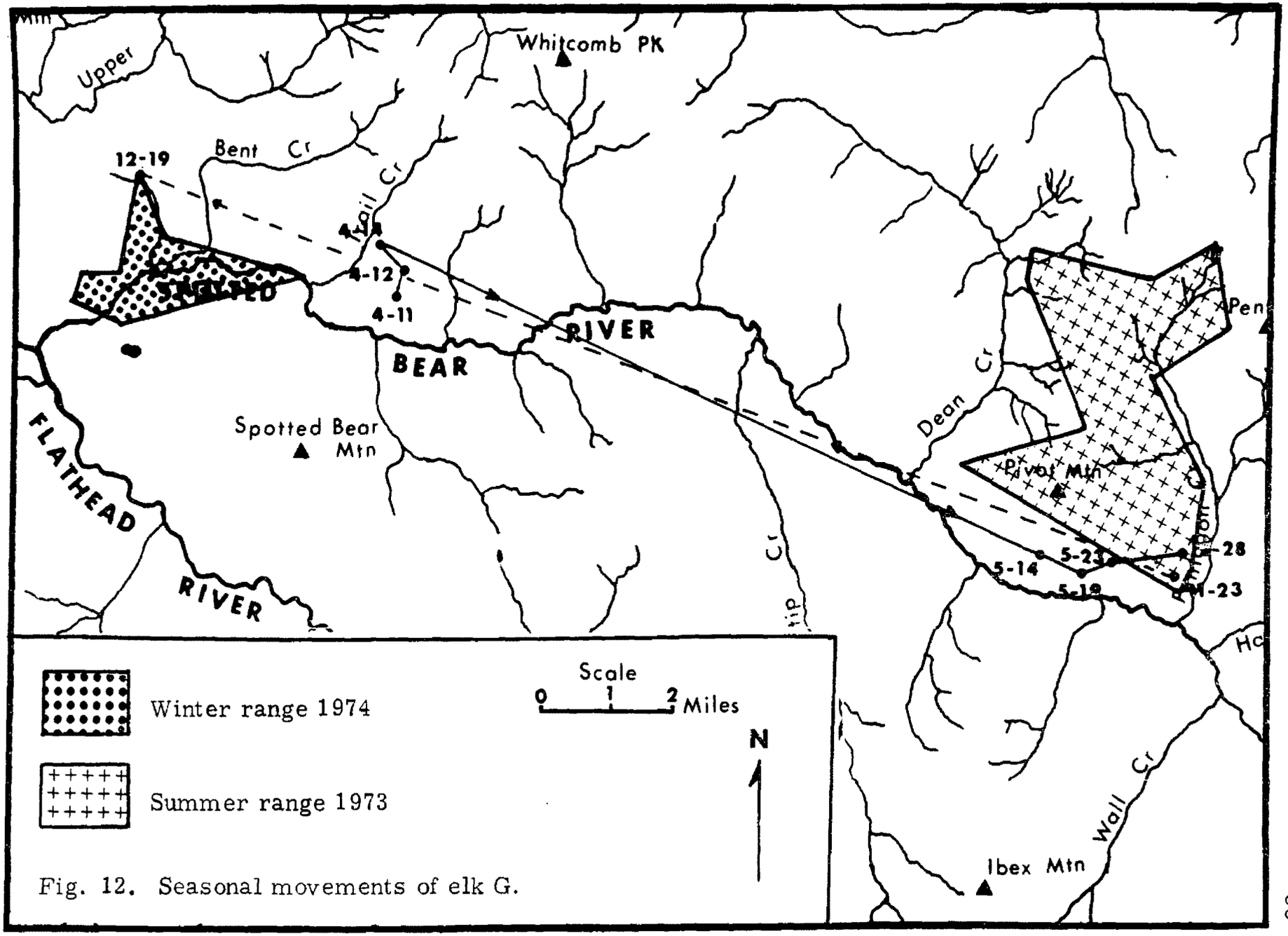

Fig. 12. Seasonal movements of elk G.

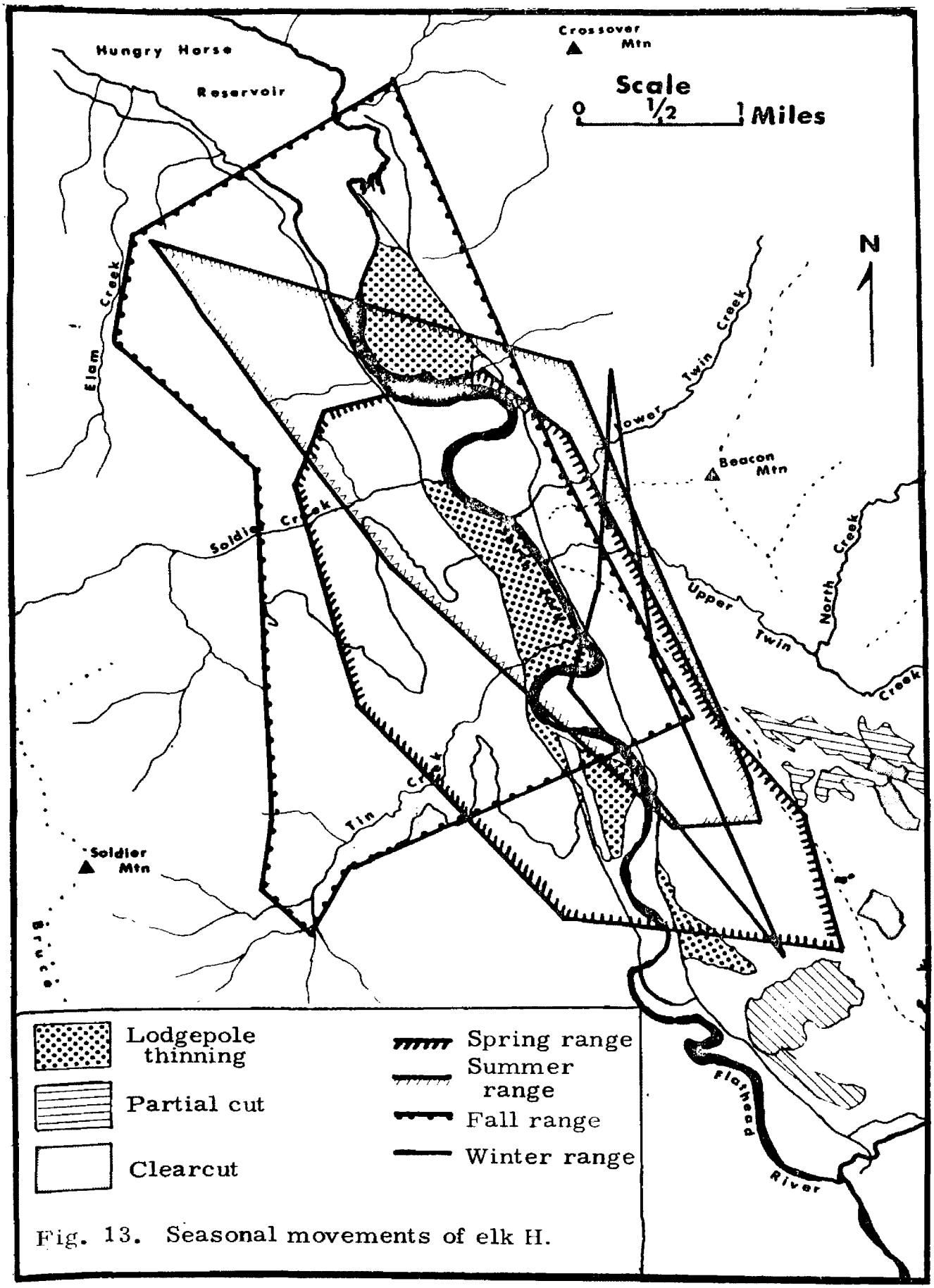

Fig. 13. Seasonal movements of elk H.

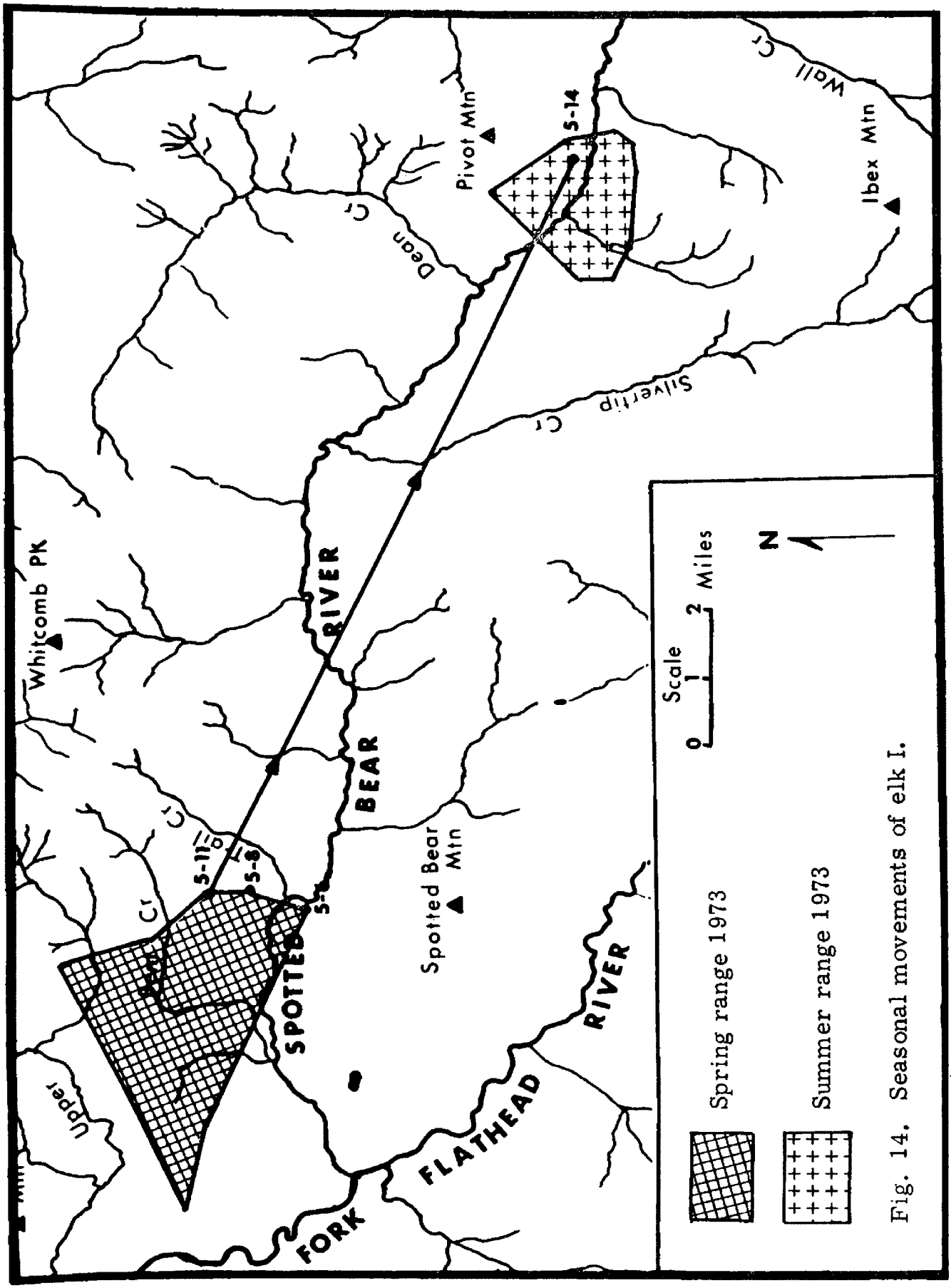

Fig. 14. Seasonal movements of elk I.

summered in this area, spending most of her time south of the Spotted Bear River in the Slim Creek area. This area was heavily timbered with few openings. She was seen only twice but was frequently located near snowslide areas and seeps. Her radio failed in September, but she was sighted back on the Horse Ridge winter range on 19 December.

Elk J was radioed at the Lower Twin Creek trap on 27 April 1973. She was estimated to be 3 years old. She spent most of May in the area behind Beacon Mountain between Upper and Lower Twin Creeks. Late in May she moved over 20 miles, travelling NE to summer in Calbick Creek in the Middle Fork of the Flathead.

Throughout June and early July elk J used large meadows in the Calbick Creek drainage. In late July and August she made more use of the timbered areas near the head of Calbick Creek. In late August she moved out of the Calbick Creek drainage into Lodgepole Creek (Fig. 15), where she remained throughout September and October using dense stands of lodgepole pine. She was located back on the winter range in mid-December. Intermediate locations indicate that she travelled down Upper Twin Creek in returning to the winter range. She wintered along the South Fork, using an area of only 1.2 square miles between Dry Park Creek and the Crossover trapsite.

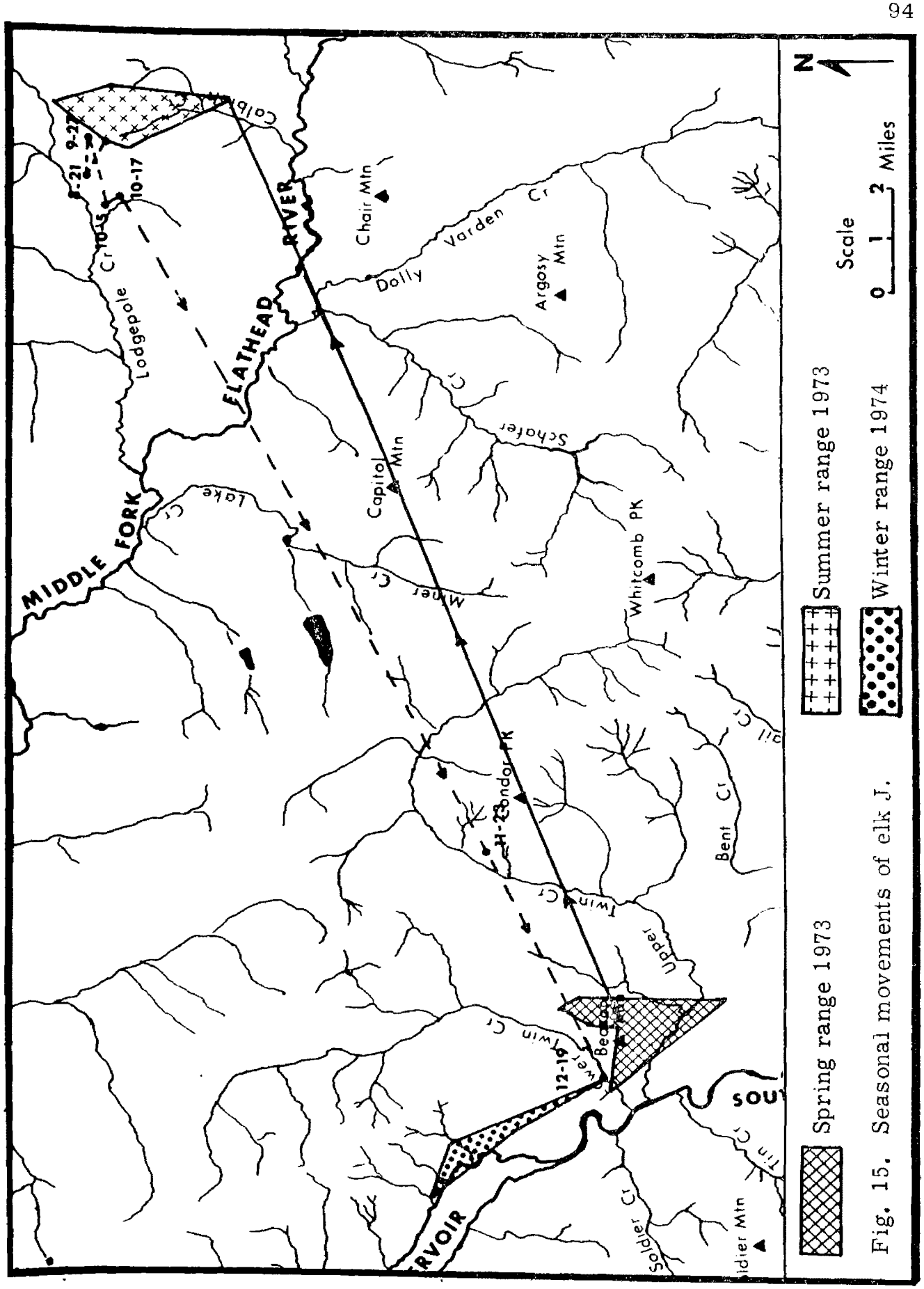

Fig. 15. Seasonal movements of elk J.

APPENDIX B

ELK TRAPPING RECORDS

TABLE 13. Elk trapped 1973

No.	Date	Trapsite[a]	Sex	Age	Eartag no.		Radio collar	Neckband
					Left	Right		
1	2/12	LTC	♀	3.5	S3924	S3925	"A"-Cochran collar	Nylon rope--5G, 1W ribbons[b]
2	2/12	LTC	♀	4.5	S3922	S3923	No	White--4 inches wide
3	2/12	LTC	♀	6.5	S3920	S3921	"B"-Yellow acrylic	White--4 inches wide
4	2/13	HR	♂	0.5	S3918	S3919	No	Nylon rope--4O, 4G ribbons[b]
5	2/13	HR	♀	4.5	S3928	S3927	No	Nylon rope--5W, 1B ribbons[b]
6	2/13	LTC	♀	3.5	S3929	S3930	No	White--4 inches wide
7	2/13	LTC	♀	4.5	S3932	S3931	No	None
8	2/15	HR	♀	1.5	S3934	S3933	No	White with red stripe
9	2/15	HR	♀	3.5	S3936	S3935	No	White with red stripe
10	2/16	C	♀	6.5	S3937	S3938	No	White with blue stripe
11	2/16	C	♀	0.5	S3950	S3949	No	White with blue stripe
12	2/16	C	♀	?	S3947	S3948	"C"-Yellow acrylic	White with blue stripe
13	3/22	LTC	♂	0.5	S3941	S3942	No	White--4 inches wide
14	3/22	LTC	♀	3.5	S3943	S3940	"D"-Pipe collar	None
15	3/26	C	♀	3.5	S3926	S3946	"E"-Pipe collar	Yellow--4 inches wide
16	4/6	LTC	♂	0.5	S3952	S3951	No	White--4 inches wide

TABLE 13. (continued)

No.	Date	Trapsite[a]	Sex	Age	Eartag no.		Radio collar	Neckband
					Left	Right		
17	4/7	HR	♀	6	S 3953	S 3954	"F"-Pipe collar	White with red stripe
18	4/8	HR	♀	2.5	S 3957	S 3956	"G"-Pipe collar	Red--5 inches wide
19	4/10	C	♀	3.5	S 3959	S 3960	"H"-Pipe collar	Yellow--4 inches wide
20	4/13	HR	♀	0.5	S 3962	S 3961	No	Red--4 inches wide
21	4/13	HR	♂	0.5	S 3964	S 3963	No	White with red stripe
22	4/16	HR	♀	6	S 3944	S 3945	"I"-Yellow acrylic	Red--5 inches wide
23	4/16	HR	♀	1.5	S 3965	S 3966	No	Red--5 inches wide
24	4/18	C	♀	10	S 3967	S 3968	No	Yellow--4 inches wide
25	4/18	C	♀	7	S 3969	S 3970	No	Yellow--4 inches wide
26	4/29	LTC	♀	2.5	S 3973	S 3974	"J"-Pipe collar	White--4 inches wide
27	5/3	HR	♂	.4	S 3976	S 3977	No	None
28	5/4	HR	♂	0.5	S 3978	S 3979	No	Red--4 inches wide
29	5/12	HR	♀	5	S 3980	S 3981	No	Red--4 inches wide
30	5/12	HR	♀	1.5	S 3983	S 3984	No	Red--4 inches wide
31	5/17	HR	♀	3.5	S 3985	S 3986	No	Red--5 inches wide
32	5/17	HR	♀	1.5	S 3987	S 3988	No	Red--5 inches wide
33	5/17	HR	♂	1.5	S 3989	S 3990	No	Red--5 inches wide
34	5/20	C	♂	1.5	S 3932	S 3931	No	Yellow--4 inches wide
35	5/22	HR	♀	1.5	S 3993	S 3994	No	Red--5 inches wide

TABLE 13. (continued)

No.	Date	Trapsite[a]	Sex	Age	Eartag no.		Radio collar	Neckband
					Left	Right		
36	5/23	HR	♂	1.5	S 3995	S 3996	No	Red--5 inches wide
37	5/25	HR	♀	3	S 3975	S 3982	No	White with red stripe
38	5/25	HR	♂	3	S 3997	S 3998	No	White--4 inches wide
39	5/26	HR	♀	0.5	S 3999	S 4000	No	White with red stripe

[a]C = Crossover trap; HR = Horse Ridge trap; LTC = Lower Twin Creek trap.

[b]B = blue; G = green; O = orange; W = white.

TABLE 14. Elk trapped winter 1974

No.	Date	Trapsite[a]	Sex	Age	Eartag no.		Radio collar	Neckband
					Left	Right		
1	1/12	HR	♀	0.5	A1052	A1051	No	Red with white blocks
2	1/21	HR	♀	5.5	A1053	A1054	No	Red with white blocks
3	1/21	HR	♂	1.5	A1055	A1056	No	Red with white blocks
4	2/8	HR	♀	0.5	A1057	A1058	No	Red with white blocks
5	2/8	HR	♂	0.5	A1059	A1060	No	Red with white blocks
6	2/9	HR	♂	0.5	A1061	A1062	No	Red with white blocks
7	2/9	HR	♀	3.5	A1063	A1064	"K"-Pipe collar	Red with white blocks
8	2/10	HR	♀	3.5	A1065	A1067	"L"-Pipe collar	Red with white blocks
9	2/11	HR	♀	4.5	A1066	A1069	No	Red with white blocks
10	2/11	LTC	♀	8.5	A1068	A1070	"M"-Pipe collar	Blue with white blocks
11	2/13	HR	♀	10	A1071	A1072	No	Red with white blocks
12	2/14	HR	♀	3.5	A1073	A1074	No	Red with white blocks
13	2/14	HR	♀	4.5	A1075	A1076	No	Red with white blocks
14	3/8	HR	♀	4.5	A1077	A1078	No	Red with white blocks
15	3/9	HR	♂	0.5	A1079	A1080	No	Red with white blocks
16	3/10	HR	♀	4.5	A1081	A1082	No	Red with white blocks
17	3/10	HR	♀	3.5	A1083	A1084	No	Red with white blocks
18	3/12	HR	♀	10+	A1085	A1086	No	Red with white blocks
19	3/12	SBL	♀	5.5	A1087	A1088	"N"-Pipe collar	Yellow with blue stripe
20	3/12	SBL	♂	0.5	A1089	A1090	No	Yellow with blue stripe
21	3/13	HR	♂	0.5	A1091	A1092	No	Red with white blocks

TABLE 14. (continued)

No.	Date	Trapsite[a]	Sex	Age	Eartag no.		Radio collar	Neckband
					Left	Right		
22	3/13	HR	♀	5.5	A1093	A1094	No	Red with white blocks
23	3/15	SBL	♀	4.5	A1095	A1096	"O"-Pipe collar	Yellow with blue stripe
24	3/15	SBL	♀	10	A1097	None	"P"-Pipe collar	Yellow with blue stripe
25	3/15	SBL	♀	0.5	A1098	None	No	Yellow with blue stripe
26	3/20	HR	♀	4.5	A1099	A1100	No	Red with white blocks
27	3/24	HR	♀	7.5	A1101	A1102	No	Red with white blocks
28	3/24	HR	♀	5.5	A1103	A1104	No	Red with white blocks
29	3/24	SBL	♂	0.5	A1105	A1106	No	Yellow with blue stripe
30	3/25	HR	♀	1.5	A1107	A1108	No	Red with white blocks
31	3/27	LTC	♂	0.5	A1109	A1110	No	Blue with white blocks
32	3/27	LTC	♂	0.5	A1111	A1112	No	Blue with white blocks
33	3/28	HR	♀	9	A1113	A1114	No	Red with white blocks
34	4/5	HR	♀	3.5	A1115	A1116	"Q"-Pipe collar	Red with white blocks
35	4/5	HR	♀	3.5	A1118	A1117	No	Red with white blocks

[a]HR = Horse Ridge trap; LTC = Lower Twin Creek trap; SBL = Spotted Bear Lake trap.