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SEASONAL MOVEMENTS OF THE  
BURDETTE CREEK ELK HERD

By

Helmut M. Zahn

B.S., University of Louisville, 1971

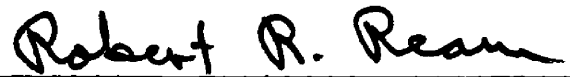
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Master of Science

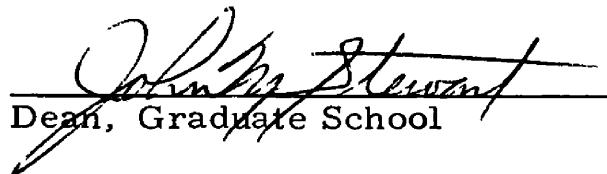
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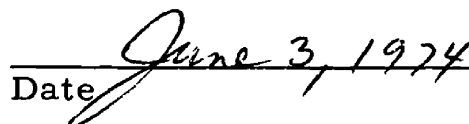
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Zahn, Helmut M., M.S., June 1974

Wildlife Biology

Seasonal Movements of the Burdette Creek Elk Herd

Director: Dr. Robert R. Ream

RRR

Eleven elk, four in 1972 and seven in 1973, were radio-tagged in the area of the Burdette Creek winter range approximately 30 miles west of Missoula, Montana. Transmitters used operated in the 164 MHz range and were tracked using fixed-wing aircraft and methods of ground triangulation. During July and August 1972, three transmitters were located 23 times. From May to December 1973, seven transmitters furnished 177 elk locations.

All but one of the 11 instrumented elk left the area of the winter range between late May and early June. Distances moved from the winter range varied from 4.5 to 20 airline miles. Calving seems to have occurred around 1 June. It was not confined to either winter or summer ranges exclusively. Summer-fall ranges varied from 2.8 to 35 square miles, being largest for bulls and cows without calves. During the summer-fall period, habitat types in the subalpine fir zone received heaviest use. Elk sightings were few in June and increased sharply for July when cow-calf groups of over 20 animals were frequently seen. Although fall ranges were nearly identical to those used during the summer of the adult cow group, some cows displayed a shift to an adjacent area in early September. Movements on summer-fall ranges by cows with calves were gradual while those of bulls and one cow without a calf were often irregular. All surviving instrumented elk returned to the Burdette Creek winter range. Return movements were related to the first heavy snowstorm of the season.

Recommendations included managing the Burdette Creek drainage as critical winter range and investigating the possibility of using road closures to achieve greater elk utilization of forage on clearcuts.

## ACKNOWLEDGMENTS

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Special thanks go to Dr. James Maddox for allowing the trap to be built on his property and to Mr. Gene Herndon for the use of one of his cabins.

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## TABLE OF CONTENTS

	Page
LIST OF TABLES . . . . .	v
LIST OF FIGURES . . . . .	vi
CHAPTER	
I. INTRODUCTION . . . . .	1
Objectives . . . . .	4
II. STUDY AREA . . . . .	6
Location . . . . .	6
Physiography . . . . .	6
Climate . . . . .	8
Vegetative Types . . . . .	10
III. MATERIALS AND METHODS . . . . .	14
Radiotelemetry . . . . .	14
Trapping and Tagging . . . . .	14
Locating Radioed Elk . . . . .	18
Evaluation of Data . . . . .	21
IV. RESULTS AND DISCUSSION . . . . .	24
Radio Performance . . . . .	24
General Use of Area . . . . .	24

CHAPTER	Page
Seasonal Movements . . . . .	25
Seasonal Habitat Uses . . . . .	26
Summer and Fall Ranges . . . . .	37
Individual Elk Movements . . . . .	39
Elk Locations and Human Activities . . . . .	59
Population Data . . . . .	61
Harvest of Tagged Elk . . . . .	62
V. CONCLUSIONS AND RECOMMENDATIONS . . . . .	63
VI. SUMMARY . . . . .	66
LITERATURE CITED . . . . .	68

LIST OF TABLES

TABLE	Page
1. Summary of instrumented elk data . . . . .	15
2. Percentage of elk locations with respect to habitat type by month from May- December 1973 . . . . .	27
3. Percentage of elk locations with respect to percent slope and canopy cover by month from May-December 1973 . . . . .	28
4. Percentage of elk locations with respect to aspect by month from May-December 1973 . . . . .	29
5. Monthly distribution of elk by elevation May-December 1973 . . . . .	30



## LIST OF FIGURES

Figure	Page
1. Location of study area . . . . .	7
2. Wig Creek elk trap . . . . .	16
3. Elk 4 leaving trap (1 May 1973) . . . . .	16
4. Movements of Elk B and C . . . . .	41
5. Movements of Elk D . . . . .	42
6. Movements of Elk 1 . . . . .	43
7. Movements of Elk 2 . . . . .	46
8. Movements of Elk 3 . . . . .	48
9. Movements of Elk 4 . . . . .	50
10. Movements of Elk 5 . . . . .	52
11. Movements of Elk 6 . . . . .	54
12. Movements of Elk 7 . . . . .	56
13. Irish Basin summer range . . . . .	57
14. Drainage head in Irish Basin . . . . .	57
15. AF/Mefe habitat type in E. F. Indian Creek . . . . .	58
16. AF/Mefe habitat type in Cedar Log Creek . . . . .	58

## CHAPTER I

### INTRODUCTION

Elk are the most sought-after big game in western Montana. Rocky Mountain elk (Cervus canadensis nelsoni Bailey) neared extinction in parts of western Montana at the turn of the century, surviving only in the area around Yellowstone National Park, along the Continental Divide and in a few isolated mountain areas (Rognrud and Janson 1971). Transplants and hunting season closures caused elk populations to increase and by the mid-1950's, western Montana became one of the prime elk-producing areas in the nation. They provide countless hours of recreation to sportsmen and nonconsumptive users such as hikers and outdoor photographers. Being large mobile mammals, elk require large tracts of land for their support. In western Montana and adjacent areas, most of the elk habitat is on national forests or other land which is managed primarily for timber production.

During the last decade, timber harvests in western Montana increased substantially compared with previous periods. The concern, by a number of public agencies, over the possible impact of increased logging activities on elk populations led, in 1970, to the formation of

the Montana Cooperative Elk-Logging Study. Study areas were chosen in western Montana where various aspects of elk ecology and the impact of logging would be investigated. The Burdette Creek winter range in the Clark Fork Management Unit was one of the areas chosen.

Burdette Creek and parts of adjacent drainages support a wintering herd of at least 200 elk (Fish and Game Department records). These animals can be readily counted from the air during winter. As summer approaches, elk become difficult to observe because they use the heavily timbered habitats surrounding the open winter range. Consequently little quantitative data on dispersal distances and seasonal habitat selections were available. Joseph Bohne, a graduate student investigating food habits in the study area (1970-1972), obtained some seasonal distributional data in areas immediately adjacent to the winter range; however, since elk were not marked during that time, he could only speculate on seasonal movements.

To fully understand the ecology of any animal requires knowledge of the animal's movement patterns (Tester and Siniff 1965). Since observations of animals under natural conditions are often difficult, indirect methods for gathering data were used until recently.

Anderson (1953) described the use of metal ear tags in determining seasonal movements of elk in the Jackson Hole area;

however, only 18.5 percent of all tags were returned and the locations of kills were not always clear.

The large-scale use of colored neckbands made it possible to collect data on a year-around basis rather than having to rely on tag returns during fall hunting seasons. Often the public was alerted to the existence of neck-banded elk and asked to cooperate by reporting all sightings (Denney 1965). Harper and Lightfoot (1966) described the types of different materials used for neckbands, and Knight (1966) commented on the reliability with which differently colored neckbands could be identified from the air, allowing for individual or group identification. Craighead et al. (1969) described a neck-banding technique that allowed for recognition of up to 9,000 individual elk.

Other indirect methods used in determining seasonal movements and distributions of elk included hunter interviews (Robel 1960), periodic pellet group counts (Dalke et al. 1965a) and periodic aerial counts (Robel 1960a).

When contrasted with simple neck-banding and ear-marking techniques, the advantages of radio-tagging are obvious. Provided the transmitter is functioning properly, it is possible to locate the instrumented animal at any time, even in areas where terrain and vegetative cover preclude normal visual observations. Studies of neck-banded elk have indicated heavy uses of open terrain to the

apparent exclusion of timbered habitats (Harper 1964).

During the last decade, biotelemetric equipment has become increasingly sophisticated and reliable. In early investigations transmitter failures were frequent (Marchinton and Jeter 1966). It is now possible to obtain data for at least a 1-year period from transmitters of the type used in big game studies (Ream et al. 1972). Consequently, the amount of data one can reasonably expect from a transmitter justifies the initial purchase price. Biotelemetric studies have been conducted successfully on such big game species as grizzly bear (Ursus arctos) (Craighead et al. 1963), moose (Alces alces) (Phillips et al. 1973), and mountain lion (Felis concolor) (Seidensticker et al. 1973).

In this study the seasonal movements of elk were investigated by radiotracking instrumented animals. Data were gathered primarily from July through September 1972 and from May through December 1973.

### Objectives

The primary objectives of this study were to determine seasonal distributions and movements of the Burdette Creek elk herd by studying a radio-tagged segment of that herd. Specifically, this included determining whether tagged elk left the winter range for distinct summer ranges, the time of such movements, the direction

and distance of dispersal, and the uses of habitat types throughout summer and fall. Secondary objectives included investigating the possibility of preferred calving areas and obtaining cow:calf and male:female ratios.

## CHAPTER II

### STUDY AREA

#### Location

The Burdette Creek winter range is located approximately 30 miles west of Missoula in the South Fork of Fish Creek drainage. The area is located within the Bitterroot Range (Fenneman 1931) on the Lolo and Clearwater National Forests (Fig. 1).

The winter range used by elk during this study occupied approximately 25 square miles. The total area utilized by marked elk during summer and fall was in excess of 150 square miles and extended from the Petty Creek drainage (Missoula County, Montana) to the Kelly Creek drainage (Clearwater County, Idaho).

#### Physiography

Elevations in the study area range from less than 4,000 feet along Fish Creek Road to over 7,000 feet along parts of the Idaho Divide. Most of the region is rough and steep with numerous slopes in excess of 50 percent.

The area is well roaded with access being provided by the Fish and Petty creek roads and numerous logging roads in the

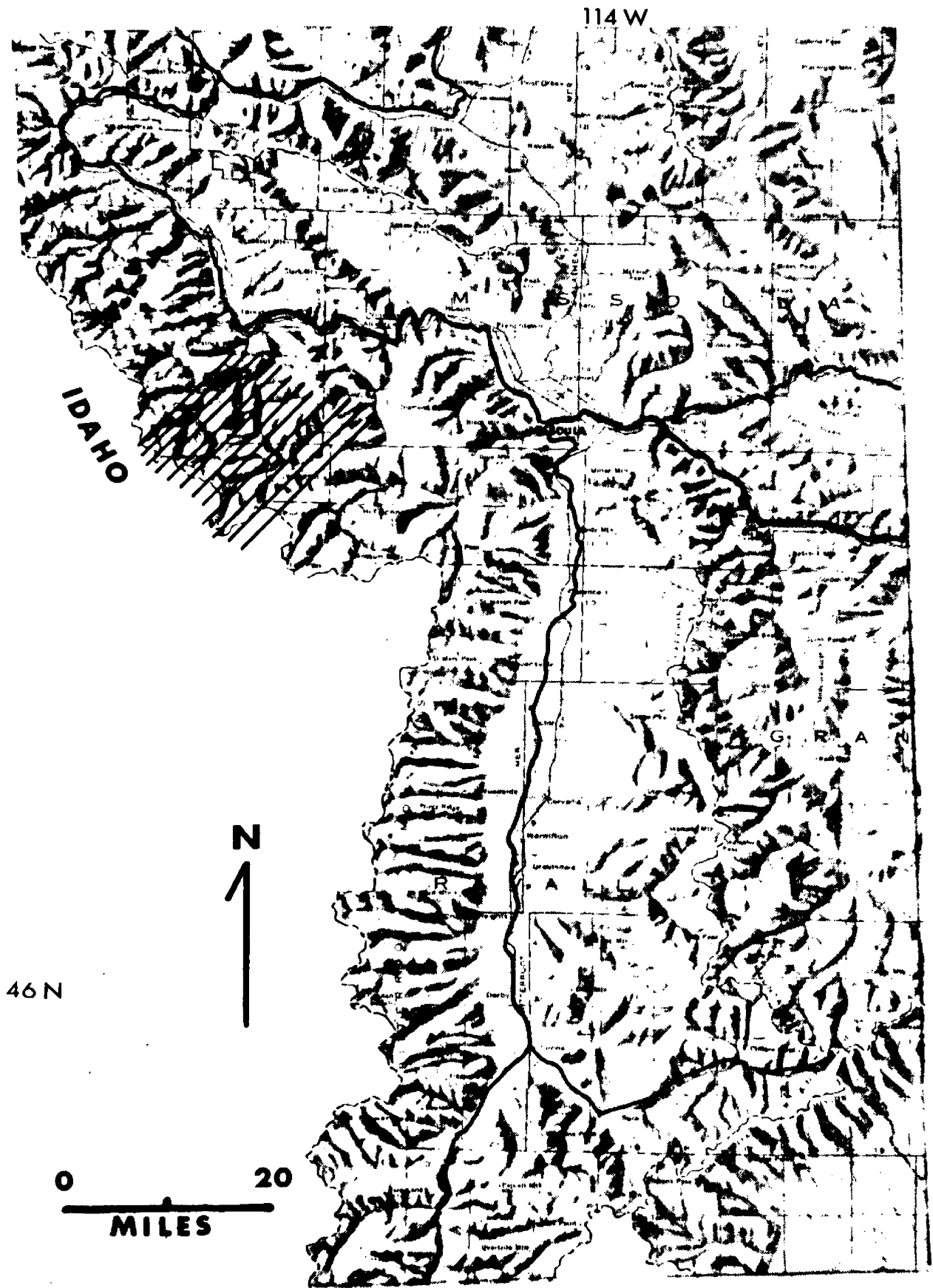


Fig. 1. Location of study area.



tributary drainages. Sizable unroaded sections occur in the higher elevations along the Idaho Border.

The bedrock geology of the area consists mainly of metamorphic Precambrian rock of the Belt series (Perry 1962). This merges into the rather large granitic Idaho batholith in upper Cache Creek and along the Idaho line.

Evidence of glaciation during the late Pleistocene is found at higher elevations west of the South Fork of Fish Creek. Characteristic of the area are bowl-shaped drainage-heads known as cirques and straight U-shaped valleys, both the result of glacial action (D. Winston, pers. comm.). Cirques frequently contain small, round lakes (tarns) such as Cedar Log and Surveyor lakes. Since neither the continental nor the cordilleran ice sheet extended this far south, glacial action was of the alpine variety.

### Climate

The climate is primarily dominated by Pacific weather systems. These maritime air masses are not only the source of considerable moisture, but also the reason for the rather moderate temperature regimes found throughout western Montana.

Occasionally a large high pressure system to the north blocks the normal westerly flow of air and causes an influx of dry continental air. In winter, this is the cause of periods of very cold

temperatures; however, it occurs most frequently during July and August, making these the driest and warmest months of the year.

The closest weather station is near Lolo Hot Springs, approximately 7 miles southeast of Burdette Creek. Temperatures and precipitation amounts recorded at the station are similar to those occurring at lower elevations on the winter range (U.S. Weather Bureau). Climatological data represents 6 year averages for the period 1968 through 1973.

Total annual moisture averages 26 inches, 42 percent of which falls as snow during December and January. A minor precipitation peak occurs in June, while July and August are the driest months, together accounting for only 8.8 percent of annual precipitation.

The higher elevations of the Bitterroot Range along the Idaho Divide receive 48 inches or more of moisture annually and snow accumulations frequently exceed 10 feet (U.S. Weather Bureau). This moisture gradient has a pronounced effect on the distribution of plant communities throughout the area.

Annual mean temperature for Lolo Hot Springs averages 41°F (5°C). January is the coldest month and August the warmest with average temperatures of 21.3°F (-6°C) and 62.1°F (16.7°C), respectively. The highest temperature was recorded on 23 August 1969 at 105°F (40.5°C) and the lowest on 30 December 1968 at

-35°F (-37.2°C). Freezing temperatures occur during all months.

### Vegetative Types

Most of the study area, with the exception of old burns, is covered by thick stands of timber. Densest growth occurs on north-facing slopes and along stream bottoms whereas south slopes are more sparsely timbered. Two major vegetational zones, based on the climax tree species, occur in the area. Species nomenclature is that of Hitchcock and Cronquist (1973). The Douglas-fir (Pseudotsuga menziesii) zone is the most important one in terms of total area, while the subalpine fir (Abies lasiocarpa) zone is confined to the higher elevations (Lyon 1973). The occurrence of these two broad vegetational zones reflects macroclimatic differences within the area but does not follow along a strict elevational gradient. Douglas-fir, on exposed sites, reaches high into the upper zone, while in protected ravines, subalpine fir communities extend down-slope. Some of the deep, moist canyons within the Douglas-fir zone contain small stands of Western red cedar (Thuja plicata).

The two major vegetational zones are not uniform and can be subdivided on the basis of their understories. Microclimatic and edaphic variations are reflected in the shrub and herb layers (Daubenmire and Daubenmire 1968). On the basis of understory dominance, Pfister et al. (1972) described eight Douglas-fir and

eight subalpine fir habitat types for western Montana. Some of these types are widely distributed throughout the area.

Within the Douglas-fir zone, the habitat type characterized by a dominance of bear grass (Xerophyllum tenax) in the understory is most common. This high-elevation representative of the Douglas-fir zone is found on cool, dry slopes. At slightly lower elevations and on moister sites is the ninebark (Physocarpus malvaceus) habitat type which is replaced on drier sites, particularly those with west aspects, by the snowberry (Symphoricarpos albus) habitat type. Shrub species common to all three types include serviceberry (Amelanchier alnifolia), mountain maple (Acer glabrum), evergreen ceanothus (Ceanothus velutinus) and shiny-leaf spirea (Spirea betulifolia).

Three other Douglas-fir habitat types are found throughout the area but their distributions are limited. The pinegrass (Calamagrostis rubescens) type is usually confined to cool, dry ridge tops and includes such species as Oregon grape (Berberis repens) and heartleaf arnica (Arnica cordifolia). Dwarf huckleberry (Vaccinium caespitosum) and kinnikinnick (Arctostaphylos uva-ursi) habitat types require warm, well-drained sites such as gentle slopes and benches. For a complete description of floral composition of all habitat types see Pfister et al. (1972).

On some xeric sites in the Douglas-fir zone, such as ridge tops and south exposures, ponderosa pine (Pinus ponderosa) seems to

be co-dominant (Habeck 1967). Here the understory is dominated by bluebunch wheatgrass (Agropyron spicatum) and Idaho fescue (Festuca idahoensis). On most other sites, ponderosa pine may be a major seral species except on mesic north and east exposures where western larch (Larix occidentalis) is found.

East of the South Fork of Fish Creek the subalpine fir zone is confined to small areas of high elevation and favorable aspect, especially along the Petty Creek-Fish Creek Divide and in the vicinity of Wig Mountain. West of the South Fork of Fish Creek, in the upper Montana and Surveyor creek drainages, subalpine fir communities dominate to the total exclusion of Douglas-fir habitats.

Along stream bottoms in the subalpine fir zone the queen's cup (Clintonia uniflora) habitat type is common and Engelmann spruce (Picea engelmannii) is frequently found. Shrubs include prickly currant (Ribes lacustre) and thimbleberry (Rubus parviflorus).

The fool's huckleberry (Menziesia ferruginea) habitat type has the widest distribution, dominating all cool aspects, but it is replaced on warmer sites by beargrass in the understory. These two types often form broad ecotones on relatively uniform slopes (Pfister et al. 1972). Where the forest canopy is open, dense Sitka alder (Alnus sinuata) thickets are present. Common forbs of subalpine communities include mountain arnica (Arnica latifolia) and prince's pine (Chimaphila umbellata).

No description of vegetative types in the study area would be complete without mentioning the evidence of past fires. During the early 1900's, forest fires swept through large sections of the Lolo and Clearwater National Forests. Repeated burnings eliminated seed sources and many sub-climax shrub communities were created. The Burdette Creek winter range is the result of a large fire in 1917 (Bohne, pers. comm.). On many mesic sites, timber stands have re-invaded the burns and shaded out the understory; shrub and bunch-grass communities have maintained themselves on the more xeric sites. Further evidences of past fires are the large stands of seral lodgepole pine (Pinus contorta) in the area of the "big burn" along the Idaho Divide.

## CHAPTER III

### MATERIALS AND METHODS

#### Radiotelemetry

Eleven elk were instrumented with pulsing transmitters in the 164 MHz range. Animals marked in 1972 were designated by letters (A through D) and those in 1973 by numbers (1 through 7). For a list of all tagged elk see Table 1. One transmitter was returned by a sportsman after Elk D was shot in Idaho. This radio was attached to Elk 5 on 1 May 1973.

#### Trapping and Tagging

Elk A, B and C were tagged in the Burdette Creek drainage after being darted from a helicopter using the neuromuscular blocking agent succinylcholine chloride. All other animals were trapped and tagged in a corral-type trap built near the Wig Creek Lodge by the Montana Department of Fish and Game (Fig. 2). The trap was located adjacent to the Burdette Creek winter range and a private road leading to the site facilitated daily checking of the trap.

The trap was baited with hay and a salt block. Use of the trap was sporadic throughout winter with no use in March. Starting in

TABLE 1. Summary of instrumented elk data

Elk	Sex	Approx. age	Date & location tagged	Date of last radio fix	Summer-fall area (sq. mi.)	Max. distance moved (mi.)
A	♀	adult	4/27/72 Burdette Cr.	6/ 9/72	?	?
B	♀	adult	3/24/72 Burdette Cr.	8/11/72	2.8	5.0
C	♀	adult	4/20/72 Burdette Cr.	8/11/72	8.1	4.5
D	♂	2	5/31/72 Wig Cr.	8/22/72 shot 10/31/72	16.0	13.0
1	♀	3-4	4/11/73 Wig Cr.	*	5.9	11.0
2	♂	1	5/ 1/73 Wig Cr.	10/ 3/73 shot 10/6/73	>35.0	20.0
3	♀	8+	5/ 1/73 Wig Cr.	*	4.9	10.0
4	♀	2	5/ 1/73 Wig Cr.	**	~19	8.5
5	♀	3-4	5/ 1/73 Wig Cr.	11/13/73	4.3	6.0
6	♀	4-5	5/ 2/73 Wig Cr.	*	3.3	11.0
7	♀	3-4	5/13/73 Wig Cr.	*	7.1	10.0

\*Radio operating as of 5/1/74.

\*\*Radio removed and replaced 4/5/74.



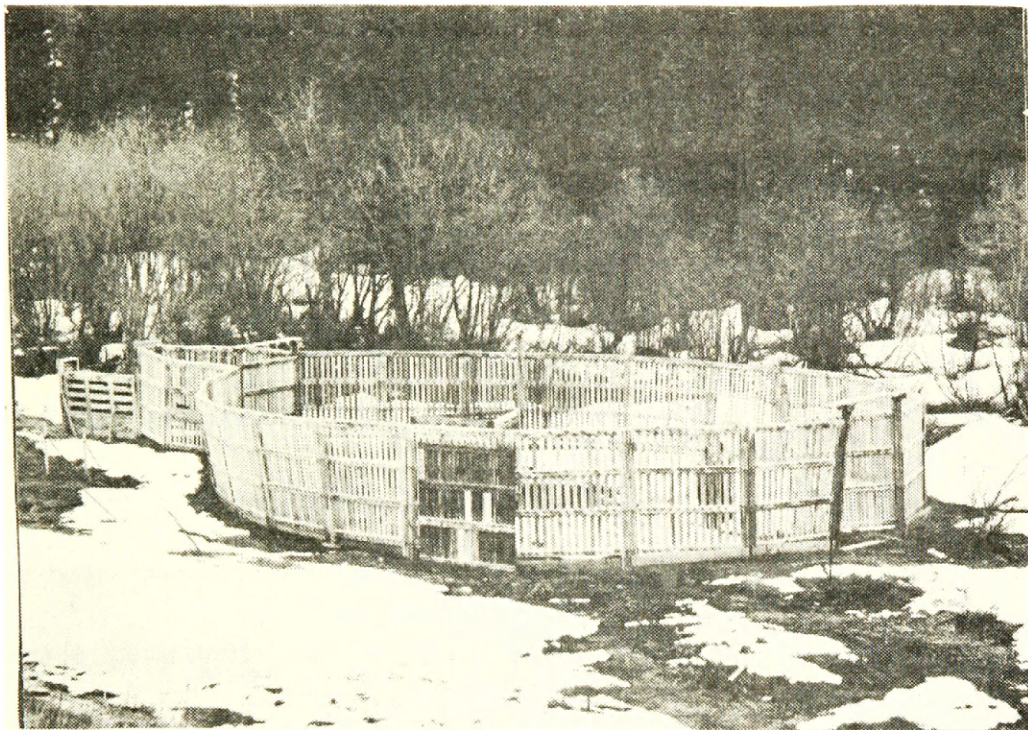


Fig. 2. Wig Creek elk trap.

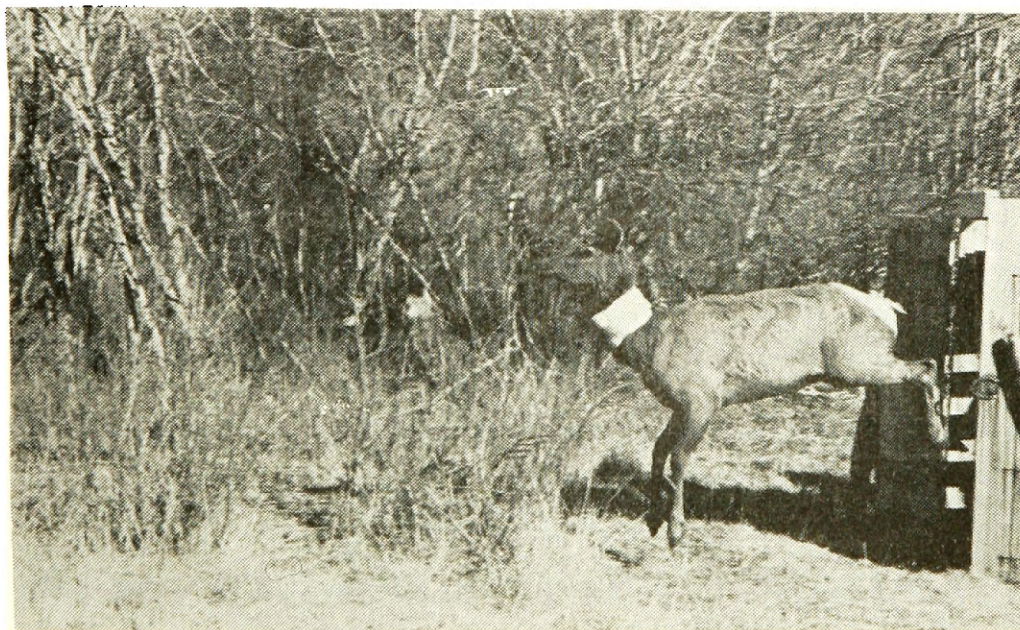


Fig. 3. Elk 4 leaving trap (1 May 1973).

late April the trap was used regularly by elk, mule deer (Odocoileus hemionus) and white-tailed deer (Odocoileus virginianus). The trap was erected over what appeared to be an old salt lick; elk start using salt in late April and use is greatest during May and June (Dalke et al. 1965). By raising the trip-wire approximately 45 inches above the ground, deer could enter the trap and leave again without getting caught. This was necessary because deer would inevitably arrive at the trap site before elk. Use of the trap by elk in late April and throughout May was restricted to the salt block whereas deer of both species also took hay. The handling of trapped elk was described by Ream et al. (1971).

Three types of radio collars were used during the study. In 1972, the transmitter and battery pack were embedded in acrylic and then attached to a 6-inch width of flexible plastic which served as the collar. The whole collar was then covered with insulating tape, providing only slight protection for the antenna. In 1973, seven radio collars were attached to elk. Two were of the all-acrylic type construction described by Denton (1973) and five were constructed using 2.5-inch diameter PVC irrigation pipes (ASC, 160 psi). A 40-inch section of pipe was heated in an oven until it was pliable. The transmitter with attached battery pack, but not the antenna, was covered with acrylic. The radio was inserted, antenna first, into the heated, soft pipe and quickly placed into a metal press that flattened

the pipe into a shape that would fit around an elk's neck. The collar was allowed to cool in the press and the flattened pipe ends were closed with a sealing compound. A bolt and a special nylon-lined locknut fastened the collar around the animal's neck.

Both pipe and acrylic collars offer good protection to transmitters and antennae but pipe collars are easier to attach in the field and more visible from the air.

All 11 elk were ear-tagged with numbered aluminum Fish and Game Department tags, and all but two received 4- or 6-inch wide individually colored neckbands.

### Locating Radioed Elk

Instrumented elk were located with an AVM Model LA11-S receiver. Aerial locations were accurate and frequently resulted in sightings of radioed animals. Accuracy of ground triangulations varied and often only approximations were possible. All locations were marked on topographic maps (U.S. Geological Survey, 1:24000 or 1:62500) and numbered. The period from July to mid-September, 1972, represented a learning period used to become familiar with the study area and aerial and ground tracking techniques.

Twenty-six flights were made in 1973; in summer and fall, flights were scheduled on the average of once a week. This format was adjusted according to apparent need; during June when elk were

dispersing, six flights were undertaken. Average flight time dropped from slightly over 2 hours in 1972 to less than 1.5 hours in 1973. This was largely the result of increased familiarity with the equipment and of using the double-whip dipole antenna system designed by Varney (Craighead et al. 1971) which eliminated the need for rectangular search patterns. Flights were initiated at sunrise or approximately 1.5 hours before sunset. Cessna-182's and Piper Super Cubs were utilized during the study. Radioed elk were located using procedures described by Denton (1973). Generally by flying near the last known position of instrumented animals, signals were picked up. Once the location of the transmitter was ascertained, it was circled to locate the animal visually. By circling, the radioed elk or others belonging to the same group were often sighted. If elk were not seen, the circled area was marked on a map and the search continued for other radioed animals. In a few cases, a signal could not be received near the last known position and it became necessary to gain altitude before receiving the signal. Thus all functioning transmitters were located on every flight. Notes taken during each flight included locations of instrumented and other elk, group composition data, and weather information such as temperature and cloud cover.

Ground-tracking of instrumented elk occurred from 5 July to mid-August, 1972, and from 11 April to 28 December 1973. A

three-element Yagi antenna was used. The antenna was hand-held vertically with the longitudinal axis pointed at the transmitter. All visual observations were made with the aid of 10-power binoculars.

Ground locations were not always accurate, as topographic features and dense vegetation influenced radio signals (Stehn 1973). The best fixes occurred when transmitter and receiver were within line of sight. In this situation, the direction of maximum signal strength was apparent and by bisecting the angle between the two nulls, one on each side of the maximum signal, an accurate bearing to the transmitter was taken (Kolenosky and Johnston 1967). If this procedure was repeated at another location, the position of the transmitter could be determined by triangulation. Radioed elk were generally approached to within 0.25-mile, so error polygon size was minimal (Heezen and Tester 1967).

Often locations of instrumented elk could not be determined from two bearings, thus additional bearings from a number of different locations were necessary. Once a transmitter was tentatively located, the location was verified by walking to a point across and/or overlooking the site. Frequently a signal that was inconclusive during the day would be clear and directional in the evening; this was apparently the result of the animal changing its topographic position.

## Evaluation of Data

In a biotelemetric study, the actual location of an instrumented animal is the most important datum. Although signals from all radioed elk were frequently received in one day, not all of those contacts resulted in actual locations. Thus all radio contacts were divided into those where a location could be determined, and those where it could not be established beyond doubt. The first category was progressively numbered, marked on appropriate maps, and a 3 x 5 card was filled out for each numbered site. The second category was not considered a location, but rather as additional data, filling the time period between two numbered locations. Such data only indicated whether the tagged animal was still in a particular area or had moved. Each numbered card represented a synopsis of a particular location for one elk.

The amount of time spent tracking seven radioed elk and the size of the area utilized by them made extensive analyses of vegetative sites impossible. At the same time, some method to quantitatively relate elk locations to seasonal habitat use was necessary. The habitat type classification method of Pfister et al. (1972) was used because it offered several advantages: it was designed especially for western Montana; it uses easily identifiable indicator plants; and most wildlife and timber management personnel are familiar with it. All sites that were repeatedly used by elk and some

of the lesser used locations were classified.

Elk location sites were normally visited during midday as that time period was generally poor for obtaining radio bearings. On arriving at a site, the exact point at which a radioed elk had been observed was located. A 10-factor prism was used to measure basal area and establish a variable plot. Understory indicator plants within the plot were recorded and, together with the dominant tree species, determined the site habitat type. Further classification included estimating tree heights, percentage canopy coverage, aspect and percent slope (Lyon 1973). A number of adjacent areas showing signs of elk use such as wallows, beds, and feeding sites were similarly sampled.

Except for areas being logged and during the hunting season, human activities in the study area were light. When such activity occurred near instrumented elk, radio bearings were taken twice each day to determine whether the animals left the area.

Summer and fall ranges of instrumented elk were determined by connecting all peripheral locations. Those resulting from movements to and from the summer and fall ranges were not considered part of the ranges. Total size of seasonal areas were measured using a polar planimeter. Areas of frequent use were identified as such. To obtain an expression for maximum distance moved between summer and winter ranges, the distance between the last known

location on the winter range and the furthest point on the summer range was measured. Because of area relief, actual distances traveled by elk would exceed these values.



## CHAPTER IV

### RESULTS AND DISCUSSION

#### Radio Performance

In 1972, four elk were instrumented with transmitters used previously in a moose study in Minnesota. Only three transmitters were still functioning by the time the field investigation began in July. Transmissions from Elk B and C were last received on 11 August and Elk D was last located on 22 August of that year. Since D was the only transmitter fitted with a new battery pack before the elk were instrumented, the premature failure of the other radios was probably due to weak batteries. Elk D was not located during a flight on 27 September, and it was assumed the transmitter was inoperative.

During April and May 1973, seven elk were instrumented in the Wig Creek trap. Radio performance was excellent for that year with only one transmitter failing some time after 13 November. One radio collar was returned still functioning 1 month after the animal was shot. For a summary of transmitter information see Table 1.

#### General Use of Area

Between 4 July and 22 August 1972, transmissions from

three instrumented elk were received 27 times resulting in 23 locations. From 1 May to 31 December 1973, 473 transmissions were received from seven radioed elk for 177 locations. Results indicated that seasonal movements between distinct summer and winter ranges occurred in most cases. Seasonal movements were dispersals rather than migrations. Elk use of the winter range was generally restricted to open mid-slopes of favorable aspect.

### Seasonal Movements

Quantitative spring movement data were not available for 1972. Isolated observations were made by Joseph Bohne and Dr. Jack Lyon. Radio failures precluded gathering data on movements back to the winter range during 1972.

Spring dispersal of all instrumented elk in 1973 occurred during a 2-week period from late May to early June. Dispersal was to the west across the South Fork of Fish Creek, and by 8 June all animals had crossed the creek. Later observations showed that four cows produced calves. Johnson (1951), working with the Gallatin elk herd, placed the peak of calving at about 1 June; using that date, it was possible to identify the calving locations of three cow elk. One calf was apparently born on the winter range, delaying departure from that area by the cow until after 6 June; the other two cows produced calves while en route to their summer ranges. Spring dispersals

involved sudden movements; this made relocations of some animals, after they left the winter range, difficult. During the dispersal period, elk were difficult to observe despite early morning and late evening flights.

In contrast to spring dispersal movements, fall movements to the winter range were gradual. They almost certainly were initiated by snowstorms. Periods of warm weather, when the snow melted, often halted further movement. By 20 November, all instrumented elk had returned to the winter range.

### Seasonal Habitat Uses

Data from instrumented elk indicated seasonal variations in utilization of various habitat types (Table 2). These variations were also reflected in such parameters as percent slope, canopy cover, aspect, and elevation of elk locations (Tables 3-5).

The winter range consists primarily of segments of the Burdette and Lupine creek drainages and small adjacent ecologically similar areas. While on the winter range, elk use habitat types of the Douglas-fir zone extensively. Bluebunch wheatgrass and snowberry habitat types, both occurring on open slopes with south aspects, are most extensively used during midwinter. If undisturbed, elk utilize these sites not only as feeding but also as bedding areas. Thus they are frequently seen during midday, bedded down in open areas,

TABLE 2. Percentage of elk locations with respect to habitat type\*  
by month from May-December 1973

	n	DF/Agsp DF/Syal	DF/Caru	DF/Phma	DF/Xete	AF/Clun	AF/Mefe	AF/Xete
May	14	8	8	42	34	0	0	8
June	35	0	0	15	24	15	31	15
July	33	0	0	15	7	6	36	36
August	28	0	0	11	7	22	46	14
September	19	0	0	5	5	21	37	32
October	22	0	0	14	8	0	55	23
November	26	0	0	31	61	0	8	0
December	7	57	0	29	14	0	0	0

\*Habitat type key from Pfister et al. (1972).

TABLE 3. Percentage of elk locations with respect to percent slope and canopy cover by month from May-December 1973

	n	Percent slope			Percent canopy cover		
		> 30	15-30	<15	> 60	15-60	<15
May	14	57	34	9	21	56	23
June	35	46	21	33	49	45	6
July	33	61	12	27	61	39	0
August	28	50	0	50	81	19	0
September	19	47	0	53	47	53	0
October	22	67	0	33	67	33	0
November	26	46	0	54	38	62	0
December	7	100	0	0	0	29	71

TABLE 4. Percentage of elk locations with respect to aspect  
by month from May-December 1973

	n	N	NE	E	SE	S	SW	W	NW	Ridge	Drainage bottom
May	14	0	0	56	11	11	11	0	0	11	0
June	35	0	9	24	12	3	3	12	4	12	21
July	33	6	3	24	9	0	0	21	10	6	21
August	28	8	4	12	0	4	0	12	10	0	50
September	19	0	10	26	5	0	0	6	0	0	53
October	22	5	19	33	0	0	0	10	0	14	19
November	26	4	0	25	13	0	4	0	0	25	29
December	7	0	14	0	14	57	0	15	0	0	0

TABLE 5. Monthly distribution of elk by elevation  
May-December 1973

	n	Min.	Max.	Mean	Mode	Median
May	14	4600	5800	4900	4600	4800
June	35	4200	6200	5400	5600	5400
July	33	4200	6300	5500	5800	5600
August	28	4200	6000	5250	5600	5400
September	19	4600	5800	5280	5200	5200
October	22	4400	6000	5220	5600	5550
November	26	4200	6200	5000	5000	5000
December	7	4400	5200	4850	4800	4800

hundreds of yards from the nearest cover. Stormy weather causes elk to leave the open slopes for drainage bottoms. Movement patterns on the winter range vary, with most movements taking place during periods of little or no snow. When snow accumulations are greatest, the animals move very little. In the study area, no net movements of instrumented elk were noted for the last 3 weeks in December 1973. McLean (1972), working with the Lochsa, Idaho, elk herd, found that elk confined their movements to small areas during February and March. Craighead et al (1973) reported that elk of the Madison drainage of Yellowstone National Park were confined to small areas near thermal features for most of the winter. Groups are largest while elk are on the winter range. On 16 April 1973, a group of 38 animals was seen in the upper Burdette Creek area.

As the snow melts, elk respond by increased movements. They begin by utilizing more areas on the winter range such as timbered ninebark and beargrass habitat types. At the same time, use of south aspects decreases. Interestingly, while the lowest monthly mean elevation occurred in December, the lowest mode value occurred in May. It should be pointed out that while instrumented elk were frequently observed at lower elevations in May than in December, the variation about the mean in May exceeded that for December. Thus, use in May of lower elevations was probably due to green-up while the variations in elevations reflected the disappearance of snow



cover over much of the winter range. The apparent downward movement during spring was similar to that reported by McLean (1972) in the Lochsa drainage. Prior to spring dispersal, elk utilize large areas of the winter range. By May, use of open slopes declined considerably, and the use of open timber types (15-60 percent canopy cover) was greatest for the year. Thus spring areas appear to be extensions of the winter range but not distinct areas in themselves.

During late May and early June, most elk dispersed to their summer-fall areas. Even those animals remaining within the Burdette Creek drainage utilized areas not used during the winter months because of deep snow or unfavorable aspects. During this period, elk became increasingly difficult to observe until by early June they were virtually never seen. This was partially due to the increased use of dense timber types. During late May and early June, utilization of heavy timber habitats increased more than twofold. However, elk continued to use dense timber types for much of the summer when they could be observed; thus, other factors must have contributed to the low number of sightings in June. Since early June is the period of parturition for most cows, calving and postnatal behavior were probably those factors. Knight (1970), investigating the Sun River elk herd, noted that elk were difficult to observe in early June and that observations of single cows were highest for this period.

Calving in the study area apparently was not confined to either winter or summer ranges, but also occurred in intermediate areas. One case of calving on the winter range was recorded, two other cases were noted where calves were born en route to the summer areas, and data from two more cows indicated that they produced their calves while on their summer-fall ranges. Picton (1960) noted that a number of calves, seen during June on summer ranges of the Sun River elk herd, indicated that calving occurred at those high elevations, or that the calves had moved at an early age. Following parturition, instrumented cow elk utilized small areas, generally less than 1 square mile, for periods of up to 3 weeks. Three locations identified as calving sites were timbered slopes with south and southeast aspects. Two of these areas had small brushy openings while the third site was located near a 5-year-old clearcut. Elevations ranged between 4,600 and 5,400 feet. Altmann (1952), investigating social behavior of elk in the Jackson Hole area, reported that calving sites were generally sunny hillsides rich in browse and cover. Brazda (1953), working in the Gallatin drainage, noted that no movement away from the calving areas occurred until after the calving season was over. He further suggested that the period of parturition was more important in governing the upward movement of cow elk than plant development. The late departure of Elk 1 from the winter range was probably related to the fact she calved there.

By late June, all instrumented elk reached their summer range. Many of these areas were within the higher subalpine fir zone. Data from tagged animals indicated that only 8 percent of all locations occurred in subalpine fir habitats during May, but by June utilization of those types increased to 61 percent. Within the Douglas-fir zone, most sites were in the beargrass habitat type (Table 2). The mode of all elevations increased 1,000 feet in 1 month. Most instrumented elk that left the winter range were later associated with a specific summer-fall range that did not overlap the winter area. Exceptions to this rule occurred and will be discussed in a later section. Ream et al. (1972) noted the use of drainage bottoms during June in the Sapphire Mountains of western Montana. This was also observed in the study area with most drainage bottom locations occurring in the Clintonia habitat type of the subalpine fir zone. In spite of continued use of heavy timber types, aerial elk sightings became more numerous during late June. This was apparently related to the formations of cow-calf groups occurring at that time. Group sizes and composition seemed to vary from day to day although exact numbers were difficult to obtain in timbered habitats.

During July, more elk were seen than at any other time during the summer and fall. Locations varied from predominantly east and west slopes during morning and evening periods to drainage bottoms during the day. The mode of monthly elevations was highest

in July at 5,800 feet. Elk were easiest to see in roadless areas where cow-calf groups of over 20 animals were common. The use of habitat types of the subalpine fir zone by instrumented elk was nearly 80 percent in July. The menziesia and beargrass habitat types were heavily utilized at this time.

Because they occur on south and west aspects, beargrass habitats tend to be rather open and were used mainly in the evenings. The overstory is dominated by either subalpine fir or seral lodgepole pine. Beargrass dominates the understory along with thin-leaved huckleberry (Vaccinium membranaceum) and grouse whortleberry (Vaccinium scoparium).

The subalpine fir/menziesia habitat type was the most heavily utilized one on the summer-fall ranges (Table 2). A "typical" site in the study area has trees 40-60 feet high with a dbh of 15-20 inches. Basal area is approximately 140 square feet/acre. The understory is dominated by menziesia (fool's huckleberry) while open areas are often densely covered by Sitka alder. Moist, open sites support willows (Salix spp.). Also characteristic of these areas are large numbers of windfalls. Walking was often only possible by using fallen tree trunks. Altmann (1952) noted that elk prefer to rest in locations surrounded by fallen trees as these seem to provide protection. Windfalls also create openings in the canopy which help to establish shrubs.

Habitat types utilized during August were similar to those of July except for a sharp increase in use of drainage bottoms. Percent use of heavy timber types by instrumented elk was greatest during this month (Table 3), causing a marked decline in the number of elk sighted. A similar response, probably related to hot weather, was noted in the Sapphire Range (Ream et al. 1972). Elk wallows located throughout the area showed evidence of use at this time.

During September, elk continued to utilize drainage bottoms. In roadless areas there was a marked increase in use of open timber types. These areas are not homogenous in their tree distribution but rather a mosaic of small brushy areas and denser timber habitats. Some instrumented cow elk moved away from areas previously frequented. These movements occurred during early September. They were probably the result of cows becoming members of harems. Similar movements during early September were noted in the Lochsa drainage (McLean 1972). The average breeding group in the study area consisted of four cows, two calves, and a large mature bull.

Elk locations in October indicated a general upward movement from the drainage bottoms, and increased use of heavy timber and ridges. This pattern continued until the first heavy snowfall. In 1973, this occurred on 31 October. The response of instrumented animals suggested that during and immediately after a storm, elk seek drainage bottoms. Individual animals reacted differently, some

started to move toward the winter range almost at once while others waited a week or so until additional snowfall forced them to move. Anderson (1954) noted that the first significant snowstorm of autumn also initiated movements to the winter range in the Jackson Hole area of Wyoming.

### Summer and Fall Ranges

Summer and fall ranges utilized by instrumented elk generally coincided for individual animals and were to the east and west of the winter range. Sizes of these ranges varied as did distances moved from the winter range (Table 1). Utilization of areas was not uniform and distributions were heterogeneous, indicating unequal intensity of habitat use. In some cases, minor shifts within the ranges were noted during early September. Once established on their summer-fall ranges, most instrumented animals were readily found because their movements were limited. Group sizes varied, being smallest for bulls and largest for cows and calves, but were smaller than those observed on the winter range. Bull groups contained from 1 to 6 individuals while cow-calf group sizes ranged between 7 and 24. Group composition was highly variable with tagged elk sometimes located together one day and separated the following day.

Sizes of areas utilized as summer-fall ranges showed

considerable variation in the study area (Table 1). Data from instrumented elk suggested that only a portion of the variations can be explained as individual differences. Thus, while bulls as a group utilize larger ranges than cows, young bulls apparently tend to move more than older ones. Elk 2, a spike bull, used an area of at least 35 square miles during summer and fall, nearly twice as much as the elk with the second largest range. Similar observations of far-ranging movements by yearling bulls were recorded in Oregon (Harper 1964) and Wyoming (Martinka 1969). One explanation for the extended movements by young bulls might be that in dispersing they associate with different cow-calf groups and thus use the combined ranges of those groups. Both instrumented bulls were young (1- and 2-year olds); their average summer-fall range was 25.5 square miles, probably larger than that of older males. Four radioed bulls in the Sapphire Range of western Montana had an average summer-fall area of 12.3 square miles (Ream et al. 1972).

Cow elk in the study area, as a whole, utilized an average summer-fall area of 6.9 square miles, while cows known to have calves averaged only 4.5 square miles. The value for the cow group as a whole is nearly identical with the 6.4 square miles obtained for the Sapphire Range (Ream et al. 1972). The average summer and fall area utilized by three cows in the Madison drainage was also 6.9 square miles (Craighead et al. 1973). The one cow identified as not

having a calf used an area of 19 square miles, nearly four times the average for cows with calves. In a similar investigation of seasonal elk movements on the South Fork of the Flathead River, a cow without a calf used an area of 12 square miles during summer and fall, largest of such seasonal areas for the cow group in that study (Simmons, pers. comm.). The argument used above to explain large movements of young bulls can probably be expanded to female elk without calves. Thus by associating with various cow-calf groups or by free individual movements, a young elk of either sex may become familiar with an area larger than that normally used. It would therefore acquire a knowledge of adjacent areas, potentially useful at some later time. In discussing the choice of a summering area by an adult elk, Knight (1970) wrote that it is not clear whether this was the result of what it learned as a calf from the cow or related to the extensive movements of the young adult.

#### Individual Elk Movements

Elk A, an adult cow, was last located on 9 June 1972 in the Burdette Creek drainage. Transmitter failure occurred sometime thereafter. A resident of the Petty Creek area reported seeing her in early July near the West Fork of Petty Creek. Since she wore a bright yellow neckband, identification seemed certain. She was seen again on the Burdette Creek winter range on 9 May 1973, with Elk 4.



Elk B, a large cow, utilized parts of the South Fork of Petty Creek drainage and adjacent John's and Garden creeks. She and her calf were seen a number of times, always associated with a cow-calf group. Based on only nine radio locations between 4 July and 11 August 1972, her summer range size was computed at 2.8 square miles (Fig. 4). She was seen in early October crossing Petty Creek Road near Gus Creek (C. Winehell, pers. comm.) with one other cow and two calves. She apparently wintered again in the Burdette Creek drainage as she was seen there on 21 March 1973.

Elk C, an adult cow, was the only instrumented animal that remained near Burdette Creek during summer. She was never seen, as all her locations were in timbered habitats. This animal utilized a summer area of 8.1 square miles (Fig. 4).

Elk D, a 2-year-old bull, was located by aircraft four times between 8 July and 22 August 1972. He was shot 31 October near Wapito Point, Idaho, a distance of 13 airline miles from the Wig Creek trap. Using only five known location points, his summer-fall range was 16 square miles (Fig. 5).

After being tagged on 11 April, Elk 1, a 3-4 year old cow, remained in the Wig Creek drainage until 19 April. She utilized open slopes near upper Wig Creek. By 26 April, she had moved to upper Lion Creek (Fig. 6). Use of the area eventually shifted to Burdette Creek. After she was located for 5 days below Wig Mountain, I

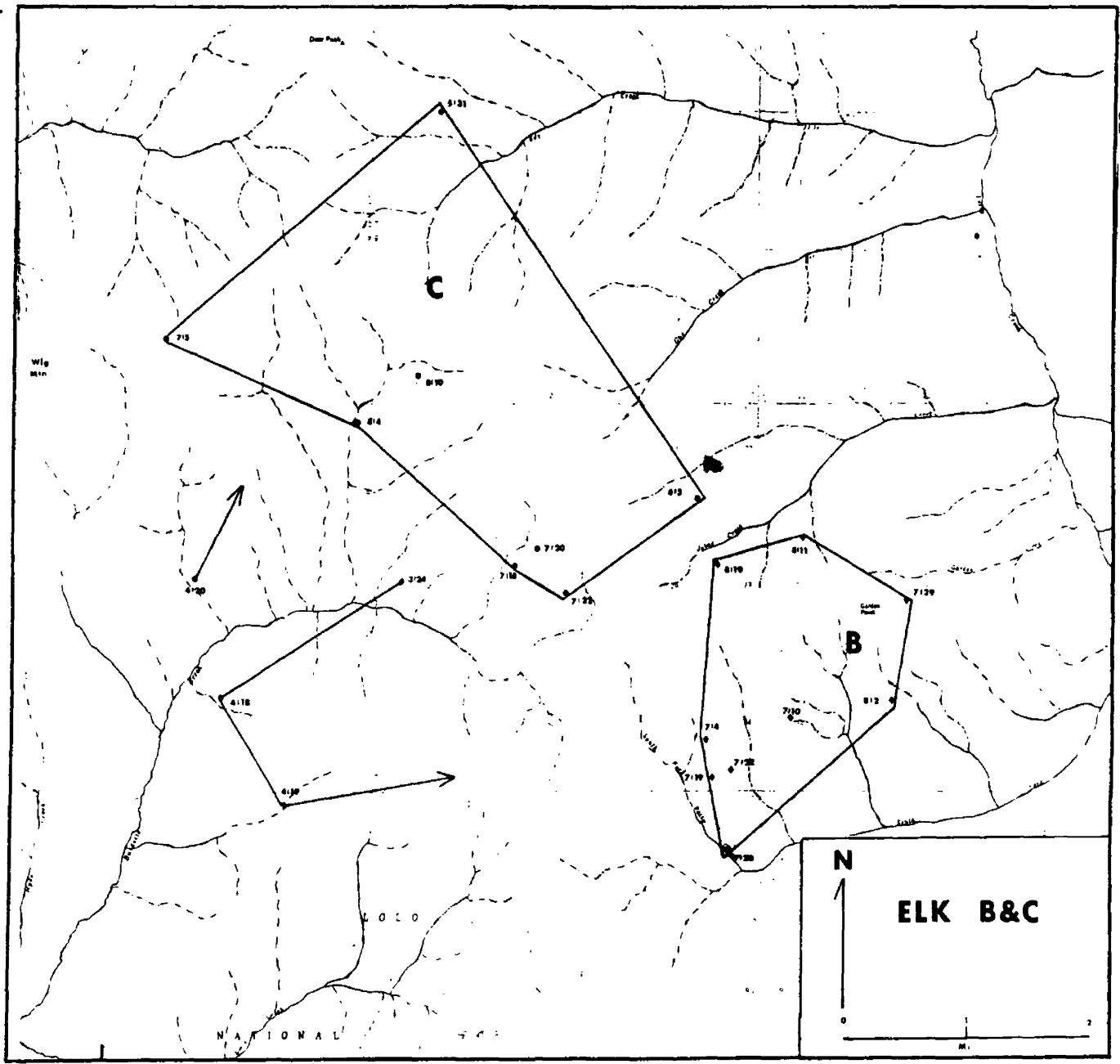


Fig. 4. Movements of Elk B and C.

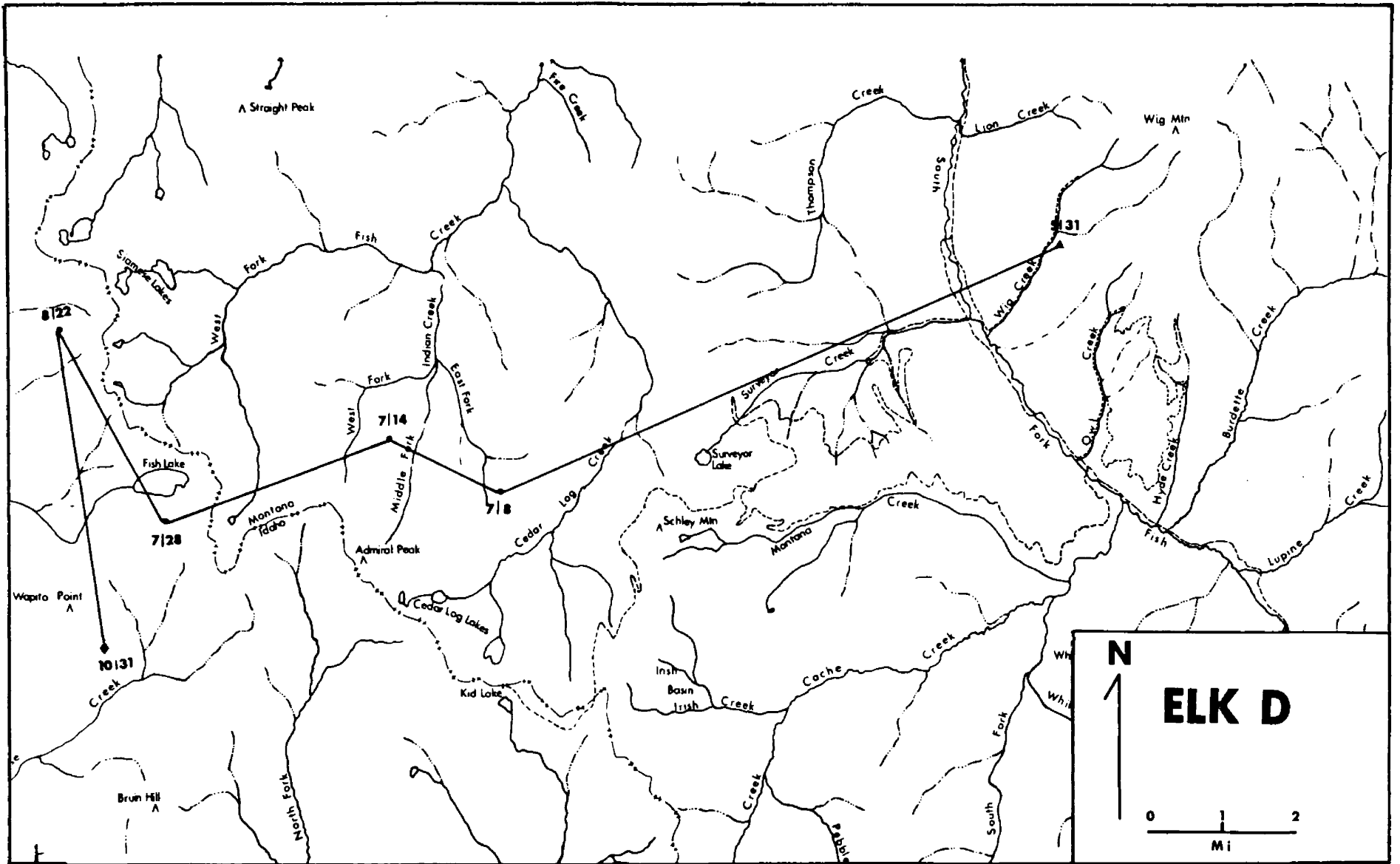


Fig. 5. Movements of Elk D.

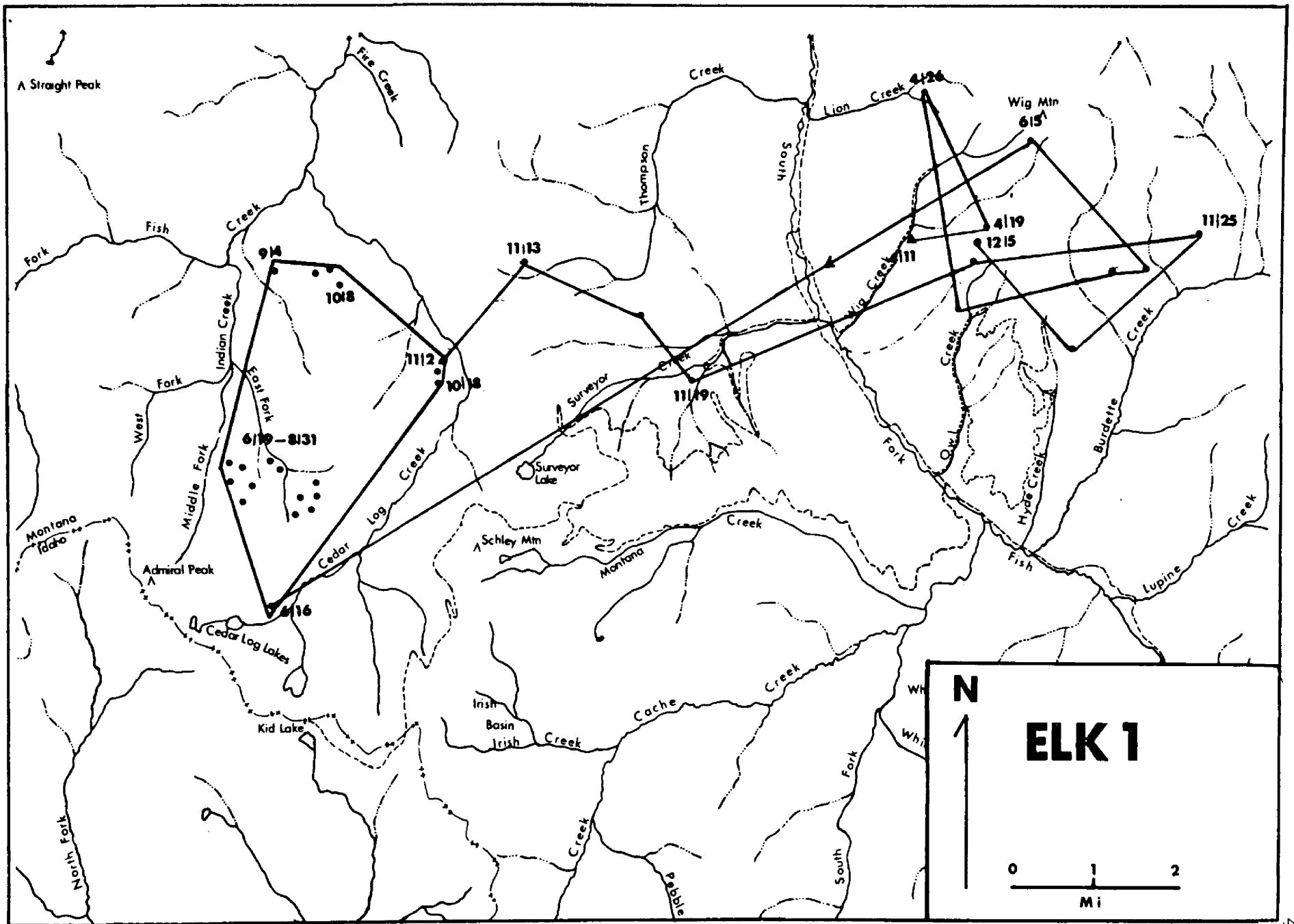


Fig. 6. Movements of Elk 1.

walked toward her on 5 June hoping to see her calf. On a densely timbered site with southeast aspect, I apparently jumped her as I heard a large animal leave the area. The radio signal changed from steady to intermittent intensity, indicating movement. She remained nearby and I eventually left the area. On the following day she was still at the same location; however, on 8 June I was unable to receive her signal. Eight days later this animal was relocated in the upper Cedar Log Creek drainage. For the rest of the summer she utilized an area of less than 2 square miles near the East and Middle forks of Indian Creek. She was seen with a calf on 25 July at the head of the East Fork, part of a cow-calf group. By 4 September, Elk 1 had moved 2.5 miles north to a point near the West Fork of Fish Creek, an area she had not utilized previously. This movement was probably related to the onset of the rut as on 5 September at least two bulls were bugling in the Middle Fork of Indian Creek. She was seen from the air on 17 September in the lower Cedar Log Creek drainage. The site was a timbered northeast slope with small brushy openings. She was part of a group of at least four cows, two calves and one large bull. By mid-October the animal had moved to a location 2 miles northwest of Schley Mountain where she remained until returning to the winter range. Her summer-fall range area was 5.9 square miles and she had moved 11 airline miles from her last location on the winter range. She remained in the Cedar Log Creek drainage until

snow accumulations in the area exceeded 2 feet. The movement back to the winter range, a distance of approximately 6 miles, was accomplished in 8 days.

Elk 2, a yearling male, displayed erratic movement patterns which often made it difficult to locate this animal. He did not have a well-defined summer-fall range but moved between areas used by other instrumented elk (Fig. 7). Total area utilized exceeded 35 square miles. After leaving the winter range on 6 June, Elk 2 moved 11 airline miles into the upper Cache Creek drainage and back again to Wig Mountain in 22 days. Two days later he was located 8 miles southwest in the upper Montana Creek drainage. He remained there for 2 weeks and was sighted once with a cow-calf group which included Elk 7. After moving north for 5 miles into the upper Thompson Creek area, the animal again returned to Montana Creek. Next, the area east of the South Fork of Fish Creek between Owl and Wig creeks was utilized for 11 days following which he again returned to the upper Montana Creek drainage. After locations north of Surveyor Lake and in Irish Basin, Elk 2 was sighted on 4 September in the Kelly Creek drainage of Idaho. He was feeding in an open area 1.5 miles north of Kellys Sister Mountain, near a group of five cows and three calves. On 11 September he had moved 2 miles southwest to a point 20 miles from the winter range. A six-point bull, three cows and one calf were feeding nearby. On 30 September and again on 2 October, Elk 2 was

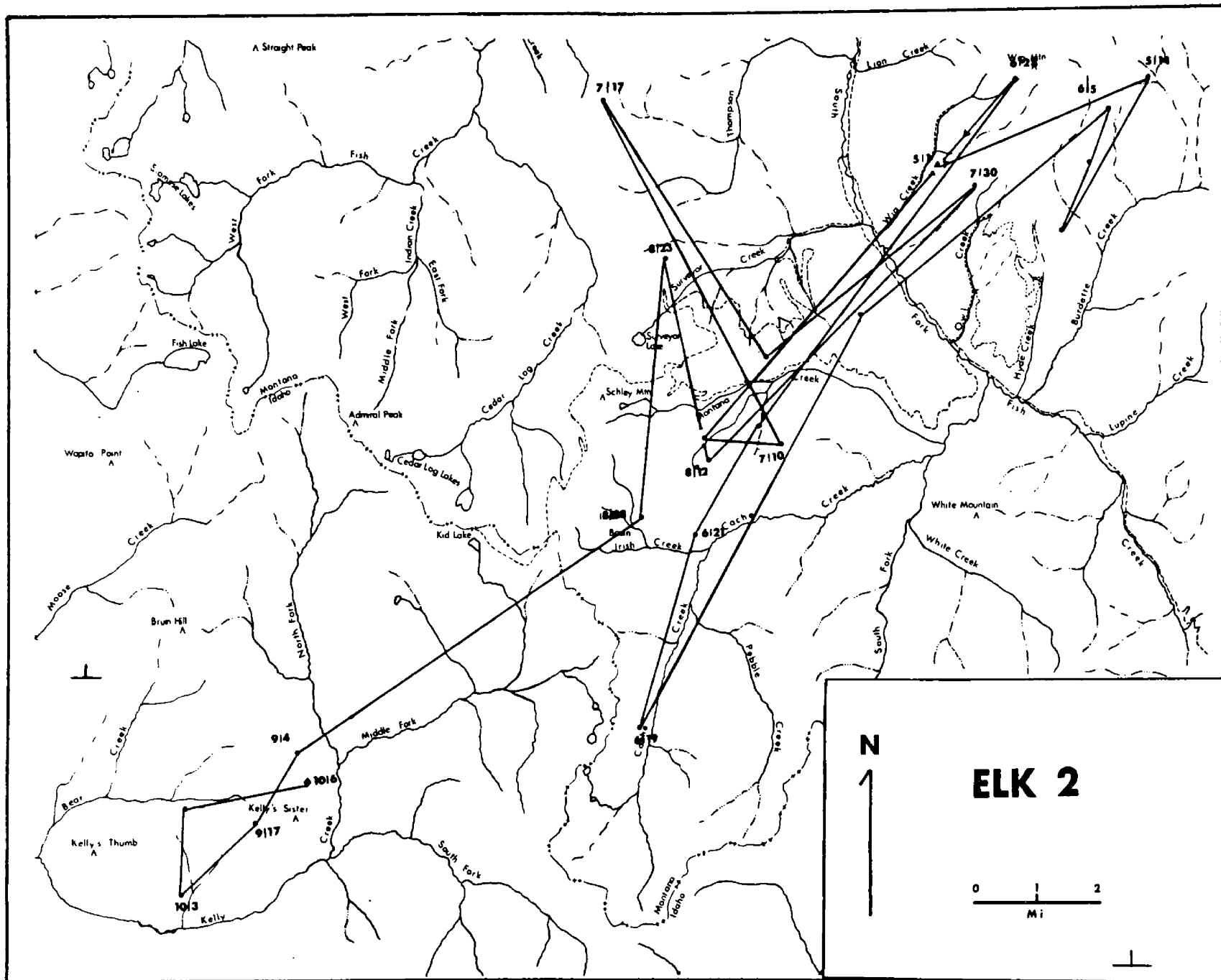


Fig. 7. Movements of Elk 2.

located near Hanson Meadows. By 3 October a number of hunting camps were erected in that area, a fact that probably caused the animal to cross into the Bear Cub Creek area. Elk 2 was shot on 6 October near Kellys Sister along with a cow and calf (D. Hagen, pers. comm.).

Elk 3 was a large cow. The degree of incisor wear indicated that she was at least 8 years old when tagged on 1 May 1973. Rectal palpation by R. Beall proved her pregnant. This animal utilized the area between Owl and Wig creeks prior to leaving the winter range (Fig. 8). She apparently produced a calf while en route to her summer range as she was located for 9 days (27 May-4 June) in a small area near upper Montana Creek. By 6 June, this animal had moved to a location near the drainage bottom of Cedar Log Creek, just west of Schley Mountain. On 30 June, she was seen with a calf near Elk 1 in the East Fork of Indian Creek drainage. On this and subsequent visual relocations, she was always part of a cow-calf group varying in size from 7 to 22 animals. The habitat types used by this and other instrumented elk made group size determination difficult. Only animals clearly identified were counted, thus group sizes recorded were conservative. Except for the period from 6 September to 4 October, when only a small area in the Cedar Log Creek drainage was utilized, Elk 3 moved often within the summer-fall range. Use was divided between the East Fork of Indian Creek



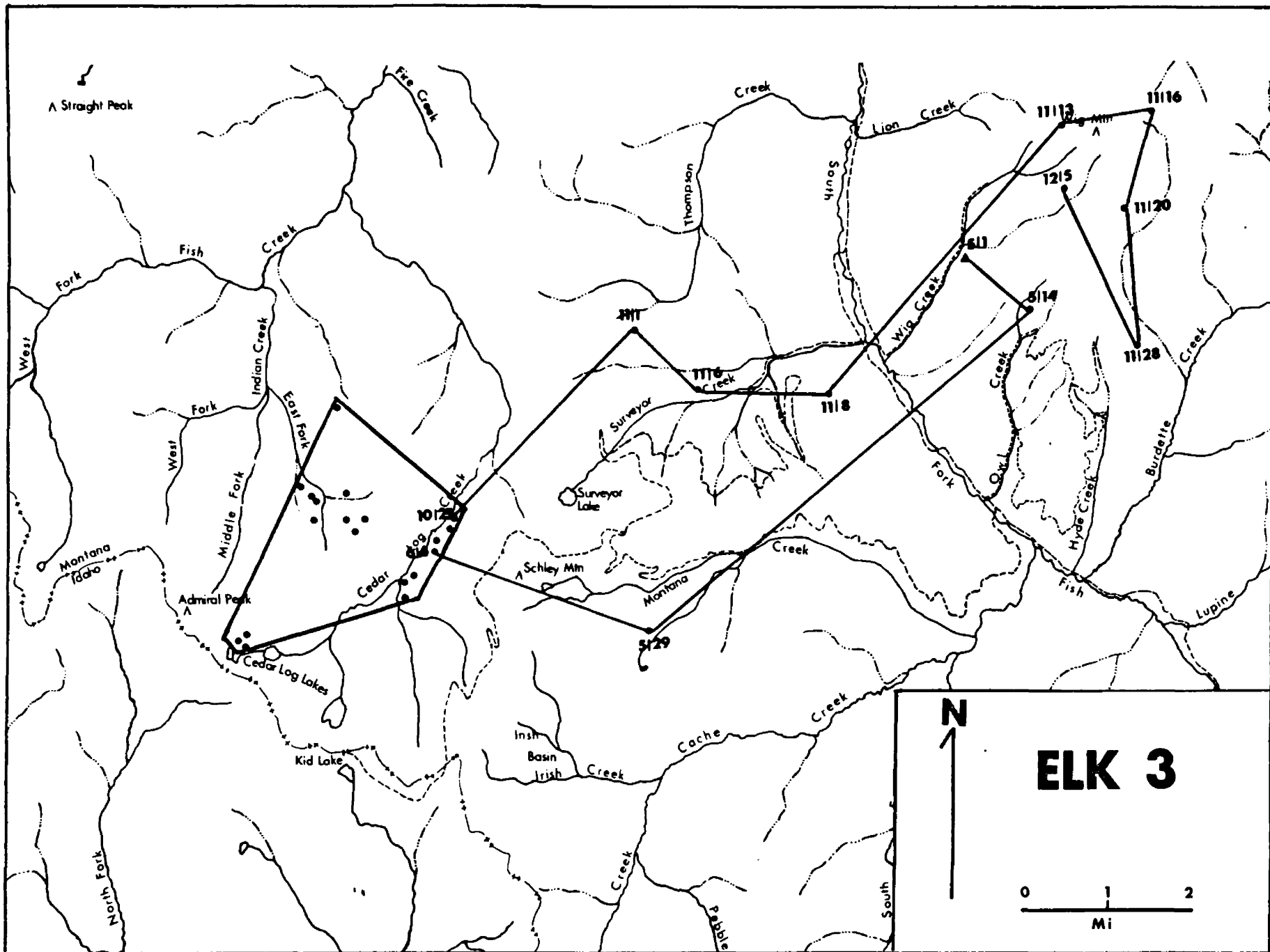


Fig. 8. Movements of Elk 3.

and Cedar Logs Creek drainages. On three occasions between 20 June and 5 July, she was located near Mud Lake. Elk 3 was probably a member of a harem group during most of September. The area she utilized during that time was the site of intensive bugling by a number of bulls. The total summer-fall range encompassed 4.9 square miles; while in the East Fork of Indian Creek drainage, she was 10 miles from the area most frequently utilized on the winter range. The first major snowstorm of the season on 31 October resulted in accumulations of over 18 inches on the Schley Mountain Road. On 1 November, the signal was located in the Thompson Creek drainage, and after two locations near Surveyor Creek she had returned to the winter range by 13 November. She was sighted on 5 December feeding with other elk on an open south slope near upper Wig Creek. The group consisted of 13 cows and 5 calves.

Elk 4, a two-year-old cow, showed some overlapping of winter and summer ranges (Fig. 9). After she left the winter range by crossing the South Fork of Fish Creek, she returned to areas east of the Creek on three occasions. Although this animal utilized a summer-fall area of 19 square miles, her activities centered near Montana Creek. Even though her movement patterns were irregular compared with those of other instrumented cows, the animal was located quickly because she was near roads. Six of 11 locations for August were along Montana Creek, near the bottom, within 0.25 miles

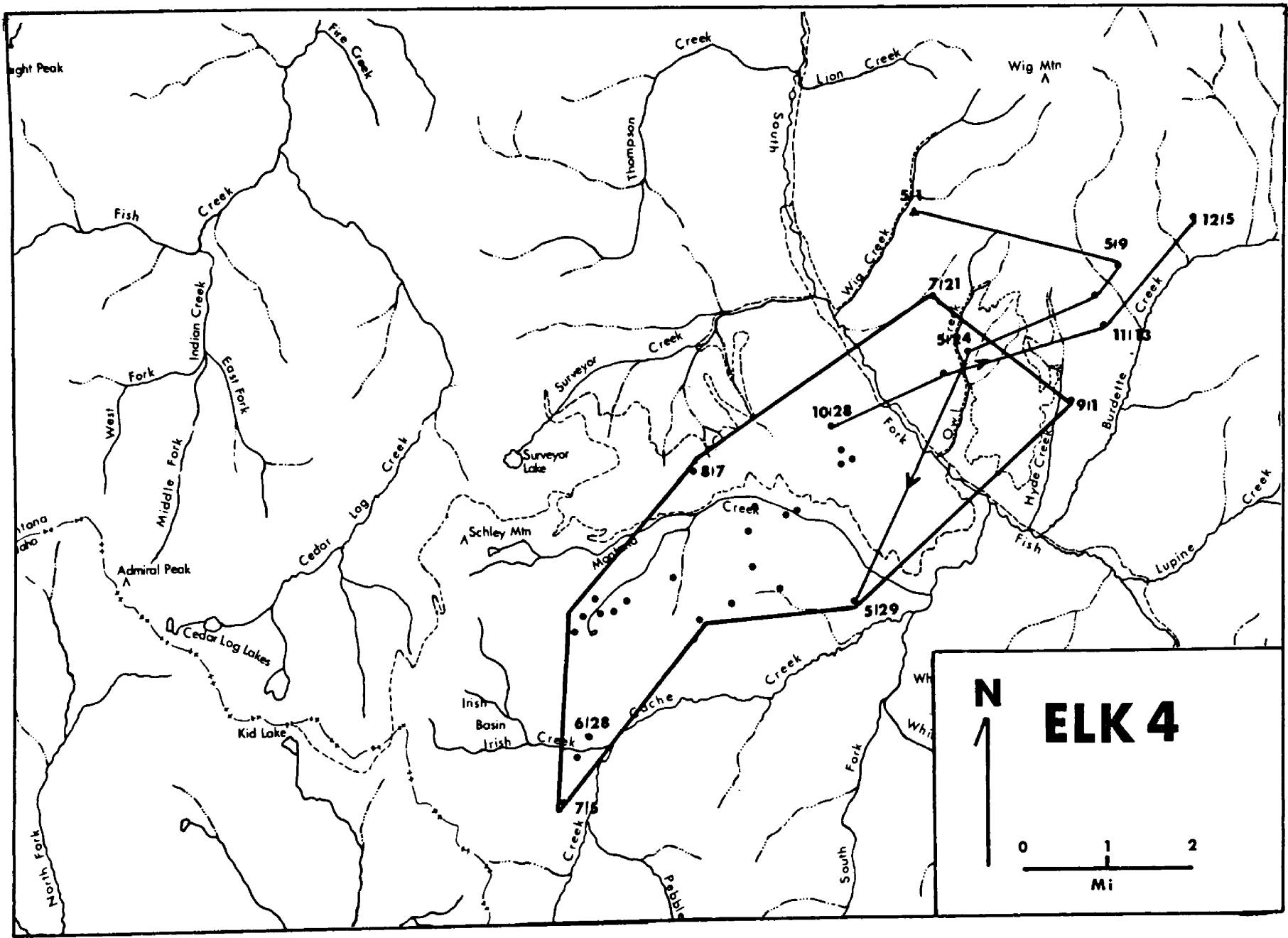


Fig. 9. Movements of Elk 4.

of the road. Elk 4 was sighted from the air three times during summer and fall, and twice in the winter; she apparently did not have a calf. This animal was darted from a helicopter on 5 April 1974 and fitted with a new transmitter.

Elk 5 was the fourth animal tagged on 1 May 1973. She showed signs of going into shock and was quickly tagged and released without being palpated. Her transmitter (same as Elk D, 1972) was not as powerful as the others but she was located, with difficulty, 2 weeks later in the area of upper Hyde Creek (Fig. 10). Of all animals instrumented in 1973, Elk 5 was the only one not seen during the remainder of the year, although she was located 43 times by radio. This was because she spent summer and fall in the dense timber habitats of Surveyor and Thompson creeks. Thus, it was not known whether the animal produced a calf that year. While utilizing most of the Surveyor Creek area, many locations during late summer were in the upper parts of that drainage. There she was frequently found less than 0.25 mile from the road. Elk 5 may have used clearcuts in the area; some locations were immediately adjacent to cuts. By 4 September, the animal moved to the upper Thompson Creek drainage, a nonroaded area where she remained for approximately 3 weeks. She was back at Surveyor Creek on 26 September, and last located in that drainage on 13 November. She utilized a summer-fall range of 4.3 square miles. Elk 5 was seen again on 6 April 1974 with Elk 1

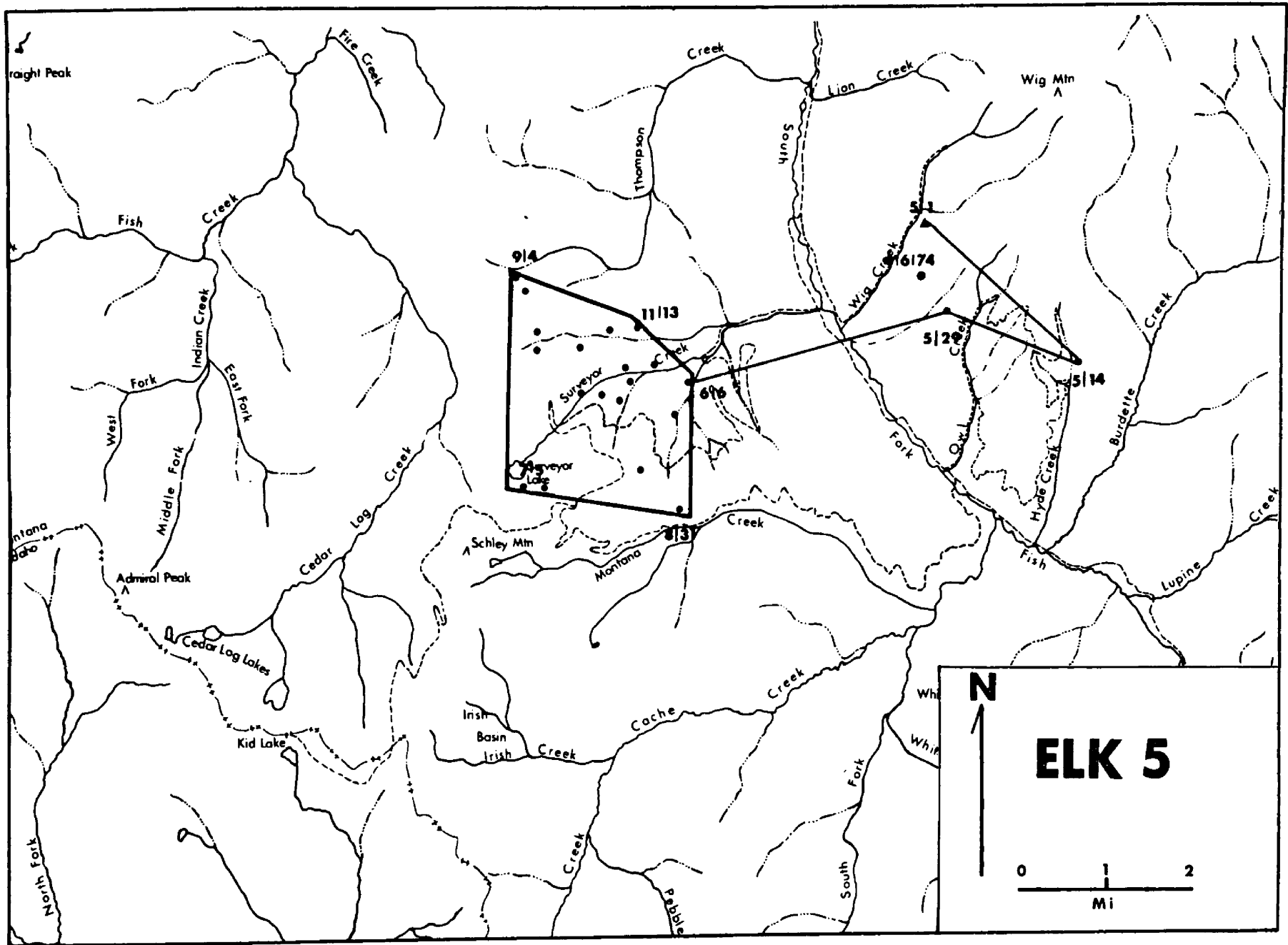


Fig. 10. Movements of Elk 5.

and Elk 3 in the Wig Creek drainage.

Trapped on 1 May, Elk 6 was not tagged and released until the following day. She appeared in better shape than the previously tagged animals. After her release, she utilized areas around Owl, Hyde and Lupine creeks until crossing the South Fork of Fish Creek some time after 25 May (Fig. 11). She calved less than 1 mile west of Fish Creek Road between Surveyor and Montana creeks on a timbered southeast slope with small brushy openings. Elk 6 remained in that area, utilizing less than 1 square mile, until 23 June. On 25 June, she was located in upper Irish Basin, an area she would use throughout summer and fall. Her summer-fall area of 3.3 square miles included locations in the upper Montana Creek drainage and an area on the Middle Fork of Kelly Creek. By mid-September, Elk 6 had moved down Irish Creek to Cache Creek where she was again located on 18 October. Four days after the opening of the big game season, Elk 6 was west of Fish Creek Road near Montana Creek. She seemed to be moving back toward Irish Basin, but heavy snows apparently stopped her movement in the upper Montana Creek area where she remained from 31 October to 10 November. By 13 November, she was back on the winter range near Lupine Creek.

Elk 7 and one other cow were trapped on 13 May. The other animal was ear-tagged and marked with a yellow and blue neckband. On the day following her capture and release, Elk 7 was seen from

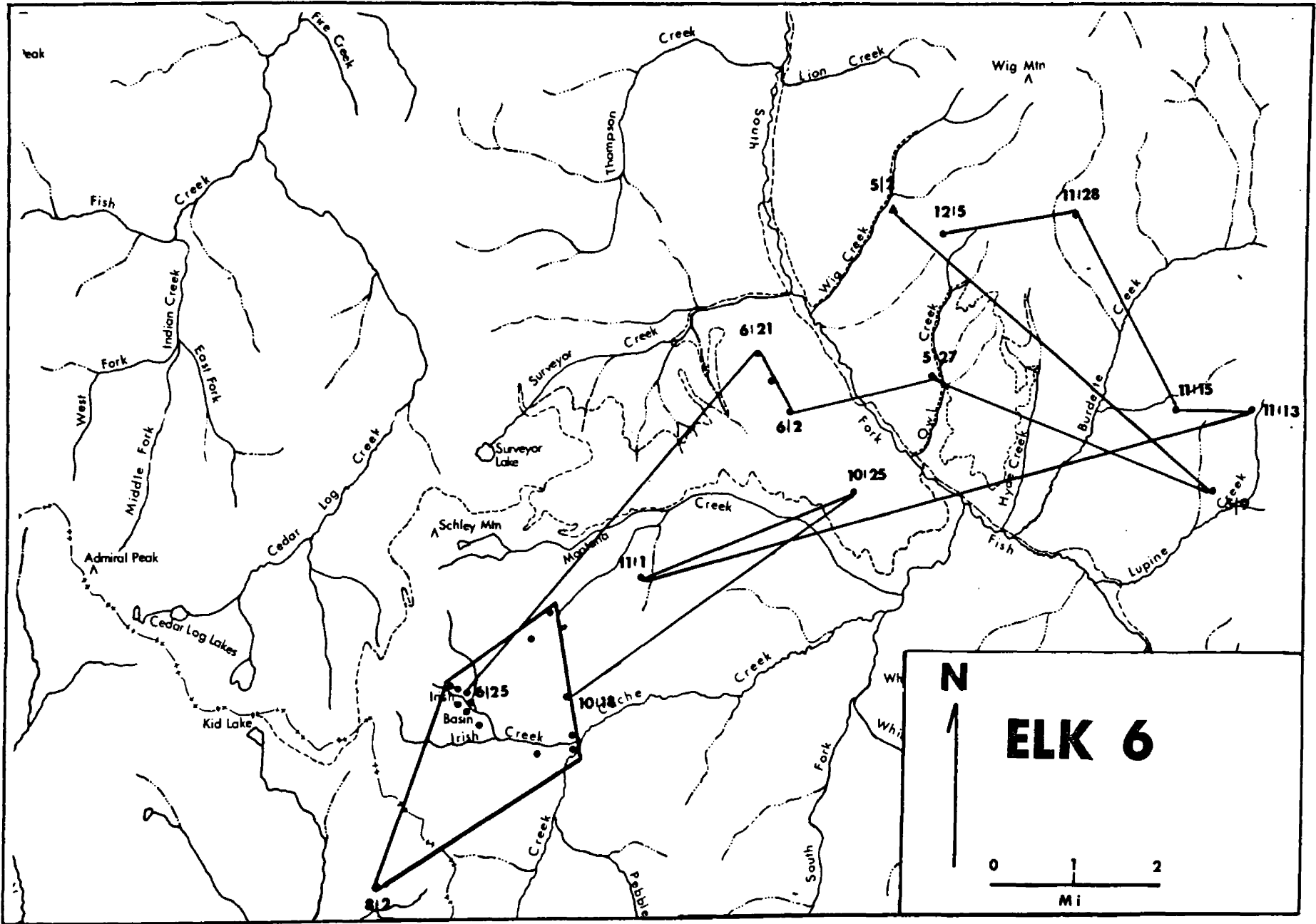


Fig. 11. Movements of Elk 6.

the air in the Burdette Creek drainage east of Wig Mountain. The last radio signal from the winter range was received on 23 May. She was not located again until 6 June, when she was found in the Cedar Log Creek drainage (Fig. 12). Since all areas to the east had been searched previously, Elk 7 probably had her calf on the summer-fall range. On 21 June, she was seen from the air near McNeil Lake in the Montana Creek drainage. Although the site was timbered, it was possible to differentiate at least four adult cows and three calves. One of the other cows was the animal captured with Elk 7 and wearing the yellow and blue neckband. Six days later, Elk 7 was still in the area and seen with Elk 4 in a group of at least seven adult cows and three calves. She continued to use areas in the Montana Creek drainage, Irish Basin (Figs. 13 and 14), and near Cedar Log Creek until late July when all her movements were confined to the vicinity of Cedar Log Creek and the East Fork of Indian Creek (Figs. 15 and 16). Elk 7 and Elk 3 were probably members of the same harem since many of their September locations coincided. Elk 7 was not seen again until 18 October when identified on a timbered ridge top along with four other cows, two calves and a large bull. The summer-fall area utilized by her was 7.1 square miles, and parts of it were 10 airline miles from the winter range. Elk 7 returned to the Burdette Creek area by 13 November. The movement back to the winter range took 2 weeks, during which time she was located five times in the Surveyor



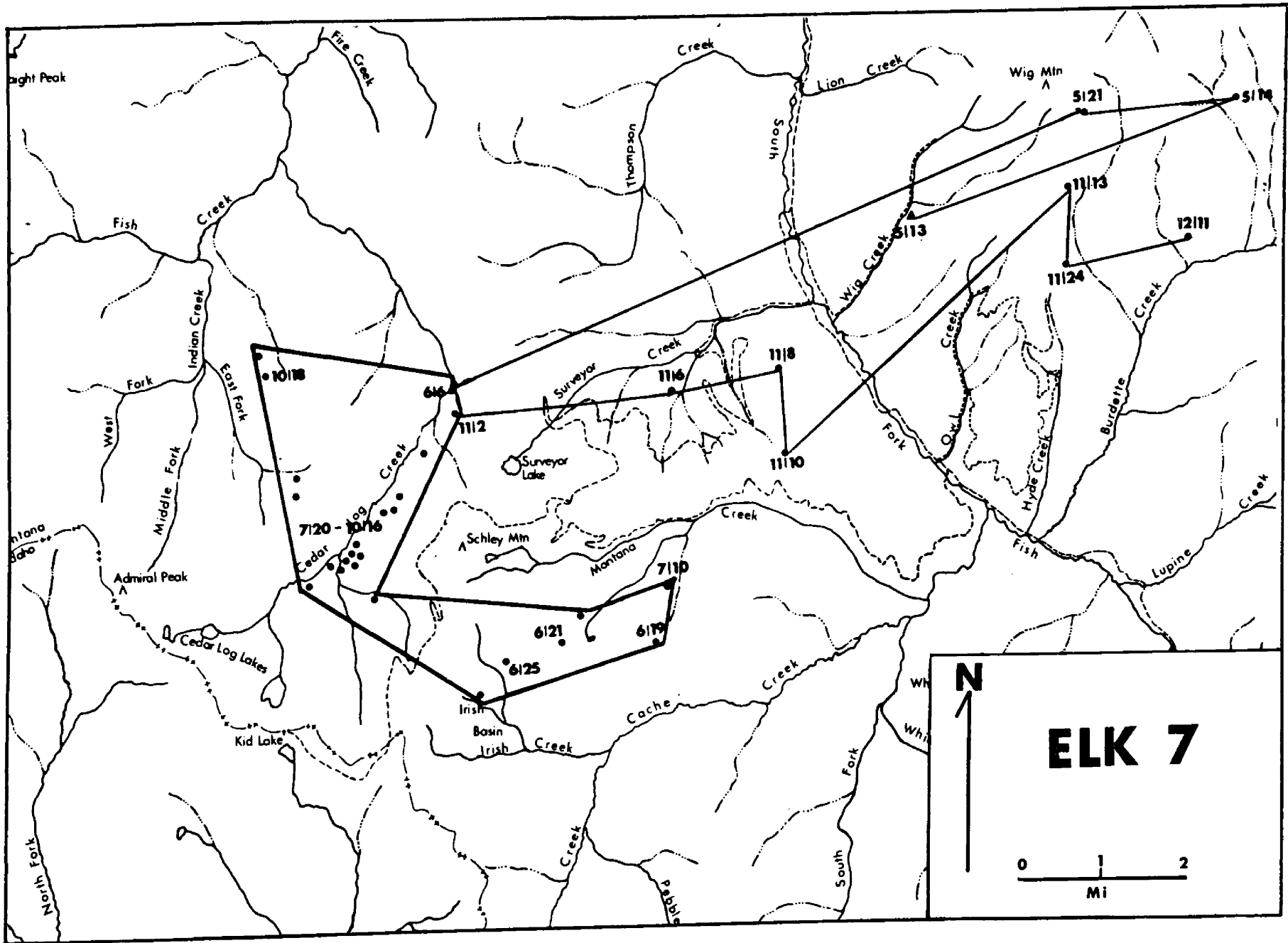


Fig. 12. Movements of Elk 7.

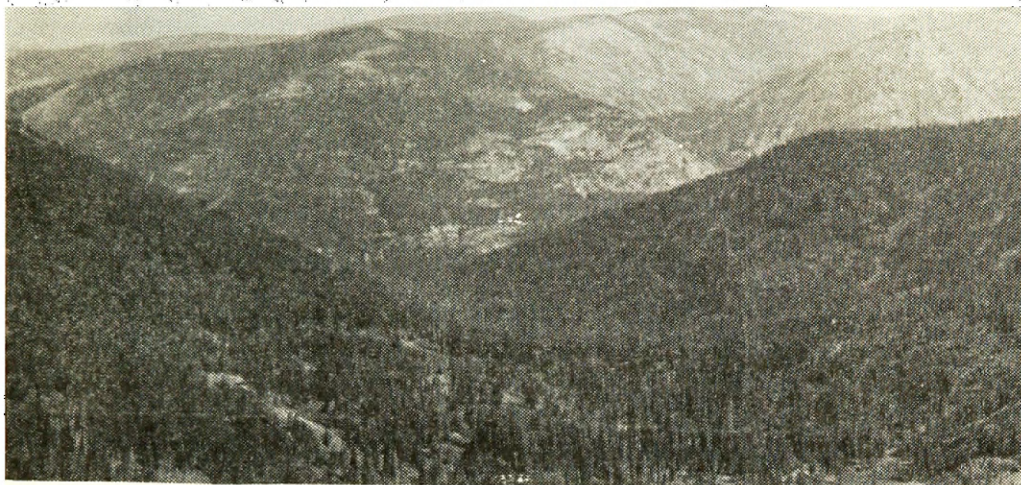


Fig. 13. Irish Basin summer range.



Fig. 14. Drainage head in Irish Basin.

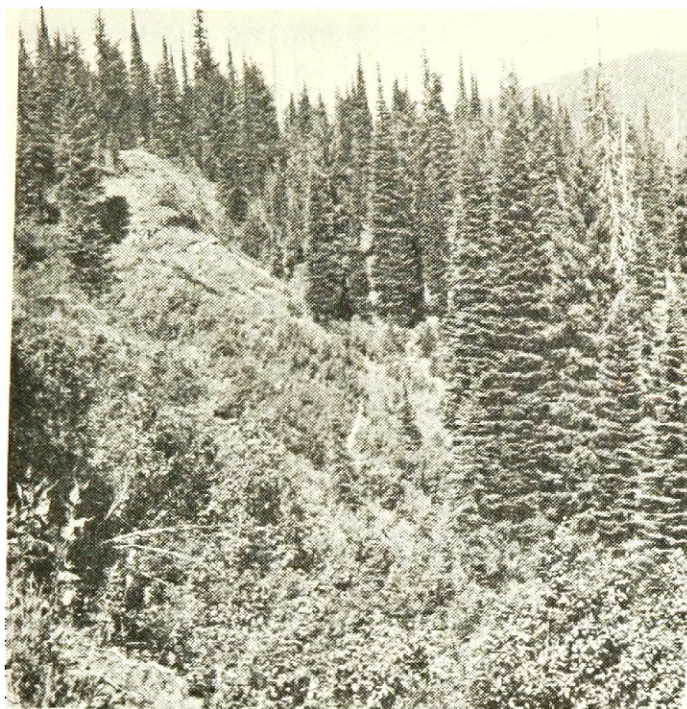


Fig. 15. AF/Mefe habitat type in E. F. Indian Creek.

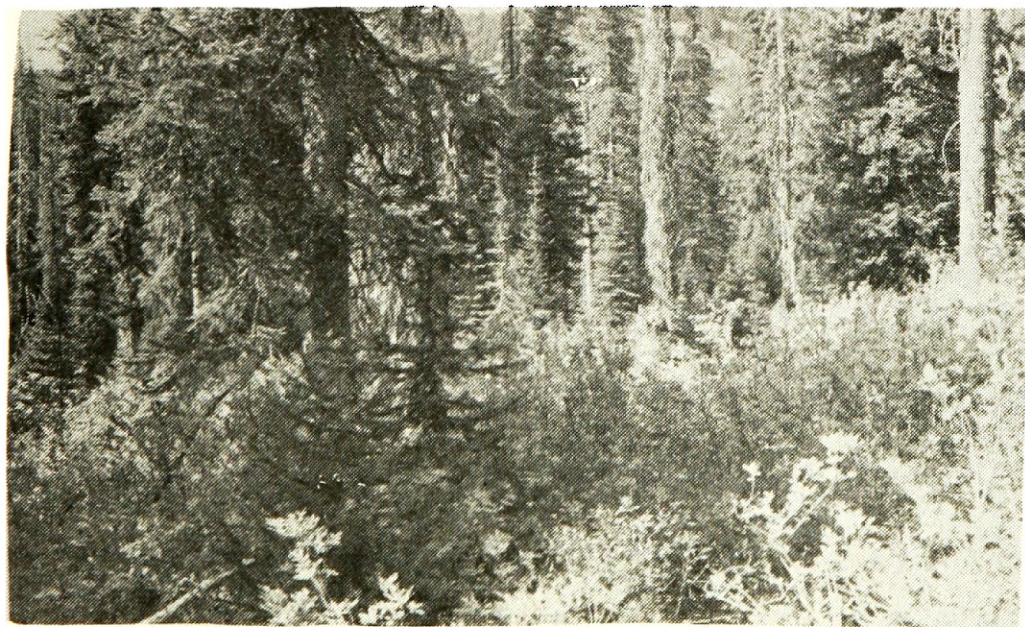


Fig. 16. AF/Mefe habitat type in Cedar Log Creek.

Creek drainage. Once on the winter range, most of her relocations were near the North Fork of Burdette Creek.

### Elk Locations and Human Activities

Human activities in the study area are mainly related to logging and hunting. During the first week of the elk season, hunter use, particularly of well-roaded areas, was high. After the second weekend, use dropped considerably; during the "bulls only" portion of the season, hunting pressure became insignificant considering the size of the area. Since many people in western Montana are "meat" hunters, they shifted their hunting activities to areas where cows were still legal, thus increasing their chances of success. Elk response to hunting was generally one of avoidance. This was well illustrated by Elk 6, who left an area near two hunting camps following the opening of the season. Both camps were established prior to opening day and their presence alone apparently did not cause the animal to move. It seems almost certain that her sudden movement of 5 miles to a dense timber habitat just west of Fish Creek Road was related to hunting activity, although it is not known whether she had an actual encounter with a hunter. Other instrumented elk did not move away from areas previously occupied although smaller movements within these ranges were noted.

In contrast to hunting, which only exerts an influence during

the season, the effects of logging and related activities often last for years. The effects include the actual logging operation, the slash burning and site preparation following the cutting, and the effects of roads which remain. The only area where sizable logging activities occurred during the study period was in the Deer Creek drainage. Pellet count data comparing elk use of the drainage prior to logging and during logging indicates a marked decline in utilization after the beginning of logging operations (Lyon 1973). During the period of the study none of the instrumented elk were located in the Deer Creek drainage. While few people would argue the fact that elk will leave areas that are being actively cut, proponents of clearcutting often point out that these open areas will eventually attract elk because of invading browse species (Resler 1972). This probably holds true in areas where few natural open areas exist (Harper 1964) but does not seem to be the case in the study area. Of all instrumented animals, only Elk 5 seemed to utilize a number of clearcuts. This occurred in the upper Surveyor Creek drainage, an area of dense timber with few natural openings. Even though Elk 5 was never located within a clearcut, the fact that she remained for days at a time very near them (within 100-200 yards), coupled with evidence of fresh elk signs around the edges of the cuts, strongly suggests that she used those cuts. Once, while quietly waiting at the edge of a cut for Elk 5, I saw another cow step out of the heavy timber and start to feed on

some shrubs. However, I was noticed by the animal, which gave alarm, and thus I was unable to see Elk 5. Few pellets or tracks were seen away from the edges of clearcuts. Since all cuts were in roaded areas, possibly elk are reluctant to move far from cover in locations where they might be disturbed by vehicular traffic. Road closures may affect behavioral changes and thus make these areas available for elk use. While a sample size of only 10 instrumented animals is not large enough to draw definite conclusions, in the study area elk seem to prefer natural open sites, such as old burns, to those created by clearcutting. In addition, half the instrumented elk used nonroaded areas for their summer-fall ranges. In areas of dense timber habitats and few natural open sites, the edges of clearcuts were utilized.

#### Population Data

Between July and September 1972, a total of 113 elk were seen; all but 16 could be classified. The cow-calf ratio for this period was 100:41.6. Among adult elk, the male-female ratio was 20:100.

From April to December 1973, nearly 500 elk were observed. On censusing flights over the winter range on 11 April and 5 December, totals of 141 and 150 elk, respectively, were recorded. Cow-calf ratios were collected from June to November at a time when the

calves could be easily identified. Observations of 170 elk during this period resulted in a cow-calf ratio of 100:42. The adult male-female ratio was 24:100.

### Harvest of Tagged Elk

During 1972 and 1973, 11 elk were instrumented; three elk were neck-banded when radios were not available. During that period, two of the instrumented animals were killed in Idaho and one of the neck-banded elk was killed in Montana. Hunting mortality for tagged elk was 21 percent for a 2-year period. All three were young bulls, either 1- or 2-year-olds. The cows not only survived the hunting season but apparently were not sighted by hunters, as many sportsmen were questioned about elk sightings.

## CHAPTER V

### CONCLUSIONS AND RECOMMENDATIONS

Although elk wintering in the area of Burdette Creek disperse in different directions and to various distances, they return to the same winter range. This seasonal movement back to the same winter range justifies the term herd when discussing the elk of the Burdette Creek and adjacent drainages. Successful management and maintenance of a herd such as this requires close cooperation between game and forest managers (Ream 1974). Areas essential to the herd should be identified as such and managed accordingly. Thus benefits to wildlife are planned and not achieved accidentally (Pengelly 1972). The Burdette Creek area is vital winter range to an elk herd that utilizes at least 150 square miles of habitat during summer. Since this figure was arrived at using only a small sample of marked animals, the total area utilized by the herd is probably larger. Any habitat changes, such as road-building and logging in summer areas, will only affect the segment of the herd summering in that particular drainage. Corresponding changes on the winter range could affect the total population. The Burdette Creek drainage is not roaded, however areas surrounding it are well roaded, thus facilitating access. Data



from instrumented elk indicate that heavy snows force elk from summer ranges back onto the winter range. Once concentrated on the winter range, elk would be highly susceptible to hunting pressure. A combination of roading the winter range and removal of escape-cover could adversely affect elk populations, especially during years of early snowfalls. It is therefore recommended that the entire Burdette Creek drainage be managed as critical winter range for big game. The recently logged Deer Creek drainage should be watched closely to see if it becomes an extension of the Burdette Creek winter range.

As more areas on summer ranges are logged it may be desirable to close roads in some areas so that elk can fully utilize invading browse species on clearcuts. Pellet counts could be used to compare elk use of cuts in areas with closed roads to those with open ones. The effect of cut size and shape could similarly be ascertained.

The cow-calf ratio of 100:42 observed in 1973 appears average for the Clark Fork Management Unit (Fish and Game Department records). It is, however, somewhat low when compared with other areas in the district and with the heavily cropped White River herd in Colorado (Boyd 1970). There seems little doubt that the segments of the Burdette Creek herd summering in Cedar Log Creek, for instance, are exposed to less hunting pressure than those utilizing easily accessible areas. Thus the herd may contain some older non-producing females which would tend to lower the cow-calf ratio. On

the other hand, such nonroaded areas would also produce the older bulls much valued by many sportsmen. Considerable cropping of such herd segments occurs in years of early snowfalls.

## CHAPTER VI

### SUMMARY

During 1972-73, 11 elk were instrumented to obtain data on seasonal movements and habitat uses of the Burdette Creek elk herd in western Montana. All but one of the animals left the winter range area in summer. Distances moved from the winter range varied from 4.5 to 20 miles. Movements off the winter range occurred in a 2-week period from late May to early June. There was no evidence for preferred calving areas for the herd as a whole, although individual animals may calf in certain areas year after year. Summer-fall ranges varied from 2.8 to 35 square miles, being largest for bulls and cows without calves. During the summer-fall period, habitat types in the subalpine fir zone received heaviest use. Elk sightings were few in June and increased sharply for July when cow-calf groups of over 20 animals were frequently seen. Although fall ranges were nearly identical to those used during the summer, some instrumented cows displayed a shift to an adjacent area in early September. All surviving instrumented elk returned to the Burdette Creek winter range. Return movements were related to the first

heavy snowstorm of the season and appeared to be gradual in contrast with spring dispersal movements which were sudden.

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