Range relationships of mule deer, elk and cattle on a rest-rotation grazing system during winter and spring
by Thomas James Komberec

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

Abstract:
A study was conducted in the timbered breaks adjacent to the Missouri River, northcentral Montana, during the summer of 1974 and the winter and spring of 1975 to obtain quantitative data on populations, range use and food habits of mule deer, elk and cattle within an area managed by rest-rotation grazing. Seven major habitat types consisting of eleven plant communities were recognized. Numbers, productivity, distribution, and range use of mule deer and elk were determined from one early winter helicopter purvey, two fixed-wing airplane surveys and regular ground observations. The fawn:doe ratio was 54.8 for mule deer and the cow:calf ratio was 70.0 for elk in late January 1975. Numbers and distribution of mule deer during the study showed no consistent trends in relation to grazing by cattle and pasture treatments. Numbers and distribution of elk during this study were greatly influenced by grazing of cattle. Elk moved from areas of previous use when cattle began using the area. Home ranges of four marked mule deer were largest for the two adult males and smallest for the female and male fawn. Three radio-collared elk had home ranges much larger than those of the mule deer, with the male having a home range more than twice as large as the home ranges of two female elk.

The Artemisia-Agpopyron habitat type was used most often by both mule deer and elk during winter and spring and by cattle during spring.

Marked mule deer and elk used the Pinus-Juniperus habitat type most often during both winter and spring. Mule deer, elk and cattle all used 0-10 degree slopes most often during winter and spring. Mule deer and elk preferred southerly exposures during both seasons while cattle used ridge tops and coulee bottoms most often. Food habits were determined from feeding site examinations, supplemented with one cow rumen sample. Browse, forbs, grasses and forbs, browse, grasses was the order of importance of forage classes used by mule deer in winter and spring, respectively. Forbs, grasses, browse was the order of importance of forage classes used by elk in winter. Grasses, forbs, browse was the order of importance of forage classes used by cattle during spring. Yellow sweetclover was the most important forb in the diet of each of the three ungulates. Western wheatgrass was the most important grass in the diet of both elk and cattle. Interspecific relationships, effect of rest rotation grazing and management recommendations of mule deer, elk and cattle on a rest rotation grazing system were discussed.

STATEMENT OF PERMISSION TO COPY

In presenting this thesis in partial fulfillment of the requirements for an advanced degree at Montana State University, I agree that the Library shall make it freely available for inspection. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by my major professor, or, in his absence, by the Director of Libraries. It is understood that any copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Signature Thomas J. Thomberry

Date 23 Feb 1976

RANGE RELATIONSHIPS OF MULE DEER, ELK AND CATTLE ON A REST-ROTATION GRAZING SYSTEM DURING WINTER AND SPRING

by

THOMAS JAMES KOMBEREC

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

of

MASTER OF SCIENCE

in

Fish and Wildlife Management

Approved:

Richard J. Mackie
Chairman, Examining Committee

James M. Peterson
Head, Major Department

Henry L. Parsons
Graduate Dean

MONTANA STATE UNIVERSITY
Bozeman, Montana

March, 1976

ACKNOWLEDGMENT

The author wishes to express his sincere appreciation to the following, among others, for their aid and contributions to this study: Dr. D. C. Quimby and Dr. R. J. Mackie, Montana State University, for project planning, technical advice and guidance in preparation of the manuscript; Dr. W. R. Gould and Dr. R. L. Eng, Montana State University, for critical review of the manuscript; Dr. J. H. Rumely, Montana State University, for verification of plant specimens and for critical review of the manuscript; Mr. R. Trueblood, Mr. R. B. Campbell, and other personnel of Region Six, Montana Department of Fish and Game, for field assistance and cooperation; Mr. J. Jones, and other personnel of the Bureau of Land Management, Malta District Office, for their cooperation; and to the Robinson brothers of the Lazy J. D. Cattle Company for their assistance and cooperation.

Last, but not least, to my parents, family and friends, for their unstinting support through the long years of academic pursuit, I wish to express my heartfelt thanks.

During the study, the author was supported by the Montana Department of Fish and Game under Federal Aid Project W-120-R-6 and W-120-R-7.

TABLE OF CONTENTS

TABLE OF CONTENTS
(Continued)

LIST OF TABLES

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

LIST OF TABLES
(Continued)

LIST OF FIGURES

ABSTRACT

A study was conducted in the timbered breaks adjacent to the Missouri River, northcentral Montana, during the summer of 1974 and the winter and spring of 1975 to obtain quantitative data on populations, range use and food habits of mule deer, elk and cattle within an area managed by rest-rotation grazing. Seven major habitat types consisting of eleven plant communities were recognized. Numbers, productivity, distribution, and range use of mule deer and elk were determined from one early winter helicopter survey, two fixed-wing airplane surveys and regular ground observations. The fawn:doe ratio was 54.8 for mule deer and the cow:calf ratio was 70.0 for elk in late January 1975. Numbers and distribution of mule deer during the study showed no consistent trends in relation to grazing by cattle and pasture treatments. Numbers and distribution of elk during this study were greatly influenced by grazing of cattle. Elk moved from areas of previous use when cattle began using the area. Home ranges of four marked mule deer were largest for the two adult males and smallest for the female and male fawn. Three radio-collared elk had home ranges much larger than those of the mule deer, with the male having a home range more than twice as large as the home ranges of two female elk. The *Artemisia-Agropyron* habitat type was used most often by both mule deer and elk during winter and spring and by cattle during spring. Marked mule deer and elk used the *Pinus-Juniperus* habitat type most often during both winter and spring. Mule deer, elk and cattle all used 0-10 degree slopes most often during winter and spring. Mule deer and elk preferred southerly exposures during both seasons while cattle used ridge tops and coulee bottoms most often. Food habits were determined from feeding site examinations, supplemented with one cow rumen sample. Browse, forbs, grasses and forbs, browse, grasses was the order of importance of forage classes used by mule deer in winter and spring, respectively. Forbs, grasses, browse was the order of importance of forage classes used by elk in winter. Grasses, forbs, browse was the order of importance of forage classes used by cattle during spring. Yellow sweetclover was the most important forb in the diet of each of the three ungulates. Western wheatgrass was the most important grass in the diet of both elk and cattle. Interspecific relationships, effect of rest rotation grazing and management recommendations of mule deer, elk and cattle on a rest rotation grazing system were discussed.

INTRODUCTION

Rest-rotation grazing (Hormay and Talbot 1961) has been increasingly employed by range and other land managers to relieve overgrazing and improve vegetation while maintaining maximum production of livestock on rangelands. The benefits of rest-rotation grazing for livestock and rangeland vegetation have been well documented (Hickey 1966). Little is known as yet of the possible effects or influences of rest-rotation grazing of livestock on habitat values for wildlife or on wildlife-livestock relationships.

During the summer of 1973, the Montana Department of Fish and Game initiated a study of the range relationships of mule deer *(Odocoileus hemionus)*, elk *(Cervus canadensis)*, and cattle *(Bos taurus)* on the Nichol's Coulee Resource Conservation Area, a rest-rotation grazing system for cattle in northcentral Montana (Knowles 1975). The objectives of the study were to obtain quantitative data on mule deer, elk, and cattle distribution, movements, range use, and food habits within the Nichol's Coulee Area, and to establish basic criteria to assist range and wildlife managers in planning and conducting sound multiple-use management on a rest-rotation grazing system. Knowles (1975) described range relationships of mule deer, elk, and cattle on the area during summer and fall. My study, conducted full-time during the summer of 1974 and from January through

June, 1975, considered these relationships during winter and spring.

DESCRIPTION OF THE STUDY AREA

The 88,810 acre Nichol's Coulee RCA study area (Fig. 1) is located in Phillips County, about 55 miles southwest of Malta, Montana. Knowles (1975) described the general physiographic and climatic characteristics of this area as well as the primary features of the rest-rotation grazing system. Ownership of land and grazing capacities are listed in Appendix Table 27. The grazing formula for the study area is shown in Appendix Figure 10, and order of treatments within and between years is given in Appendix Figure 11.

Climatological data for the period January through June, 1975 (Table 1) were obtained from the U. S. Department of Commerce Weather Station Roy 24 NE (Mobridge), located 17 miles southwest of the study area. Except for January, the mean monthly temperatures were an average of 3.62° F less than the corresponding 11 year monthly means; the range of deviation of monthly temperatures from normals was minus 1.0 for May to minus 6.8 for February. Northwest winds averaging 5 to 10 miles-per-hour with gusts to 30 miles-per-hour were common during winter and early spring. Eighty-four percent of the 41.5 inches of snowfall from January through June 1975 occurred during March and April, while 85.5 percent of total precipitation for the same period fell during April, May, and June.

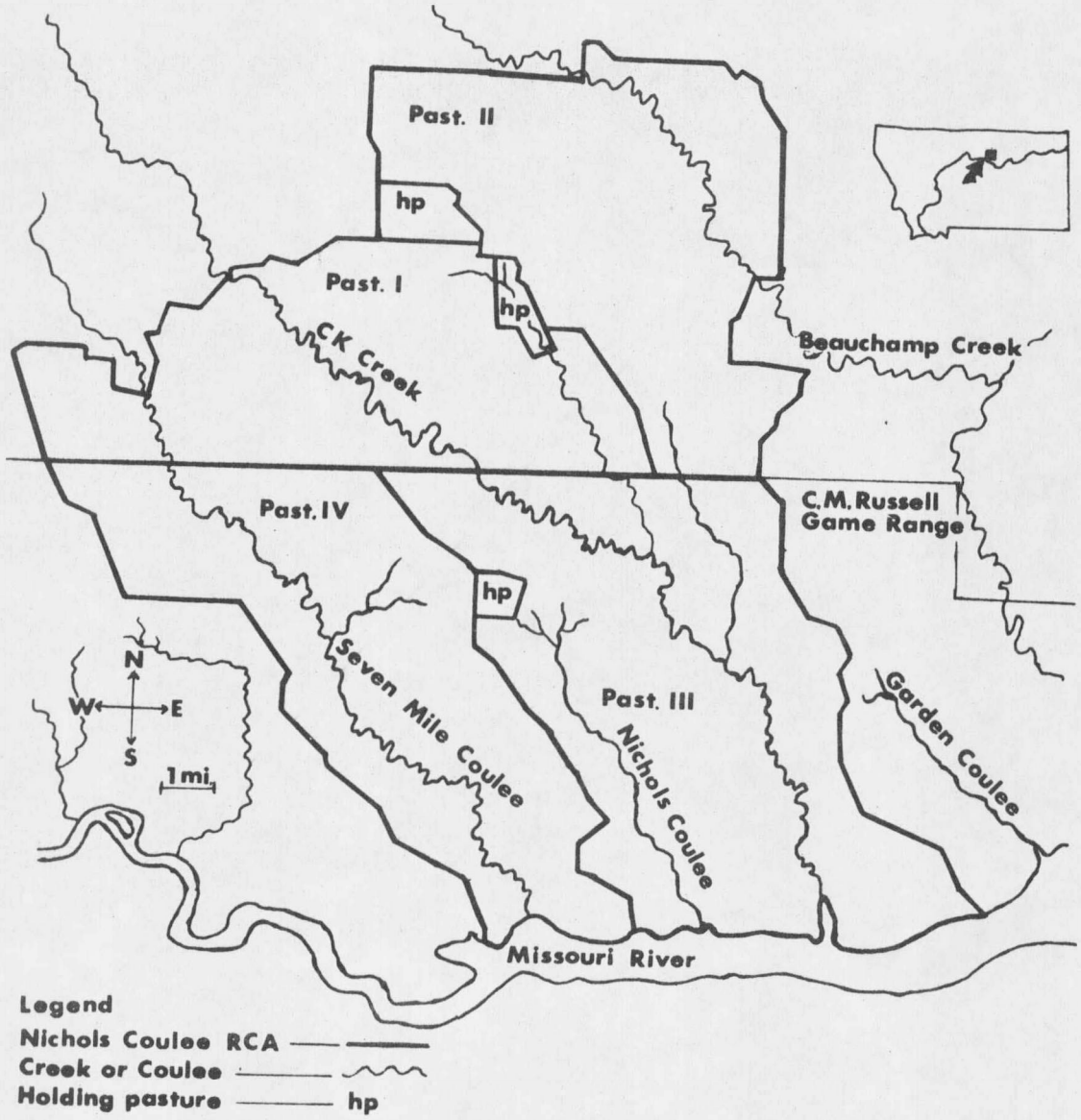

Figure 1. Map of the study area showing boundaries and drainages.

TABLE 1. MEAN TEMPERATURE AND PRECIPITATION FOR 1974 AND JANUARY-JUNE 1975, SNOWFALL FOR 1975, AND 11-YEAR MEANS. U. S. DEPARTMENT OF COMMERCE WEATHER STATION ROY 24 NE (MOBRIDGE), MONTANA.

	Temperature (° F)			Precipitation (inches)			
	Year		11-Year[1]	Year		Snowfall	11-Year
Month	1974	1975	Mean	1974	1975	1975	Mean
Jan.	17.5	21.4	11.7	.12	.26	1.0	.58
Feb.	29.7	15.3	27.1	.10	.19	5.5	.21
March	33.1	29.1	31.8	.83	.98	19.5	.57
April	46.9	38.4	44.1	.81	2.18	15.5	1.36
May	50.4	54.1	55.1	4.44	3.21	0	2.02
June	68.0	62.4	64.3	2.08	3.07	0	2.80
July	73.7	--	71.5	4.82	--	--	1.69
Aug.	64.8	--	70.7	4.09	--	--	1.90
Sept.	55.6	--	57.6	.61	--	--	1.06
Oct.	48.2	--	47.1	.65	--	--	.58
Nov.	34.5	--	31.2	.41	--	--	.32
Dec.	26.9	--	17.3	.04	--	--	.43
Totals	45.8	36.78	43.8	19.00	9.89	41.5	13.52

[1]No data January and February 1964.

Knowles (1975) reported that seven of the eight habitat types described by Mackie (1970) for the Missouri River breaks, occur on the Nichol's Coulee RCA study area. A summary of the general occurrence and vegetational characteristics of these habitat types and the 11 plant communities which currently occur on each as described in detail by Knowles (1975) is presented below. Mean percentage canopy coverage and frequency of occurrence of plant taxa found in each of the 11 communities during summer and fall are shown in Appendix Table 28.

Artemisia-Agropyron Habitat Type

This habitat type occupied approximately 57 percent of Pastures III and IV and almost all of Pastures I and II. It was comprised of three distinct plant communities as follows:

The *Artemisia tridentata-Agropyron spicatum* community was well developed along edges of main ridges, on the tops of side ridges and on the more level portions of ridge sides. Big sagebrush *(Artemisia tridentata)*, bluebunch wheatgrass *(Agropyron spicatum)*, and yellow sweetclover *(Melilotus officinalis)* was the most common shrub, grass, and forb, respectively. These taxa were also dominant species recorded at ungulate feeding sites during winter and spring.

While the *Artemisia tridentata-Agropyron smithii* community was best represented on the main ridges, it was also found on sites similar to the *Artemisia tridentata-Agropyron spicatum* community. Western wheatgrass *(Agropyron smithii)*, big sagebrush, and pale bastard toadflax *(Comandra umbellata)* was the dominant grass, shrub, and forb, respectively. Big sagebrush and western wheatgrass were feeding site dominants on this community during winter. These taxa and pale bastard toadflax were dominant on ungulate feeding sites recorded during spring.

The *Artemisia tridentata-Agropyron smithii-Bouteloua gracilis* community was the dominant community of Pastures I and II, but was restricted to level ridge tops in Pastures III and IV. Blue grama *(Bouteloua gracilis)* and western wheatgrass were the dominant grasses.

Big sagebrush and fringed sagewort *(Artemisia frigida)* was the most frequent shrub and forb, respectively. The above taxa were the most often recorded as dominants at feeding sites during winter and spring. However, forbs of the *Tragopogon dubius* union (Mackie 1970) increased in importance as spring progressed.

Pinus-Juniperus Habitat Type

Characteristic of sloping ridge sides, with development determined by degree of slope and exposure, this habitat type occupied 26 percent of the area. Distribution was confined mostly to Pastures III and IV. Three plant communities were characteristic:

The *Pinus ponderosa-Agropyron spicatum* community occurred at the borders between the *Pinus-Juniperus* type and *Artemisia-Agropyron* dominated ridge tops, in shallow basins at the heads of drainages, and on narrow side-ridge tops with scattered ponderosa pine *(Pinus ponderosa)*. Rocky Mountain juniper *(Juniperus scopulorum)*, bluebunch wheatgrass, and yellow sweetclover was the dominant shrub, grass, and forb, respectively. Winter feeding site examinations showed these plant taxa to be dominant then.

The *Pinus ponderosa-Juniperus scopulorum* community was best developed on slopes with some north exposure, with decreasing frequency of occurrence toward south exposures. Dense thickets of Rocky Mountain juniper were characteristic. Green needlegrass *(Stipa viridula)*, yellow sweetclover, and juniper had the greatest coverage for grasses,

forbs, and shrubs, respectively.

The *Pinus ponderosa-Artemisia longifolia* community occurred on steep, unstable shale slopes usually with a south aspect. Prairie sand reedgrass *(Calamovilfa longifolia)* was the dominant grass. Long-leaf sagebrush *(Artemisia longifolia)* was the most frequent shrub. Yellow sweetclover was the dominant forb, although soapweed *(Yucca glauca)* was quite characteristic of this community. Along with the above taxa, western wheatgrass was recorded as a feeding site dominant on this community during winter.

Pseudotsuga-Juniperus Habitat Type

This minor habitat type, characteristic of steep northerly exposures was restricted to Pastures III and IV where it covered one percent of the area. Maximum abundance was along the west edge of the study area, while this type was absent on the east boundary.

Sarcobatus-Agropyron Habitat Type

About six percent of Pastures III and IV along the Missouri River bottoms, coulee bottoms, and footslopes was covered by this habitat type. Western wheatgrass was the dominant grass, especially in coulee bottoms. Greasewood *(Sarcobatus vermiculatus)* was the dominant shrub along the river and a short distance north in major coulees. Big sagebrush gradually increased in abundance with distance from the river. Yellow sweetclover was the most important forb. These plant

taxa were also most often recorded in feeding sites during winter.

Artemisia longifolia Habitat Type

This habitat type occurred on unstable, steep south and southwest shale slopes, being most conspicuous in the southern part of Pastures III and IV, where it covered four percent of the area. Longleaf sagebrush and yellow sweetclover were dominant shrubs and forbs, respectively. Western wheatgrass and prairie sand reedgrass were the dominant grasses. Soapweed was also recorded as a feeding site dominant during winter.

Agropyron-Symphoricarpos Habitat Type

Found in the flood plains of major coulees and in minor drainages, this habitat type combined with the *Xanthium strumarium* type occupied approximately six percent of Pastures III and IV. Western wheatgrass, western snowberry *(Symphoricarpos occidentalis)* and yellow sweetclover was the predominant grass, shrub, and forb, respectively. Green rabbitbrush *(Chrysothamnus viscidiflorus)*, silver sagebrush *(Artemisia cana)*, and wild licorice *(Glycyrrhiza lepidota)* were also recorded as dominant taxa on ungulate feeding sites examined during winter and spring.

Xanthium strumarium Habitat Type

This minor habitat type occurred in the actual cuts of intermittent streams. Vegetation was sparse and generally restricted to silty banks and areas not severely flooded. Cocklebur *(Xanthium*

strumarium) was the characterizing species.

During winter, shrubs, dry grasses, and stems of persistent forbs, such as yellow sweetclover, were the dominant vegetative forms in all habitat types on the study area. With the progression of spring, forbs of the *Tragopogon* and *Poa* unions, especially, contributed greatly to the floral diversity of Nichol's Coulee RCA.

METHODS

Habitat analyses were similar to those described by Knowles (1975). Twenty-three permanent transects were established in stands representative of six major habitat types during the summer of 1974. Canopy coverage (Daubenmire 1959) and frequency of occurrence of herbaceous taxa were recorded among twenty 2 X 5 dm. plots on each transect; these data for shrubs were recorded in superimposed 4 X 10 dm. plots (Pyrah 1973). Supplementary data on plant composition in habitat types were obtained by measuring coverage and frequency using ten 2 X 5 dm. and ten 4 X 10 dm. plots for forbs and shrubs, respectively, at each ungulate feeding site examined (Knowles 1975). Plant nomenclature followed Booth (1950) and Booth and Wright (1966).

Range usage was determined by recording observations of mule deer, elk, and cattle along nine vehicle observation routes similar to those established by Knowles (1975). Eight of these routes were located within Pastures III and IV of the Nichol's Coulee RCA. Routes were covered systematically, at approximately weekly intervals, during morning and evening. Observations were recorded as to species, time, group size, activity, habitat type, slope, exposure, and location. Sex and age-class of mule deer and elk were recorded when possible. The occurrence of any two or more of the three ungulate species within a distance of one-eighth mile of each other was also noted.

Additional data on range usage were obtained by two aerial surveys over the study area using a fixed-wing aircraft during January and April, 1975, and an intensive helicopter survey of Pastures III and IV during mid-January, 1975. The latter also provided basic population data for mule deer and elk on the study area.

Movements and home ranges of mule deer and elk were determined by relocations of five individually marked mule deer, including three equipped with radio-transmitters, and three radio-transmitter equipped elk. Radio transmitters were applied by personnel of the Montana Fish and Game Department during August, 1974 (Knowles 1975); two additional mule deer were ear tagged and marked by Knowles during June, 1974. Relocations of radio-equipped animals were usually made during mid-day; those of ear-marked mule deer were made during normal observation periods. Home range areas of marked mule deer and elk were determined by the modified minimum area method of Harvey and Barbour (1965).

Food habits were determined by examination of recently vacated ungulate feeding sites to record frequencies of plant use by species (Cole 1956). One instance of use was defined as usage of an individual leaf or rooted stem for grass and grass-like plants, an individual leaf or twig for shrubs and trees, and individual leaves or stems for forbs. A minimum of 50 instances of use were recorded at each feeding site. Dominant plant species were recorded at all feeding sites examined. Food habits data were compiled using the aggregate percentage method

(Martin *et al.* 1946) by season and habitat type. Supplementary data on the food habits of cattle were obtained by examination of contents of the rumen of one cow found dead on the study area during June, 1975.

RESULTS

Mule Deer Populations and Range Use

Results are based on observations of 612 mule deer, comprising 119 separate groups during winter (January-March), 1975, and 225 individuals in 81 groups during spring (April 1-June 15). An additional 201 mule deer were observed during helicopter surveys of Pastures III and IV in January, 1975.

Population Characteristics

Knowles (1975) described mule deer population characteristics and trends on the study area during early January of 1974 and 1975. These data indicated an increase of 9.2 percent in numbers of mule deer on the area from 1974 to 1975. The increase occurred entirely within Pasture III, which had not been grazed by cattle during the previous grazing season.

Mule deer densities varied between pastures and between drainages within each pasture (Fig. 2, Table 2). In January, 1975, the deer density was 1.9 times greater in Pasture III than in Pasture IV. Within Pasture III, the density of mule deer in the CK Creek drainage was 3.5 times greater than in the Nichol's Coulee drainage.

Of the 612 mule deer observed from the ground during the winter of 1975, 82 percent occurred in Pasture III. Most of these were found in four extensive concentration areas (Fig. 3). Three areas of concentrated

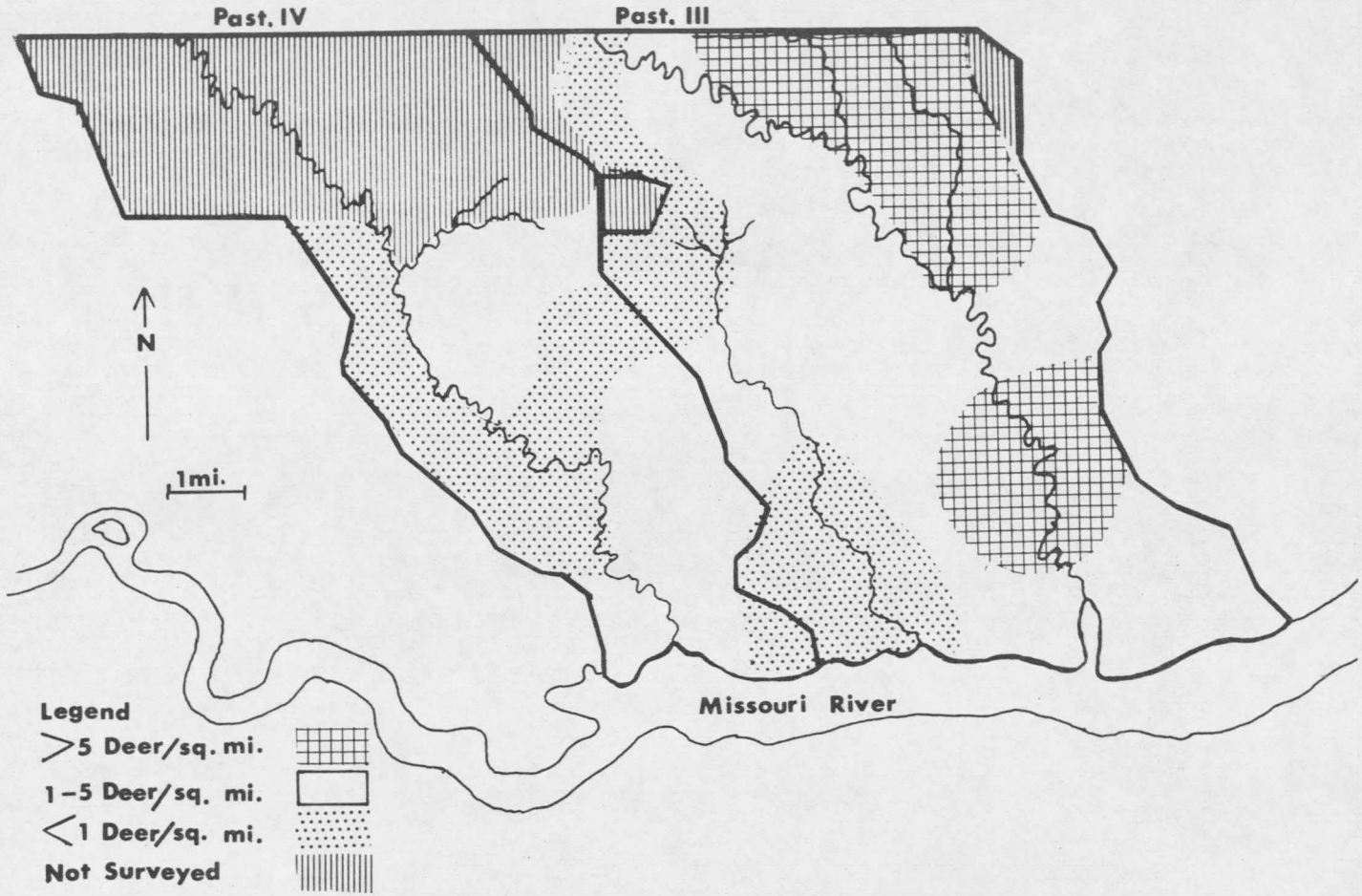

Figure 2. Distribution of mule deer January 1975-helicopter survey.

TABLE 2. MULE DEER NUMBERS BY SEX, AGE CLASS AND LOCALITY DURING JANUARY 1975 HELICOPTER SURVEYS OF NICHOL'S COULEE RCA.

Area	Total	Males	Females	Fawns	Males: 100 Females	Fawns: 100 Females	Fawns: 100 Adults	Percent Fawns	Deer Per Sq. Mile
Pastures III & IV	201	40	104	57	38.5	54.8	39.6	28.4	3.4
Pasture III	164	32	82	50	39.0	61.0	43.9	30.5	3.9
Pasture IV	37	8	22	7	36.4	31.8	23.3	18.9	2.1
CK Coulee	147	31	73	43	42.5	58.9	41.4	29.3	4.9
Nichol's Coulee	17	1	9	7	11.1	77.8	70.0	41.2	1.4
Seven Mile Coulee	37	8	22	7	36.4	31.8	23.3	18.9	2.1

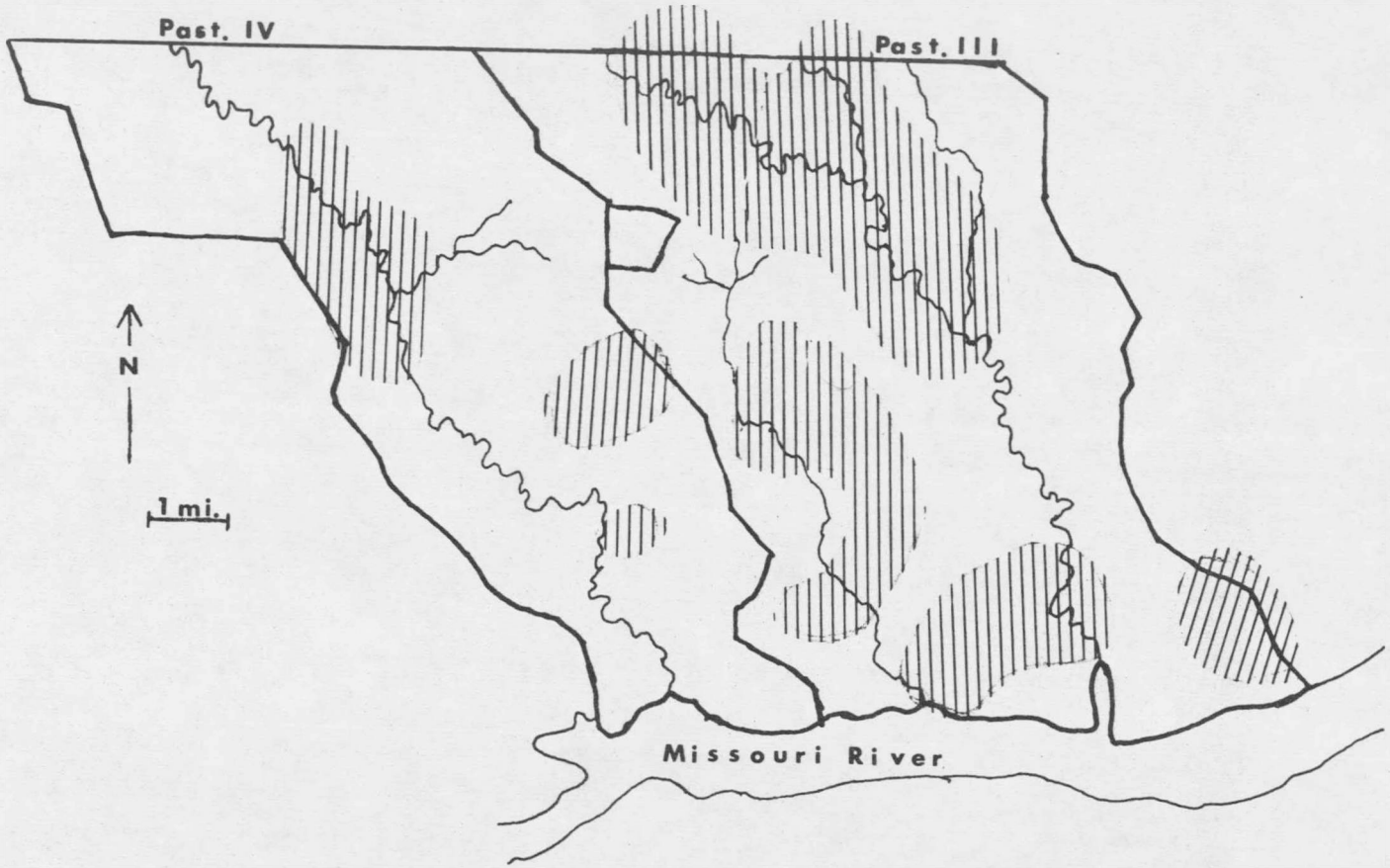

Figure 3. Distribution of mule deer on Nichol's Coulee RCA during winter 1975.

use occurred in Pasture IV, though these areas were much smaller, more widely separated, and contained fewer mule deer than those in Pasture III. Ground observations during the spring showed much the same distribution as winter (Fig. 4), with 83 percent of 235 mule deer observed being in Pasture III.

The January, 1975, helicopter survey showed 54.8 fawns per 100 females in Pastures III and IV, an increase of 9.6 percent from 1974 to 1975 (Knowles 1975). The number of fawns per 100 does was 1.9 times greater in Pasture III than in Pasture IV. The fawn:doe ratio for ground observations during January, 1975, over the whole study area was 67.5:100. The difference in fawn:doe ratios between the helicopter survey and ground observations during January, 1975, may have been due to more frequent observations in Pasture III where higher than average numbers of fawns occurred.

Home Range and Movements

Knowles (1975) differentiated between normal and total home range, in describing mule deer movements during summer and fall, with normal including areas of intensive use, and total, all points of relocation. I compiled home ranges for mule deer relocated during the winter and spring in a manner comparable to the normal classification.

Three radio-collared and one ear-tagged mule deer were relocated a total of 30 times during winter and spring (Table 3). The 2.5

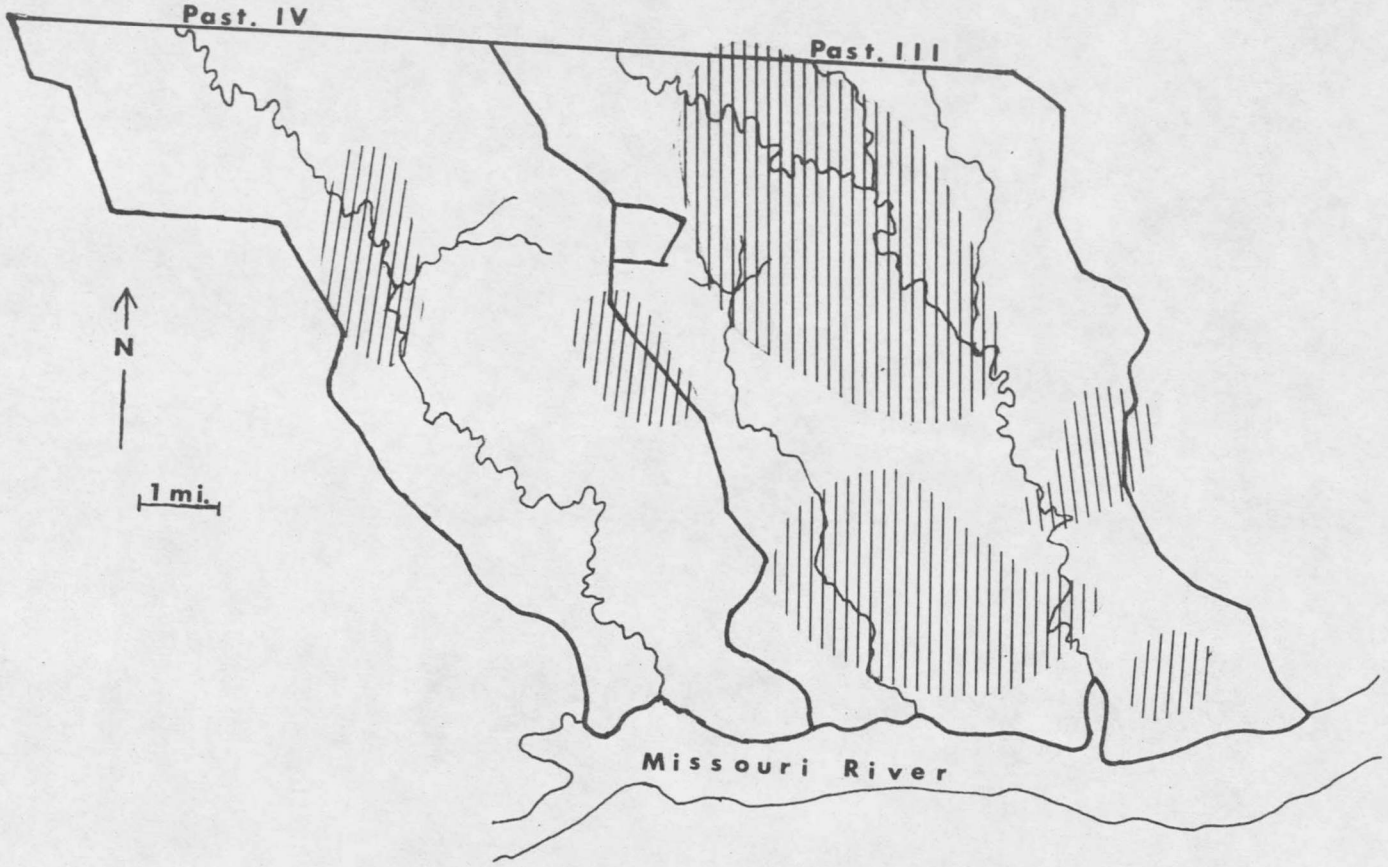

Figure 4. Distribution of mule deer on Nichol's Coulee RCA during spring 1975.

TABLE 3. SUMMARY OF HOME RANGES AND MOVEMENTS DURING WINTER AND SPRING FOR THREE RADIO-COLLARED AND ONE EAR-TAGGED MULE DEER.

Animals		Times	Dates of First-Last Observations	Home Range Area (Acres)	Distance Moved (Miles)		
Sex	Age	Relocated			Max.	Min.	Mean
Male	2.5+	14	1/20 - 6/24	1703	1.7	0.22	1.1
Male	1.5+	8	2/10 - 6/24	1138	2.6	0.16	1.1
Female	1.5+	3	1/18 - 1/31	506	1.3	0.34	0.9
Male	Fawn	5	1/19 - 6/2	370	3.8	0.50	1.6

year-old male had the largest home range, 1,703 acres, followed in descending order by the yearling male, 1,138 acres, the yearling female, 506 acres, and the male fawn, 370 acres (Fig. 5, Table 3). Home ranges of the three radio-collared deer during winter and spring were much smaller than their normal home ranges during summer and fall. Differences ranged from 91 percent for the 2.5 year-old male to 66 percent for the yearling female. Radio-triangulations of the radio-collared deer, without visual contact, suggested that the home range of the 2.5 year-old male may have been about 50 percent larger than determined only by recorded visual relocations. Addition of relocations by triangulation did not affect the determined home range sizes of the two yearlings. The yearling female was last seen on January 31 and apparently died sometime prior to recovery of the collar in May.

During summer and fall, 1974, the yearling male was the only marked mule deer which experienced cattle grazing within its home range (Knowles 1975). No cattle grazed that area during winter and spring, 1975. Large numbers of cattle grazed the home range of the 2.5 year-old male and some cattle grazed the male fawn's home range from April 1, 1975, until observations ceased on June 15.

Knowles (1975) noted an extension during late fall of the 2.5 year-old male's home range to the edge of timber in CK Creek drainage and of the yearling buck's use of rangeland to the north of the timber

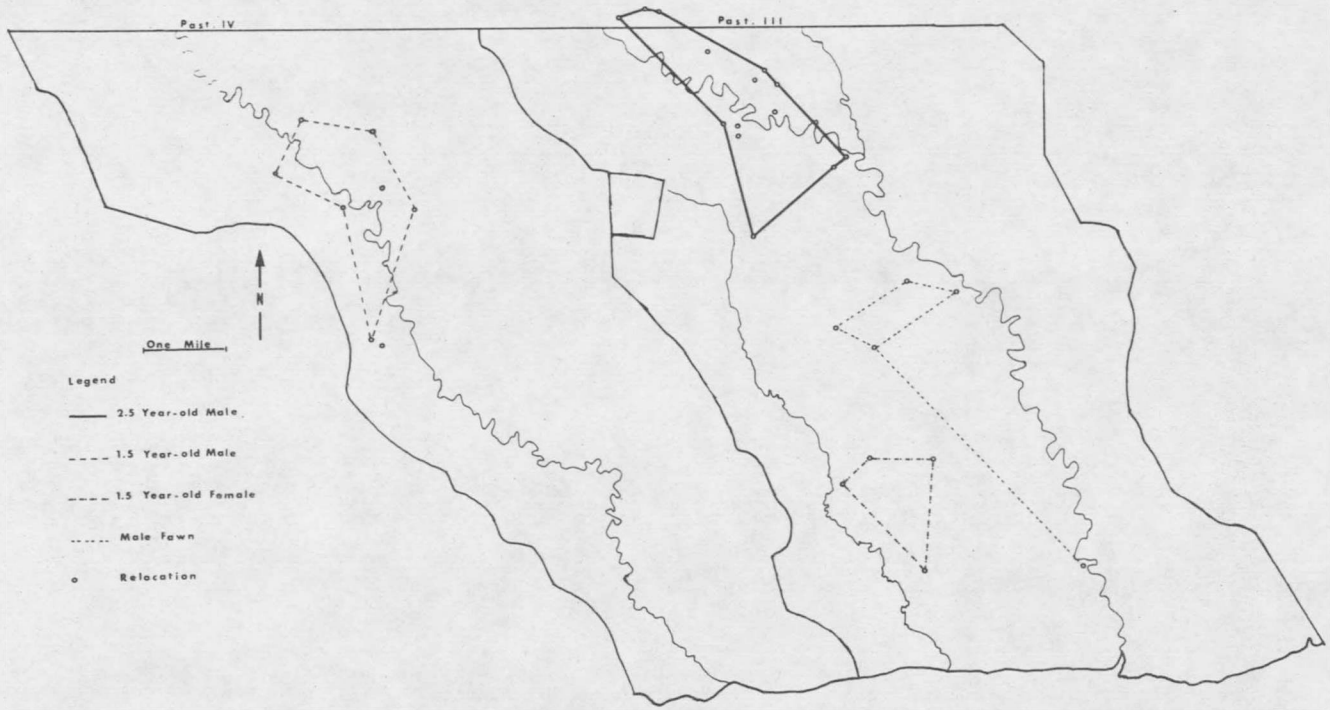

Figure 5. Home ranges of three radio-collared and one ear-tagged mule deer on Nichol's Coulee RCA during winter and spring 1975.

in Seven Mile Coulee. These areas continued to be used extensively during winter and early spring.

I did not observe the heavy use of burned areas within home ranges of radio-collared deer described by Knowles (1975). Also, the radio-collared animals did not appear to be attracted by or associated with water sources, although some deer were observed eating snow and gnawing ice on frozen streams during the winter. Heavy precipitation during spring provided free water throughout the study area.

Although the marked mule deer appeared to have smaller home ranges during winter and spring than those recorded by Knowles (1975), distances moved between successive relocations were quite similar. The maximum, minimum, and mean distances moved by the marked deer between successive relocations from early January through late June are listed in Table 3. The longest recorded movement was by the male fawn on June 2 when he was observed nearly four miles from his normal home range. The yearling male moved the least distance between successive relocations. Mean movements were about equal for the two adult males. Mean distances traveled by the yearling female and male fawn were lower than those of adult males through the winter until the fawn moved abruptly in early June. The 2.5 year-old male also seemed to move greater distances in early June, possibly because of intensive human activity within its home range.

Group Size and Characteristics

Mean group size increased from January through March, then decreased through June. During winter the most commonly observed group size was 2-5 (Table 4). Single mule deer and groups of over 11

TABLE 4. MONTHLY AND SEASONAL FREQUENCIES OF MULE DEER GROUP SIZES AND MEAN GROUP SIZE DURING WINTER AND SPRING.

Month Season	Group Size				Mean Group Size
	1	2-5	6-10	11+	
January	9.1	70.5	13.6	6.8	4.5
February	9.7	51.6	29.0	9.7	5.4
March	4.5	45.5	45.5	4.5	5.6
Winter	7.6	56.3	29.4	6.7	5.1
April	8.3	50.0	41.7	-	4.8
May	41.5	51.2	7.3	-	2.4
June (1-15)	68.8	31.2	-	-	1.4
Spring	37.0	46.9	16.1	-	2.9

animals were observed with about equal frequencies during winter. No groups larger than ten mule deer were observed after March. The tendency toward larger group sizes during late winter appeared to be related to use of open and level areas during that period. Groups of 2-5 deer continued to be observed most commonly during spring, except in June when the frequency of single animals increased sharply. This change has been related to intolerance of pregnant females to other deer during fawning (Dasmann and Taber 1956, Einarsen 1956, Geist 1971, and Knowles 1975).

Activity Habits and Patterns

Running was the most frequently recorded activity among all deer observed during winter (Table 5). Feeding was the dominant activity over-all during spring and ranked second for observations during the winter. The dominant activity for the marked mule deer was feeding during both seasons (Table 6). Knowles (1975) reported an increase in the occurrence of alert and running deer during fall, which he related to increased wariness due to hunter disturbance. The greater occurrence of observations of alert and running animals during winter may reflect increased usage of open and level areas affording less security and greater sight distances than the timbered breaks.

Activity periods were somewhat longer during winter and early spring than reported by Knowles for summer and fall; some deer were observable during most daylight hours. Similar activity periods were described by Mackie (1970).

Use of Habitat Types, Slopes, and Exposures

Mule deer used the *Artemisia-Agropyron* habitat type most frequently during both winter and spring (Table 7). The *Pinus-Juniperus* habitat type was second most important during the winter and during June. It was the single most important type used by marked mule deer during both winter and spring (Table 6). The *Sarcobatus-Agropyron* habitat type was more frequently used over-all during spring, except

TABLE 5. SEASONAL PERCENTAGES OF ALL MULE DEER ACTIVITIES OBSERVED WITHIN EACH HABITAT TYPE AND TOTAL SEASONAL AVERAGES; AND MONTHLY PERCENTAGES OF ACTIVITIES FOR ALL MULE DEER ON ALL HABITAT TYPES.

Habitat Type Month	Traveling	Feeding	Activity Winter/Spring			
			Feeding and Traveling	Bedded	Running	Alert
Artemisia-Agropyron	70/47	55/75	90/-	6/5	62/74	44/41
Pinus-Juniperus	21/27	7/4	10/-	71/62	31/13	37/29
Artemisia longifolia	-/7	23/4	-/-	12/5	5/2	17/2
Sarcobatus-Agropyron	9/20	15/17	-/-	12/30	3/11	3/29
Average	16/6	25/44	5/-	4/9	32/20	19/21
January	40	17	-	5	12	26
February	5	17	8	5	48	16
March	3	36	6	1	38	15
April	5	44	-	12	20	18
May	9	52	-	3	18	17
June	-	9	-	18	23	50

TABLE 6. PERCENTAGES OF OBSERVATIONS OF 4 MARKED MULE DEER BY ACTIVITY CLASS, HABITAT TYPE, EXPOSURE, AND SLOPE DURING WINTER AND SPRING.

	Marked Mule Deer				
	Male 2.5	Male 1.5	Female 1.5	Male Fawn	Mean
Activity					
Alert	42.9	--	33.3	20.0	24.1
Bedded	21.4	37.5	33.3	--	23.1
Feeding	14.3	25.0	33.3	40.0	28.2
Running	14.3	37.5	--	40.0	23.0
Traveling	7.1	--	--	--	1.8
Habitat Type					
Artemisia-Agropyron	28.5	50.0	33.3	40.0	38.0
Pinus-Juniperus	64.3	12.5	66.7	60.0	50.9
Artemisia longifolia	7.1	--	--	--	1.8
Sarcobatus-Agropyron	--	25.0	--	--	6.3
Agropyron-Symphoricarpos	--	12.5	--	--	3.1
Exposure					
N	21.4	--	33.3	60.0	28.7
NW	21.4	--	33.3	20.0	18.7
NE	21.4	12.5	--	--	8.5
S	7.1	--	--	--	4.9
SW	7.1	--	--	--	1.8
SE	7.1	12.5	33.3	--	13.2
W	14.3	37.5	--	--	13.0
E	--	12.5	--	20.0	8.1
Ridge Top	--	12.5	--	--	3.1
Slope					
0-10°	35.7	87.5	66.7	40.0	57.5
10-25°	50.0	12.5	33.3	40.0	25.6
25-35°	14.3	--	--	20.0	8.6