Response of White-tailed deer following a forest fire in the Long Pines, southeastern Montana
by Keith William Wittenhagen

A thesis submitted in partial fulfillment of requirements for the degree of Master of Science in Fish and Wildlife Management
Montana State University

Abstract:
In June of 1988 a forest fire burned 74% of the 27,862 ha of National Forest in the Long Pines of southeastern Montana and created a mosaic of burned and unburned timber and grasslands. An earlier study conducted in this area suggested that the diversity and security provided by the multi-aged ponderosa pine (Pinus ponderosa) stands before the fire were fundamental in maintaining high density white-tailed deer (Odocoileus virginianus) populations during all seasons (Dusek 1980). I observed post-fire whitetailed deer population characteristics and how they have responded to the new habitat complex. A total of 1,564 white-tailed deer observations were recorded for the Long Pines during the June-August 1993 and January-December 1994 field seasons. A more diverse habitat was created as a result of the fire. The amount of browse in the study area increased and food habit data suggested the whitetails diet was primarily comprised of browse making up 70% percent yearlong. The major difference in range use from Dusek's (1980) study was white-tailed deer use of more open areas (open ponderosa pine, bum, and agricultural) compared to more closed canopy use before the fire. Twenty-four percent of whitetail observations for all seasons were in agricultural areas. Dusek (1980) also found agricultural areas to be important in his pre-fire study. Agricultural areas received their greatest use during winter and late summer. The results of this study suggest that the fire improved the habitat and quality of white-tailed deer found in the Long Pines. Hunter use, success and opportunity in the Long Pines has virtually stayed the same. The overall hunting success rate for both nonresidents and residents was 71%. Thus, the combination of quality, success and opportunity, without having to obtain landowner permission, make this area unique and important.

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A thesis submitted in partial fulfillment

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APPROVAL

of a thesis submitted by

Keith William Wittenhagen

This thesis has been read by each member of the thesis committee and has been found to be satisfactory regarding content, English usage, format, citations, bibliographic style, and consistency, and is ready for submission to the College of Graduate Studies.

April 3, 1997
Date

Chairperson, Graduate Committee

Approved for the Major Department

April 3/97
Date

Head, Major Department

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Graduate Dean

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Signature [signature], Deceased

Date April 3, 1997

VITA

Keith William Wittenhagen was born July 5, 1967 in Las Vegas, Nevada to Keith L. and Nettie Wittenhagen. In 1985 he graduated from Custer County District High School in Miles City, Montana and enrolled at Phillips University at Enid, Oklahoma. He received an Associate of Arts degree from Miles Community College in 1987 and enrolled at Montana State University of Bozeman. In 1990 he received a Bachelor of Science degree in Biology and started an independent study on ferruginous hawks for the Bureau of Land Management. He began his studies toward a Master of Science degree in Fish and Wildlife Management in January, 1993. He married Lori Hutchinson in July, 1993.

MEMORIAL

Keith William Wittenhagen passed away on November 6,1996, during the final preparation of this paper, as a result of a car-train accident. Keith enjoyed spending time with his wife and family, he loved to hunt and fish, and collect antlers with his dogs, Meeka and Molly. Keith was a member of the Rocky Mountain Elk Foundation, N.R.A., National Wildlife Association, Duck's Unlimited, he helped teach hunter's safety, and the Grace Bible Church.

This thesis is a tribute to Keith's knowledge, understanding, and dedication to wildlife management in Montana. Keith's passion toward hunting and wildlife management can be seen throughout the pages of this manuscript. Those of us who were privileged enough to know Keith will miss him, but more importantly Montana has lost Keith's keen insight into management issues and his gentle nature of dealing with people from all walks of life. He will be missed.

ACKNOWLEDGMENTS

I would like to extend my appreciation to those who assisted me during the study. Thanks to Dr. Harold Picton for his guidance and assistance during the study; Drs. Jay Rotella and Carl Wambolt for review of the manuscript, and Dr. Tom McMahon for serving on my committee. Special thanks to the landowners and permitees in the Long Pines area for their hospitality and access to their land and/or allotments. A special thanks to Neil Martin and the secretaries at Fish, Wildlife, and Parks for all their help and guidance. The helpful staff at the U.S.D.A. Forest Service in Camp Crook provided assistance and information that was important to the study. Thanks to all the hunters who cooperated and took the time to fill out the questionnaire. A special thanks to Alan and Marilyn Hutchinson for providing room, meals, and shelter for my dogs. Thanks are extended to Dr. Dan Gustafson for providing assistance and guidance in computer imagery and statistical analysis. A special thanks to my parents for their support throughout my college years. Finally, sincere thanks to my wife for financial and moral support, and for having the patience of Job. This study was funded by Montana Fish, Wildlife & Parks. William J. Semmens completed the final detail editing of the manuscript following Keith's death.

DEDICATION

This paper is dedicated to a friend, Jerry Wiseman, who passed away in the spring of 1995 in the Long Pines. Jerry like many of us loved the Long Pines. Every chance he had he went to the Long Pines. It seems fitting that Jerry moved on in the Long Pines. I'll come visit you in the Long Pines Jerry at some of your favorite spots.

TABLE OF CONTENTS

TABLE OF CONTENTS - continued

LIST OF TABLES

LIST OF FIGURES

ABSTRACT

In June of 1988 a forest fire burned 74% of the 27,862 ha of National Forest in the Long Pines of southeastern Montana and created a mosaic of burned and unburned timber and grasslands. An earlier study conducted in this area suggested that the diversity and security provided by the multi-aged ponderosa pine (*Pinus ponderosa*) stands before the fire were fundamental in maintaining high density white-tailed deer (*Odocoileus virginianus*) populations during all seasons (Dusek 1980). I observed post-fire white-tailed deer population characteristics and how they have responded to the new habitat complex. A total of 1,564 white-tailed deer observations were recorded for the Long Pines during the June-August 1993 and January-December 1994 field seasons. A more diverse habitat was created as a result of the fire. The amount of browse in the study area increased and food habit data suggested the whitetails diet was primarily comprised of browse making up 70% percent yearlong. The major difference in range use from Dusek's (1980) study was white-tailed deer use of more open areas (open ponderosa pine, burn, and agricultural) compared to more closed canopy use before the fire. Twenty-four percent of whitetail observations for all seasons were in agricultural areas. Dusek (1980) also found agricultural areas to be important in his pre-fire study. Agricultural areas received their greatest use during winter and late summer. The results of this study suggest that the fire improved the habitat and quality of white-tailed deer found in the Long Pines. Hunter use, success and opportunity in the Long Pines has virtually stayed the same. The overall hunting success rate for both nonresidents and residents was 71%. Thus, the combination of quality, success and opportunity, without having to obtain landowner permission, make this area unique and important.

INTRODUCTION

The Long Pines portion of the Custer National Forest in the past has supported relatively stable, high-density populations of white-tailed deer. A substantial proportion of older bucks in this area has made the Long Pines popular and important to hunters.

Two lightening-generated fires in June of 1988 quickly spread and joined together to form the Brewer fire. On 29 June the fire was brought under control. The fire burned approximately 74% of the 27,862 ha of National Forest in the Long Pines creating a mosaic of burned and unburned timber and grasslands (Havig et al. 1988). An earlier study of whitetails in the Long Pines suggested that the diversity and security provided by the multi-aged ponderosa pine stands were fundamental in maintaining high density deer populations during all seasons (Dusek 1980). Dusek's work indicated that the ponderosa canopy was particularly important in the winter, because of its snow-interception and thermal qualities. This study was developed to interpret the response of white-tailed deer to post-fire effects in the Long Pines.

My primary objectives were to document post-fire white-tailed deer population characteristics, their relationships to a new habitat complex and to compare post-fire to pre-fire information. An additional added objective was to document some attributes of epizootic hemorrhagic disease (EHD) in whitetails in southeastern Montana.

STUDY AREA DESCRIPTION

The Long Pines is a small range of hills located approximately 25 km southeast of Ekalaka in Carter County, Montana. The range is L-shaped, about 23 km long, 6 to 19 km wide, and rises 366 m above the surrounding plains to a maximum elevation of 1,256 m. Hills within the range are flat-topped, with some steep ridges, and V-shaped valleys. Unique sandstone outcroppings and rimrock structures are more evident since the fire. In addition to ponderosa pine being the predominant woody vegetation, there are various-sized grassland meadows, aspen (*Populus tremuloides*) groves, deciduous woody draws, shrub communities, canyons, and badlands scattered throughout the study area.

The Long Pines (total area = 27,862 ha) is included in the Sioux Division of the Custer National Forest. The study area, in addition to the National Forest land, included some surrounding private land (total area studied = 48,174 ha) (Fig. 1).

Major drainages in the area are Box Elder Creek to the northwest, Tie Creek to the south, and the Little Missouri to the east. Many drainageways extend across the prairie, but most lack standing water except during spring and after big thunderstorms. Permanent water sources include natural springs, stock ponds, and stock tanks. Soils in the Long Pines are well-drained and generally clay "gumbo", silt, or rocky in steeper areas. The surrounding terrain is level to rolling prairie comprised of mixed grasses, sagebrush (*Artemisa* spp.), and several varieties of agricultural plantings.

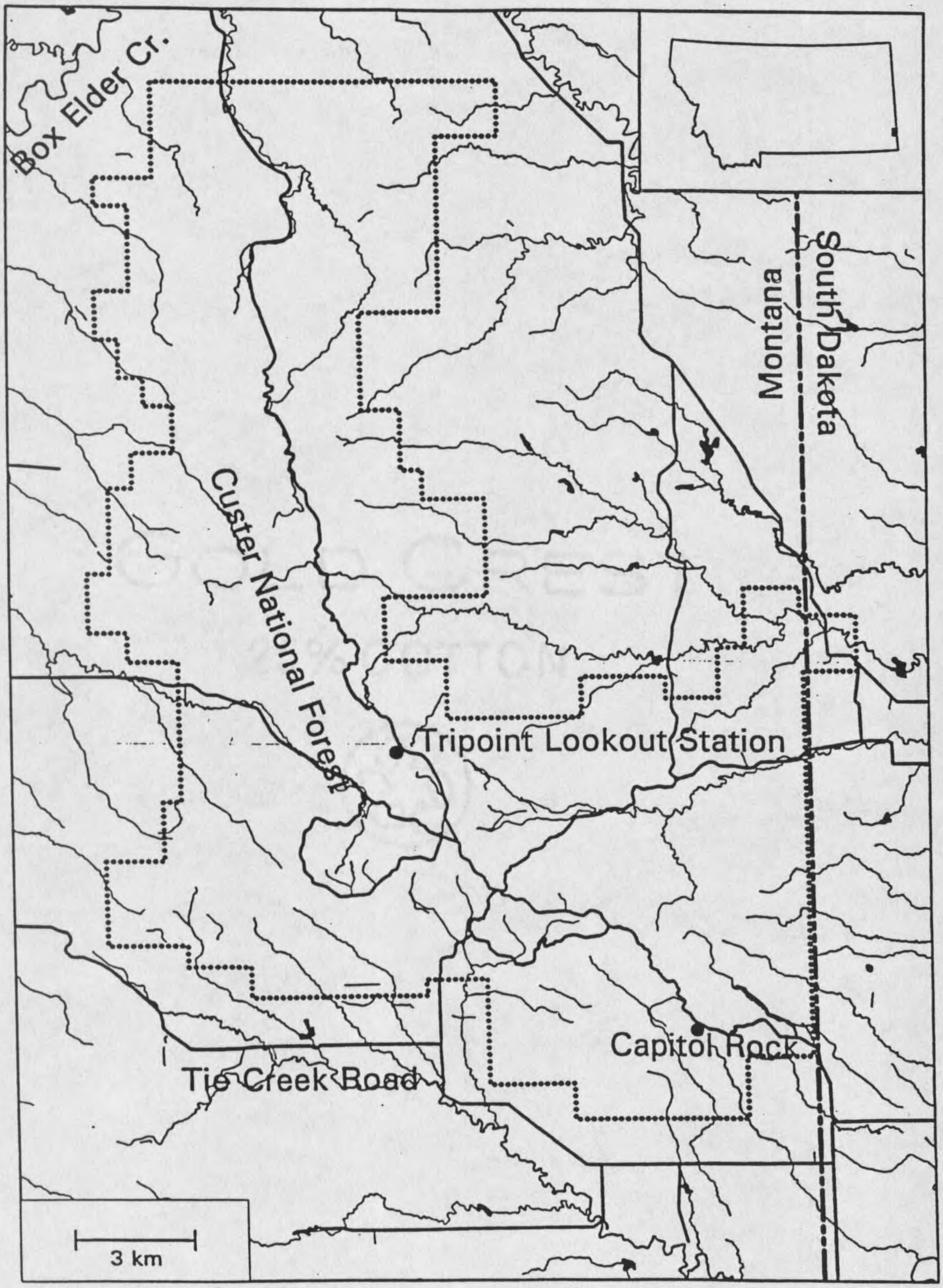

Fig. 1. Map of the Long Pines study area showing main roads, streams, and forest boundaries.

Vegetation

The Long Pines, according to Pfister et al. (1977), is classified as a ponderosa pine climax series. There are five habitat types and five phases under this climax series that describe the Long Pines. The predominant habitat types in the Long Pines are ponderosa pine/common chokecherry (*Prunus virginiana*), ponderosa pine/common snowberry (*Symphoricarpos albus*), ponderosa pine/bluebunch wheatgrass (*Agropyron spicatum*), and ponderosa pine/little bluestem (*Andropogon scoparius*).

The bluebunch wheatgrass/green needlegrass (*Stipa viridula*) habitat type occurs on more productive sites, such as non-wooded draws and open north-facing slopes. Needle-and-thread (*Stipa comata*), rather than green needlegrass, was the co-dominant on most of the grassland communities sites during Thompson's (1993) study. On drier, less productive sites the little bluestem/threadleaf sedge (*Carex filifolia*) habitat type existed, but was not as common as the bluebunch wheatgrass/green needlegrass habitat type (Havig et al. 1988).

The green ash (*Fraxinus pennsylvanica*)/common chokecherry habitat type dominated moist draws, drainageways, and springs throughout the study area. Quaking aspen stands occurred throughout the study area but especially in draws that burned. Growth of aspen has been phenomenal since the fire (6 years). Stands continue to sucker and increase in height with some trees exceeding 5 m.

Post-Fire Conditions

A mosaic of burn intensities occurred during the Brewer Fire, which significantly changed plant communities and stand distribution. Severely burned areas totaled 34% of the burn, moderately burned areas covered 28%, and lightly burned areas accounted for 38% (Havig et al. 1988). In stands where understories of chokecherry and aspen existed, and where woody draws were burned, regeneration of these species has been excellent. Young ponderosa pine are coming back well as a result of extensive planting and natural regeneration. In the severely burned areas, invading species including spreading dogbane (*Apocyum androsaemifolium*), horseweed (*Conyza canadensis*), and woolly plantain (*Plantago patagonica*) still exist; however, other seral components are now more abundant. Most grassland communities are well adapted to fire. Grassland communities in the Long Pines sustained little permanent damage as a result of the fire and have recovered well.

Land Use

Major land uses within the Long Pines are logging, cattle grazing, and recreation. All of the National Forest land is grazed. A few (3) allotments are in a rest-rotation grazing system allowing certain pastures to be rested from livestock grazing on a yearly basis. Most of the recreational use is by hunters. Hiking, camping, picnicking, bird-watching, and motorcycle/all-terrain vehicle riding are also common uses. Private land in the study area is used primarily for livestock and production of small grains.

Climate

The climate of the study area is continental and semi-arid. Summers are hot and dry, while winters are cold and dry. Rain gauges and a digital thermometer, that recorded the maximum and minimum temperature for the day, were set up within the study area to verify if one weather station (Ekalaka or Camp Crook, SD) was more appropriate for weather information. The Long Pines weather resembled the Ekalaka weather more closely. The mean annual precipitation for Ekalaka is 42.37 cm, one-half of which falls during the months of May, June, and July. During this study the annual precipitation was 59.84 cm in 1993 and 53.70 cm in 1994 (NOAA 1994).

The summer of 1993 was cool and wet, with precipitation 28.53 cm above normal and temperatures averaging 10.39 degrees Centigrade (C) below normal for April through July (Fig. 2). In May alone 22.94 cm of precipitation was recorded at the Ekalaka station. The Ekalaka station reported temperatures for January, March, and April of 1994 to be near normal with the only exception being February. Mean temperatures for February were 12.83 degrees C below normal (-9.45 degrees C). Precipitation for that same period was 4.57 cm above normal (8.46 cm). Spring (April, May, and June) temperatures were near normal; however, precipitation amounts were down 5.13 cm from normal (20.40 cm). Summer temperatures and precipitation for 1994 were near normal. Fall (October, November, December) temperatures were near normal, but precipitation amounts were

10.95 cm above normal (5.97 cm). October precipitation was 11.12 cm above normal (2.84 cm); and most of it fell in the form of rain (NOAA 1994).

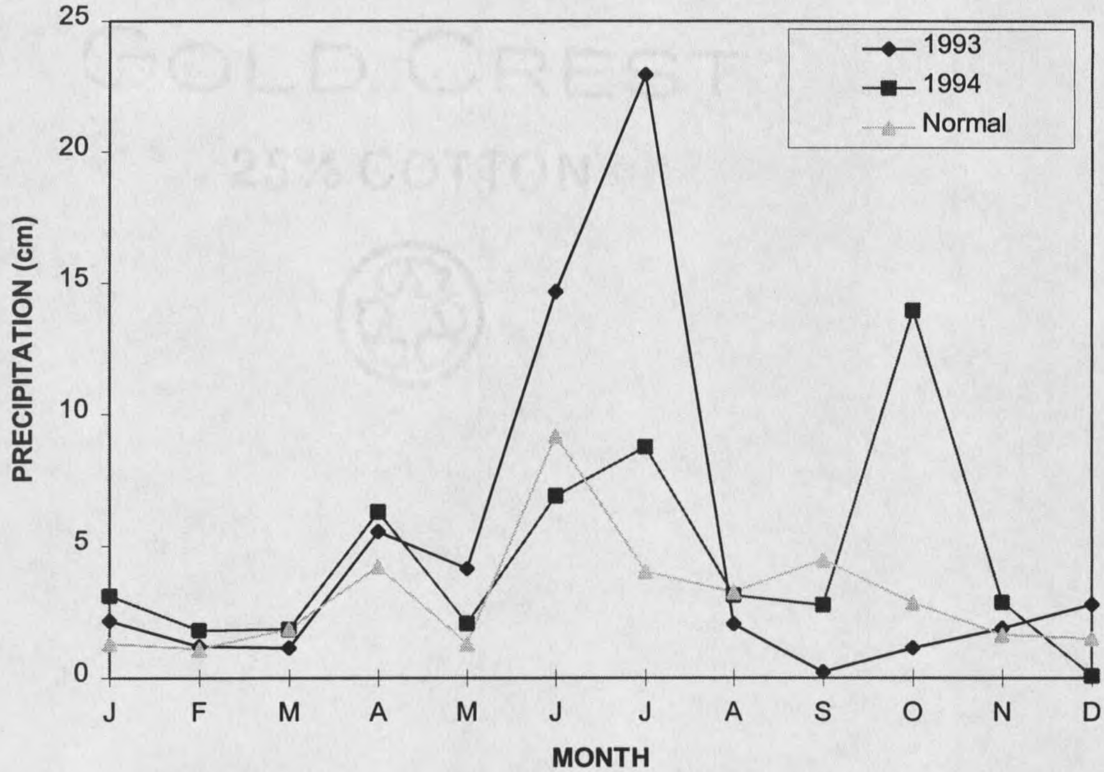

Figure 2. Monthly precipitation in the Ekalaka area for 1993 and 1994.

METHODS

Distribution and Range Use

In the summer of 1993, I initiated a study to evaluate habitat use and requirements of the whitetail deer population after a large forest fire. Field dates were: June-August 1993; January-December 1994; and brief periods in the fall of 1995.

To determine range use and habitat relationships, regular and systematic observations with the aid of a 12-36X spotting scope and 9X binoculars were made during morning, afternoon, and evening periods from aerial and ground reconnaissance. More than 90% of my days in the field from March through October were spent ground searching. These searches allowed me to obtain several different types of information. Seasonal and annual trends were estimated primarily from vehicle survey routes and optimal vantage points.

The number of white-tailed deer observed in different land-use categories were multiplied by a correction factor to get an adjusted "actual -use estimate". Due to the lack of available information, this correction factor used previously on mule deer was used on whitetails for this study. The observability indices were based on the following assumed observability rates used by previous researchers (Swenson et al. 1983) for both species of deer in southeast Montana: 30% in dense pine, 33% in moderate density pine, 35% in scattered or open pine, juniper breaks and badlands, 40% in creek riparian and

50% in sagebrush grassland, grassland and dryland agriculture (Mackie et al. 1981, Swenson et al. 1983). This gave an estimate of the actual use of the land types.

Because of weather conditions and inaccessibility to most of the study area during January and February, most of the observations were made from the periphery of the study area, mainly the Tie Creek road. Aerial flights along with snowmobile trips into the study area supplemented otherwise limited observations. In addition to visual sightings of deer, tracks helped define deer use of the study area. March conditions were more favorable, and I was able to spend more time hiking in the core of the study area. At that time I was able to record how the white-tailed deer had used and were using the habitat.

White-tailed deer were recorded using Universal Transverse Mercator (UTM) coordinates as to species, time of observation, activity, location (habitat type and general surroundings), and when practicable by sex and age class (Table 1). Deer were classified as male, female, or fawn during summer and as adult or fawn during the winter (1 deer = 1 observation). Activities were categorized as feeding, bedded, or traveling.

Aerial surveys, using a Piper Supercub, were flown for complete coverage of the study area during the winter, spring, and summer of 1994. Observation flights were made to document whitetail distribution and use in both the burned and unburned areas of the Long Pines, as well as to locate areas for ground surveys. Surveys began approximately 1/2 hour before sunrise and were completed within 2 hours after sunrise. Flight paths generally followed drainages. This method provided the best visibility of all terrain.

More than one pass was made for complete coverage when the width of the drainage or dense vegetation required closer inspection to determine presence of deer.

Night surveys provided additional information on deer use and numbers. Night observations were aided by a 1 million candle-power spotlight and binoculars. Major roads were divided into sections, each section was assigned a number, and survey sections and times were randomly chosen (without replacement).

Table 1. Deer-use categories used in surveys

Agriculture	Any form of crop grown but mainly small grains and alfalfa.	
Open	Non-timbered land containing grass, forbs, and/or shrubs.	
Riparian	An area of land directly influenced by permanent water included in this area ephemeral streams and washes.	
Ponderosa Pine		
	Dense	1,197+ trees per ha.
	Moderate	502 trees per ha.
	Open	Up to 66 trees per ha.
Burn	Visible fire damage resulting in the death of vegetation (trees included) after the fire (regenerating forest under 1.5 m).	

Spring surveys were used to ground truth wintering areas for winter use. The distribution of pellet groups, dead animals, and shed antlers indicated whether an area was used or not.

Food Habits

Feeding-site examinations were performed to confirm plant identifications made during the fecal analysis and to provide an evaluation of the completeness of the fecal-analysis results. Feeding deer were observed, and a starting point was randomly selected within their area. Starting from this point a transect was run. An outward spiral pattern was walked within the area of use. Each plant in this transect was examined for signs of use. The transect was terminated when use on a total of 100 plants was recorded. These data were treated as indicating presence or absence of use of a plant species.

Fecal pellets were periodically collected from randomly selected deer locations within the study area during all seasons, except fall, for analysis of fecal content. Only pellet groups considered fresh (moist appearance and texture) were collected. For each fecal group encountered 10 pellets were collected. The pellets were then cleaned of foreign debris and air dried in paper bags. Pellets were analyzed by season: January, February, and March = winter; April, May, and June = spring; July, August, and September = summer; and October, November, and December = fall. A random sample was then taken from the combined sample, ground up, and submitted to the AAFAB Composition Analysis Laboratory at Colorado State University for analysis.

Physical Attributes Of Individual Deer

Hunter harvested deer were the only deer collected during the study. Field-dressed animals were weighed and aged according to tooth replacement and wear (Severinghaus 1949). On older deer the primary incisor was pulled and sent to Matson's Laboratory for cementum age determination to determine if my assessment of the animals age was correct. If the animal supported antlers; main beam length, circumference around the base, inside spread, and number of points were recorded.

Causes Of Mortality

Ground searches during all seasons allowed me to assess mortality. Locations of dead deer, and, if possible, sex, age, the cause of death, and species were recorded. During spring surveys, bone marrow from the femurs of dead white-tailed deer were evaluated for fat consistency. Gelatinous marrow indicated a low amount of fat left in the marrow, and starvation was considered the probable cause of death (Cheatum 1949). I concentrated my efforts in areas, depending on the season, where I knew deer to frequent based on my work experience and knowledge of the area . In the winter and spring I concentrated in wintering areas. In the summer and fall I concentrated my efforts along drainages, because (EHD) infected animals generally seek water before death.

Winterkill - I assumed that bucks shot and not recovered in the fall had antlers whereas bucks that died as a result of winterkill had shed their antlers. Nutritionally stressed animals often die in March, April, and even May. It is at this time that the animal has depleted its fat reserves and any inclement weather will probably lead to death.

EHD - EHD (a virus transmitted by biting midges of the genus *Culicoides*) information was collected in the fall of 1994 as well as the fall of 1995.

Hunter Use Of The Long Pines

Hunter use of the Long Pines during the fall of 1994 was analyzed to better understand hunter use and harvest. Deer hunting during the fall was the only type of hunting considered.

Questionnaires were given to all individuals encountered, in the field, hunting in the Long Pines. Questions included: origin of hunters, periods of use, number of hunters, harvest information, their opinion on the effects of the fire, and the single most important factor attracting them to the Long Pines. The hunting season was arbitrarily split into 3 parts; first two weeks, middle two weeks, or the last week. Hunters were asked to denote which period(s) they hunted. Only national forest lands in the study area were considered.

Vegetation

I used data collected by the U.S.D.A. Forest Service, a vegetation-monitoring program conducted since the fire. Plot sampling, habitat types, series, and phases that were used by the Forest Service follow Pfister et al. (1977). Scientific names of plant species follow the terminology by Scott and Wasser (1980). Complete descriptions of the vegetation in the study area are given in Hansen and Hoffman (1988) and Thompson (1993).

Three different classifications for tree densities were determined by the number of trees per ha (Table 1). Ten areas for each tree-density classification were sampled. The number of trees in a (9.14 X 9.14 m) area was recorded and converted to achieve the approximate trees per ha classification. The average of the ten areas for each tree classification was then used. Open density ponderosa pine was defined as up to 66 trees/ha, moderate density ponderosa pine was defined as 502 trees/ha, and dense ponderosa pine was defined as 1,197+ trees/ha.

RESULTS

Distribution and Range Use

During the study period, a total of 1,564 white-tailed deer observations were recorded. Twenty-four percent of the 1994 field observations for all seasons were in the agricultural type, followed by; burn (22%), open density ponderosa pine (18%), open grassland (16%), moderate density ponderosa pine (10%), riparian (9%), and dense ponderosa pine (1%). The corrected "actual-use estimates" for those same types were 19, 25, 21, 12, 12, 9, and 2% respectfully. The most common observed activity in all seasons for whitetails was traveling followed by feeding and bedding.

Winter - As previously mentioned, temperatures were near normal and precipitation amounts were above normal for the winter of 1994 in the Long Pines. However; mean temperatures for February were 12.83 degrees C below normal (-9.45 degrees C), and 20 of the 28 days were below normal. Precipitation amounts for January and February of 1994 in the Long Pines were 4.90 cm. This was 2.51 cm above normal (2.39 cm). During that period it snowed 26 out of the 59 days.

A total of 485 observations of white-tailed deer were made during this season. White-tailed deer employed three different strategies for surviving winter. Whitetails on the southern and eastern borders of the national forest bedded on mostly open, south facing slopes during the day, and used agricultural areas at dusk. Some deer stayed in the national forest and utilized the available resources in a situation similar to yarding. Other deer migrated to areas outside the study area; Conservation Reserve Program (CRP) lands, the Little Missouri River drainage to the southeast, and the Box Elder drainage to the west. Whitetails that migrated to CRP areas did so in the fall and did not return to the forest until the spring.

Over 85 white-tailed deer were trapped by local residents during a three year period in the early 1990's near Capitol, MT (13 km away). The deer were tagged with ear tags used on cattle and some (3+) of these deer were observed as well as harvested in the Long Pines in the fall. These incidental efforts by local residents substantiated my observations that some deer chose to migrate to other areas.

White-tailed deer that utilized the national forest during the winter bedded in areas that ranged from dense pockets of ponderosa pine to areas of downed trees in burns. Forty-four percent of winter observations for white-tailed deer were in agricultural areas. As previously mentioned both whitetails and mule deer, would leave the national forest in the evening and head for the agricultural areas (haystacks included) that border the national forest. Deer would leave the agricultural areas in the morning and head back to the national forest, although some did choose to stay in nearby riparian areas during the day. Excluding the agricultural areas, open (66 trees/ha) density ponderosa pine and burn areas were used the most (17% and 14% respectfully). Moderate density (302 trees/ha) ponderosa pine and open grassland were also used frequently (10% a piece). While dense (1197+ trees/ha) ponderosa pine areas only made up 4% of the observations (Fig. 3). The adjusted "actual-use estimates" for those same areas were 36, 20, 17, 12, 8, and 2% respectfully.

Spring - By the third week of March grass and forbs were beginning to grow. With the sprouting of new vegetation, deer began to leave the wintering areas and disperse. Average group size per observation diminished from 12 to four. A total of 444 white-tailed deer observations were recorded for this season. Deer were more visible at this time because of their feeding in more visible areas (along the side of roads and open meadows) longer into the morning. Does isolated themselves in May to fawn. The first fawns began accompanying does in late June. Males occupied "bachelor" groups, the yearling whitetail deer, mainly males, were observed in areas where whitetails were not frequently seen (Fig. 3).

Thirty-five percent of the spring observations of white-tailed deer were in open ponderosa pine. Open grassland, burn, riparian and moderate-density ponderosa pine represented 22, 16,14, and 12% of the observations respectfully. Few (1% combined total) deer were recorded in agriculture and dense ponderosa pine. "Actual-use estimates" for those same areas were 38, 16, 17, 14, 14, and 1% respectfully.

A total of 232 shed antlers were found during the 1994 field season. Sixty-nine out of the 232 were antlers that were shed that year (fresh sheds). The survey crews working for the USDA-Forest Service were finding sheds, about an equal amount of fresh sheds compared to my findings for that same period, in the burned areas. So, I concentrated most of my efforts in unburned areas. As a result, most all (>90%) of the sheds I found were in forested areas, mainly open and moderate density ponderosa pine.

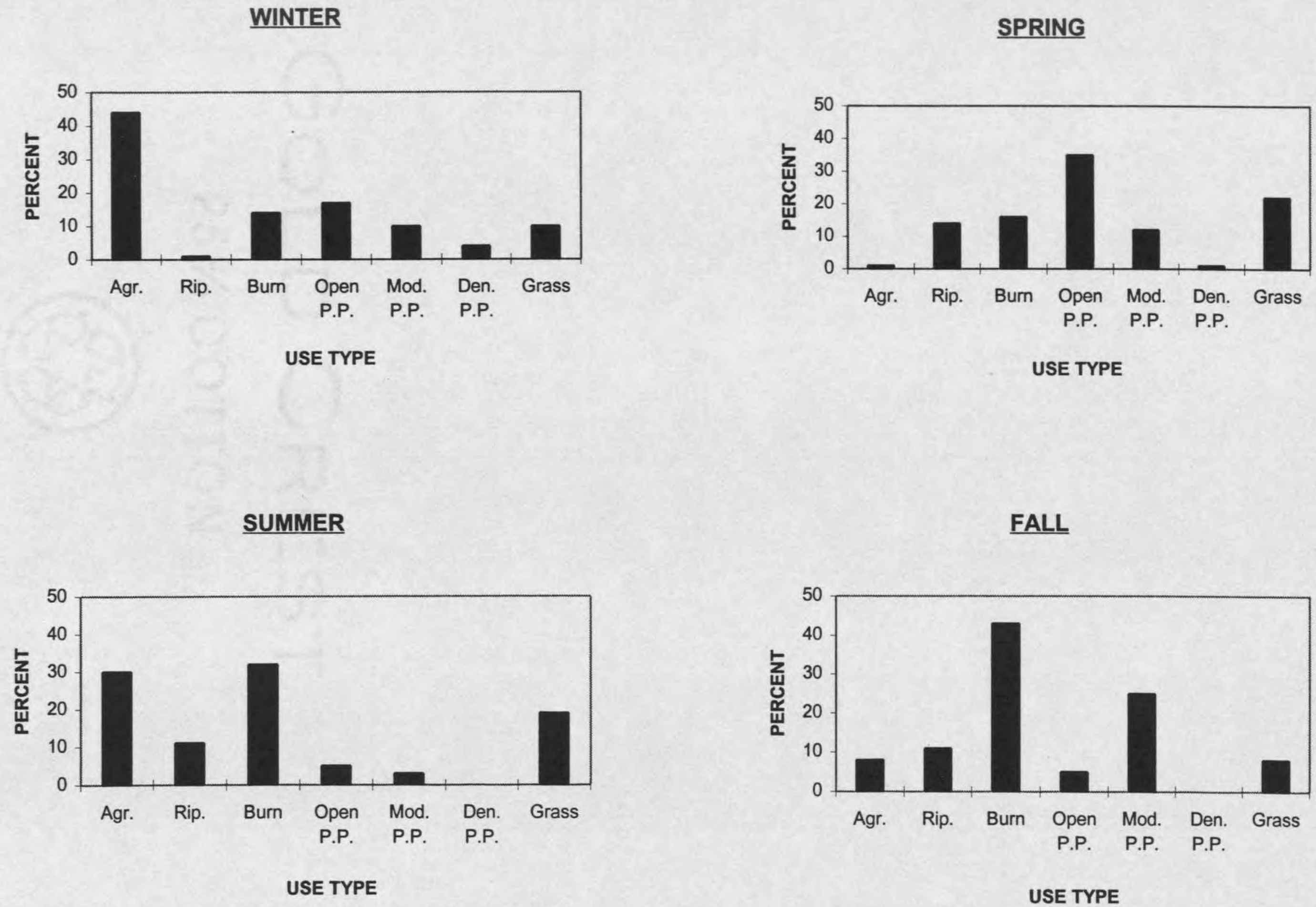

Fig. 3. Seasonal white-tailed deer land-use by percent in the Long Pines as observed during fieldwork in 1994; winter n = 485, spring n = 444, summer n = 373, and fall n = 155.