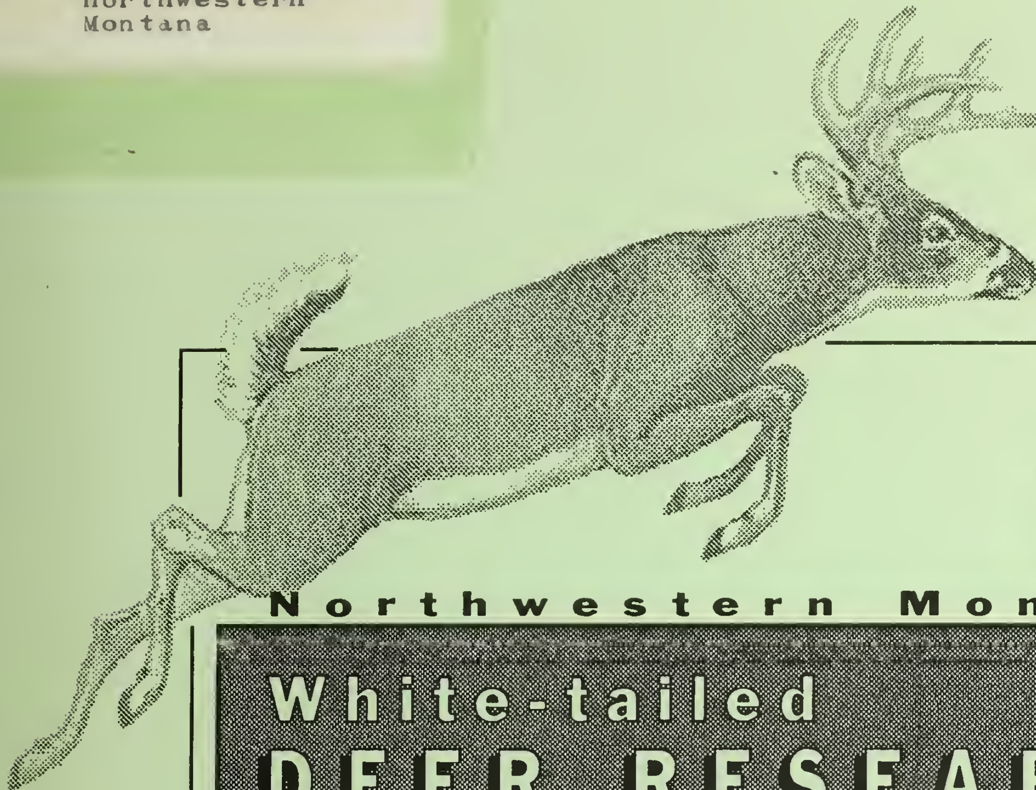

1990

Northwestern Montana

White-tailed DEER RESEARCH

- Progress Report -

Montana Department of Fish, Wildlife & Parks

JOB PROGRESS REPORT

STATE:	Montana		
PROJECT NO:	W-100-R-3	TITLE:	Big Game
ELEMENT:	II	TITLE:	Research and Technical Services
SUBPROJECT NO.:	2	TITLE:	Deer
STUDY:	BG-1	TITLE:	Population Ecology of White-tailed Deer in Northwestern Montana
JOB NO:	10		

Period Covered: July 1, 1989 - June 30, 1990

Prepared by: Gary L. Dusek   Approved by: John P. Weigand

John T. Morgan   Terry N. Lonner

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ABSTRACT

A study of population ecology of white-tailed deer (*Odocoileus virginianus*) initiated in northwestern Montana during January 1988 continued through the year ending 30 June 1990. Population parameters, distribution, and habitat use were monitored in an area including the Tally Lake and Fortine Ranger Districts. During autumn 1989, 131 harvested whitetails taken on the study area were examined for composition by sex and age and for physical condition. An additional 142 deer were captured and marked on winter ranges in 1990 and 11 were captured on summer ranges. Three camera surveys were conducted on winter ranges during December 1989 through March 1990. Population surveys were continued, and population size was estimated for the Bowser-Tally Lakes winter range.

JOB OBJECTIVES:

To develop techniques for estimating population parameters, to determine basic biological and ecological parameters for white-tailed deer in coniferous forests of northwestern Montana and to relate those parameters to characteristics of individual habitats and potentially limiting factors, including:

a) physical and biological characteristics of individual habitats;

b) interactions between changing environmental conditions and population characteristics; and,

c) hunting, land use practices, and other human-related factors.

INTRODUCTION

A study of habitat relationships and population ecology on white-tailed deer in forested habitats of northwestern Montana continued through the biological year ending in May 1990. This study was initiated during January 1988 as a 10-year project to investigate population ecology of white-tailed deer in northwestern Montana (Dusek 1989). The major thrust was to provide a conceptual basis and approach to monitoring population trend and more intensive management of white-tailed deer in coniferous forests. Emphasis during the report period included intensive trapping and monitoring in the Tally Lake and Fortine Districts and associated winter ranges. The area, characterized by intensively managed timber resources and relatively high road densities, also has contributed a representative portion of regional whitetail harvests (Fig. 1).

Previous effort on white-tailed deer in northwestern Montana includes the works of Janke (1977), Leach (1982), Mundinger (1981,1984), Krahmer (1989), and others. Previous effort in a portion of present study area included that of Mundinger and Riley (1982, 1983).

STUDY AREA

Study areas include portions of the Flathead and Kootenai National Forests (Tally Lake and Fortine Ranger Districts) and surrounding State and private timbered lands in the Salish Mountains (Fig. 2). Both have been described previously (Dusek 1989). Major drainages include the Stillwater and Tobacco

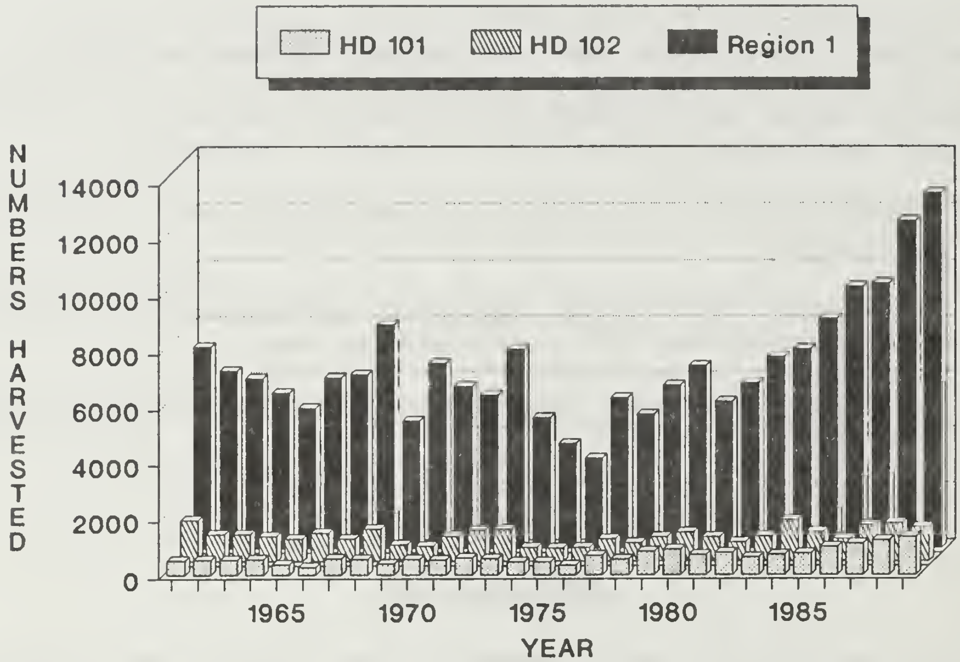

Figure 1. White-tailed deer harvest from 1961-89 in all of Region 1 and in hunting districts 101 and 102.

Rivers. The area encompasses all of deer hunting district 102 and portions of hunting districts 101 and 110.

Timbered lands are predominantly second growth forest and are intensively managed for timber production. Topographical and vegetational characteristics and the climatic pattern have been described in a previous report (Dusek 1989). Description of habitat types follows Pfister et al. (1977). Winter ranges include comparatively dry sites below 1,100 m in elevation occupied by the Pseudotsuga menziesii/Symphoricarpos albus h.t. Summer ranges primarily include lower subalpine habitat types of the Abies lasiocarpa series with the P.m./Calamagrostis rubescens h.t. occupying drier, southerly exposures. Many of the upper drainages of the Salish Range are occupied by a Pinus contorta/Xerophyllum tenax c.t. Riparian sites include streams with yearlong surface flow and sloughs and potholes locally abundant in the uplands.

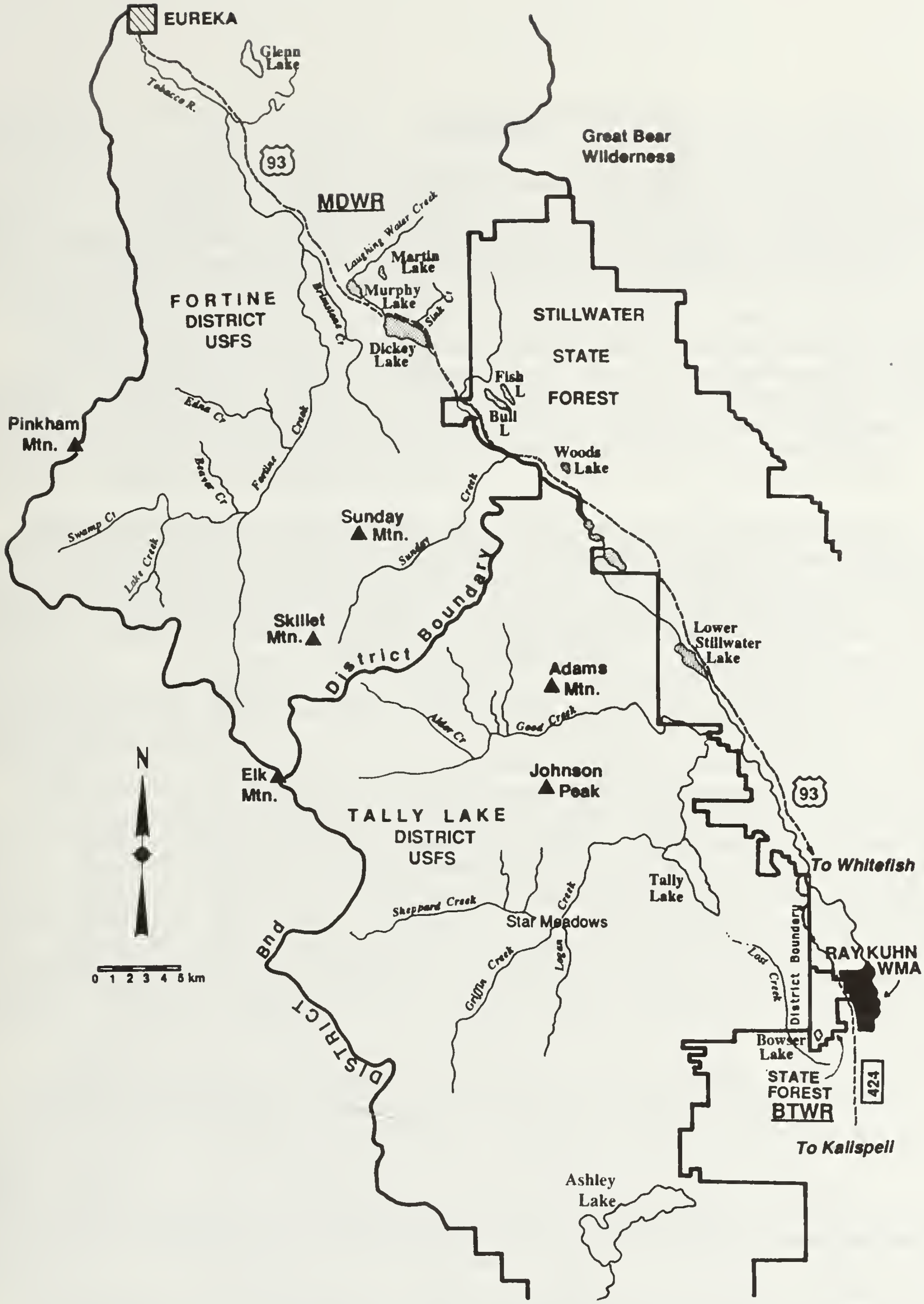

Figure 2. The study area including the Salish Mountains, the Bowser-Tally Lakes winter range (BTWR), and the Murphy-Dickey Lakes winter range.

METHODS

During the biological year ending 31 May 1990, 142 additional deer were captured on winter ranges during January-February 1990, and 11 were captured on summer range near Star Meadows in August 1989 and May 1990. Two deer initially captured and marked during previous winters were recaptured during winter 1990. The radio collar was replaced on an adult female (88019) recaptured on the Bowser-Tally winter range (BTWR). The neckband on a yearling male (89215), recaptured on the Murphy-Dickey winter range (MDWR), was replaced with a radio collar. Traps were baited with alfalfa during winter and baited with salt during spring and summer. During winter 1990, 97 new deer were marked on the BTWR, and 45 were marked on MDWR.

Trapping since the project was initiated brings the total animals marked to 395 and the total number radio-collared to 101. All trapping was facilitated with Clover traps (Clover 1954). Capture and handling procedures, as described previously (Dusek 1989), included assigning an age, obtaining a blood sample, and measuring heartgirth of each captured deer.

Remote camera surveys, employing cameras with infrared (IR) sensors, were used on the BTWR during early and late winter 1989-90 and on MDWR during late winter only. Camera unit construction and procedures generally followed those described by Mace et al. (1990). A passive approach was used to photograph deer (i.e., sites were not baited). Photographic sampling of the BTWR population followed a stratified design at a resolution of 1 camera/ 2-4 km^2. Stratification was based on pellet group density during spring 1989 (Dusek 1989). Ten 1-km^2 quadrats were randomly selected at MDWR over a portion of the winter range where marked deer were available. Individual quadrats sampled were randomly selected among strata, but actual locations within quadrats were determined from field reconnaissance and accessibility. Sites were placed along trails with current documented use, preferably at a junction of 2 or more heavily used trails. All sites were visited midway through a 2-week session to change film if necessary and to check operation of units.

Analytical procedures also followed Mace et al. (1990). All exposures were examined to determine cause of exposure (i.e., initial set-up and film check, mechanical malfunction, environmental causes, or the presence of an animal). A date-reference time-line was developed for each site during each session from date of deployment to date of removal. Total individual deer-visits per day were noted as was individual days in which units were not functioning. A deer-visit is defined as an individual photographed at a site irrespective of the number of individuals in a frame (e.g., 3 deer within a frame were treated as 3 deer-visits); subsequent exposures of the same individual(s) were not used. That is, each individual regardless of social grouping was treated as an independent observation. Each photo with at least a portion of an animal within the frame also was treated as an individual data record. For white-tailed deer, numbers of individuals were determined from examination of individual and consecutive photos. Number and identification of marked deer also were recorded.

Fixed-wing aerial surveys were conducted during all months to electronically locate radio-collared deer. Herd composition and the proportion of the population marked were determined from classification while cruising roads on the Tally Lake summer range during July and August 1989 and the BTWR by snowmobile during February and March 1990.

Capture-resight data from the late winter camera session at BTWR were used to estimate numbers of deer on the winter range in 1990 using a Monte Carlo simulation described by Minta and Mangel (1989). A maximum likelihood estimate and 95% likelihood interval were derived from 10,000 iterations of the Monte Carlo simulation. Numbers of marked deer in the survey area were determined from monitoring distribution of radio-collared deer, and visual sightings of neckbanded deer from snowmobile routes and camera sessions.

During the 1989 general big game hunting season, 131 harvested whitetails were examined at check stations to determine condition and composition by sex and age. Ages were assigned by tooth eruption and wear for all deer (Severinghaus 1949), and a middle incisor was extracted from those of assigned ages $\geq$2 years for age assignment by the cementum annuli technique (Matson's Lab, Milltown, MT). Length of the diastema was measured on all deer, and antler measurements, including length and diameter of the main beam and number of points, were taken from all males of ages $\geq$1 year.

Pellet group transects were run during April-May 1990 as previously described (Dusek 1989) using the rationale of Longhurst and Connolly (1982) and the analytical procedures of Davis (1982). Sampling intensity was increased from 25 1-milliacre circular plots to 50 per transect to increase precision (Dusek 1989). Individual transects were placed within 13 randomly selected 1-km^2 quadrats for a total of 650 sampled plots.

Estimates of survival among radio-collared females of ages $\geq$1 year and males $\geq$2 years followed Heisey and Fuller (1985) using the software MICROMORT. Time intervals, or seasons, used previously (Dusek 1989) were modified because the daily rate of survival could not be assumed constant through the autumn archery and rifle hunting seasons. The autumn period was split between early autumn (1 Sep.-15 Oct.), that included the archery season, and late autumn (16 Oct.-30 Nov.) that included the rifle season. Because documented mortality among radio-collared deer was negligible during the archery season and daily probability of survival was not different from that of summer (May-Aug.), the 2 periods were combined in the analysis. Winter (Dec.-Feb.) and early spring (Mar.-Apr.) also were combined because daily survival rates were not different, irrespective of cause. Thus, 3 periods (prehunt, rifle hunt, and posthunt) were used in which probability of daily survival was assumed constant throughout each period.

RESULTS AND DISCUSSION

Trap Efficiency

From 10 January through 24 February 1990, a total of 172 white-tailed deer were captured over 429 trap-nights, including all recaptures and mortalities, for an overall trap efficiency of 0.40 deer caught/trap-night. There was no apparent difference in overall trap efficiency between years, but vulnerability of deer to trapping apparently differed between the 2 winter ranges in 1990 (Table 1). The higher trap efficiency at MDWR probably reflected the fact that more than one-third of the total effort there in 1990 involved an area not trapped previously, a portion of the winter range between Fortine Creek and Dudley Slough. Also, because less time and effort were spent on MDWR, deer may also have been less wary of traps. Most trapping on the BTWR in 1990 occurred in areas also trapped in previous years, and thus, some deer probably were conditioned to avoid traps. Four deer (2% of all captures) died at the trapsite during winter 1990. All resulted directly from trap-related injuries. Fawns of both sexes were relatively abundant among 142 new deer marked during winter 1990 (Fig. 3).

Application of Remote Camera Surveys

General Operation of the System

Three camera survey sessions during winter 1989-90 resulted in 853 exposures over 415 camera nights at 28 sites (Table 2). Of the total exposures, 653 (77%) were of wildlife; 604 (71%) were of white-tailed deer. During the 3 sessions, a total of 555 deer-visits were identified among all exposures involving white-tailed deer. Of 25 individually marked deer photographed at camera sites during all sessions, none made repeated visits to the same camera site within a 2-week sampling period. However, one individual was photographed at 2 different sites during session 1. During late winter-early spring of the previous year, a marked yearling male (88022) was photographed at the same site

Table 1. Efficiency of Clover traps for capturing white-tailed deer on 2 winter ranges, 1988-90.

Month and location[a]	Year	Total trap nights	Total deer captured	Total deer marked	Total captures/ trap night
December					
BTWR	1988	100	41	30	0.41
January					
BTWR	1989	152	53	41	0.35
	1990	193	66	55	0.34
MDWR	1989	70	27	24	0.39
	1990	45	20	17	0.44
February					
BTWR	1989	129	65	52	0.50
	1990	162	54	42	0.33
MDWR	1989	42	22	20	0.52
	1990	44	32	28	0.73
March					
BTWR	1989	42	19	13	0.45
Total	1989	535	227	175	0.42
	1990	429	172	142	0.40

[a] Bowser-Tally Lakes winter range (BTWR); Murphy-Dickey Lakes winter range (MDWR).

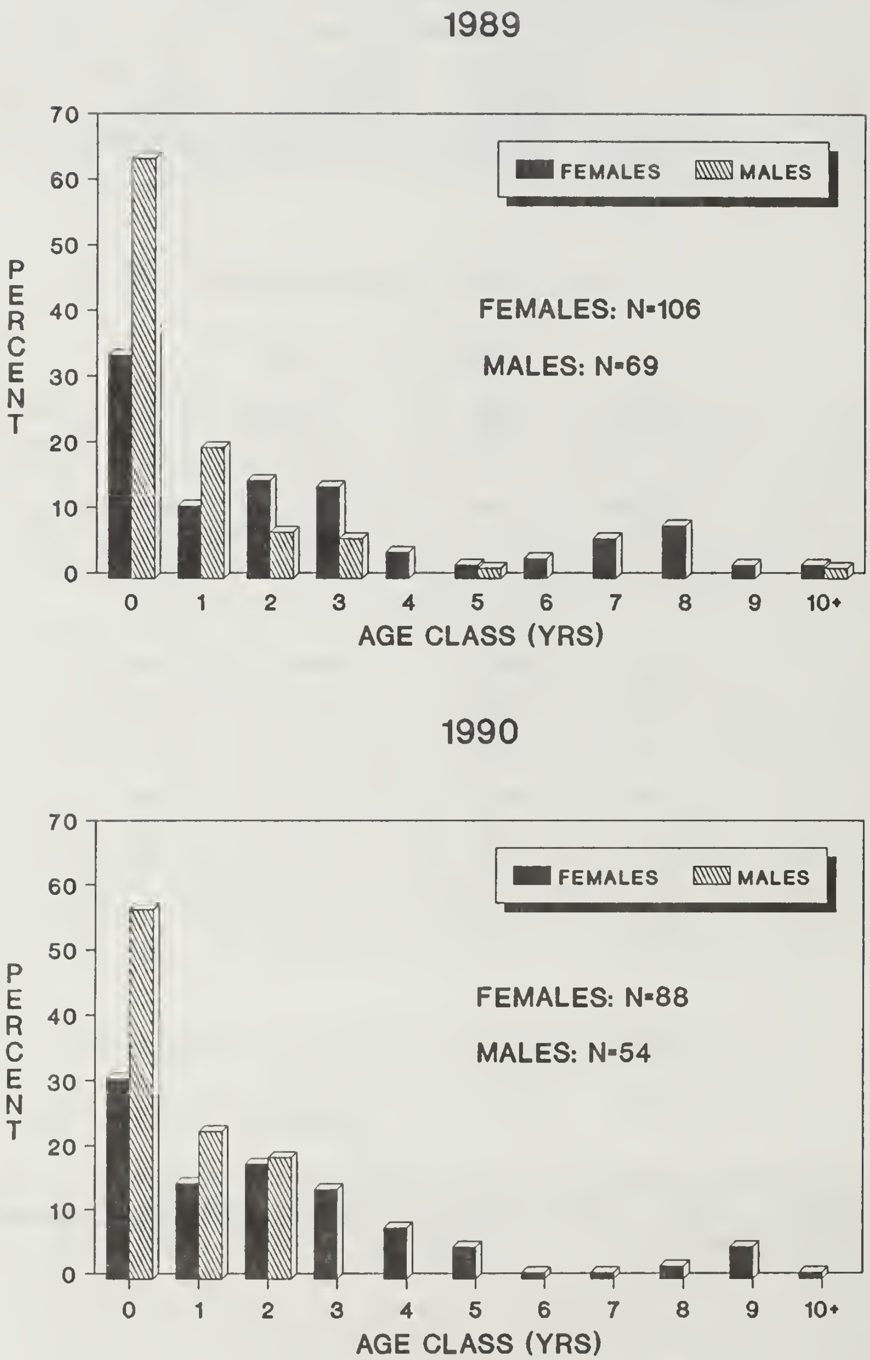

Figure 3. Age composition (%) by year of 317 deer captured during winter on BTWR and MDWR combined, 1989-90.

Table 2. Summary of remote camera surveys at Bowser-Tally and Murphy-Dickey Lakes winter ranges during winter 1989-90.

	Session number		
	1	2	3
	BTWR	MDWR	BTWR
Dates operated:	12/18-1/2	2/20-3/7	2/27-3/16
No. stations: (functional)	10	10	8
Grid density: (no./km^2)	1:3.5	1:2.8	1:4.7
Total frames:	192	312	349
System check:	34 (18%)	33 (11%)	27 (8%)
Wildlife:	132 (69%)	241 (77%)	280 (80%)
Unkn. variable	26 (14%)	38 (12%)	42 (12%)
Frames w/ WTD:	130	207	267
No. indiv.:	126	183	246
Daylight:	74 (59%)	133 (73%)	208 (85%)
Darkness:	52 (41%)	50 (27%)	38 (15%)
Total classif.:	113	169	230
No. marked:	5 (4%)	6 (4%)	13 (6%)

on 6 different days after the camera had been in operation at the site for approximately 5-6 weeks. Four other marked deer were photographed at the same sites during spring 1989 with second and third visits occurring 3-4 weeks following deployment of cameras.

In addition to human activity, other wildlife identified in photographs included mule deer (O. hemionus), elk (Cervus elaphus), and coyotes (Canis latrans). The number of system check exposures was reduced from session 1 to session 3 (Table 2) as a result of increasing confidence in the system and function of individual units. Most exposures caused by unknown variables were presumed the result of animals moving out of the field of view during the 2-3 second lapse between detection by the IR sensor and shutter release.

The proportion of individual deer photographed during nighttime decreased from early to late winter (Table 2). This suggested a transition from daily activity rhythms balanced with diurnal and nocturnal activity near the time of winter migration to a strongly diurnal rhythm by late winter. This probably was not a behavioral response to cameras because individual sites at BTWR differed between sessions and only one session was conducted at MDWR.

Winter migration onto BTWR occurred during session 1 as determined from estimated dates of arrival among 33 radio-collared deer that wintered on the survey area. Eleven (33%) deer, including 3 yearlong residents, were on the area when camera sites were set up on 18 and 19 December 1989. Fourteen (42%) moved onto the area between 16 and 31 December coinciding with the session, and the remaining 8 (25%) either moved onto the area after 1 January 1990 or did not move onto the winter range. The relatively high rate of deer visits on day 5-9 of session 1 probably coincided with movement of deer onto the winter range (Fig. 4). The overall lower rate of daily visitation to camera sites by deer during session 1 than during session 3 could be at least partially explained by the fact that no more than 75% of the winter population was there at the time of the early winter session.

Deer-visit Index vs. Time

A 3x4 contingency analysis indicated that the number of deer-visits per day at camera sites was not independent of time ($X^2 = 17.43$, 6 df, $P < 0.01$). Deer-visits per day appeared to decrease with increasing number of days from the beginning of the session (Fig. 4). These results are from all 3 sessions combined. Camera noise, flash, etc. may have modified animal behavior to an extent that they used alternate trails during daily travel on subsequent days. There was little apparent difference in nocturnal and diurnal exposures over a session which was not surprising because 23% of daytime exposures also used a flash. As mentioned previously, operation of camera units beyond a 2-week period apparently allowed deer to become accustomed to units and individuals routinely used the same travel routes and were repeatedly photographed. One would have to question the desirability of elimination of the camera-influenced bias if their response to camera use were predictable from session to session. One alternative might be to determine the response of deer to sites baited with aromatic attractants compared to unbaited sites. At this point, it is uncertain as to whether it is necessary to eliminate the temporal bias to use the deer-visit per day as an index of population trend.

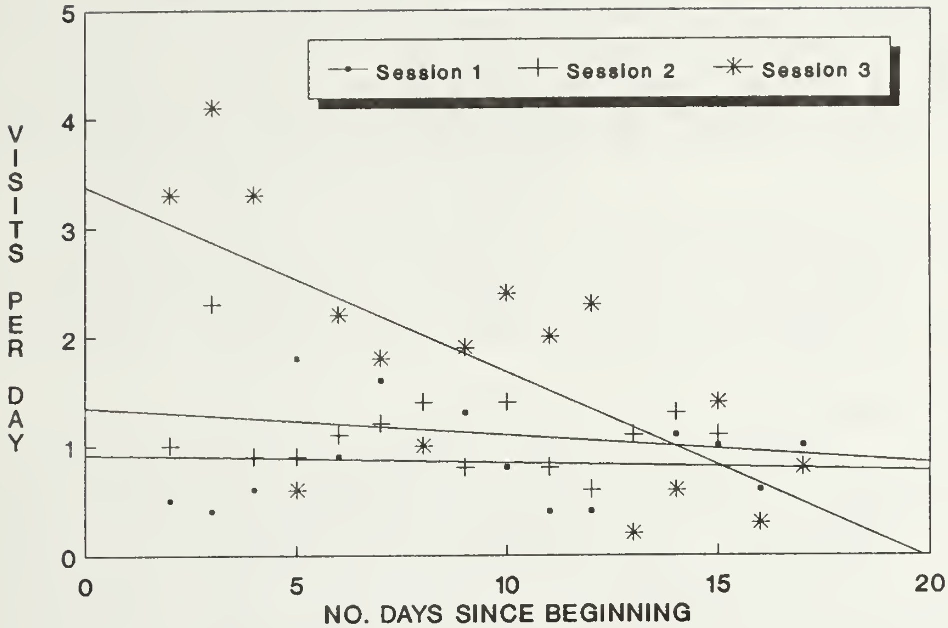

Figure 4. Trend in deer-visits per day during 3 remote camera surveys during winter-early spring 1989-90.

Population Characteristics

Composition by Sex and Age

Composition of the population on the BTWR during winter and in the Tally Lake District during early spring appears in Table 3. Recruitment (proportion of fawns in late winter/spring populations) appeared slightly lower than in 1989 but still higher than that reported by Mundinger and Riley (1983) during the early 1980's. Use of cameras to classify deer may minimize some of the bias associated with differential observability between sex and age groups (Downing et al. 1977). There was little apparent change in herd composition with respect to fawns and adults from winter to early spring. However, a lower proportion of fawns in classifications during May compared to February-March probably reflected difficulty in distinguishing fawns from adults or perhaps some undetected fawn mortality occurred during or following spring migration.

Table 3. Seasonal herd composition of white-tailed deer on the Tally Lake District and/or the Bowser-Tally winter range from vehicle surveys, helicopter census, and remote camera surveys, 1988-90.

		Herd Composition (%)					Sex and age ratios		
Period and survey type	Number classified	Adults ≥1 yr	Fawns	Adult fem ≥1 yr	Yrlg male	Adult male ≥2 yrs	FF:100 fem	FF:100 adults	Bucks:100 does
Jan/Feb 1989:									
Vehicle	63	65	35					54	
Photography	110	59	41					69	
March 1989:									
Helicopter	284	58	42					71	
Photography	80	56	44					78	
Dec/Jan 1989-90:									
Photography	113	64	36	55	4	5	66	57	16
Feb/Mar 1990:									
Vehicle	166	61	39					64	
Photography	230	60	40					67	
May 1990:									
Photography	203	71	29	56		15*	51	40	26

* Includes all males ≥1 year of age.

Reproduction

Radioimmunoassay for pregnancy-specific protein B (PSPB) in serum from 212 female white-tailed deer during 1988-90 indicated that yearlings were essentially the youngest breeding age class (Table 4). Only 3 (5%) of 61 female fawns had successfully bred. Among 151 older females, 93% of the yearlings and 95% of the adults were pregnant. These rates were comparable to those reported for whitetails in the Swan Valley (Mundinger 1981) and in eastern Montana (Dusek et al. 1989).

Six females (2 fawns, 4 adults) were necropsied to determine reproductive status during the report period. Neither fawn was pregnant, whereas all those ≥1 year of age were pregnant. A yearling carried a single fetus, and 3 older females carried twins.

Only 18 (14%) of 129 females classified (marked and unmarked) in and around the Tally Lake District during July/August 1989 were accompanied by fawns. Eleven does had a single fawn at-heel, and 7 were accompanied by twins resulting in an estimated ratio of fawns:producing female of 139:100. Approximately 34% of adult females had fawn(s) at-heel during September/October 1988 (Dusek 1989). Reproductive success was determined from reobservation among 25 of 106 individually marked females (≥1 yr.) associated with both BTWR and MDWR. Fifteen (60%) were accompanied by fawn(s) that included none of 5 yearling females. Three adult females were observed with twins at-heel, whereas the other 12 were accompanied by a single fawn. These observations were made from August 1989 through May 1990, but should represent a minimum proportion of females rearing fawns to an age of weaning (about 4 months). Although it is not likely that reproductive success among adult females can be estimated from classification of deer during summer-early autumn, productivity among producing females determined during that period may serve as an index of early reproductive success.

Survival/Mortality

Survival rates of radio-collared deer by season and age appear in Table 5. Survivorship was not determined for fawns and yearling males in both study areas or for adult males at MDWR because radioed individuals among these groups were not available for study throughout the mortality year.

Annual survival among adult females (≥2 yrs., Table 5) appeared lower than that among yearling females (0.89-1.00). Throughout the mortality year (1 May-30 April), lowest survival rates were observed during the period of rifle hunting (16 Oct-30 Nov) and the posthunt period (Dec.-Apr.), respectively (Table 5). Nine deaths were documented among radioed deer during the

Table 4. Age specific pregnancy rates of white-tailed deer from serum assay among 212 captured females, 1988-90.[a]

	Age					
	Fawns		Yearlings		Adults	
Year bred	n	% preg.	n	% preg.	n	% preg.
1987	11	0	3	100	13	92
1988	27	7	14	100	60	95
1989	23	4	12	83	49	96
All years	61	5	29	93	122	95

[a] Serum samples were taken during late December through early March on the Bowser-Tally and Murphy-Dickey Lakes winter ranges.

past year in addition to 8 the previous year. Two deaths included adult males taken by hunters during autumn 1989. Three of seven females died during the period of rifle hunting; 2 were taken by hunters and cause of death was undetermined for the other. The specific cause of death was not determined from 4 females that died during the pre- and posthunt periods. Annual survivorship of females ≥ 2 years was 0.84 for those associated with BTWR and 0.77 for those associated with MDWR. However, the difference between areas was not significant ($Z = 0.75$, $P > 0.20$).

Twelve nontrap-related deaths of neckbanded deer were reported during the past year of which 7 resulted from hunting. Two deaths resulted from collisions with automobiles, 2 from predation presumably domestic dogs, and the cause of one death was undetermined.

Condition Parameters

Whole weights determined from heart girth during January/February 1989-90 increased with age through at least 4 years among both sexes of deer (Table 6). A relationship of heart girth and whole weight of deer in Virginia (Smart et al. 1973) slightly overestimated weights of whitetails in northwestern Montana. Scale weights of 8 deer including both sexes among all ages averaged 1.76 kg less than estimates from

Table 5. Annual and seasonal probabilities of survival among radio-collared white-tailed deer associated with the Bowser-Tally Lakes and Murphy-Dickey Lakes winter ranges during combined mortality years (May-April) 1989-90.

Variable	Sex and age				
	2-7 yr fem		≥8 yr fem		≥2 yr male
	BTWR	MDWR	BTWR	MDWR	BTWR
No. deer (max.)	70	28	11	9	8
No. radio days	17,097	5,931	2,297	2,631	1,685
No. deaths	5	5	4	1	2
Annual survival	0.89	0.73	0.54	0.88	0.64
95% CI	0.81-0.99	0.55-0.96	0.30-0.99	0.67-1.00*	0.35-1.00*
Seasonal survival					
Prehunt (May-15 Oct)	1.00	0.94	1.00	1.00	1.00
Rifle hunt (16 Oct-Nov)	0.89	0.88	0.85	1.00	0.64
Posthunt (Dec-Apr)	1.00	0.89	0.64	0.88	1.00

* Upper confidence level truncated at 1.00.

Table 6. Estimated whole weights (kg) by sex, age, and year of 282 white-tailed deer on Bowser-Tally and Murphy-Dickey Lakes winter ranges during January-February 1989-90.

Age (yrs) and year	Females			Males		
	n	$\bar{x}$	SE	n	$\bar{x}$	SE
0						
1989	26	31.0	0.4	34	30.4	0.5
1990	27	31.1	0.5	31	32.5	0.6
1						
1989	10	49.3	1.3	9	52.5	2.2
1990	13	50.0	1.0	14	54.8	1.2
2						
1989	14	55.2	1.1	3	55.3	2.1
1990	16	57.3	0.9	10	60.0	1.8
3						
1989	13	55.6	1.0	3	65.8	2.5
1990	12	56.8	0.9			
4-7						
1989	13	59.0	1.6	1	65.4	
1990	15	61.8	0.8			
≥8						
1989	10	57.7	1.5	1	70.4	
1990	7	63.3	1.9			

heart girth for the same deer. Dressed carcass weights from 60 hunter-killed deer examined at check stations during autumn 1989 indicated an age-related pattern similar to that of heart girth measurement (Fig. 5). Knowlton et al. (1980) reported that wild deer continue to gain weight through 4 years of age in females and 5-6 years in males.

Only data from January and February 1989 were used for comparison with 1990 when weight estimates were obtained only for those months. Data within sex and age classes were pooled for January-February because a 4 factor ANOVA indicated no change in weight ($P > 0.10$) through the period, but main effect differences due to sex, age, and year were significant as were the

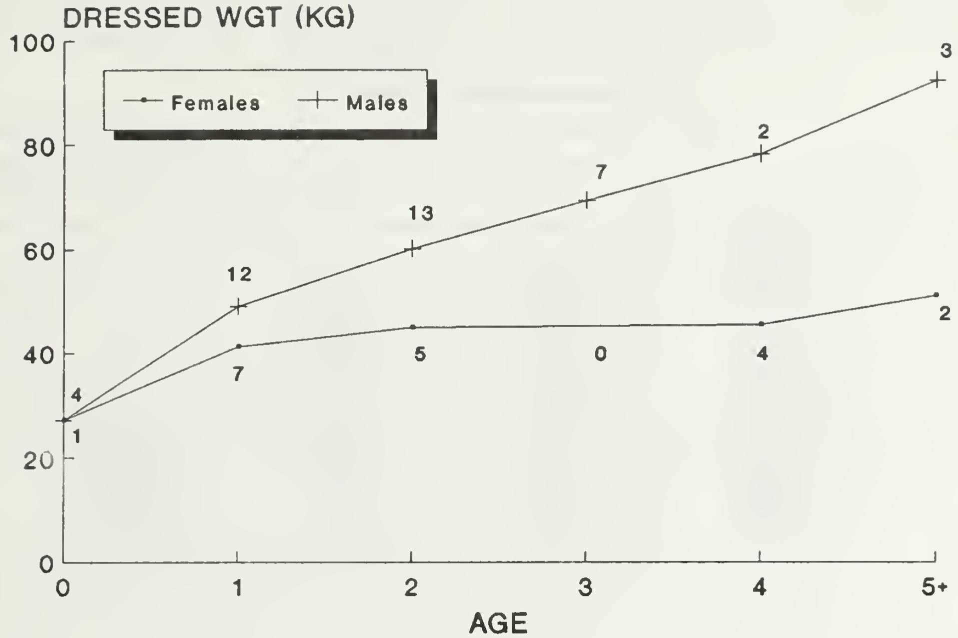

Figure 5. Field-dressed carcass weights (kg) of 60 white-tailed deer weighed at hunter check stations during 1989.

interactions of sex and age ($P < 0.01$). Sex, age, and year accounted for 93% of the variation in weight during January and February. Deer probably experienced some weight loss between late autumn and January, a period that included the onset of cold winter weather and migration from summer to winter ranges. During January-February, weight loss may have been somewhat more gradual and also may have continued beyond the period of trapping as suggested by general appearance of deer from photos taken during March and April (Dusek 1989).

Whole weights of harvested deer were estimated from dressed weights using a dressing index, or dressed weight expressed as a proportion of the whole weight, from deer specifically collected for study and from deer that died incidental to trapping ($n = 15$, $\bar{x} = 0.72 \pm 0.01$ SE). Based on these estimates for October-November and estimates based on heart girth measurement during January-February, apparent weight loss of fawns was 18 and 17% for females and males, respectively. Females older than fawns experienced weight losses of 10-13%. For yearling, 2-year-old, and older males, observed weight losses were 21, 29, and 40%, respectively. An initial, rapid loss of weight, followed by a leveling off or more gradual weight loss through winter, was consistent with physiological and behavioral adaptation to winter in northern environments where forage resources occur in limited abundance and/or quality (Peek et al. 1990). Adult males normally experience weight loss during late autumn-early winter, as a result of breeding behavior, regardless of abundance and quality of forage resources (Woolf and Harder 1979).

Analysis of blood parameters from samples taken during December 1988 to March 1989 indicated that serum urea nitrogen (SUN), packed cell volume (PCV), and hemoglobin (Hb) varied by month, PCV and Hb differed between fawns and adults, and none showed differences between males and females (Dusek 1989). However, all suggested a decline in dietary status from December 1988 through February 1989 despite no apparent weight loss through that period. A 4 factor ANOVA indicated that SUN values differed significantly between years ($P < 0.01$), but main effects due to age, sex, and month were not significant ($P > 0.10$). Mean values of pooled samples were 30.3, 25.4, and 32.4 mg/dl for 1988, 1989, and 1990, respectively.

Diastemal length of whitetails during autumn 1988 increased at least through 4 years of age in both females and males (Dusek 1989). Mean diastemal length of yearling males examined at hunter check stations in 1989 was less than that for 1990 ($\bar{x}$ = 72.3, 69.4 mm, 58 df, $t = 3.27$, $P < 0.01$). Rationale for comparing measurments among yearling males followed that of Swenson and Stewart (1982). Yearlings had experienced only 1 winter, thus minimizing cumulative effects of environmental conditions on growth and condition over several years. Yearling males also were numerically abundant ($\underline{n}$ = 29, 31) among deer examined.

Mean basal diameter and mean length of the main beam, and maximum spread among males $\geq$1 year of age increased with age (Dusek 1989). With addition of 1989 check station data, ANOVA indicated differences attributable to age ($P < 0.01$) and year ($P < 0.05$) for both main beam length and basal diameter. Mean beam length was greater among all age classes of bucks in 1988 than in 1989 particularly among deer $\leq$2 years of age (Fig. 6). Among 32 yearling males examined during autumn 1989, both antlers among 22 (69%) consisted of a single tine, or "spike", 6 had a maximum of 2 points/side, and 4 had a maximum of 3 points. Thirteen of 19 2-year-olds had a maximum of 3 points/side, 2 were 4-pointers, and 4 were 2-pointers. Among 21 males older than 2 years, 9 carried a maximum of 4-5 points.

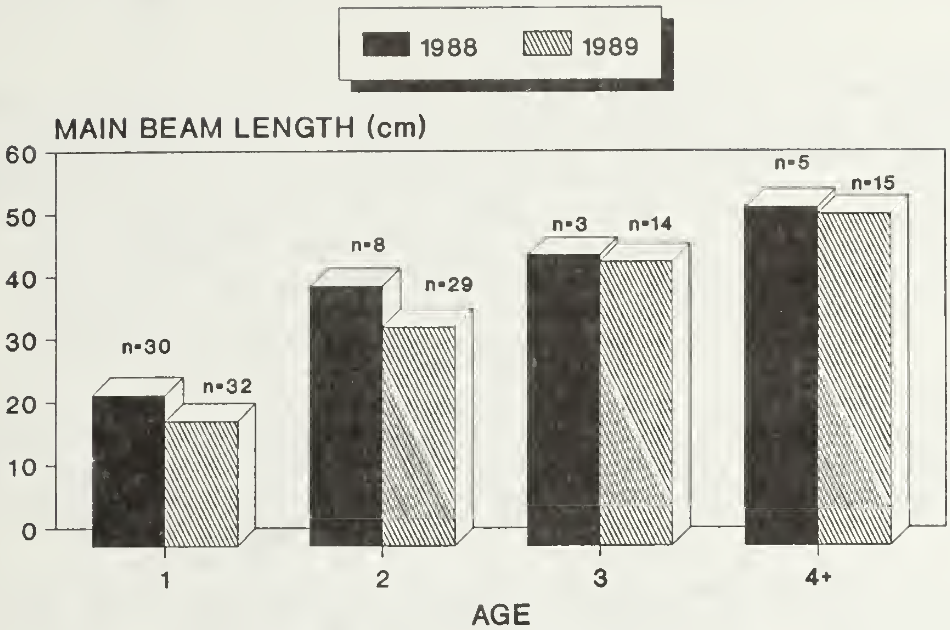

Figure 6. Main antler beam length (cm) of white-tailed deer bucks examined at check stations in 1988 and 1989.

Population Density

A 24-km^2 area surveyed by helicopter, remote camera surveys, and pellet group counts in 1989 (Dusek 1989) was used to estimate population size again in 1990. All trapping effort in 1990 at BTWR was conducted within this survey area bounded on the east by the Stillwater River, on the south and west by Lost Creek, and on the north by Hanson Lake. Camera placement in the area during late winter 1990 is shown in Figure 7.

Remote camera and snowmobile surveys during February/March 1990 suggested that 6-8%, respectively, of the late winter-early spring population on BTWR was marked. A minimum of 134 marked deer occurred within the survey area that included all radioed deer using the survey area during late winter, all neckbanded deer captured within the area during winter 1990, excluding known mortalities, and neckbanded deer from previous years known by reobservation or recapture to occur within the area. Mortality was assumed minimal from December through mid-March, and movement by deer into or out of the area also was assumed minimal.

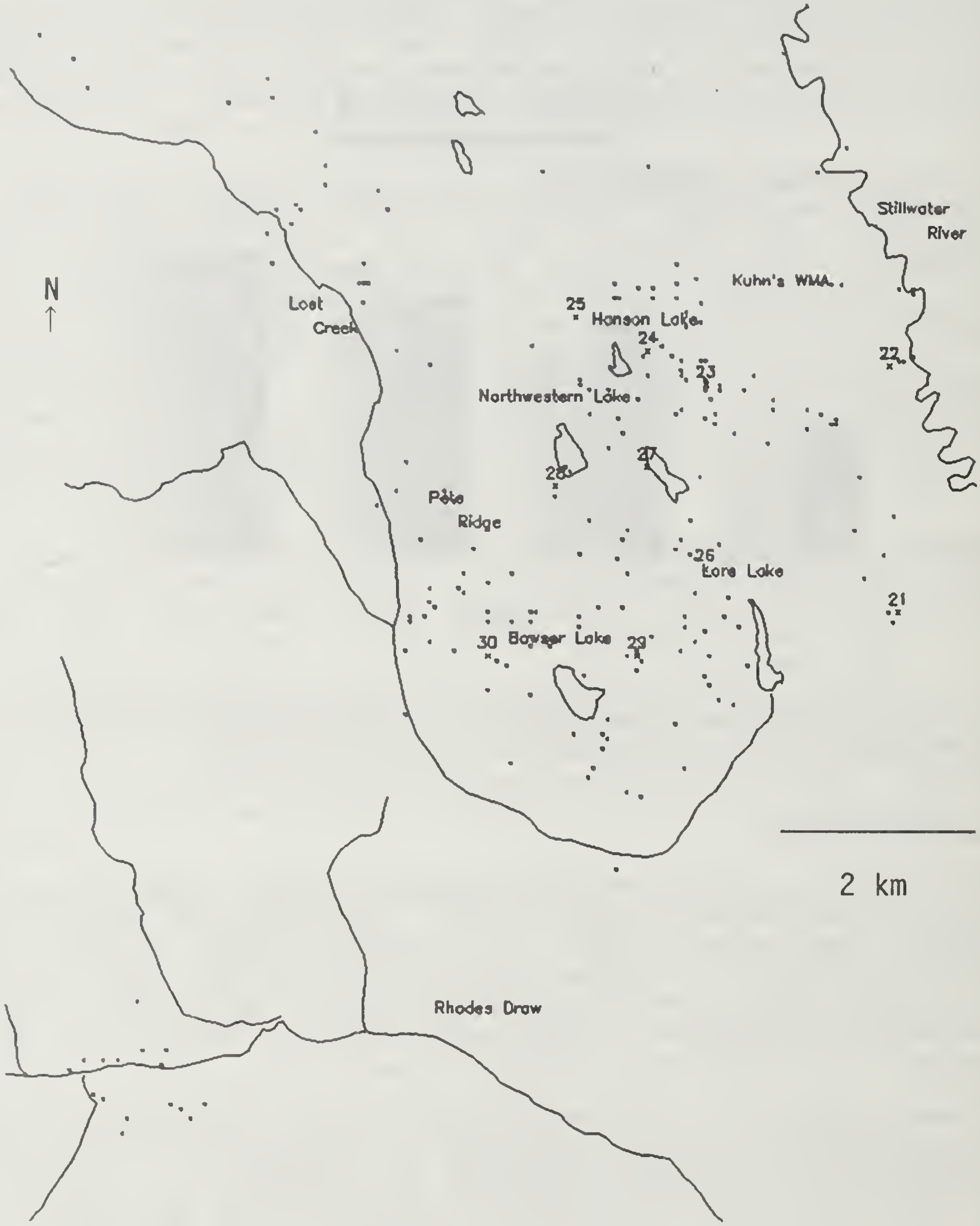

Figure 7. Winter distribution of white-tailed deer on the Bowser-Tally Lakes winter range (·) and location of camera sites (X) during late winter 1990.

Monte Carlo results yielded a MLE of 2,189 and a 95% likelihood interval of 1,920-2,539 on the survey area (Fig. 8). This compared to a raw Lincoln-Peterson estimate of 2,067 deer. A Lincoln-Peterson estimate for late winter 1989 was 2,057 (Dusek 1989).

Deer density varied from 32 to 203 deer/km^2 among individual pellet group transects. Pellet group density was converted to deer density based on a standard daily defecation rate of 12.7 for white-tailed deer (Longhurst and Connolly 1982) over a mean 98-day period that deer occupied the winter range. Sampling intensity was less in the low density stratum along bottomlands of the Stillwater River east of the farm-to-market road (Dusek 1989). A high density stratum included rolling uplands and a series of potholes west of the farm-to-market road.

Analysis of pellet group data resulted in an estimate of 3,064 deer in the survey area with an average density of 128 deer/km^2 compared to 133/km^2 in 1989. One (3%) of 33 radio-collared deer captured in the survey area during previous years, wintered off the survey area in 1990.

Pellet group surveys probably overestimated deer numbers on the survey area. This may be partially due to the fact that tilled sites along bottomlands of the Stillwater River were not sampled. More importantly, the commonly used daily defecation rate, ≈13, determined from penned deer (Eberhardt and Van Etten 1956) was approximately half that reported for free-ranging deer (Rogers 1987, Sawyer et al. 1990). Rogers (1987) also implied that daily defecation rates are subject to regional variation as well as that attributable to sex and age. There are no comparative data for white-tailed deer in the northern Rocky Mountain region.

Estimates derived from pellet group counts may serve as an index sensitive to population change exceeding a level of precision at current sampling intensity. Based on a sampling effort of 650 plots in the 24-km^2 survey area, precision was ±13% ($\alpha = 0.05$). Upper and lower limits were 3,450 and 2,678 animals, respectively. Precision for the high density stratum was ±12% (550 plots), while that for the low density stratum was ±43% (100 plots). Even considering that all deer associated with this winter range in 1989 did not use the winter range in 1990, a measurable change in population size was not evident between the 2 years from pellet group counts. Likewise, capture-resight procedures suggested nothing more than a negligible increase in wintering population between years.

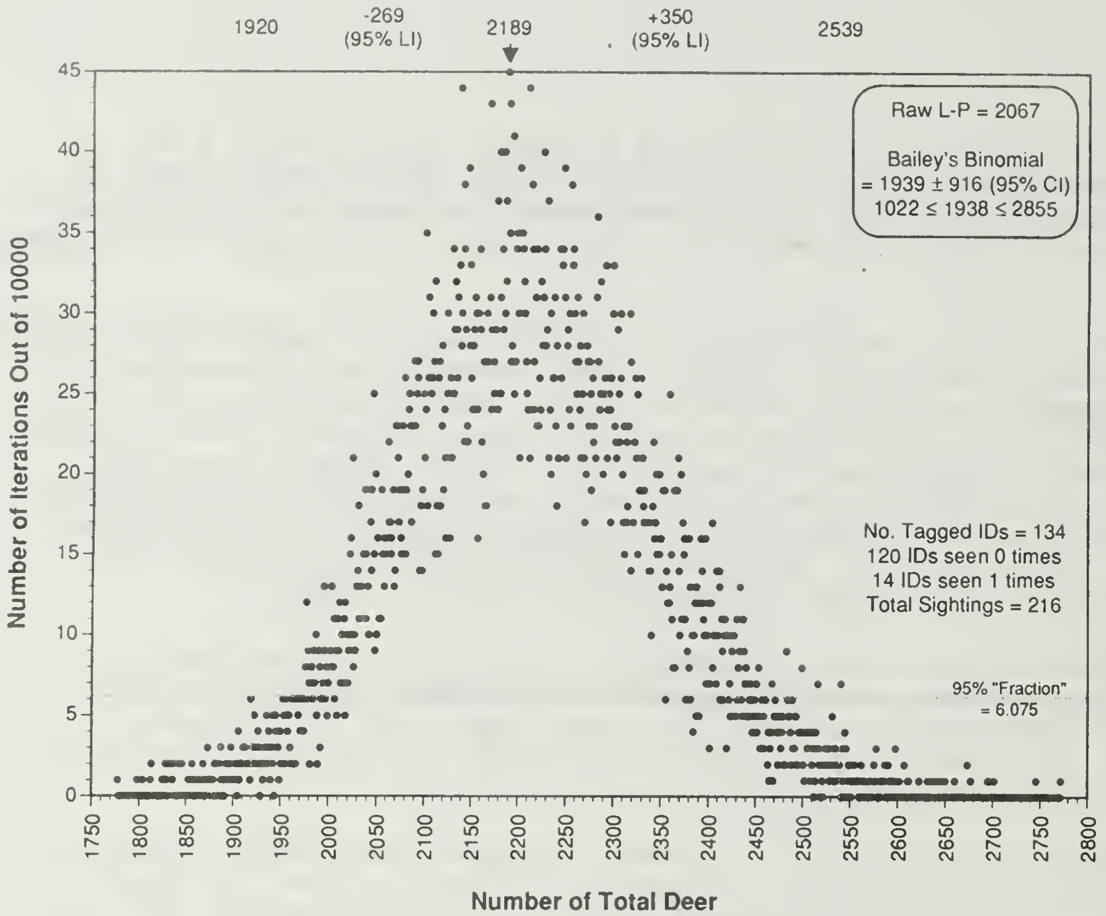

Figure 8. Monte Carlo computation of the maximum likelihood estimate and 95% liklihood interval compared with the binomial and Lincoln-Petersen estimates.

Movements and Distribution

This discussion is devoted to documenting distributional patterns of deer on the BTWR and MDWR and throughout the Fortine District. That on the Tally Lake District has been summarized by Morgan (1990).

General Movement Patterns

The extent and timing of movement by radio-collared deer off the BTWR in late March-early April 1990 to transitional and summer ranges followed the pattern described by Mundinger and Riley (1982, 1983). Distance between geographical centers of activity for winter and summer home ranges varied from 23 to 31 km (Dusek 1989). Major areas of concentration during late spring through autumn included both Good Creek and Star Meadows.

Radio-collared deer moved onto the winter range from October 1989 through early February 1990 although most moved onto BTWR during mid-to-late December as mentioned previously. The early migrants included 3 adult females captured in Griffin Creek during August 1989. Two of these (90243, 90246) wintered in Rhodes Draw (Fig. 7), and the other (90245) wintered on the BTWR survey area.

As in other years, spring migration was not characterized by the staggered pattern of movement observed during autumn/winter 1989-90. Estimated dates of departure from the winter range by radio-collared deer suggested that spring migration occurred about a week earlier in 1990 than in 1989. In 1990 the first evidence of spring migration was observed on 30 March. All but 2 spring migrants left the winter range before 10 April. One adult female (88016) left in early May as she had in 1988 and 1989, and one adult male (90310) left BTWR in early June 1990.

Among 3 females radio collared on the north side of Ashley Lake in March 1988, one of 2 survivors (88064) remained there throughout the year; the other (88063) summered in Griffin Creek immediately south of Star Meadows a pattern similar to that in 1988.

Most deer wintering on MDWR summered primarily within the Fortine Ranger District. Only one of 18 radio-collared females during spring 1989 was a yearlong resident on the winter range. However, another female (89201), captured and radio-collared in Stewart Creek in February 1989, remained near the capture site throughout most of the year; she moved onto the more intensively used portion of the winter range behind Murphy Lake in February 1990 and remained there through March. Furthest movement from the winter range in 1990, as in 1988 and 1989, included an adult female (88043) that summered in Grand Creek at the base of Elk Mountain, a straight-line distance of 29 km from her winter home range. Although the winter trapping effort in 1990 included a larger portion of the winter range than during the previous 2 winters, distribution the following spring was still similar to that of summers 1988 and 1989. Fifteen of 19 deer occurred in the Fortine Creek drainage though all but 2 were in second and third order drainages. The meadow area at the confluence of Swamp and Lake Creeks was again a major concentration area during late May.

<u>Density Distribution</u>

Density distribution of deer on BTWR generated from pellet group counts (Fig. 9) indicated the greatest area of winter concentration occurred in an area of low ridges interspersed with potholes from Cliff Lake south to Bowser Lake, bounded by Pete Ridge on the west and on the east by the ridge just northeast of Baney Lake. Lowest densities, as mentioned previously, occurred

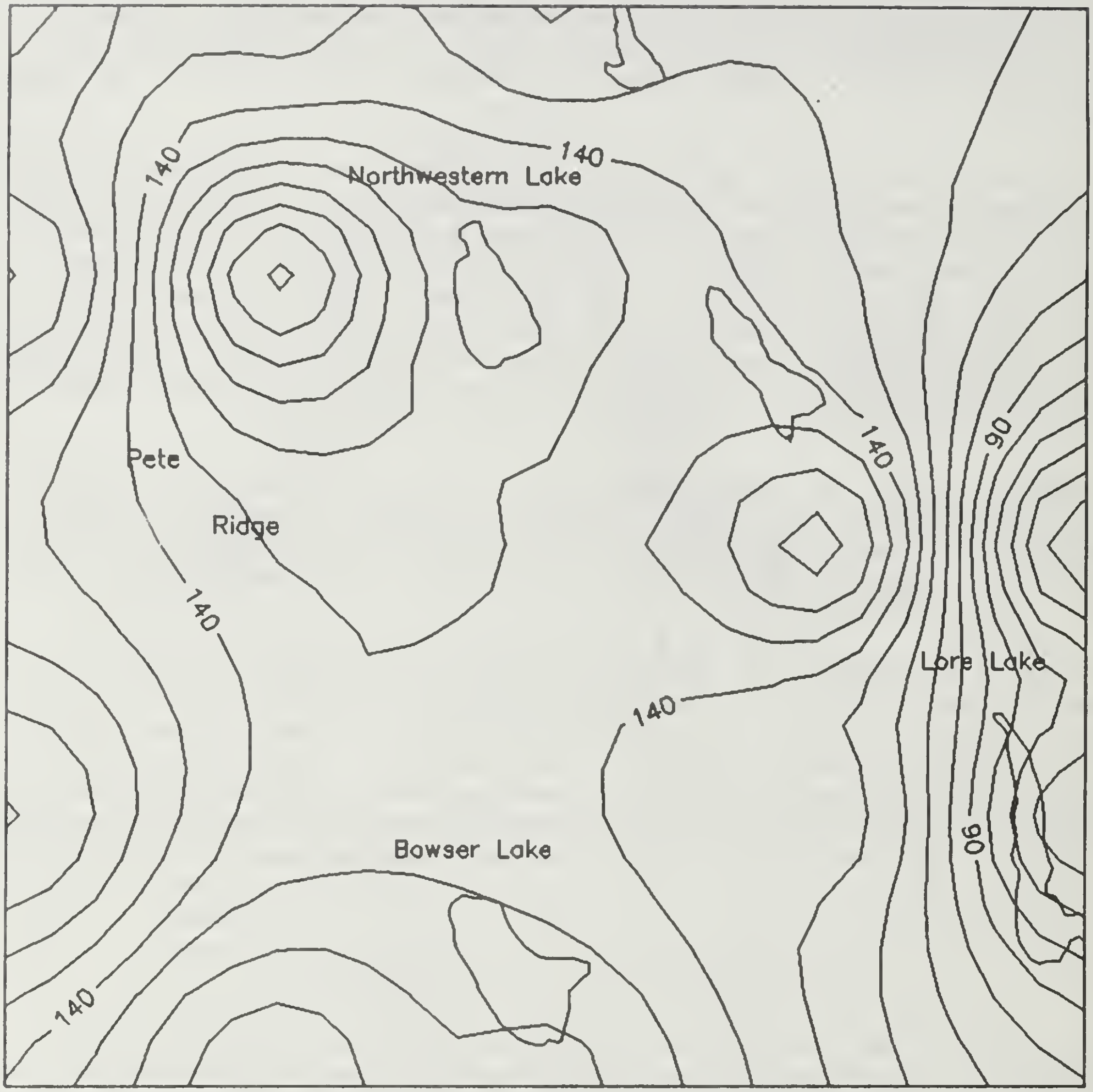

Figure 9. Deer density (deer/km^2) contours on the Bowser-Tally Lakes winter range from pellet group counts during April 1990.

along bottomlands of the Stillwater River that included the Kuhns WMA (Fig. 7). Relative abundance from remote camera surveys expressed as deer-visits/day (Table 7) suggested a similar pattern of density distribution.

Remote camera surveys at MDWR (Fig. 10, Table 7) suggested comparatively high deer abundance from Murphy Lake east to Martin Lake, along Cripple Creek, and around Ant Flat. Although white-tailed deer may occasionally use the upper Summit Creek drainage as indicated from locations of radio-collared deer, only mule deer were photographed at that particular site.

Table 7. Density distribution of white-tailed deer on Bowser-Tally and Murphy-Dickey Lakes winter ranges during February/March 1990 from deer-visits per day at camera sites.

Winter range	Site No.	Location	No. days functioning	Deer-visits/ day
MDWR				
	9011	N. Hagadore Lake	15	1.9
	9012	Martin Lake	15	0.9
	9013	Sink Creek	15	0.0
	9014	S. Hagadore Lake	15	0.4
	9015	Murphy Lake	15	2.7
	9016	Ant Flat	15	1.2
	9017	Cripple Creek	14	2.0
	9018	E. Dudley Slough	14	1.0
	9019	E. Dudley Slough	14	0.9
	9020	E. Dudley Slough	14	0.6
BTWR				
	9021	S. Kuhn's WMA	16	0.4
	9022	N. Kuhn's WMA	16	0.8
	9023	State Forest	16	2.2
	9024	Cliff Lake	14	2.0
	9026	Lore Lake	15	2.1
	9028	E. Pete Ridge	14	1.4
	9029	E. Bowser Lake	9	2.9
	9030	Pete Ridge	10	4.1

Figure 10. Winter distribution of white-tailed deer on the Murphy-Dickey Lakes winter range (•) and location of camera sites (X) during late winter 1990.

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Submitted by: Gary L. Dusek

Summer habitat use of white-tailed deer on the Tally Lake Ranger District of the Flathead National Forest

Job Objectives:

1. Determine season long and diel activity and habitat use patterns of white-tailed deer on summer ranges on the Tally Lake District of the Flathead National Forest.

2. Determine use and importance of various seral stages of coniferous forest and riparian communities and how spatial distribution of these communities to form habitat complexes influences distribution and abundance of deer.

3. Determine the importance of various habitat features such as: slope, aspect, elevation, vegetative structure and species composition of forest stands, and distance to cover, riparian areas, and roads.

INTRODUCTION

White-tailed deer summer use of coniferous forest in northwest Montana has been study previously by Leach (1982), Mundinger (1984), and Krahmer (1989). The Tally Lake District northwest of Kalispell, initially studied in the early 1980's, has been shown to be important as whitetail summer range (Mundinger and Riley 1982, 1983). However, extensive timber harvesting and road building on the district could potentially disrupt traditional patterns of whitetail activity and habitat use on summer ranges.

This study was initiated to investigate whitetail activity and habitat use while deer occupy summer ranges on the Tally Lake District as well as diel patterns during that period. This report describes research activities during the first of 3 summer field seasons (1 May-30 November 1989). Major effort during the period concentrated on familiarizing myself with the study area, testing summer trapping techniques to increase the number of radio-collared deer in specific areas, and obtaining relocations of deer through aerial, ground, and 24-hr telemetry efforts.

STUDY AREA

The Tally Lake District has been described previously by Mundinger and Riley (1982) and Dusek (1989). My study area includes that portion of the district containing all deer relocations and outlined by major physiographic points north of Ashley Mountain, east of the Flathead/Lincoln County Line, south of Martin Falls, and west of Tally Lake.

The study area drains to the northeast into the Stillwater River via Good, Logan, and Martin Creeks (Fig. 1). Elevation ranges from 1020 m at Tally Lake to 1935 m on Mount Swaney. Subalpine fir/queen's cup beadlilly (*Abies lasiocarpa*/*Clintonia uniflora*) is the major habitat type (Pfister et al. 1977) throughout the study area. However, habitat alteration through logging, cattle grazing, and natural fires has produced a forest which is a mosaic of mature mixed conifer, large stands of lodgepole pine (*Pinus contorta*), new clearcuts, various stages of regrowth, riparian meadows, and other natural openings.

Major species present in the overstory include lodgepole pine, Douglas-fir (*Pseudotsuga menziesii*), subalpine fir (*Abies lasiocarpa*), and western larch (*Larix occidentalis*). Common grass, forb, and shrub species include pine grass (*Calamagrostis rubescens*), timothy (*Phlem pratense*), strawberry (*Fragaria virginiana*), yarrow (*Achillea millefolium*), arnica (*Arnica* spp.), beargrass (*Xerophyllum tenax*), spiraea (*Siraea betulifolia*), rose (*Rosa gymnocarpa*), twinflower (*Linnaea borealis*), buffaloberry (*Shepherdia canadensis*), alder (*Alnus* spp.), willow (*Salix* spp.), snowberry (*Symphoricarpus albus*), and huckleberry (*Vaccinium* spp.).

Two areas which support large numbers of deer throughout the summer are the Star Meadows complex formed by the confluence of Logan, Griffin, and Sheppard Creeks; and the Alder, Corduroy, Good Creek complex. Star Meadows is approximately 65 km^2. One-third is meadow bottom consisting of a mixture of open meadowlands, willows, and scattered timber. The slopes of the complex are a mosaic of timber and cutover areas. The Alder, Corduroy, Good Creek Complex is about half the size of Star Meadows. Contrastingly, the area primarily consists of large stands of 60-70 year old lodgepole pine, a remnant of large fires during the early part of this century. This complex lacks large meadows but a number of small wet meadows are associated with each drainage.

METHODS

Deer relocations were obtained via fixed-wing aircraft surveys, ground triangulation using a hand-held H-antennae, 24-hr telemetry sessions using 3 truck mounted null antennae arrays, and visual sightings either incidental or purposely obtained.

Figure 1. Tally Lake deer project study area, Tally Lake Ranger District, Flathead National Forest.

Test transmitters were placed at known locations to check accuracy of relocation procedures (White and Garrott 1990). Date, time, and UTM coordinates were recorded for each relocation and plotted on aerial photographs and/or topographic maps.

Streams, lakes, and prominent peaks were digitized using program CAPTURE (Desktop Digitizing Package 1988). These data as well as aerial and ground relocations were plotted using program SURFER (Surfer Reference Manual 1988). Summer home ranges were calculated using program TELEM (Coleman and Jones 1988) and plotted separately.

An attempt was made to trap deer in specific areas on summer range in order to increase the number of radio-collared deer in areas where 24-hr telemetry sessions were being conducted. Three Clover traps (Clover 1954) baited with salt blocks and apples were placed around Star Meadows during August 1989. Trapping and handling followed procedures previously described (Dusek 1989).

RESULTS and DISCUSSION

Thirty-four radio-collared deer moved from winter range on to the Tally Lake District and occupied their summer ranges by the beginning of the report period (Table 1). During summer 1989, 4 additional deer were trapped and 471 ground and air relocations were recorded among 38 deer summering on the district, yielding information on distribution, movements, and habitat use.

Distribution

Summer distribution showed clustering of deer in certain parts of the study area with little documented use elsewhere (Fig. 2). Twenty-three deer moved to the northern portion of the study area bounded by Martin Creek and associated drainages. These deer primarily used the Good Creek bottom and south facing slopes as a travel corridor and transitional area, moving to higher elevations as the snow melted. Four deer summered in each Alder and Corduroy Creeks and 6 deer in the Adams Mountain/Miller Creek area. Fifteen deer summered in the southern portion of the study area with 4 deer in both the Logan and Griffin portions of Star Meadows and 3 in the upper portion of Sheppard Creek.

Initially, many deer around Star Meadows restricted their movements to the south facing slopes as much of the bottom was flooded during the spring. In June many deer made use of the meadow for foraging and fawning, retreating back to the slopes as the meadow dried out later in the summer.

Table 1. White-tailed deer monitored on Tally Lake District, summer 1989.

DEER NUMBER	SEX	AGE	SUMMER LOCATION
88001	F	6	LISTLE CREEK
88010[a]	F	3	GERGEN CREEK
88014	F	5	GOOD CREEK
88016	F	3	GOOD CREEK
88019	F	5	GOOD CREEK
88020	F	2	MARTIN CREEK
88021	F	4	MARTIN CREEK
88063	F	9	GRIFFIN CREEK
89070	F	3	CORDUROY CREEK
89083	F	5	ADAMS MOUNTAIN
89084	F	4	CORDUROY CREEK
89087	F	4	LOGAN CREEK
89089	M	3	ALDER CREEK
89090[c]	M	2	SHEPPARD CREEK
89092	F	8	ALDER CREEK
89095	M	2	GOOD CREEK
89096	F	2	ALDER CREEK
89098	F	5	MILLER CREEK
89099	M	4	LISTLE CREEK
89100	F	3	FOX MOUNTAIN
89117	F	2	NELSON CREEK
89119	F	4	CORDUROY CREEK
89124	F	2	MILLER CREEK
89134	F	9	CORDUROY CREEK
89148	F	4	LOGAN CREEK
89149	F	2	NORTH EVERS CREEK
89157[b]	F	3	EVERS CREEK
89163	F	3	LOGAN CREEK
89188	F	3	GRIFFIN CREEK

Table 1, continued.

DEER NUMBER	SEX	AGE	SUMMER LOCATION
89189	F	4	MARTIN CREEK
89195	F	4	ALDER CREEK
89197	F	7	SHEPPARD CREEK
89230[c]	F	7	STAR FACE
89237	F	2	STAR FACE
89243[d]	F	4	GRIFFIN CREEK
89244[bd]	F	6	STAR FACE
89245[d]	F	3	GRIFFIN CREEK
89246[d]	F	1	GRIFFIN CREEK

[a]Lost contact, July 1989
[b]Died, cause unknown, fall 1989
[c]Harvested, November 1989
[d]Trapped, August 1989

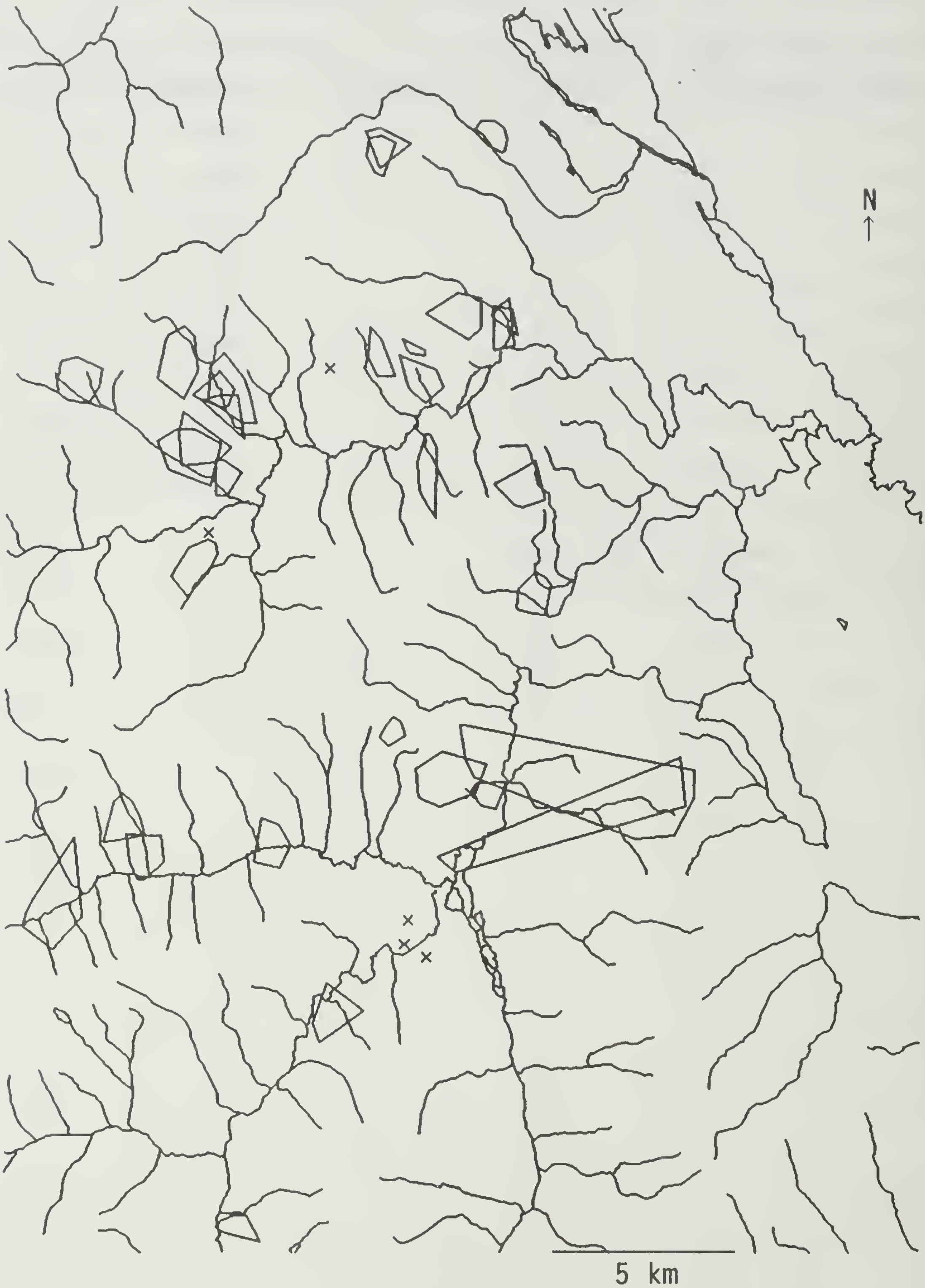

Figure 2. Home range locations (X=deer with < 10 relocations) of 38 deer monitored on the Tally Lake District, summer 1989.

Elevational use by deer ranged from 1100 m at the confluence of Miller and Goods Creeks to 1585 m near the peak of Adams Mountain with some intra-seasonal movement. Little use was made of uplands exceeding 1600 m within the center of the study area, the Sylvia Lake/Hand Creek area in the southeast, the upper portions of Logan Creek, or the lower portions of Logan and Good Creeks. The latter however were used as transitional areas.

Home Range

Once deer arrived on their summer home ranges there was very little movement until fall migration (Fig. 2). Two deer which spent May-July around the northern portion of Star Meadows moved to Tally Mountain in Early August. Although this move was included as part of the summer home range it should more accurately be considered an accessory area. Summer home ranges of all deer, excluding the 2 above, and based on 90% of relocations, averaged (SE) 96 ha ($\pm$70).

Habitat Use

Figure 2 illustrates an association of whitetails with riparian areas within summer home ranges as that of almost every deer encompassed a creek drainage. Many drainages only flow intermittently or move underground for part of their course. However for the most part they are mesic sites as are areas within the home ranges of those deer not associated with a specific creek.

A vegetation cover map of the study area is being developed with the aid of Landsat imagery and program ERDAS (ERDAS, Inc. 1987). Through general observations however, it should be noted that most individual deer relocations fell in timbered areas although often bordering another type including cutover areas. On the larger scale summer home ranges of individual deer encompassed areas of mixed timber, stands of lodgepole, cutover, and riparian areas. The complex of vegetation communities along with topographic features may determine deer distribution.

Diel Patterns

Twenty-four hour telemetry sessions were conducted twice in both July and August 1989. Usable data were obtained for 3 deer in Corduroy Creek and for 6 deer on the north side on Star Meadows. Diel home ranges for these deer averaged (SE) 119 ha ($\pm$106), larger than the seasonal home ranges for the same deer (Figs. 3 and 4). A major reason for 24 hour monitoring was to obtain data on deer movement at night when aerial locations could not be obtained. Night locations tend too increase overall

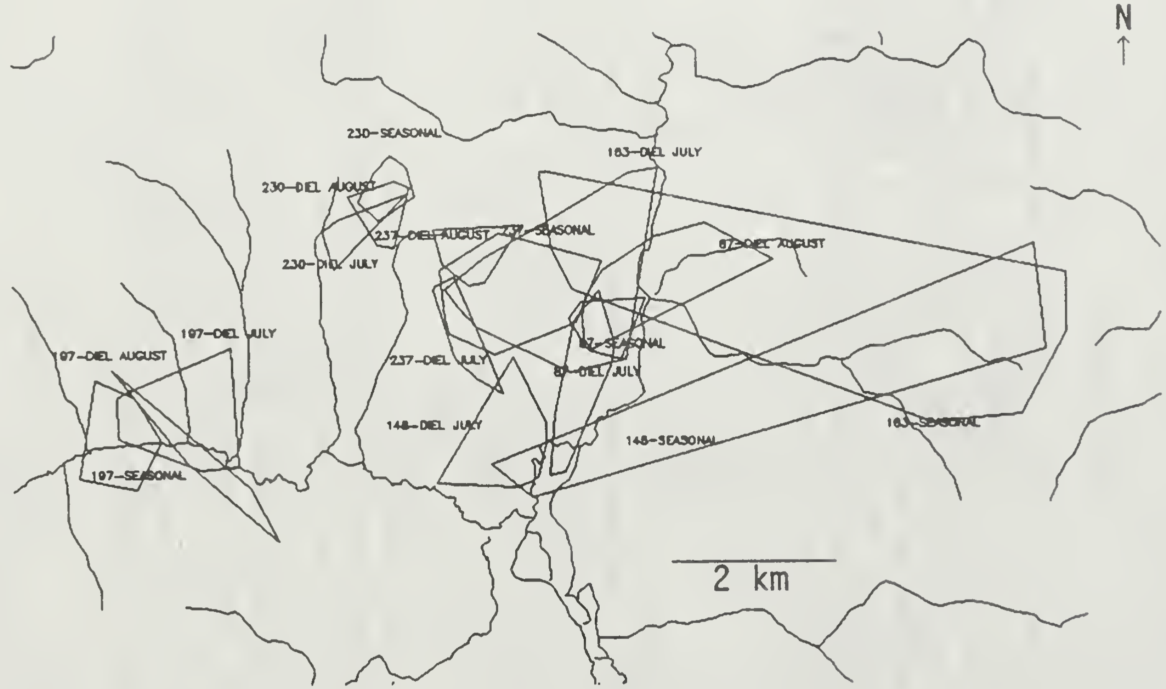

Figure 3. Seasonal and diel home ranges of 6 deer monitored during Star Meadows 24-hr sessions, July and August 1989.

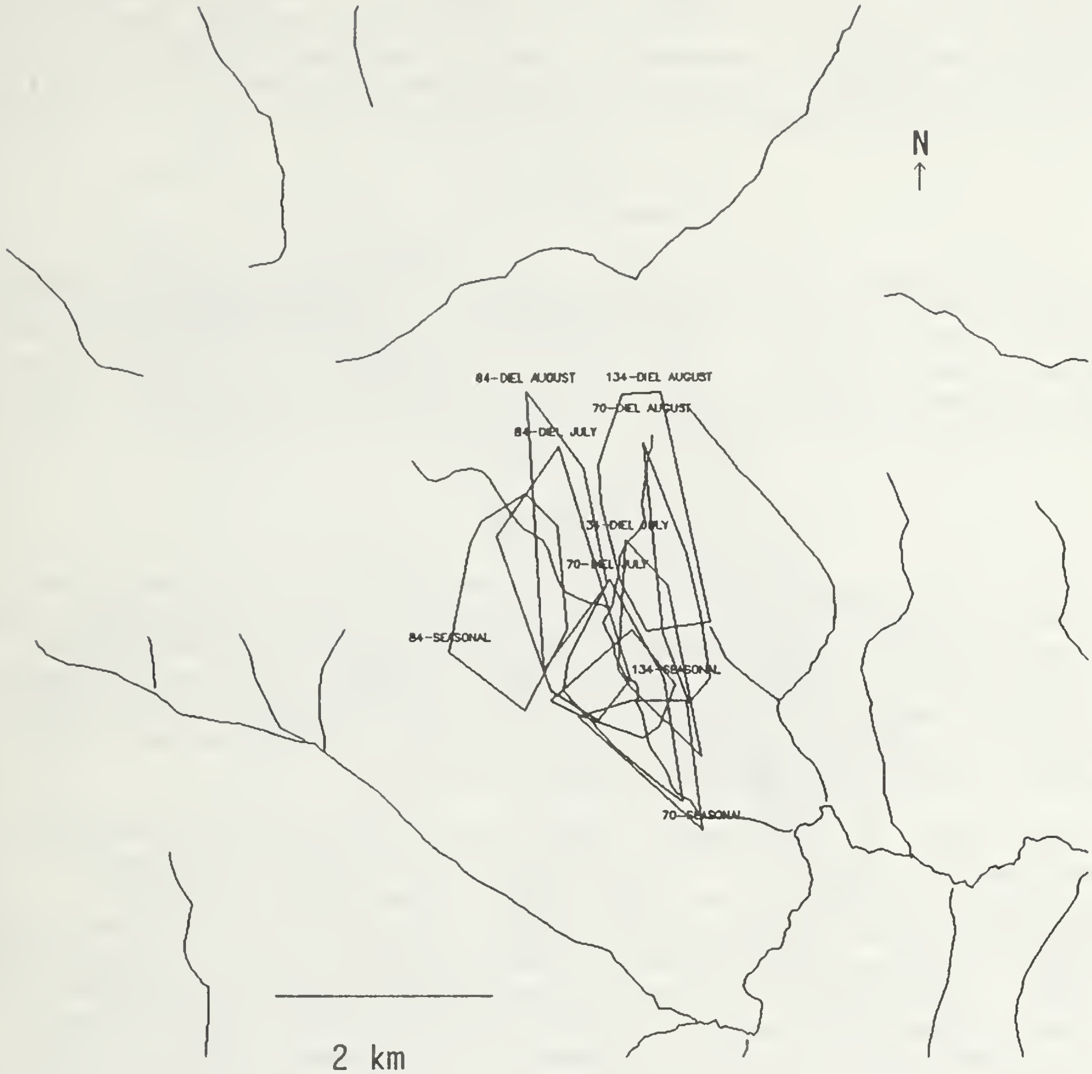

Figure 4. Seasonal and diel home ranges of 3 deer monitored during Corduroy Creek 24-hr sessions, July and August 1989.

home range size. Diel ranges also represent 1 day's movement out of the whole summer; on that given day it is possible that a deer was making non-typical movements (eg; an exploratory move). Finally, any inherent system-related error can skew the locations and an effort has been made to reduce this.

Summer Trapping

During August 1989, 6 deer were captured over 36 trap nights (17%) and radio collars were placed on 4 females. On 9 occasions traps had been tripped with no capture. Evidence suggests that 4 trips were deer caused. This effort suggested that deer can be trapped during spring/summer at fairly high efficiency and this should improve with better trap placement and setting.

Migration

Some deer began exhibiting home range shifts as early as late July; 2 deer moved from Star Meadows to Tally Mountain where they remained through November then moved to their respective wintering areas on Pilot Knob and Pete Ridge. Two deer trapped in Griffin Creek during August 1989 moved to wintering areas in Rhodes Draw in mid-September. For the most part however, major moves did not occur until November-December.

Movements between summer and winter range often occurred between aerial relocations (10-14 days) and hence getting transitional locations was difficult. Available evidence suggests that deer summering in the northern portion of the study area traveled down Good Creek to its confluence with Logan Creek (Fig. 5). Along this portion of the drainage the topography is less severe and from here deer could move across Short, Round, and Birch Meadows to winter ranges in the Bowser, Kuhn's, Pete Ridge area. Most Deer summering in the southern portion of the study area including Star Meadows moved either over Tally Mountain or the Reid Divide to get to wintering areas.

Deer began leaving the winter range near Bowser Lake in late March 1990. Deer moving to Star Meadows did so in as little as 3 days probably following routes similar to that of their fall migration. Deer associated with summer ranges in and around Good Creek often spent a few days in the meadows immediately north of Tally Lake and along the snow free portions of Good Creek.

Year long elevational changes were similar to that found by Dusek (1989). Highest elevational use occurred in July with some variation throughout the summer (Fig. 6). Elevations on winter range were lowest in February. Elevational change was more rapid when deer moved to summer range between March and April than to winter range between October and January.

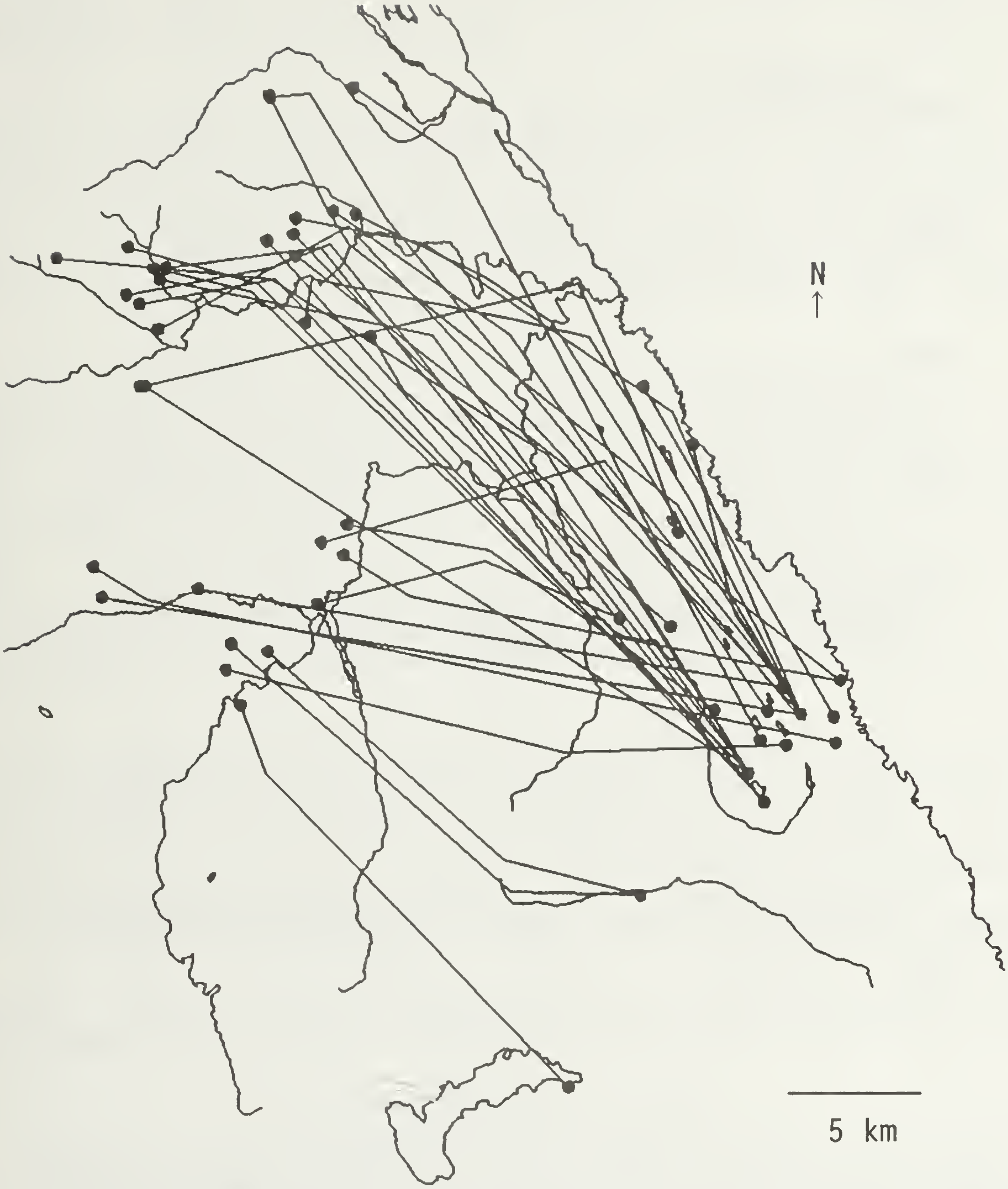

Figure 5. White-tail deer movements between summer and winter ranges 1989-90.

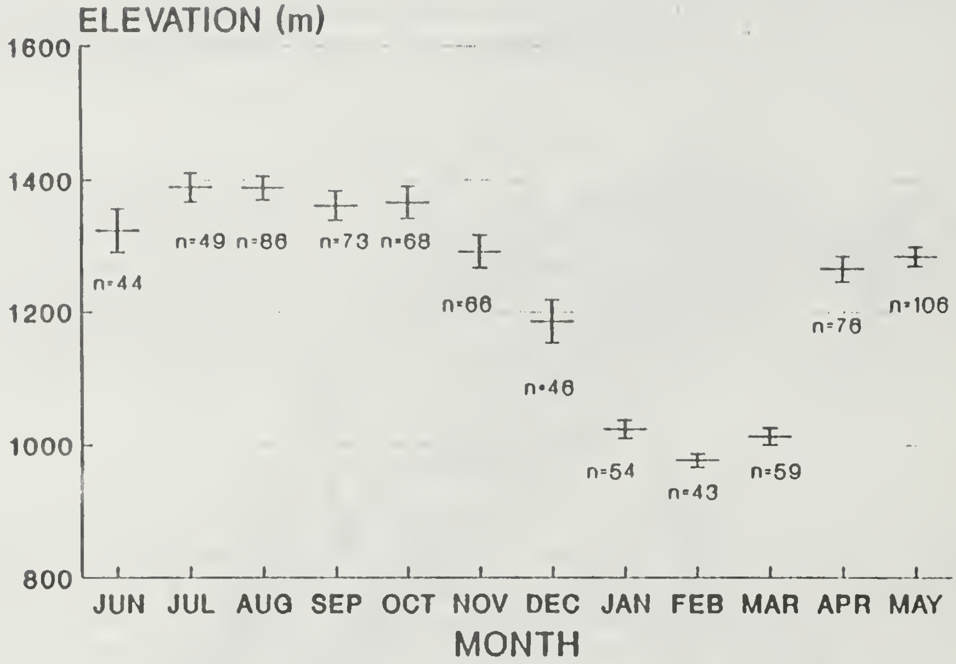

Figure 6. Elevational change (mean ± se) between summer and winter ranges 1989-90.

FUTURE WORK

1990-91 Field Season

The 1990-91 field season will be the most intensive as far as gathering data on deer locations. The anticipated field schedule includes locating deer from the air 3 times/month. Ground relocations will be limited as their accuracy has been questioned (Schmutz and White 1990). Twenty-four hour monitoring will be conducted monthly in the Star Meadows and Corduroy Creek areas.

Summer trapping will continue and be expanded to include Corduroy Creek as well as Star Meadows. The number of deer trapped will depend on the number of radio collars available.

Remote camera surveys will be conducted to experiment with using this method to estimate deer numbers as well as obtain deer relocations in specific drainages.

Habitat data collection will begin in the 1990-91 field season. The basic procedure will be to develop a number of habitat component layers using ERDAS (ERDAS, Inc. 1987). Layers will include: vegetation type, riparian areas, roads, slope, aspect, and elevation. The topographic layers are already complete and useable. The road and riparian layers are being updated and corrected. The vegetation layer must be created for the specific requirements of this project.

The procedure to create the vegetation layer involves separating the study area into a number of vegetation types based on differences in reflective and infrared light wavelengths picked up by the satellite. Vegetation will be separated based on its possible influence on deer behavior. This will primarily be dependent on vegetation structure, ie: foraging areas or grassy openings, hiding cover or shrub/sapling stands, and mature timber. Foraging areas will be separated as cutover areas or natural openings. Hiding cover we be separated as natural willow/shrub areas or sapling regrowth after clearcutting. Mature timber will be separated as mixed conifer or mostly lodgepole.

On ground data collection will involve walking into a randomly selected group of deer relocation sites. Information on species presence and relative abundance will be obtained for various layers of the forest. Canopy and horizontal cover will be noted as well as slope, aspect, and elevation. Average age, height, trees/ha, and basal area/ha for the stand will be obtained from Forest Service records.

Two deer will be collected monthly to assist in food habits analysis. Rumens will be analyzed at the Wildlife Research Lab in Bozeman.

1991-92 Field Season

During the summer of the 1991-92 field season, emphasis will still be on obtaining deer relocations. The schedule of aerial relocations and twenty-four hour monitoring sessions should remain near the 90-91 level. Summer trapping will be conducted in the Star Meadows and Corduroy Creek areas. Camera surveys also will be conducted around Star Meadows. Also during this time the vegetation cover type map will be completed and transferring the appropriate GIS files from the Forest Service to the Fish, Wildlife, and Parks computer system will take place. Most data analysis will take place after the summer field season has ended.

Data Analysis

In habitat use studies there are typically 4 questions to be answered (White and Garrott 1990). These concern the availability of various habitat components, the degree of use, any preference shown, and whether a particular habitat component is critical to an animal's survival or presence on an area. In this study we are concerned not only with the habitat components at individual deer locations but also with the complex of components making up the area surrounding a given location or group of locations. Hence these questions need to be asked about habitat complexes as well.

In this study, availability of habitat components will be determined within the whole study area and within 2 subunits (ie; Star Meadows and the Alder, Corduroy, Good Creek complex). Because the vegetation component has been digitized in cell format as a discrete number of types the availabilty of each will be determined by the summation of cells for that type. Availability of components such as slope, aspect, and elevation will be calculated by an analysis of random points.

Availability of habitat in complexes is more difficult to quantifify due to the difficulty in assigning a size to the complex. One possible method would be to consider the area within the seasonal home range of a deer as a habitat complex. However, there are probably portions of that area which are not used and should not be included as available. The method I will use is to delineate the complex as a given area around each individual deer location. From testing of aerial relocations I know that the distance between the actual and recorded location can be off 50-150 m. A circle with a 150 m radius is approximately 7 ha which will be used as the complex area. The habitat composition of this area will then be compared to random circles.

Utilization will be measured based on radio telemetry relocations. Habitat use on a seasonal basis will be determined by individual aerial relocations, visual sightings, and ground location to a lesser degree. Diel monitoring will be used to look for habitat use patterns throughout 24 hour periods.

There are a number of approaches for determining preference or avoidance (Manly et al. 1972, Neu et al. 1974, Johnson 1980, Marcum and Loftsgaarden 1980, Heisey 1985). The appropriate test to be used is partially determined by the type of data available. In general, when the actual proportion of each habitat component is known the procedure by Neu et al. (1974) has done well in comparison with the others (Alldredge and Ratti 1980) and will be the method used to evaluate use of vegetation types. When availability is estimated based on random points then the Marcum and Loftsgaarden (1980) approach is appropriate and will be used on topographic data, as well as nearness to roads and riparian areas.

After a preference is detected it is often desired to determine whether the habitat component is critical. As discussed by White and Garrott (1990) this cannot be determined by simply looking for preference. Rather a perturbation study with a large sample size needs to be conducted to see if the animal's condition or use of an area changes after the habitat is altered.

In this study there are deer concentrated in 2 areas which are apparently quite different. Star Meadows is an area with great interspersion of the major vegetation types. While the Alder, Corduroy, Good Creek complex is more uniformly uncut timber. An appropriate test may be to alter one area and measure the deer response. Since Star Meadows cannot be brought back to mature timber, cutting timber in the Good Creek area is more realistic. Such an opportunity exists with the planned timber harvests in the Alder, Corduroy, Gergen Creek areas.

A number of radio-collared deer are already using this set of drainages. Through aerial and diel relocations the present study will provide a great deal of pre-cutting data. Depending on when the stands are harvested post-cutting data may be obtained during this study or if not a follow-up or continuation study is highly recommended.

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