2002 Annual Animal Survey Report

for the

Minnesota Army National Guard
Camp Ripley Training Site
and
Arden Hills Army Training Site

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MINNESOTA DEPARTMENT OF NATURAL RESOURCES
CAMP RIPLEY SERIES REPORT NO. 13

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EXECUTIVE SUMMARY

The Department of Defense has established survey programs at military installations across the country to monitor natural resources and examine the impact of military activities on the natural environment. The twelfth year of animal surveys has been completed at the Minnesota Army National Guard (MNARNG) Camp Ripley Training Site, and the second year at the Arden Hills Army Training Site (AHATS) by the Minnesota Department of Natural Resources (MN DNR). Animal surveys were completed on Land Condition-Trend Analysis (LCTA) wildlife core and special use plots, and elsewhere throughout the installations. Monitoring and protection of threatened, endangered, and rare species also continued in 2002.

Camp Ripley

Songbird surveys were conducted on 30 LCTA core and special use plots. As in past years, red-eyed vireos, American redstarts, ovenbirds, common yellowthroats, least flycatchers and eastern wood-pewees were the most commonly heard species. Although attempts were made to verify the presence of hooded and cerulean warblers in previously occupied territories, no hooded or cerulean warblers were documented this year.

Bald eagles occupied four territories within Camp Ripley; however, only two pairs nested producing one fledgling each. The osprey nest at Sylvan Dam was occupied again and produced three young. Red-shouldered hawk nest sites and territories located in previous years were surveyed to document occupancy and nesting activity. Five active red-shouldered hawk nests were found, with two in territories not documented in earlier studies. Red-shoulders were also observed in nine other old territories.

In the past several years, Camp Ripley has had difficulty managing large numbers of cliff swallows that nest under the eaves of buildings. This year several techniques were used successfully to prevent swallows from nesting in these areas.

Monitoring of radio-collared wolves continued throughout the year using ground and aerial tracking. Radio tracking has confirmed that two wolf packs use Camp Ripley as the main part of their territories. One long-range dispersal was made by a young female wolf collared with a satellite collar in 2001. Her dispersal took her into Ontario and the Upper Peninsula of Michigan. Three new satellite collars were deployed in January 2002; however; all three collars functioned properly for a short time and then began to fail. Inspection of one of these collars recovered in December revealed that both antennas had been chewed off. Currently, there are VHF radio collars on three wolves (two north pack, one south pack) and failed satellite collars on two wolves (one in each pack).

The fourth and final year of the White-tailed Deer/Jack Pine Study was completed. Data from radio-collared deer has provided information concerning habitat use and home ranges. The study was refined to include evaluation of the influence of nutrition on deer use of jack pine stands for thermal cover/snow shelter. The eleventh annual Disabled Veterans Deer Hunt and the annual Archery Deer Hunt were again successful with 46 and 3,772 hunters respectively. The first youth archery deer hunt was held at Camp Ripley this year. Eighty-seven youth hunters and their mentors participated in the hunt. During each of the hunts, samples were collected from harvested deer to test for chronic wasting disease (CWD). All samples tested were negative.

Ground and aerial radio tracking of nine black bears was used to monitor reproductive success, movements, and mortality throughout the year. In November, a female bear (2020) that had been lost when its collar failed in 2001 was found at her den in Hole-in-Day marsh. This was the first year that Camp Ripley was included in the statewide sampling to estimate bear population numbers.

Bat surveys recorded the presence of the five bat species documented in previous surveys and two additional species. The two new species were the northern long-eared bat and the eastern pipestrelle.

Surveys for Blanding's turtles were conducted in June. Nineteen turtles were observed, of which eight were new captures and 11 were recaptures from previous years. Four nests were located and protected using wire cages. By mid September, three of these nests had hatched. Anuran surveys were conducted for the tenth year at Camp Ripley. Of eight species that were recorded, the most abundant were spring peepers and gray treefrogs.

Arden Hills Army Training Site

Presently, 1,523 acres of what was historically known as the Twin Cities Army Ammunition Plant (TCAAP) have been transferred to MNARNG. With that transfer, MNARNG renamed the facility the Arden Hills Army Training Site (AHATS). Management of the resources on this site became the responsibility of MNARNG at the time of transfer. Population studies will be an ongoing part of the installation's INRMP, which was completed in November of 2001.

The second year of songbird surveys was completed on 14 LCTA plots established in various habitats throughout AHATS. Forty-three avian species were recorded, with 139 birds documented. Red-winged blackbirds, house wrens, song sparrows, American goldfinches, and Brewer's blackbirds were the most abundant species. Ospreys were observed on the nesting platform for the fourth year, and four young were banded.

One Blanding's turtle nest was located and protected with a wire cage. The cage was later destroyed by a road grader and nest fate could not be determined. Three anuran surveys were conducted from April to July. Of the five species recorded, only western chorus frogs were heard during all three surveys. The annual butterfly survey, conducted by the St. Paul Audubon Society, documented 24 species including six species that were not recorded in 2001.

INTRODUCTION

A long-term environmental monitoring program is being conducted at Camp Ripley and the Arden Hills Army National Guard Training Sites (AHATS). The program's primary function is to evaluate and monitor the impact of military activities on natural resources. Land Condition Trend Analysis (LCTA) was developed to standardize flora and fauna data collection at military installations nationwide (Tazik et al. 1992). Since 1991, Minnesota Department of Natural Resources (MN DNR) personnel have conducted LCTA and other wildlife surveys at Camp Ripley. LCTA plots have been surveyed at AHATS since 2001. Animal surveys conducted in 2002 for both installations are summarized in this report. As in previous years Marty Skoglund, Camp Ripley Environmental Supervisor, and Pam Perry, DNR Regional Nongame Specialist at Brainerd, supervised the 2002 season.

CAMP RIPLEY TRAINING SITE

Camp Ripley is located in the central portion of Minnesota approximately 100 miles northwest of the Minneapolis/St. Paul metropolitan area. Camp Ripley occupies a gross area of 52,795 acres (approx. 82 sq. miles) within Morrison County and is bordered on the north by the Crow Wing River and on the east by the Mississippi River. Land ownership is 98% state land under the administration of the Minnesota Department of Military Affairs (DMA), with the remainder under lease from ALLETE Power Company.

Camp Ripley's landscape was sculpted during the last glacial period (the Late Wisconsinan). Because the glaciers receded along the northern two-thirds of the Camp, a sharp contrast is evident from north to south, both topographically and biologically. The high diversity of life forms (over 600 plant species, 202 migratory and resident bird species, 51 mammal species, and 23 reptile and amphibian species) is also a result of Camp Ripley's location along the forest transition zone in central Minnesota. Dryland forest dominates the landscape, covering 27,875 acres or 55% of the installation. The remainder is almost equally divided between wetlands, dry open grass and brush lands, and odd areas.

Camp Ripley supports the state mission for military reserve component training as a 7,800 person, year-round training facility for the National Guard, primarily consisting of units from Minnesota, North Dakota, South Dakota, Wisconsin, Iowa, and Illinois. The civilian training mission focuses primarily on law enforcement activities, natural resource education, environmental agencies, and emergency management activities. The central mission of the natural resource management program is to ensure that the multiple demands for land use can be met without sacrificing the integrity of Camp Ripley's resources and training mission.

The Land Condition Trend Analysis (LCTA) program was initiated at Camp Ripley in 1991. LCTA is a program that provides for inventorying and monitoring biological and physical resource data as a means of quantifying the condition of the land. Under this system, permanent study plots were established to inventory the flora and fauna of Camp Ripley, and are referred to as special use and core plots.

Birds

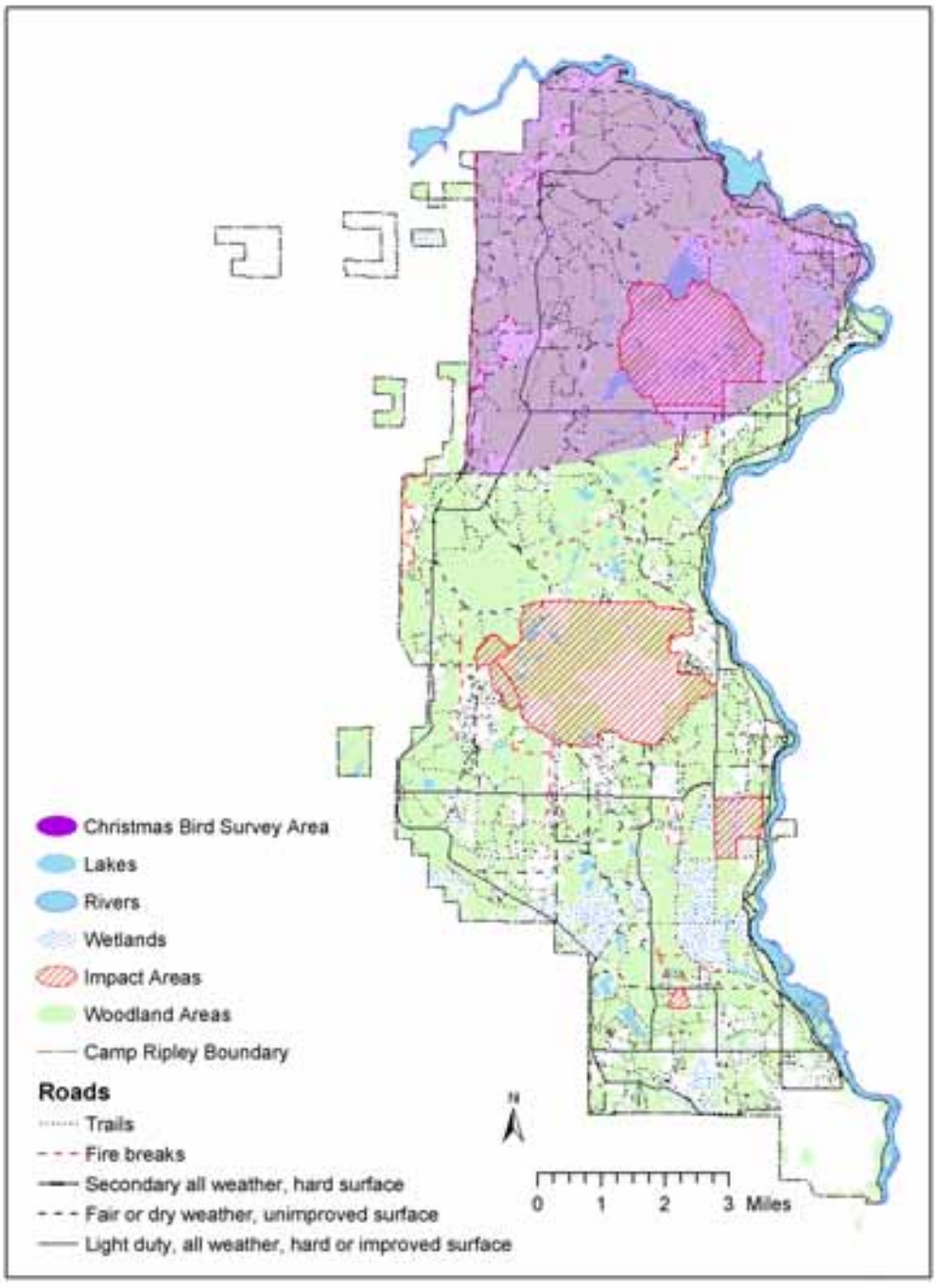
Christmas Bird Count

The Christmas Bird Count (CBC) at Camp Ripley was conducted on January 1, 2002 in coordination with the surrounding Pillager area CBC counts. Five people spent 9 3/4 hours and traveled 99 total miles searching for various bird species. Sixteen bird species and 52 total birds were observed (Table 1). Additionally 79 white-tailed deer, 7 porcupine, two fox squirrels, one gray and one red squirrel were observed. The survey area in Camp Ripley basically consists of the area north of Casino Road, including the Crow Wing River and part of the Mississippi river (Fig. 1).

Table 1. Totals from Christmas Bird Count conducted on January 1, 2002.

Species	**Number Observed**
Black-capped Chickadee	11
Canada Goose	6
Bald Eagle	6 (5 adult/1 immature)
Red-breasted Nuthatch	6
American Crow	4
Blue Jay	4
Northern Shrike	3
Hairy Woodpecker	2
Rough-legged Hawk	2
Downy Woodpecker	2
Common Raven	1
White-breasted Nuthatch	1
Pileated Woodpecker	1
Barred Owl	1
Ruffed Grouse	1
Northern Cardinal	1
TOTAL	52

Figure 1. Christmas Bird Count (CBC) survey area at Camp Ripley.



Songbirds

Songbirds have been surveyed on approximately 90 LCTA plots at Camp Ripley each year from 1991 to 2000. Beginning in 2001, surveys of 30 plots have been conducted annually, on a rotational basis, with a complete count of all ninety sites scheduled for the fourth year (Fig. 2). Conducting a sample of point counts each year allows detection of fluctuations in the number of species and individuals, but reduces the amount of effort expended in any one year. However, due to the quick spread in 2002 and possible negative avian population effects of West Nile Virus, all 90 plots will be surveyed in 2003.

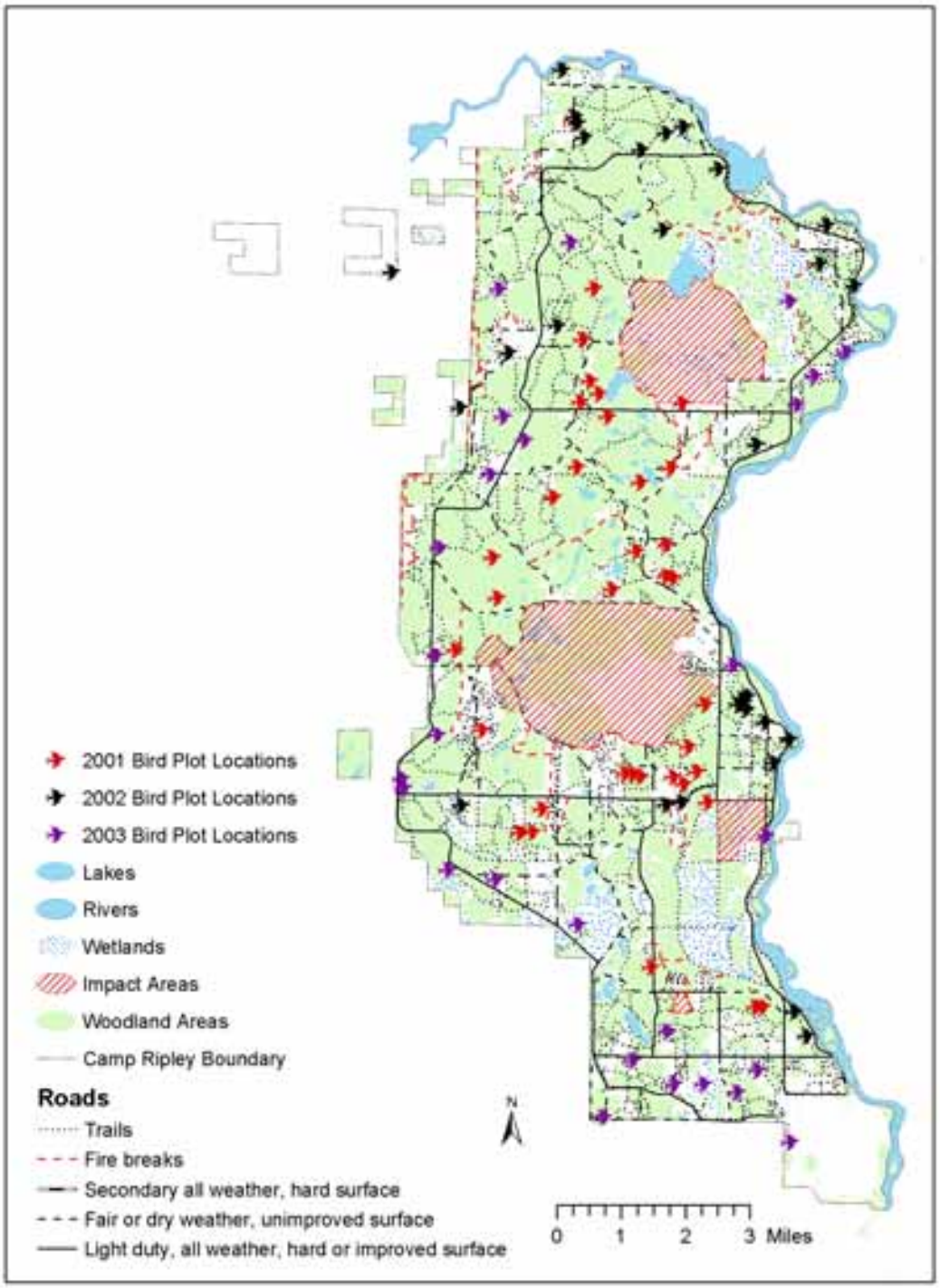
The 2002 songbird surveys took place from June 14 to July 2 within 30 randomly selected LCTA core and special use plots (Fig. 2). All species and individuals seen or heard within 50 meters of the midpoint of each LCTA plot during one 10-minute point count were documented. As in past years, red-eyed vireos (*Vireo olivaceus*), American redstarts (*Setophaga ruticilla*), ovenbirds (*Seiurus aurocapullus*), common yellowthroats (*Geothlypis trichas*), least flycatchers (*Empidonax minimus*) and eastern wood-pewees (*Contopus virens*) were the most commonly heard species.

Hooded and Cerulean Warblers

The hooded warbler (*Wilsonia citrina*) is primarily a species of the southeast and east-central United States (Sauer et al. 2001) and is a species of special concern in Minnesota. Camp Ripley is one of two areas in Minnesota with confirmed hooded warbler nesting records. Hooded warbler territories have been documented since 1996 at Camp Ripley by using call-back tapes. Multiple attempts were made to elicit a callback response from hooded warblers in previously occupied territories. However, no hooded warblers were documented. Hooded warblers have not been heard since 2000 and this small population may no longer exist on Camp Ripley.

Attempts were also made to document the presence of cerulean warblers (*Dendroica cerulea*) in previously occupied territories. However, no cerulean warblers were documented at Camp Ripley in 2002. The cerulean warbler is a rare southeastern Minnesota summer resident (Janssen 1987) where it is listed as a species of special concern. Cerulean warblers are very sensitive to fragmentation in their breeding habitat, which may be a cause for the species' nationwide decline during the last 20 years (Bessken 2000). Their decline has been so severe that

Figure 2. LCTA plots scheduled for songbird surveys in 2001, 2002 and 2003.



in 2000, environmental groups petitioned the federal government to add the cerulean warbler as a threatened species on the Endangered Species List (Southern Environmental Law Center 2001). Additionally, the US Fish and Wildlife Service recently completed a Status Assessment of Cerulean Warblers (Hamel 2000) for possible listing under the Endangered Species Act.

Bluebird Route in Veterans Cemetery

Bluebird (*Sialia sialis*) houses were installed in the Minnesota Veterans Cemetery in 1994. The boxes are monitored each year for bluebird activity and reproduction.
In the spring of 2002, all of the houses along the east and south borders of the Cemetery were removed during a construction project. On May 13, these houses were relocated to the north, west and southwest borders of the Cemetery.

During 2002, a volunteer monitored the eleven houses. She found three houses in use by bluebirds, resulting in 11 fledged bluebirds. Additionally, two houses were used by house wrens (*Troglodytes aedon*) and two were used by tree swallows (*Tachycineta bicolor*), resulting in four fledged wrens and twelve swallows.

Bald Eagle

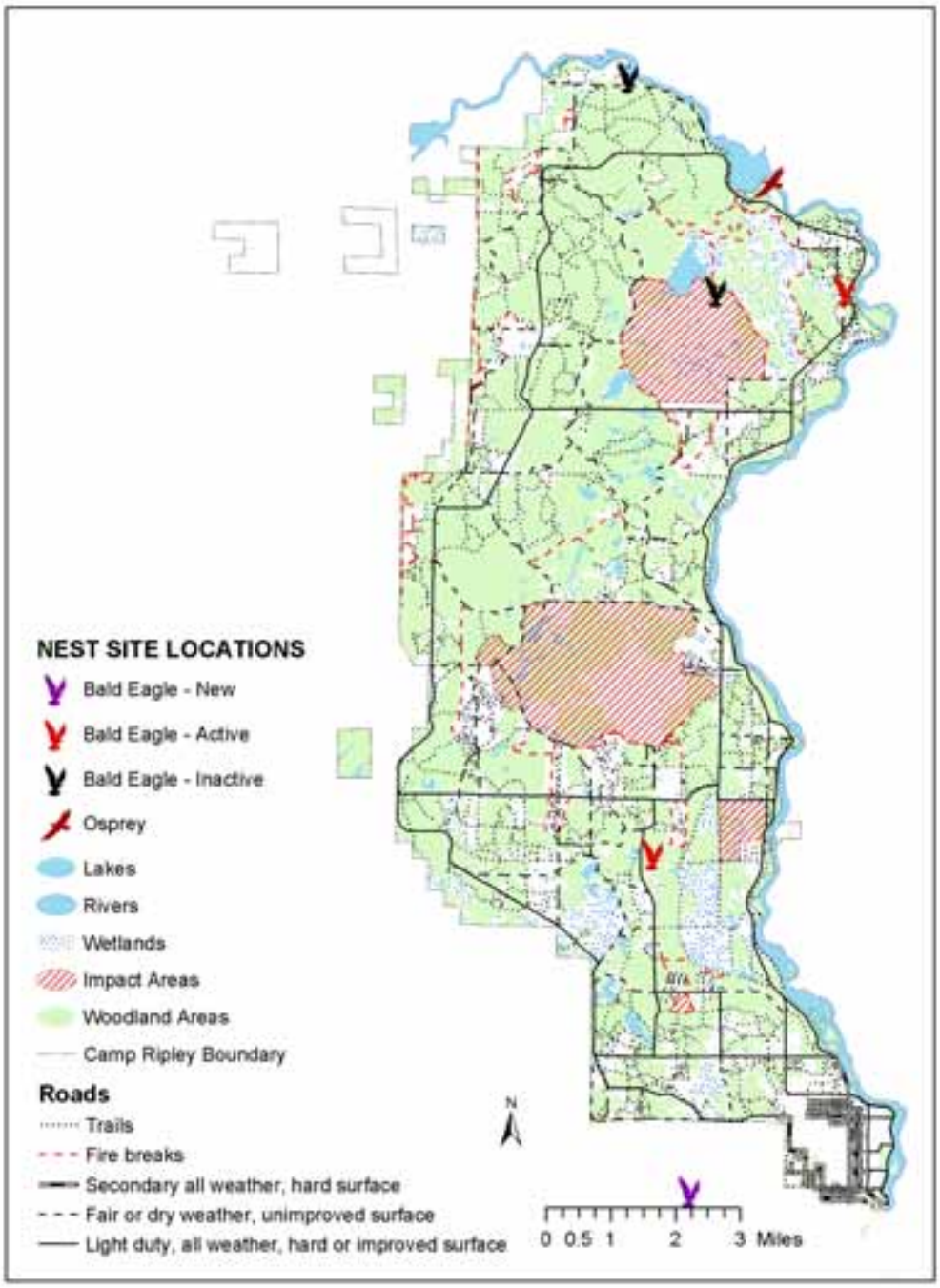
In 2001, bald eagles (*Haliaeetus leucocephalus*) successfully nested at four sites on Camp Ripley (Fig.3). This year only two nests, those adjacent to Cody road and East Boundary road, were used to fledge eaglets. Young eagles were observed at both these nests in June.

A pair of eagles was observed early in the year in the Yalu nest, yet the pair abandoned the nest early. A lone eagle was observed near the nest on Leach Impact Area (Mud Lake), but no nesting occurred. A new nest was located one mile to the south of Camp. This pair's territory may include Camp Ripley. Efforts will be made in 2003 to document use by bald eagles in this nest and/or surrounding habitat.

Osprey

The nesting platform at Sylvan Dam was used again this year. A pair of adult ospreys (*Pandion haliaetus*) was observed at the nest on April 18th. Three young were produced, and all

Figure 3. Nesting activity at bald eagle and osprey nest sites at Camp Ripley in 2002.



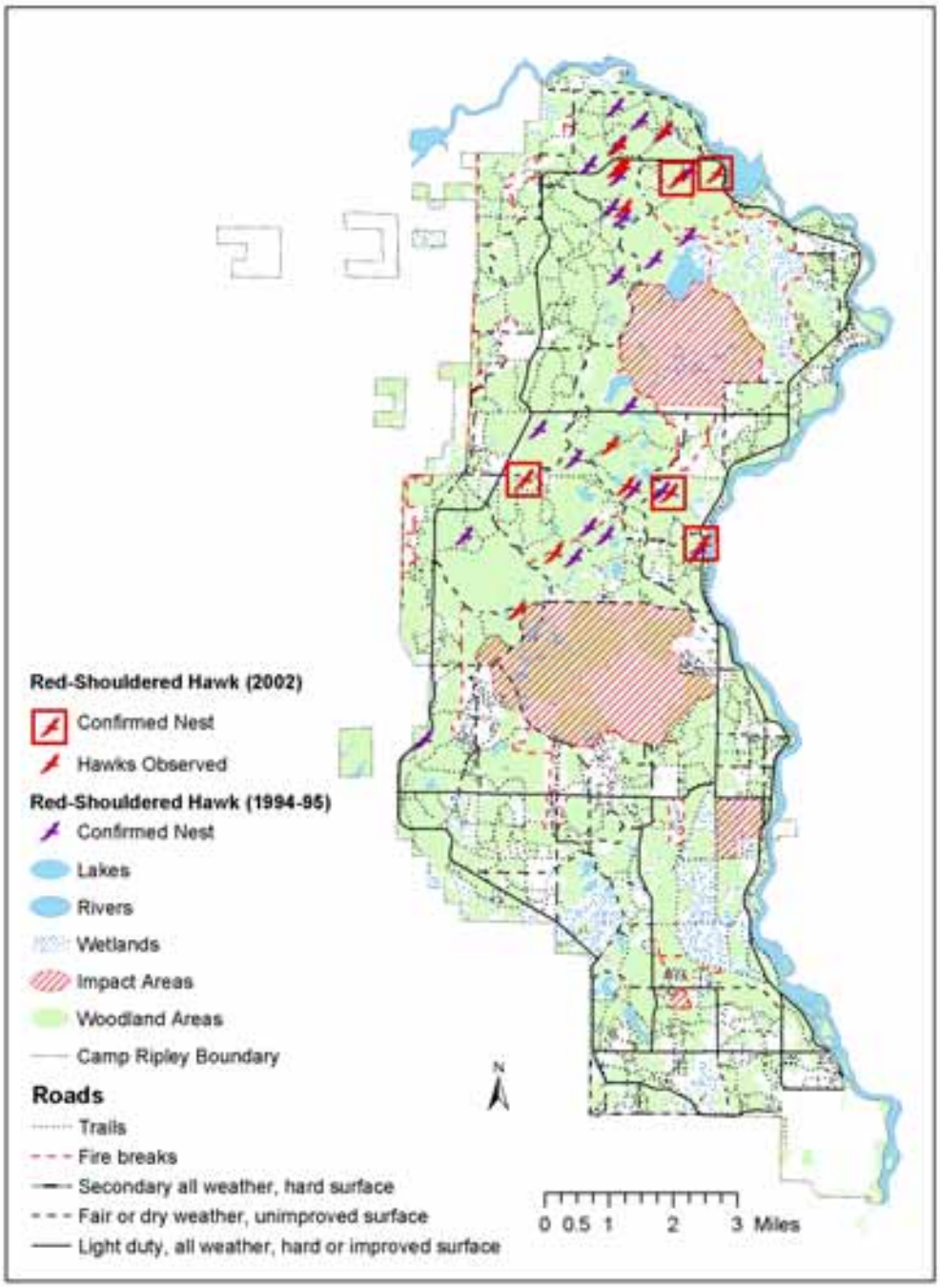
fledged by August 7. This platform is currently located atop an electrical highline pole. It may be moved to a separate pole nearby, where it will be accessible to biologists. With assistance from the University of Minnesota Raptor Center, a banding program would allow Camp Ripley biologists to monitor more closely birds returning to the nest, plus add an additional community outreach opportunity. The other osprey nest platform currently located along the Crow Wing River will be moved by the next nesting season. This platform has never been used by ospreys for nesting.

Red-shouldered Hawk

Minnesota is the on the northern extent of red-shouldered hawk (*Buteo lineatus lineatus*) range. Due to this and population declines in the northern part of it's range, the red-shouldered hawk is listed as a special concern species in Minnesota. Research concerning red-shouldered hawk breeding ecology and habitat use in central Minnesota was conducted in part at Camp Ripley (Belleman 1998). Typical habitat for these hawks at Camp Ripley consists of upland, hardwood forests with a relatively open subcanopy. Nest trees were most often 50-70 year old aspen and oaks that were located on slopes and near water. Nest sites were located using call broadcast surveys and aerial and/or ground searches. Twenty-seven breeding areas were located at Camp Ripley. Prior to 1993, only 28 nests were recorded by the MN DNR Natural Heritage Database and Coffin and Pfannmuller (1988), with an estimated 200 pairs statewide. Ornithologists have estimated the population of red-shoulders at Camp Ripley to be around 40 breeding pairs, which is higher than known densities anywhere else in Minnesota (Merrill 2000).

The Protected Species Management Plan (Merrill 2000) recommends annual call playback surveys or estimation of the number of breeding pairs of red-shouldered hawks on Camp Ripley. The Plan also notes that several areas of Camp Ripley have not been thoroughly surveyed for red-shouldered hawks. In April and May 2002, an additional effort was made to document red-shouldered hawks and nesting territories at Camp Ripley. As in past surveys, call broadcast surveys plus aerial and/or ground searches were conducted. Primary effort focused on previously documented hawk nests/territories, since red-shoulders tend to consistently defend exclusive home ranges from year to year (Craighead and Craighead 1956). Additionally, a DNR helicopter was used to fly transects in order to document suspected red-shouldered hawk nests. Hawks were observed in 12 of 27 previously documented territories (Fig. 4).

Figure 4. Red-shouldered hawk nests and territories from 1994-1995 and 2002.



Five red-shouldered hawk nests were found in use, with two in territories not documented during the 1994-1995 study (Fig. 4). Red-shouldered hawks were observed in nine additional old territories, but nests for these birds were not found. Further attempts will be made in 2003 to locate additional nests. A graduate student project through the University of Minnesota is being planned for 2004-2006.

Ruffed Grouse

Ruffed grouse (*Bonasa umbellus*) populations have been monitored in the south half of Camp Ripley (route #38) by MN DNR personnel since 1979 (Fig. 5). Surveys have been conducted in the spring of each year except for 1984, 1990, 1991, and 1992. In 1998, Camp Ripley Environmental personnel started conducting an additional route (#39) in the northern portion of Camp. Route #39 is not used with MN DNR state census data.
In other parts of the state, drumming surveys are conducted just once on each route. However, routes #38 and #39 (Fig. 6) at Camp Ripley are conducted multiple times to allow local high school students the opportunity to participate.

Drumming counts are conducted for four minutes at ten stops along each route. The official count for route #38 occurred on April 26, 2002. Drumming was heard at three of the ten listening stations. This number is down from last year, in which 1.6 drumming grouse were heard per stop. In 2002 only one grouse was heard along route #39 compared to two in 2001. Drumming counts at Camp Ripley have declined since 1999, as they have throughout Minnesota, which may indicate population levels are in the trough of their 10-year population cycle. Grouse populations in Minnesota tend in be the highest at the start/end of a decade, as demonstrated by counts at Camp Ripley.

Figure 5. Ruffed grouse drums/stop on route #38 from 1979-2002. Missing data points indicate years when surveys were not conducted.

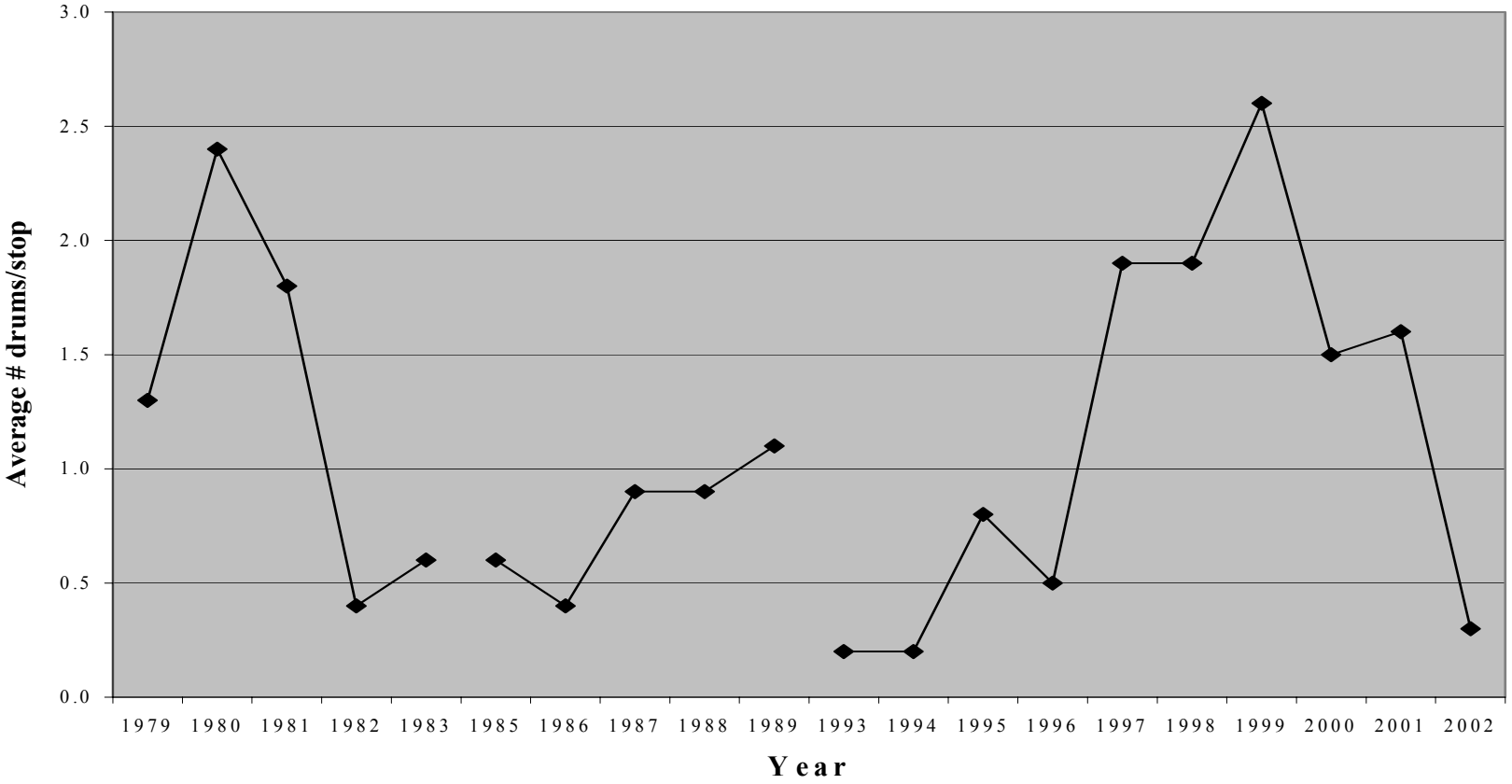
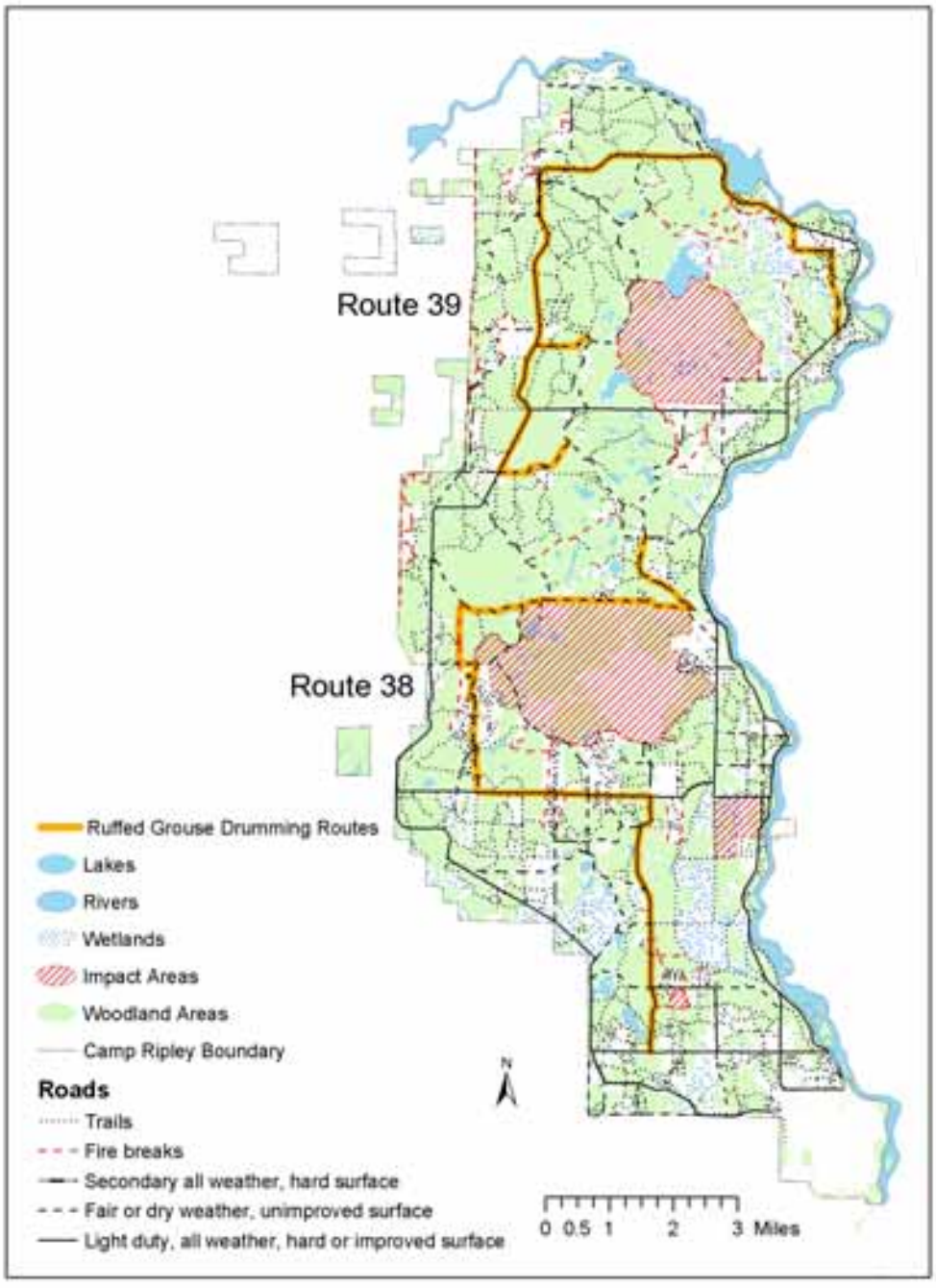


Figure 6. Drumming routes for ruffed grouse surveys at Camp Ripley.



Swallow Control

Multiple reports of swallow nesting activity were made to the Environmental Office this spring (2002). Cliff swallows (*Petrochelidon pyrrhonota*) were building mud nests under eaves of doorways to mess halls, residential buildings, the education center, the medical center, and other buildings (Appendix B, Image 1). Debris from nests and fecal material would collect on the sidewalks in front of doors and then be tracked into buildings causing a mess and a health hazard. Swallows and rock doves (*Columbia livia*) were also nesting in the rafters above the viewing bleachers on West Range.

Fine mesh netting was installed in some places, such as over the bleachers on West Range. Additionally, a product called Nixalite was discovered, and installed on other problem areas (Appendix B, Image 2). Nixalite is composed of stainless steel wires bunched together and attached along a long strip of metal. The wires extend from the metal strip in a formation somewhat like a hairbrush, with wires extending from 0-180 degrees. The ends of the wire are sharp, but not dangerous to approaching birds. Otherwise referred to as "porcupine wire", Nixalite is maintenance free, easy to install, not highly visible, and proved to be very effective. After installation of Nixalite and netting, swallows were excluded completely from previously used areas. Additional problem areas will be handled by the Department of Public Works at Camp Ripley.

Wild Turkey

Wild turkeys (*Meleagris gallopavo*) were observed throughout Camp Ripley this year. Multiple broods were observed, and a flock of 25 was observed on January 1, 2003. Several lighter colored turkeys have been observed in various locations throughout Camp (Appendix B, Image 3). They range in color from having a white shading over dark feathers to almost all white.

Mammals

Gray Wolf

North and South Packs

The gray wolf (*Canis lupus nubilis*) is a state listed special concern species and a federally listed threatened species in Minnesota. In the mid 1990s, the range of gray wolves in Minnesota expanded to include Camp Ripley. Since then, 20 wolves have been captured and radio collared to determine pack size, movements and possible effects of military training (Table 2). Pack numbers in Camp Ripley have fluctuated during this time between one and two packs. Additionally, occupied territories of Camp have also fluctuated from north to south. Two males (#17 and #18) were captured in the fall of 2001 in the south half of Camp, the older of the two (#18) moving north and the younger (#17) staying in the south (Figs. 7 & 8). Both males have been observed with female wolves, and occupy separate territories.

A helicopter capture was conducted again in January, 2002. Both males were recaptured and fitted with satellite radio-collars. The alpha female from the north pack (#14) was also recaptured and her collar was replaced with a new VHF collar. A new adult female (#20) was located with the older male, captured, and collared with a VHF collar. For multiple years, the alpha female (#14) was tracked through radio-telemetry and observed with pups; therefore, it was presumed the new female in the pack was a subordinate animal. However, during a telemetry flight on May 14 female wolf #20 was observed in a den with 3 pups (Fig. 7). At the same time, the other adult female in the pack (#14) was found in a den 595 meters (0.37 mile) from #20's den. Female #14 was not observed with pups. Male wolf #18 was located near one or both of these females during most telemetry flights in 2002.

The younger of the two males (#17) was always located in the southern portion of Camp. During the helicopter capture, a young female (#19) was located with the south male, and subsequently captured. She was also fitted with a satellite collar (Fig. 8).

Table 2. All wolves captured and collared at Camp Ripley 1996-2002.

Wolf #	Sex	# of Captures	Age at 1st Capture	Date 1st Capture	Fate	Comments
1	F	1	Yearling	9/10/96	dead	Trapped/shot on farm, Cass County (8/97)
2	F	2	Pup	9/19/96	dead	Shot
3	F	1	Yearling	9/20/96	dead	Poisoned
4	M	2	Yearling	9/23/96	dead	Hit by car
5	F	1	Yearling	2/21/97	unknown	Dropped collar for data retrieval
6	F	3	4-5 years	2/21/97	dead	Hit by car
7	M	3	10 month	2/21/97	dead	Shot
8	F	1	10 month	2/21/97	unknown	Dropped collar for data retrieval
9	M	2	3-4 years	2/21/97	unknown	Pillsbury State Forest
10	M	1	Pup	8/29/97	dead	Starved? (9/23/07)
11	F	4	Pup	10/31/97	dead	Shot in Hillman area? Collar found in swamp
12	M	2	Yearling	11/4/97	dead	Killed by ADC in Pine County (7/26/99)
13	M	1	Yearling	2/3/98	unknown	Dropped collar for data retrieval
14	F	3	Yearling	9/14/98	ALIVE	Former Alpha? North Pack
15	M	3	>3 yrs	2/2/99	dead	Unknown, found dead (7/01)
16	F	1	1-2 years	1/18/01	dead	Found dead in Michigan (9/02)
17	M	2	1-2 years	9/26/01	ALIVE	South Pack
18	M	2	3-4 years	11/15/01	ALIVE	Alpha Male, North Pack
19	F	2	1-2 years	1/30/02	ALIVE	South Pack
20	F	1	>3 years	1/29/02	ALIVE	Current Alpha? – North Pack

Figure 7. North wolf pack locations and den sites for year 2002.

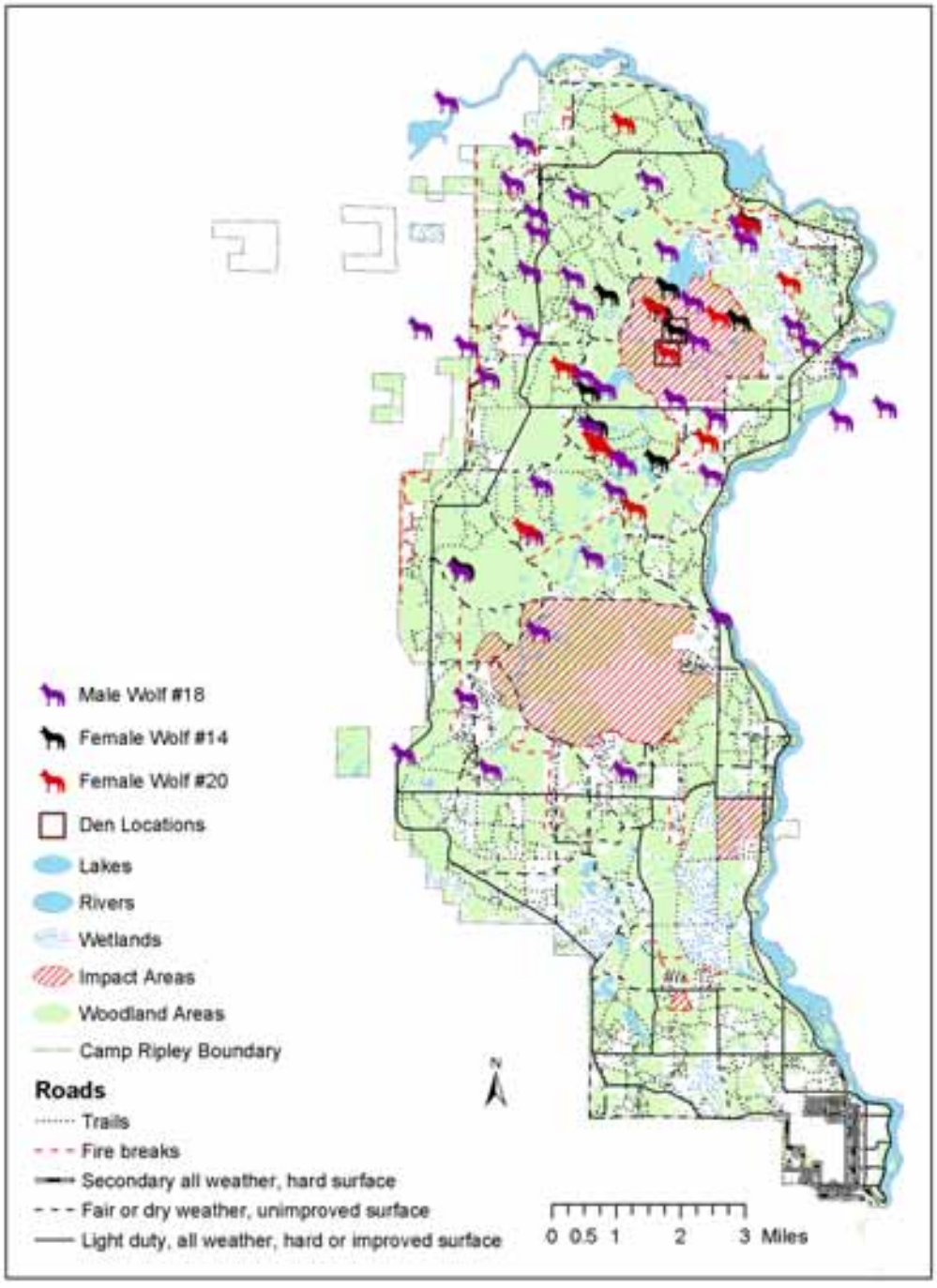
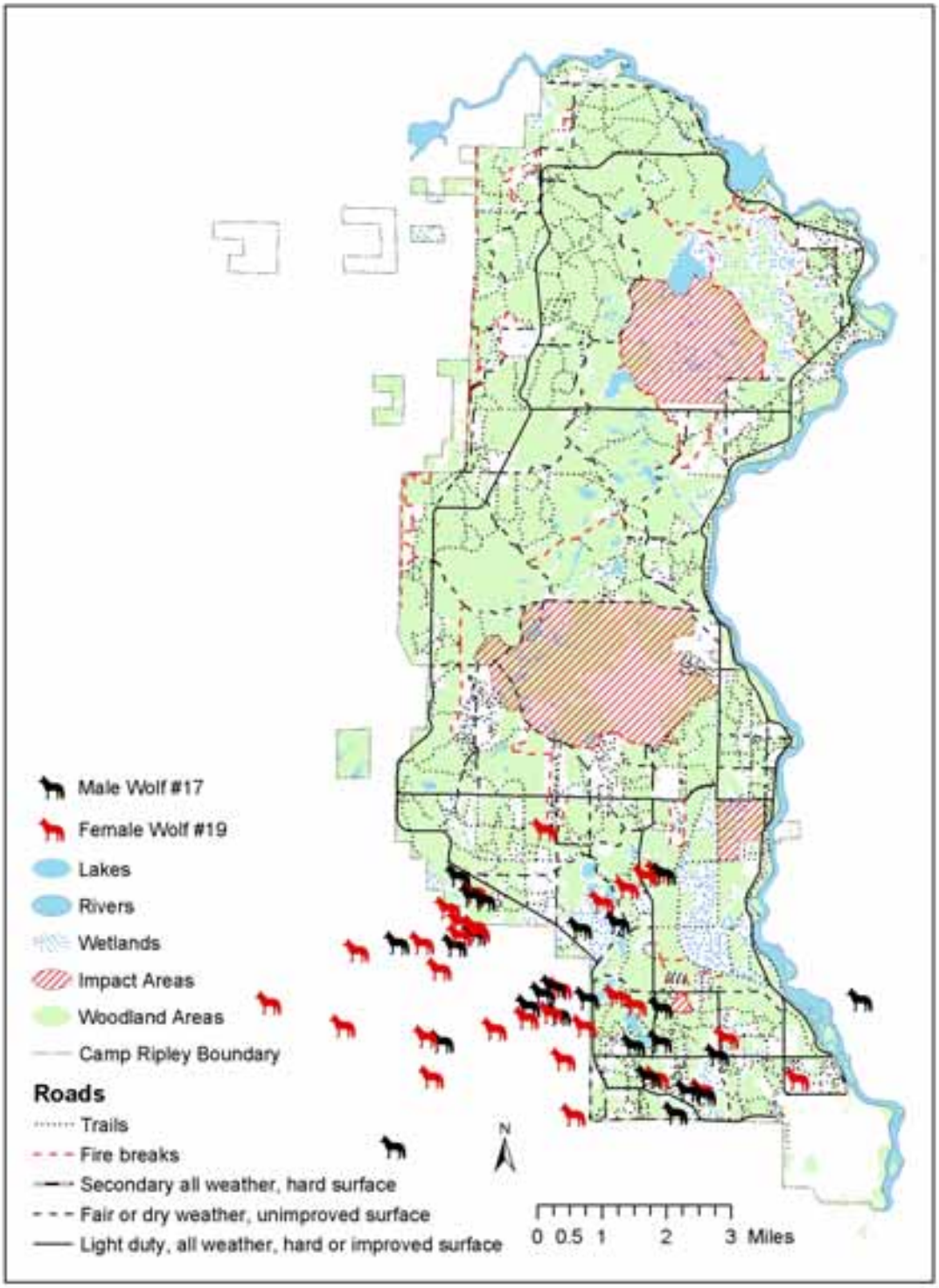


Figure 8. South wolf pack locations during 2002.



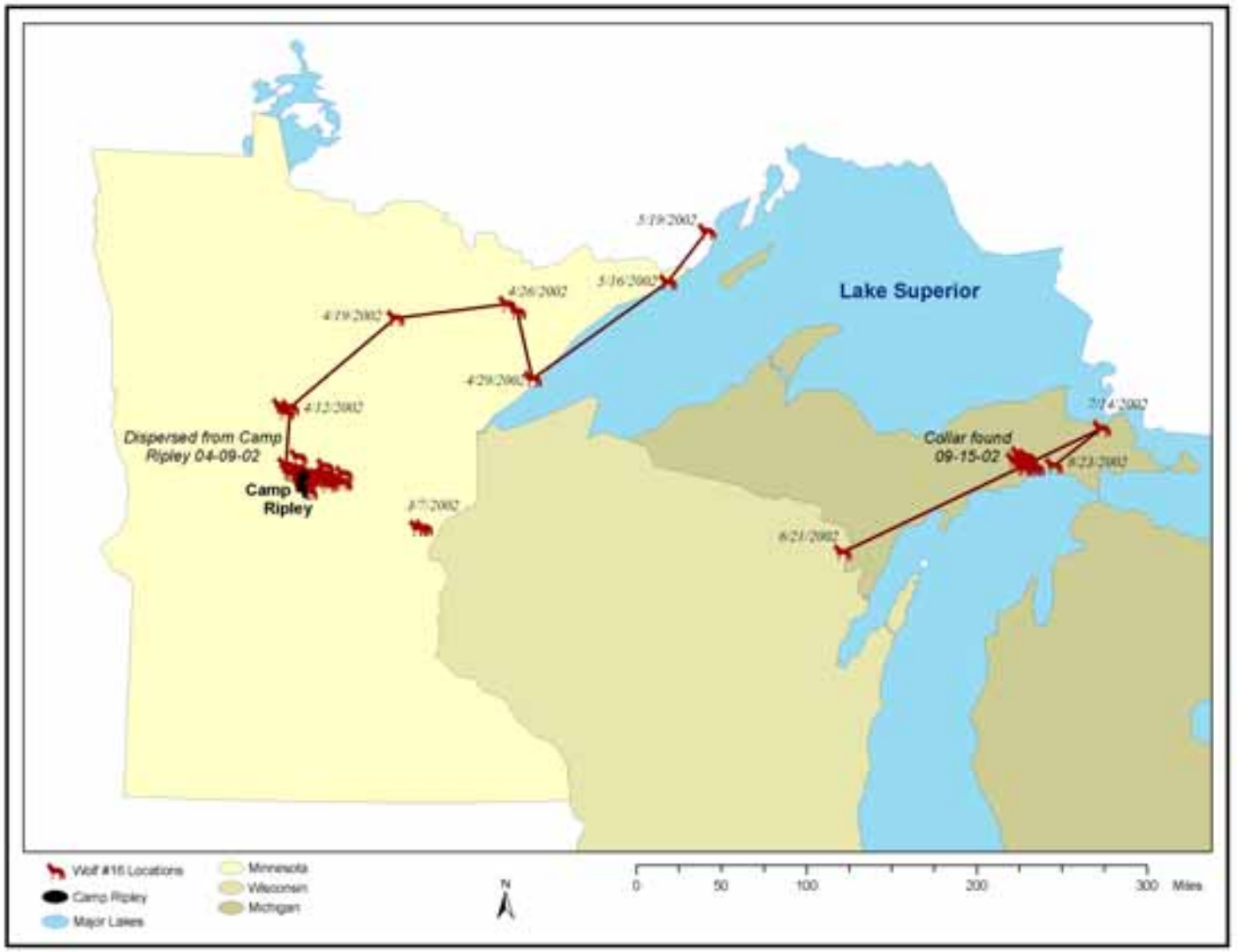
The Traveling Wolf - 2002

During the helicopter deer and wolf capture in January 2001, a young female (#16) was collared with a satellite collar (Microwave Telemetry Inc., Columbia, MD). This wolf experienced no injuries from her capture, but did have an existing rump wound above the tail, presumably from inter-pack hostility. The VHF component in this wolf's collar failed in March 2001, but her satellite component continued to send sporadic locations through early September 2002 (Fig. 9). In March of 2002, wolf #16 traveled 72 miles (115.8 km) to the east, near the Wisconsin border, and returned to Camp. On April 9, she started traveling north, and was located 24 miles (38.6 km) north into Ontario on May 19. The next satellite location was 33 days later, when she appeared near the Wisconsin-Michigan border. She continued traveling until she reached the Upper Peninsula of Michigan, a habitat that resembles Camp Ripley. In July and August she was observed multiple times by local residents, and identified by her ear tag and collar. It was hoped that she would keep moving north into Canada, but on September 17 she was found dead 300 feet from a rural residence. An investigation into her death is ongoing. Since her locations were sporadic, it is difficult to track her exact path and number of miles traveled. However, by using straight lines from each location, her total length of travel was estimated at 1028.8 miles (1655.6 km) in 86 days (11.96 miles/day or 19.2 km/day).

Satellite collared wolves

As previously mentioned, three wolves (#17, #18 and #19) were fitted with satellite collars (H.A.B.I.T. Research Ltd., Victoria B.C.) during the helicopter capture in January 2002. All three collars functioned properly for a short time and then began to fail. Only one collar (on #18) continued giving sporadic locations by satellite after March. Fortunately, all the collars could be tracked by traditional VHF signals and none of these wolves dispersed. On December 13, 2002 the south female (#19) was accidentally captured west of Camp in a coyote trap set by a nearby landowner. She was collared with a VHF collar and released unharmed. Inspection of the satellite collar explained why satellite locations had stopped. Both antennas (VHF and Satellite) had been chewed down to the base. In December, the VHF portion of the south male's (#17)

Figure 9. Locations of satellite collared female wolf (#16) from January 2001-September 2002.



collar stopped functioning. It is imperative for future satellite collar studies that these collars be retrieved and examined to determine the cause of failure. A helicopter net-gunning crew will capture these wolves in February 2003 and the collars will be replaced with VHF collars. A combination of aerial and ground telemetry will be used to maintain at least semimonthly monitoring of collared gray wolves in 2003.

White-tailed Deer

Research

A report from the fourth and final year of the White-tailed Deer/Jack Pine Study is included in Appendix A. The goal of this study was to examine the relative influences of winter severity and nutrition on use of the jack pine (*Pinus banksiana*) - hardwood habitat type as winter thermal cover by white-tailed deer (*Odocoileus virginianus*) in Camp Ripley. During February 1999, 40 female deer were captured and radio collared from two study sites (see Figure 1 of Appendix A) by net-guns fired from a helicopter. Capture operations were repeated in January or February of 2000, 2001, and 2002 to replace deer that died during the preceding year or deer from which GPS collars were released. Additional does were captured for a companion study of a new GPS radio collar prototype.

Telemetry locations were used to determine winter home range. Mean home ranges did not differ between deer of the two study sites. Movement of deer between summer and winter ranges was evaluated to determine if Camp Ripley deer are migratory. Differences were observed in percent of deer migrating from NW and SW study sites. In the first three years (1999-2001) 42-57% of deer migrated from the SW study site compared to 21-25% of deer from the NW study site.

Radio telemetry and the mortality switch in each collar were used to monitor survival of deer. Of the 29 radio collared deer mortalities through April 15, 2002, 15 (52%) were killed by hunters, 4 (14%) were caused by automobiles off Camp, and 4 (14%) were predator related. Results from the first two years of the study demonstrated a significant difference in survival rates for NW deer versus SW deer.

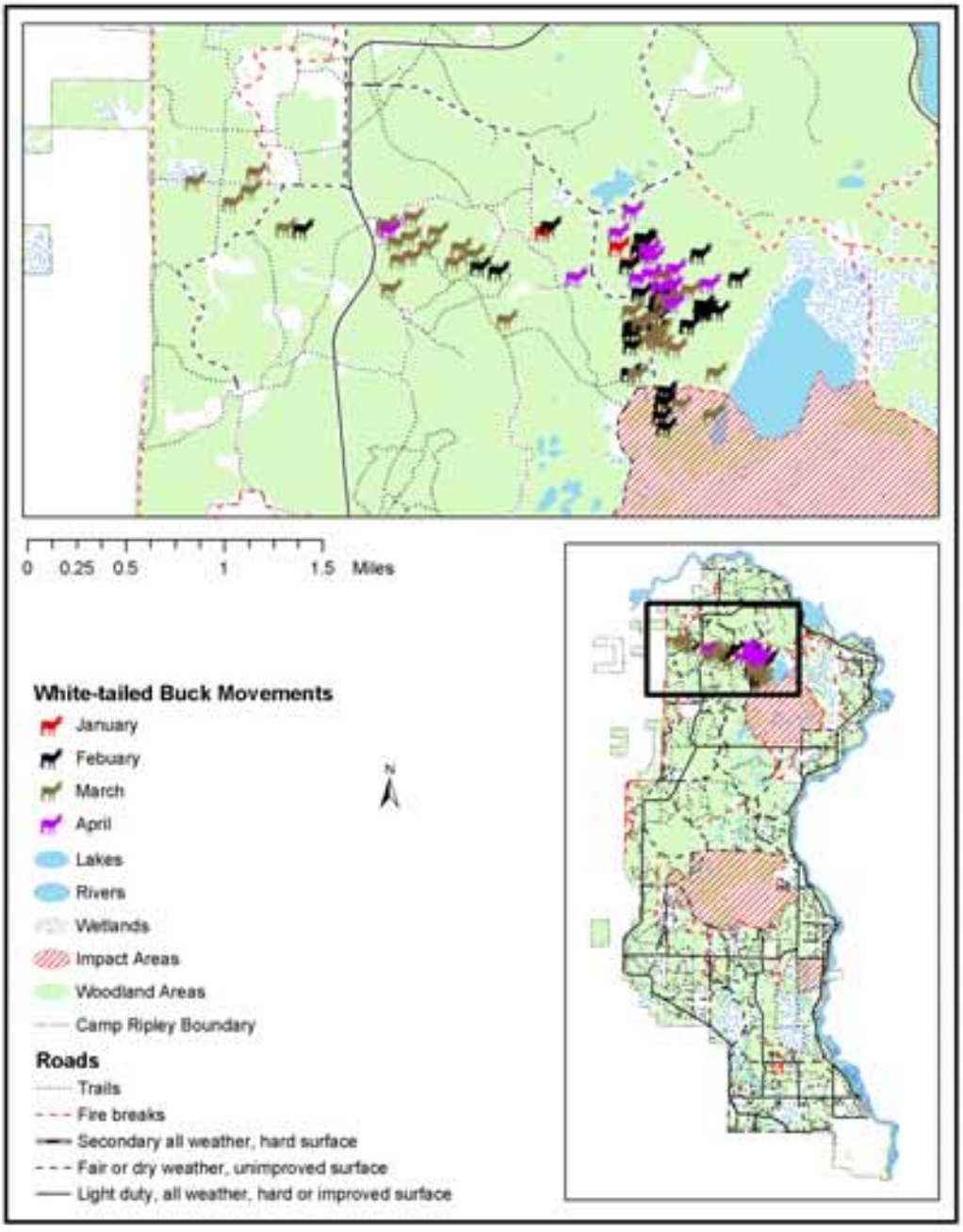
Additional data analysis for both study sites is in progress, which will include data from 2002. Data from a detailed habitat analysis and the large data sets of telemetry locations will be used to compare the habitat compositions of home ranges of deer with and without daily access to unnatural high quality food in adjacent agricultural fields. Habitat use will be related to winter weather conditions, nutrition, and human disturbance.

Buck with GPS Collar

A young male deer was also captured in the northwest portion of Camp during the helicopter net-gunning in January 2002, and fitted with an experimental GPS collar. This collar contained a segment of expandable fabric between the traditional leather sections. Hopes were that the collar would expand to fit the growing neck of the buck, and that the deer could be tracked throughout the fall. However, the fabric expanded in May, so we dropped the collar off the animal and downloaded the data.

The collar had taken 97 locations from January 29 to April 13, 2002 that encompassed an area of approximately 4.31 km^2 (1,065 acre) (Fig. 10). During January to April 2001, a buck in the southwest portion of Camp occupied a 6.29 km^2 (1,555 acre) home range. The northwest buck traveled a total tracked distance of 58.3 km from January to April, while the southwest deer traveled 78.06 km from January to April. One explanation for the discrepancy in distances and home ranges is that the southwest deer had been migrating southwest of Camp to feed on crop residue in nearby fields. The northwest buck did not have that option, so occupied generally the same area throughout January to April. Home ranges and distances for both deer were estimated using minimum convex polygons calculated by Arc-View Animal Movement extension software.

Figure 10. GPS collar locations for a male white-tailed deer from January 29-April 13, 2002.



Disabled Veterans Deer Hunt

The eleventh annual disabled veterans deer hunt was held on October 9 and 10, 2002. Forty-six hunters participated this year, with a total of twelve deer harvested (26% success).

Table 3. Information from annual disabled veterans white-tailed deer hunt at Camp Ripley from 1992-2002.

Year	Deer Harvested	Adult Males	Adult Females	Fawns	Permits Issued	Hunters	Percent Success	Largest Deer (lbs)
1992	7	4	2	1	19	19	37	152
1993	11	5	4	2	31	31	35	132
1994	14	3	3	8	42	40	35	185
1995	6	1	5	0	40	39	15	142
1996	9	3	4	2	40	39	23	132
1997	9	2	2	5	40	38	23	152
1998	11	2	5	4	39	37	30	129
1999	8	4	3	1	38	35	23	137
2000	14	5	5	4	40	38	37	181
2001	4	2	2	0	44	38	10.5	124
2002	12	3	8	1	46	46	26	144
Total	**105**	**34**	**43**	**28**	**419**	**400**		
Average	**10**	**3**	**4**	**3**	**38**	**36**	**27**	**146**

Archery Hunt

Since 1954, an annual archery hunt has been held at Camp Ripley. The hunt is one of the largest archery deer hunts in the United States. It draws nationwide attention due to the healthy deer population and the opportunity to pursue one of Ripley's notoriously large bucks. As in previous years, hunters were allowed to apply for one of two 2-day seasons, October 17-18 or October 26-27, 2002. A total of 324 deer were harvested by 3,772 hunters, a success rate of 11.6% (Table 4).

Youth Archery Hunt

The first youth archery hunt was held at Camp Ripley this year. This is the first youth deer hunt of its kind in Minnesota. The Minnesota Deer Hunter's Association coordinated the hunt, which was a cooperative project with the Minnesota State Archery Association, Camp

Table 4. Information from the archery deer hunts at Camp Ripley 1980-2002.

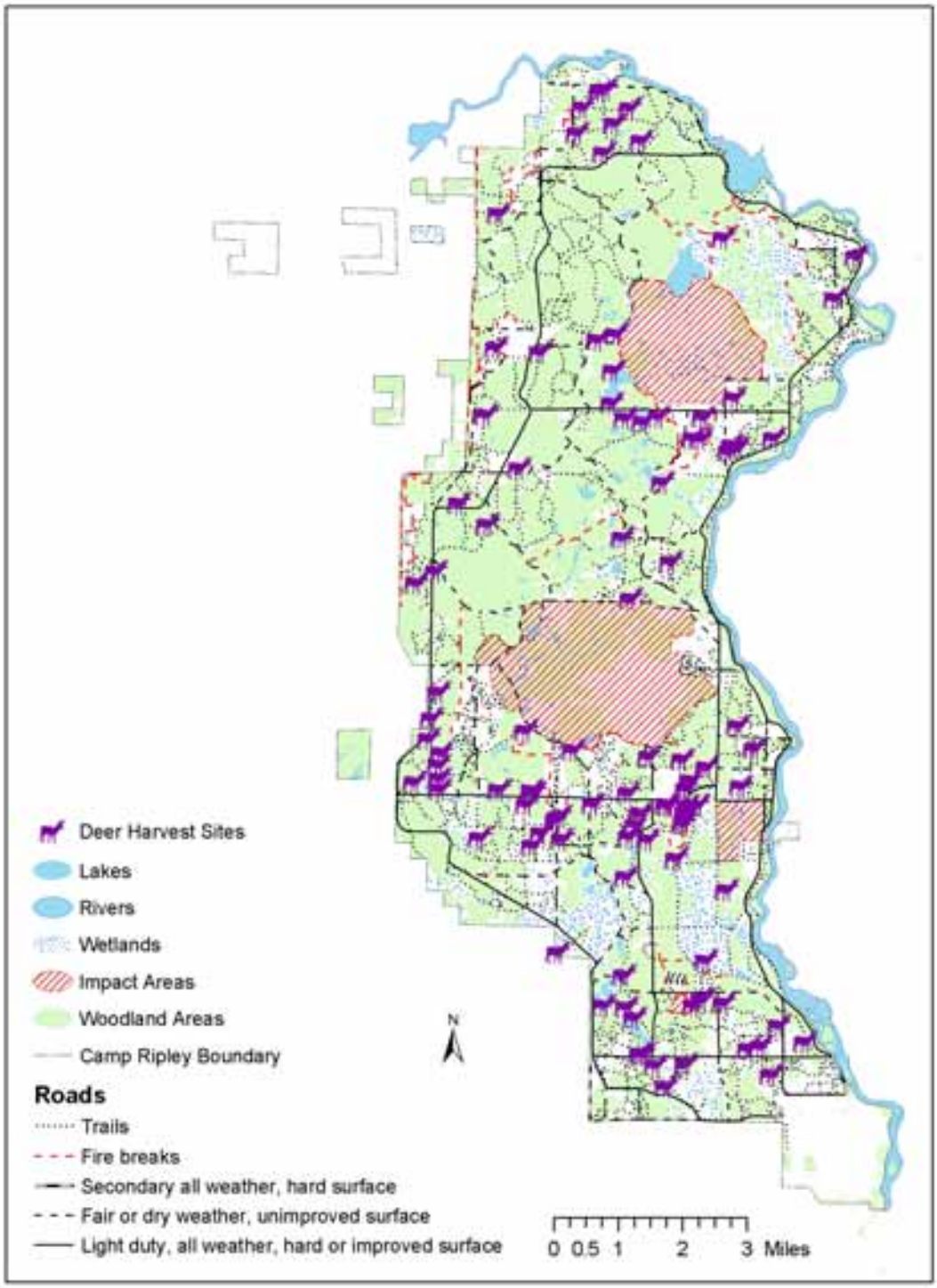
Year	# Deer Harvested	Adult Males	% of Total	Adult Females	% of Total	Fawns	% of Total	Permits Issued	No. of Hunters	Percent Success	1st Season	2nd Season	Largest Deer (lbs)
1981	153	48	31	45	29	60	39	2,587	1,972	7.8	10/10-10/25	3 weekends	272
1982	200	67	34	86	46	47	23	3,000	2,274	8.8	10/23-10/24	10/30-10/31	236
1983	237	89	38	94	40	54	22	3,500	2,831	8.4	10/08-10/09	10/15-10/16	253
1984	387	162	42	151	39	74	19	4,500	3,815	10.1	10/06-10/07	10/27-10/28	238
1985	278	118	42	113	41	47	17	5,000	3,996	7.0	10/12-10/13	10/27-10/28	257
1986	257	106	41	83	32	68	26	5,000	3,940	6.5	10/11-10/12	10/25-10/26	243
1987	284	122	43	91	32	71	25	5,000	4,112	6.9	10/10-10/11	10/24-10/25	250
1988	241	91	38	101	42	49	20	5,000	4,090	5.9	10/08-10/09	10/22-10/23	262
1989	215	95	44	75	35	45	21	4,000	3,136	6.9	10/17-10/18	10/28-10/29	226
1990	301	137	46	115	38	49	16	3,500	2,585	11.6	10/27-10/28	11/17-11/18	225
1991	219	87	40	90	41	42	19	4,000	2,217	9.9	10/19-10/20	11/30-12/01	232
1992	406	228	56	140	35	38	9	4,500	3,156	12.9	10/31-11/01	11/21-11/22	224
1993	287	147	51	82	29	58	20	5,000	4,127	7.0	10/21-10/22	10/30-10/31	237
1994	267	136	51	95	36	36	13	4,000	3,158	8.5	10/20-10/21	10/29-10/30	237
1995	247	102	41	100	41	45	18	4,500	3,564	6.9	10/19-10/20	10/28-10/29	256
1996	160	75	49	55	34	27	17	4,000	3,154	5.1	10/17-10/18	10/26-10/27	248
1997	142	67	47	57	40	18	13	3,000	2,316	6.1	10/16-10/17	10/25-10/26	243
1998	189	116	61	50	26	23	12	3,000	2,291	8.2	10/15-10/16	10/31-11/01	249
1999	203	100	49	83	41	20	10	3,000	2,335	8.7	10/21-10/22	10/30-10/31	251
2000	375	228	61	109	29	38	10	4,000	3,128	12.0	10/19-10/20	10/28-10/29	247
2001	350	192	55	126	36	32	9	4,500	3,729	9.4	10/18-10/19	10/27-10/28	272
2002	324	186	57	102	32	36	11	4,500	3,772	11.6	10/17-10/18	10/26-10/26	235
Average	260	123	46	93	36	44	18	4049	3168	8			245

Ripley (Department of Military Affairs), MN Dept. of Natural Resources, and Minnesota Bowhunters Incorporated. Two hundred sixty-seven youth between ages 12-17 applied for 100 available permits. They were required to have completed a safety course, and have an adult mentor present while hunting. Eighty-seven youth hunters participated in the hunt, of which 13 were successful in harvesting a deer (15% success rate).

Chronic Wasting Disease Testing

Camp Ripley Environmental staff were trained and certified by the MN DNR and USDA to extract white-tailed deer brain stems for chronic wasting disease testing. Chronic wasting disease is a debilitating and fatal disease in cervids caused by an abnormal protein in the brain. Due to recent CWD outbreaks in Wisconsin, and the occurrence in one farm-raised elk near Aitkin, Minnesota, samples were taken from Camp Ripley deer. During October 2002, a total of 106 white-tailed deer brain stem samples were taken during the four Camp Ripley hunts (Fig. 11). Samples were sent by the MN DNR to a certified testing lab. All usable samples tested negative (105). Unfortunately, the sample size was not high enough to give an estimate of confidence (whether or not there is CWD in deer at Camp Ripley). In order to reach a 95% confidence level, 175 samples will need to be taken during 2003. Postcards with individual sample results were sent to all hunters that donated their deer heads for sampling.

Figure 11. Harvest sites of white-tailed deer sampled for CWD at Camp Ripley in 2002.



Black Bear

A black bear (*Ursus americanus*) study is being conducted in cooperation with the MN Department of Natural Resources Bear Research Project in Grand Rapids. The study is designed to monitor the reproductive success, movements, and mortality of bears on Camp Ripley. The first Camp Ripley bears were radio collared in 1991. Since then thirty-nine bears have been fitted with radio collars. Currently eight bears are wearing radio-collars.

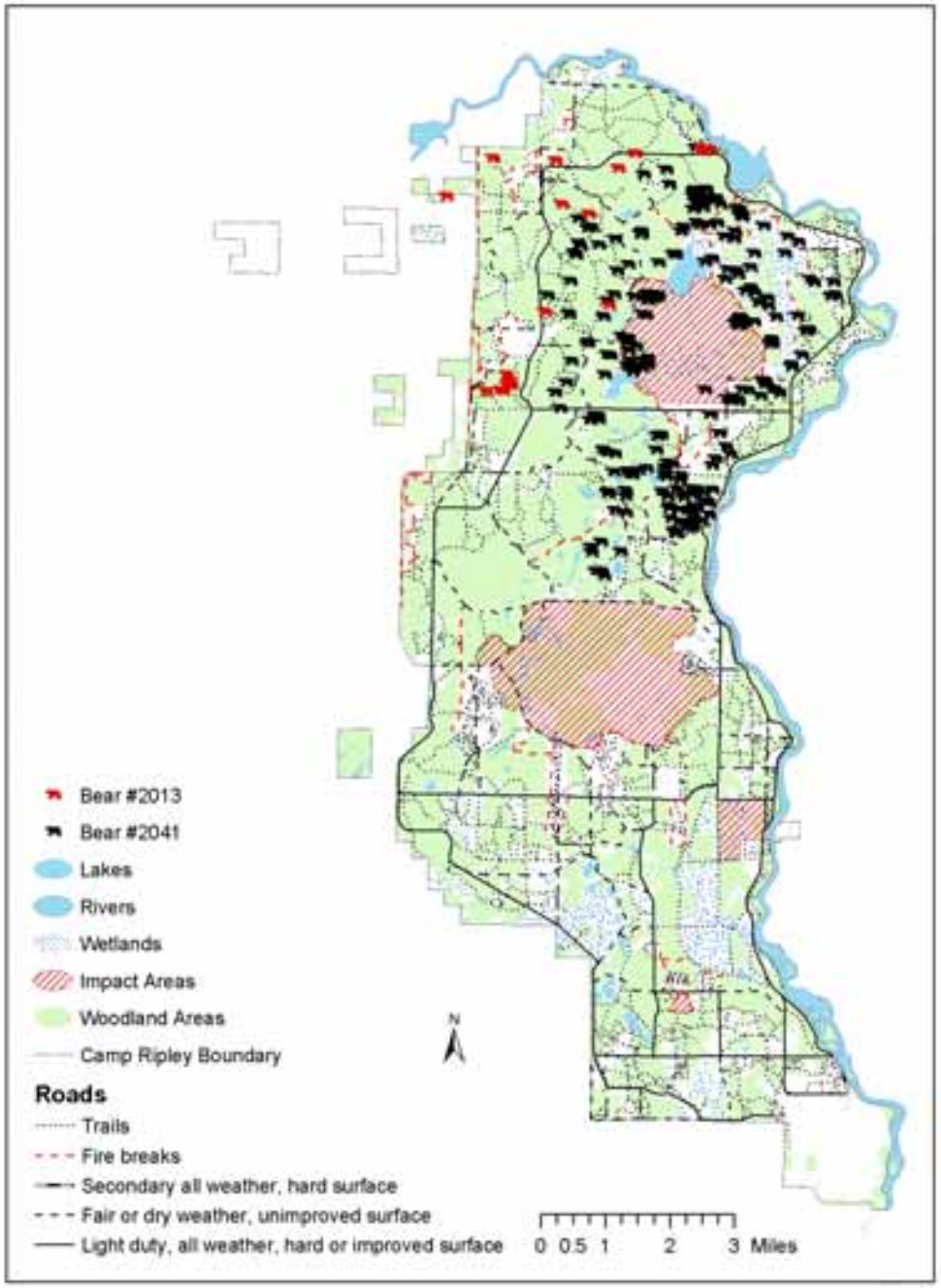
GPS Data - Bears #2041 and #2013

Two female adult bears, #2013 and #2041, were fitted with Global Positioning System (GPS) collars during den visits in February/March 2002. Both were monitored throughout the year through traditional VHF radio-telemetry. During the winter of 2002-2003, bear #2013 denned above ground, next to a fallen tree. Her GPS collar had been producing very faint signals, and was difficult to locate from a long distance. In order to not disturb the bear, and consequently lose her collar, she was not worked on in December 2002. She will be visited in the spring of 2003, when it is believed she will have newborn cubs, and be less likely to run from researchers. Bear #2041 denned this winter on an island in Training Area 49. She was in an excavated hole, so was more accessible. Her collar was removed and replaced with a VHF collar. The data from her collar indicates she occupied the northwest portion of Camp, and that her territory overlaps with bear #2013 (Fig.12). However, both bears occupy some of the same areas at different times of the year.

Bear #2020

Bear #2020 was fitted with a GPS collar (ATS) in February 2001 and tracked until June 2001 when the radio-collar stopped functioning. Numerous possible sightings of bear #2020 during the spring of 2002 prompted trapping. Five barrel traps were set in this bear's traditional area on June 6, 2002. Traps were checked daily and re-baited as needed. At one site, raccoons repeatedly consumed bait and were trapped and relocated. On June 13, a 235 lb. male bear was captured (#2064). He was fitted with a VHF collar, measured, weighed and released. Bear #2054 was also captured in a trap on June 21, and was released. Shortly after #2054 was released from

Figure 12. GPS and VHF locations from bear #2041, and VHF locations from bear #2013 in 2002.

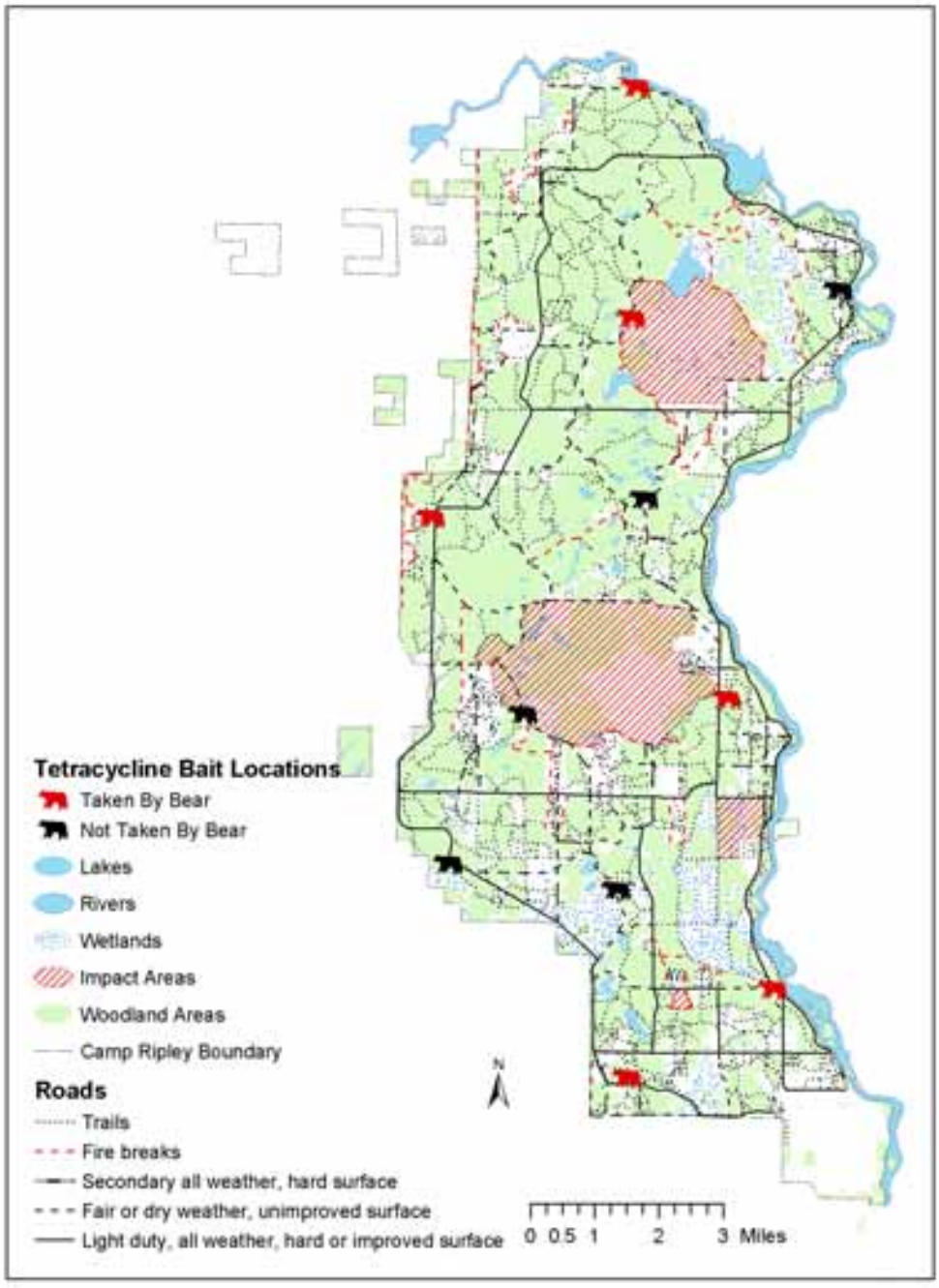


the trap, she and her sister (#2053) were together and were being followed closely by an un-collared male bear. Unfortunately, bear #2020 was not captured, and the traps were closed on June 27. In July/August 2002, a bear fitting #2020's description (ear tags/collar) was observed numerous times at a private residence across the Mississippi river from Camp. A remote camera was set over a bait pile in Camp near the river crossing for two weeks, but no bears visited the bait. Two other sightings of bear #2020 with three cubs were reported from Range Control during the summer. In November 2002, a bear was observed at a den in Hole-in-Day marsh. She was later identified as #2020 by ear tags. Two yearlings were also observed in the den. If weather and circumstances permit, she will be re-collared in February/March of 2003.

Tetracycline Sampling

In an effort to estimate statewide black bear population numbers, the DNR placed tetracycline-laced baits throughout known Minnesota bear range. This is the third time the DNR has used this method to mark bears. Tetracycline tablets are wrapped in bacon and hung in trees no closer than three miles apart. Once a bear consumes the tablets, the tetracycline is absorbed in newly growing bone. If that animal is taken in that year's harvest, a bone sample is removed at registration and checked under ultraviolet lights for signs of tetracycline. The number of marked bears is added to a modeling program, and used to estimate population numbers for the state. For the first time, Camp Ripley was used as an additional sampling area. Eleven baits were hung in aspen trees throughout Camp (Fig. 13). Six of eleven baits were clearly taken by bears (54.5%), three baits were not taken (27%), and two baits were taken by unidentified animals.

Figure 13. Tetracycline bait sites used in conjunction with Minnesota bear survey in 2002.



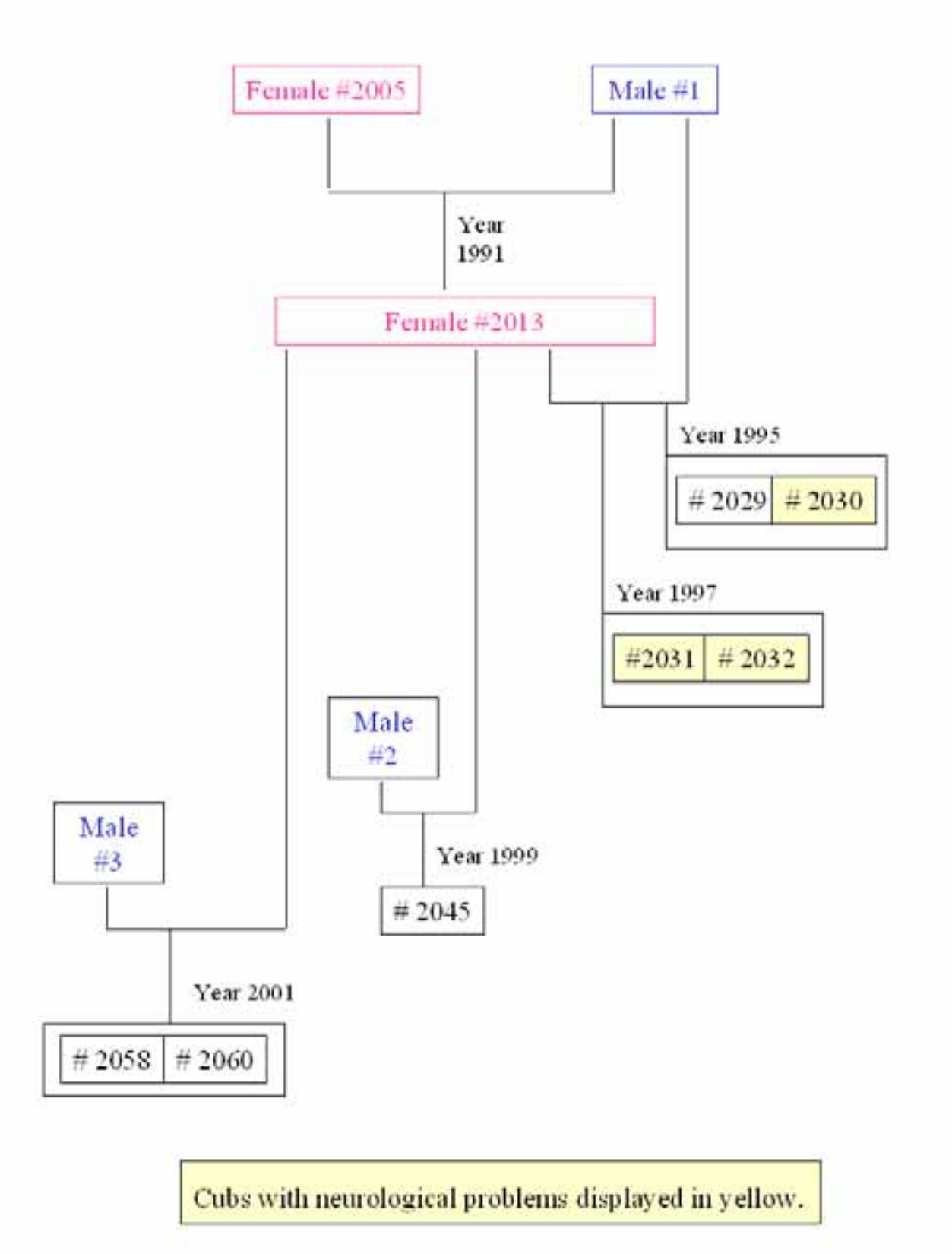
Genetic Sampling

Nineteen hair samples taken during bear captures and/or den visits at Camp Ripley were sent for genetic analysis in August 2002. Wildlife Genetics International, of Nelson, British Columbia performed the DNA testing and analysis on hair samples. Several questions were posed concerning Camp Ripley bears.

Bear #2020 was initially tagged in 1992 while still in the natal den with her mother (#2003). She was not collared at that time. In 1999, a den was found inadvertently but the female bear was unidentifiable due to missing ear tags. She was given the identification #2052, and radio-collared. Genetic analysis confirmed that bear #2020 was in fact the same bear that was recaptured and identified as #2052.

Bear #2013 was born to #2005 in 1991. She was fitted with her first radio-collar in 1993 and has been tracked with several other collars ever since. She has produced 10 cubs. Of these, cubs #2030 (born in 1995) and #2031 and #2032 (born in 1997) had apparent neurological problems. Genetic analysis of hair samples from #2013 and her young (#2029, #2030, #2031, and #2032), indicate these young were fathered by an unknown male (referred to as Unknown Male #1) (Fig. 14). It was also proven that Unknown Male #1 was #2013's father. The neurological problems acquired by some of #2013's cubs are likely from an autosomal recessive allele present in Unknown Male #1's DNA, and therefore passed on to #2013 from her father. Offspring from the mating of Unknown Male #1 and #2013 would have a 25% chance of developing a neurological disorder. Analysis also indicates that the latest three (#2045, #2058, and #2060) of #2013's cubs were fathered by two different males, Unknown Male #2 and Unknown Male #3 (Fig. 14). Most likely littermates #2058 and #2060 shared the same father.

Figure 14. Family history obtained from genetic sampling on bear #2013 and her relatives.



Prairie Vole

Prairie voles (*Microtus ochrogaster*) are listed as a species of special concern by the Minnesota DNR. Typical habitats are grasslands with primarily native species and little accumulated litter (Merrill 2000). This species has been documented on Camp Ripley in past studies. Most recently, one prairie vole was captured during small mammal trapping in 2001 on LCTA plot #4. In July 2002, an effort was made to document the occurrence of prairie voles on Camp Ripley. Trapping occurred at ten plots in grasslands that had been previously trapped, and in additional grassland areas where prairie voles were expected to occur (Fig. 15). Forty Sherman live-traps were set in configurations of two or four parallel lines, depending upon grassland shape and size. Traps were set during the afternoon, checked and closed the next morning, and opened again in the afternoon. The traps were then checked and picked up the second morning, for a total of 80 trap nights per plot. No prairie voles were documented in 2002.

Scent Post Survey

During the past 27 years, the Minnesota DNR has conducted scent post surveys throughout the state to track population trends of major furbearer-predator species. Routes have been run within Camp Ripley since 1985.

Scent post surveys were conducted along five segments of the Camp Ripley route (Fig. 16) during the first week in October 2002. Ten scent post stations are placed along each segment of the route. The most common animal to leave tracks through stations was white-tailed deer (26 of 50 stations) (Table 5). One coyote (*Canis latrans*), red fox (*Vulpes vulpes*), and weasel (*Mustela spp*.) were also detected. The most interesting station was completely torn up by a flock of turkeys. The scent disc was kicked into the road, and there were turkey tracks all through and around the station.

Figure 15. Locations of prairie vole sampling at Camp Ripley in 2002.

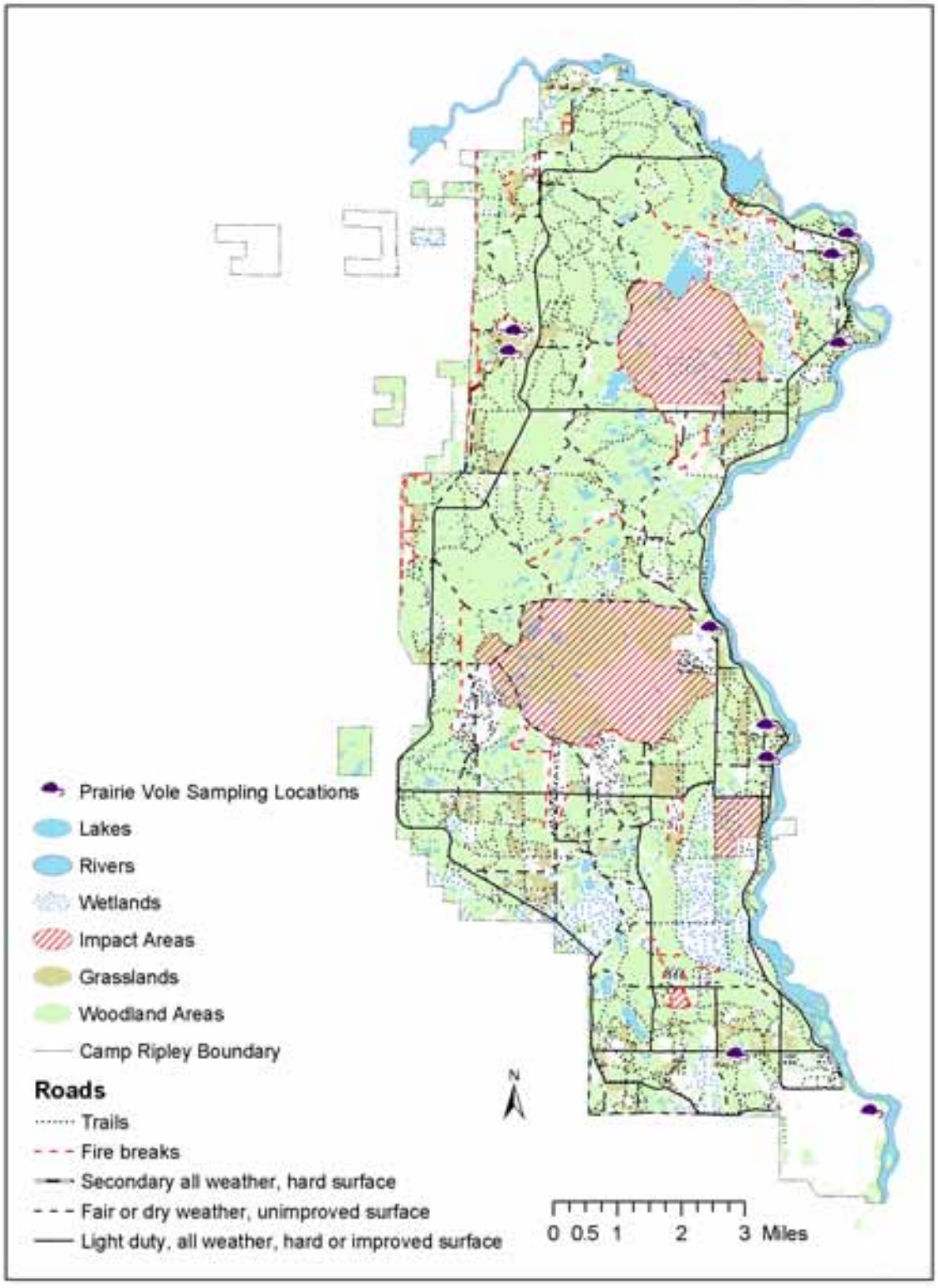
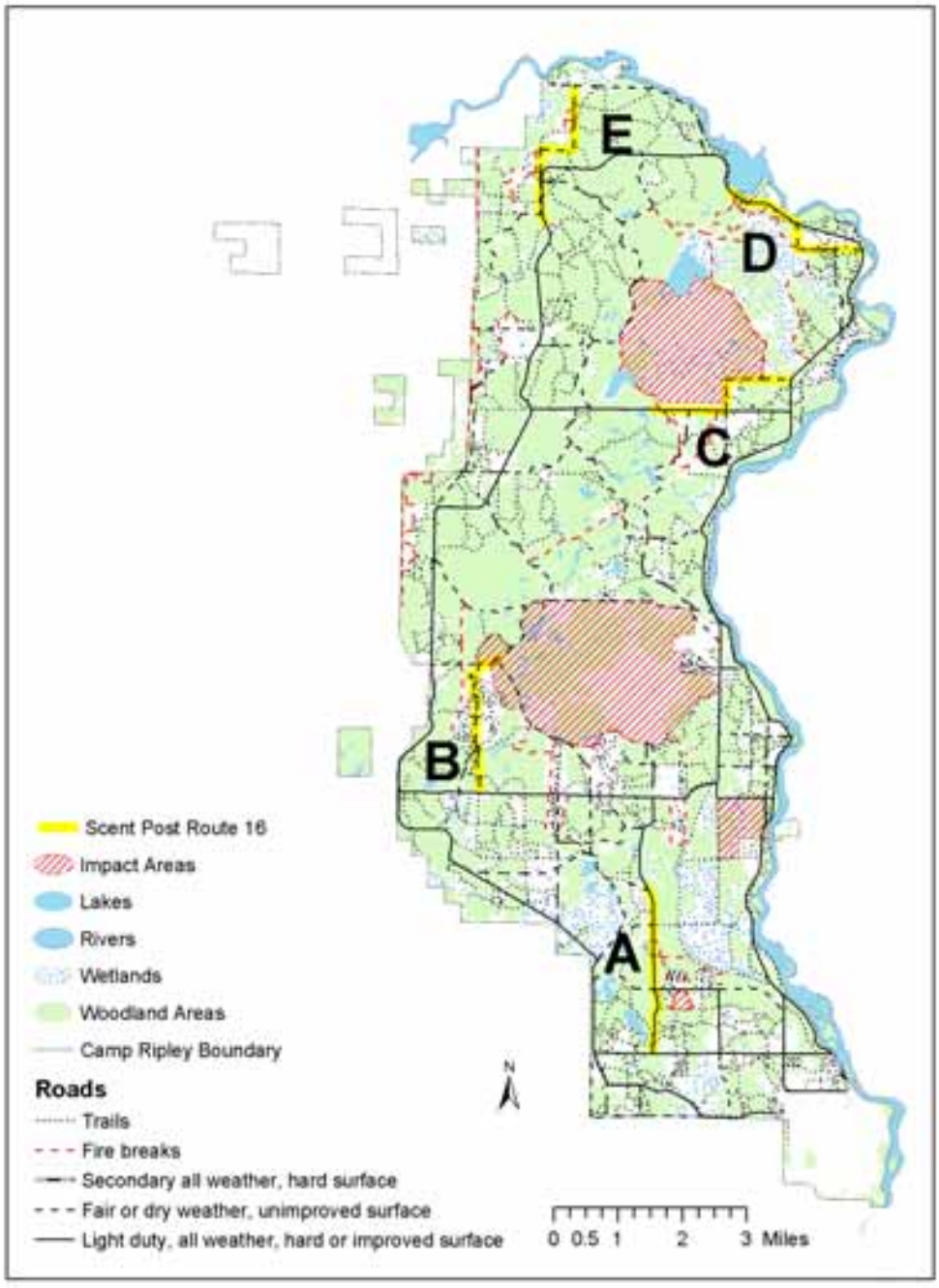


Table 5. Results from Scent Post Surveys conducted at Camp Ripley from 1985-2002. Stars (*) indicate years when survey was not conducted.

	Number of Visits by Each Species to Scent Post Stations (10 stations along each of 5 routes=50 stations) by Year																	
Species	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Coyote	10	7	7	2	*	*	16	12	11	12	20	6	9	2	2	0	*	1
Grey Wolf	0	0	0	0	*	*	0	0	1	0	0	0	0	3	9	1	*	0
Red Fox	3	0	0	1	*	*	2	0	2	2	3	4	6	7	2	6	*	1
Skunk	0	0	1	1	*	*	5	6	3	3	1	3	2	5	3	7	*	1
Raccoon	8	2	4	10	*	*	4	1	1	4	1	3	2	5	2	2	*	0
Deer	8	3	8	9	*	*	5	4	4	7	4	7	5	8	6	8	*	13
Squirrel	0	0	1	0	*	*	1	1	2	0	2	1	0	1	2	1	*	1
Mink	0	0	1	0	*	*	2	2	0	0	0	0	0	0	0	0	*	0
Rabbit	0	0	1	0	*	*	0	0	0	0	0	0	0	0	0	0	*	0
Badger	0	0	0	0	*	*	1	0	0	0	0	0	0	1	0	0	*	0
Bear	0	0	0	0	*	*	0	1	0	1	0	0	0	1	1	0	*	0
Woodchuck	0	0	0	0	*	*	0	0	1	0	0	0	0	0	0	0	*	1
Weasel	0	0	0	0	*	*	0	0	0	1	0	0	0	0	0	0	*	1
Porcupine	0	0	0	0	*	*	0	0	0	1	0	0	0	0	0	0	*	1
Mouse	0	0	0	0	*	*	0	0	0	0	1	0	0	5	1	0	*	0
Cat	0	0	0	0	*	*	0	0	0	0	0	0	1	0	0	0	*	0
Muskrat	0	0	0	0	*	*	0	0	0	0	0	0	0	1	0	0	*	0
Bobcat	0	0	0	0	*	*	0	0	0	0	0	0	0	1	0	1	*	0
Total	**29**	**12**	**23**	**23**			**36**	**27**	**25**	**31**	**32**	**24**	**25**	**40**	**28**	**26**		**20**

Figure 16. Segments from scent post survey route 16, conducted at Camp Ripley in 2002.



Bats

Previous surveys at Camp Ripley detected the presence of five bat species; little brown (*Myotis lucifugus*), big brown (*Eptesicus fuscus*), hoary (*Lasiurus cinereus*), silver-haired (*Lasionycteris noctivagans*) and red (*Lasiurus cinereus*). In 2002, bat surveys were conducted from August 5-29 with the use of a bat detector (Skye Instruments - SBR 2100). Bat detectors intercept bat echolocation calls, and convert them to a signal humans can hear. The new signal is played on the detector, with the frequency in KHz shown on an LCD screen. Bat species are differentiated by the range of frequencies they emit and by species-specific nuances in their calls. During 2002, surveyors stopped at 23 random areas (Fig. 17) and listened for 10 minutes, documenting all bats heard during this time. This method is used to survey species richness, not actual population size or abundance, since certain bat species move long distances while foraging each night (Bat Conservation International Web Site 2002). Ultrasound detection is limited based on equipment sensitivity, bat distance and call intensity. Several times an echolocation signal would be picked up on the animal's flight past the researcher, but that duration was not long enough to sort out frequency range for that animal. Additionally, to the un-experienced surveyor's ear and obscure written descriptions from previous researchers, bat calls are difficult to determine using a bat detector. Mist nets are often used to corroborate bats identified with bat detectors, however most bats observed during surveys at Camp Ripley flew too high to be captured in mist nets.

Using call descriptions from previous studies, bat surveyors documented seven species; big Brown (27), hoary (6), little brown (3), northern long-eared (2), eastern pipestrelles (3), silver-haired (1), and red bats (multiple) (Table 5). Two species not documented in past surveys were the northern long-eared bat (*Myotis septentrionalis*) and eastern pipestrelle (*Pipistrellus subflavus*). In the instance of the two long-eared bats, there were rapid clicks heard in the 90's on Bastogne Road, and then in the 112-115 KHz frequency range on Bennet Road in Hole-in-day Marsh. This is the only species of bat in this area that emits signals over 91. The eastern pipestrelles were identified by their frequencies in the 60-80 KHz range. Pipestrelles were documented on Bennet Road in Hole-in-day Marsh, and along Kodiak Road. Multiple red bats were heard between two open grasslands, but the actual number was un-discernable.

Figure 17. Locations of bat surveys conducted at Camp Ripley in 2002.

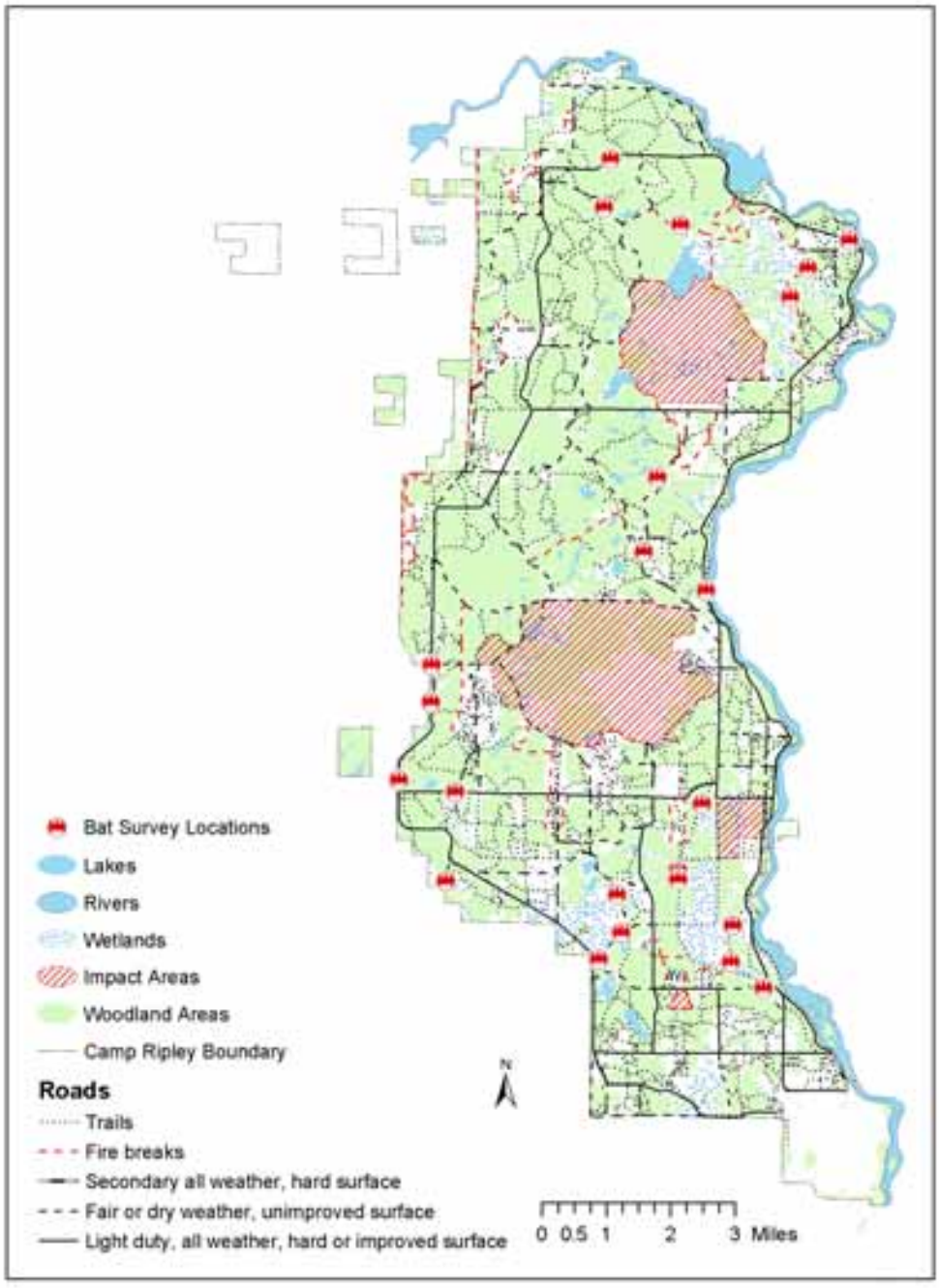


Table 6. Results from bat surveys conducted at Camp Ripley in 2002.

Survey Area	UTM	Date	Time	Species Heard	# Seen	Frequency Heard	Description
East Boundary	395828/5127393	8/5/02	2200	Red	Multiple		In between clearings
Sylvan Dam	393844/5128753	8/5/02	2100	Big Brown	5-6	26-38	
Champagne	393683/5108587	8/6/02	2107	Big Brown	3	26-38	
Wetlands on Marne	389543/5109316	8/6/02	2124-2126	Un-ID	1		Flew by too fast to scan frequencies
Cunningham between wetlands	390116/5109986	8/6/02	2136-2155	Big Brown	1	26-38	
Miller Pond	390015/5110942	8/6/02	2100-2106	Hoary	1	20-38	
		8/6/02	2100-2106	Big Brown	1	26-38	
Mississippi River	392234/5118591	8/7/02		Big Brown	1	26-38	By bear bait
Turtle firebreak	394793/5126684	8/7/02		Big Brown	1	26-38	1st wetland south on trail
	394346/5125965	8/7/02		Big Brown	1	26-38	By turtle nest
OP-19	391594/5127776	8/7/02		Hoary	1	20-38	
Pond on Pusan	389841/5129443	8/13/02	2056	Big Brown	3	29	
Bastogne	389677/5128213	8/13/02	2147	N. Long-eared	1	90's	Rapid clicks
Bennet	392140/5113228	8/19/02	2045	Big Brown	2	26-38	
				Eastern Pipestrelle	2	60-88	Rapid clicks
				Little Brown	1	40's best frequency	Smaller
				Long-eared Myotis	1	112-115	
Bennet	391539/5111541	8/19/02	2119	Big Brown	1	26	
Bennet	391541/5111322	8/19/02	2129	Big Brown	2	26	
Bennet	392867/5109235	8/19/02	2148	Big Brown	1	26	
Bennet	392899/5110168	8/19/02	2200	Big Brown	1	26	
Kodiak/Corrigidor	385360/5116711	8/14/02	2100	Big Brown	2	29	
		8/14/02	2100	Hoary	1	23	Slow metallic chirp
Normandy	384547/5113812	8/15/02	2100	Hoary	1	20-30	
Normandy	385337/5115775	8/15/02	2118	Hoary	1	20-30	
Normandy	385958/5113525	8/15/02	2151	Hoary	1	20-30	
Kodiak	385713/5111285	8/15/02	2215	Unknown	1	60-65	Rapid clicks/flybys
Minshaw Trail south of Pantano	390683/5119548	8/26/02	2042	Silver Haired	1	20-50	Like popcorn fast clicks
		8/26/02	2042	Little Brown	2	40-74	Fly bys
Frog Lake	391014/5121426	8/26/02	2102	Big Brown	1	26-38	Typical pattern

The majority of bats detected were big brown. This species was frequently heard along East Boundary, Kodiak and other roads while driving from one survey site to another. Bennet Road in Hole-in-Day Marsh had the highest species richness during surveys.

Future bat surveys would benefit by either contracting with an experienced bat researcher, purchasing more sophisticated equipment, or surveying concurrently with mist nets. Additionally, actual roosting habitats on Camp Ripley are unknown. Some bats may be flying 20 miles from roosting sites to feed at Camp, yet many are probably roosting/rearing young on site. Radio-telemetry could be used to track movements of bats within and around Camp.

Beaver

Road damage caused by dam building activities of beaver (*Castor canadensis*) continues to be a problem on Camp Ripley. In the past, a trapper was brought in to remove beavers from problem areas. However, this method was not solving the problem. New beavers would re-colonize problem areas after problem beavers were removed. A device called a "Clemson Leveler" has been used at Camp in the past, and if installed correctly does prevent beavers from blocking culverts with debris. In order to manage beavers effectively, meetings were held with Camp Ripley Environmental staff, DNR Enforcement and Wildlife, and the Camp Ripley Department of Public Works supervisor. Protocols were established concerning trapping and the installation of more Clemson levelers. All culverts on Camp were checked, numbered and mapped. Problem areas are reported to the Environmental Office by the DPW supervisor. Those areas are then checked by the DNR Animal Survey Coordinator or Little Falls Area Manager, who makes the decision to trap or install a Clemson leveler at the site. A Beaver Management Plan will be written by the Environmental Office in 2003.

Reptiles and Amphibians

Blanding's Turtle

Blanding's turtle (*Emydoidea blandingii*) road surveys were conducted from June 7 though June 25, 2002. Nineteen turtles were captured this year (Fig. 18, Table 7), 11 which were recaptures from previous years. One young male (8 years old) was captured along the north survey route. Four nests were protected using wire cages (Appendix B, Image 4 - 5). Two of the females that nested were identified. The other two were watched while nesting, but not handled. Nests were checked periodically for predation, disturbance, and turtle emergence. The first nest with hatched turtles was located on Wonsan Road. The eggs were deposited on June 22, 2002. Fifteen hatched eggshells and two dead hatchlings were found in the nest on September 5, 75 days after being deposited. The second nest was almost completely hatched on September 9, with four of 16 turtles still yet to hatch. The remaining four turtles hatched while researchers were present. Those eggs were deposited on June 20, 81 days prior to dispersal from the nest. The third nest to hatch was laid on June 18, and hatched sometime between September 9 and 13, 2002. Of ten eggs in the nest, eight hatched and two did not. The fourth nest did not hatch. However, Blanding's turtle nestlings have been known to over-winter in the nest, so this nest may hatch out in the spring of 2003.

An opportunity to observe how quickly turtle nests can be destroyed by predators occurred on June 21. During an evening survey, a skunk was observed digging out a turtle nest. Upon closer inspection, we realized that the skunk was digging out a snapping turtle (*Chelydra serpentina*) nest while the turtle was still laying eggs. This emphasizes the importance of protecting Blanding's turtle nests as soon as they are found.

Figure 18. Locations of Blanding's turtle captures and nests at Camp Ripley in 2002.

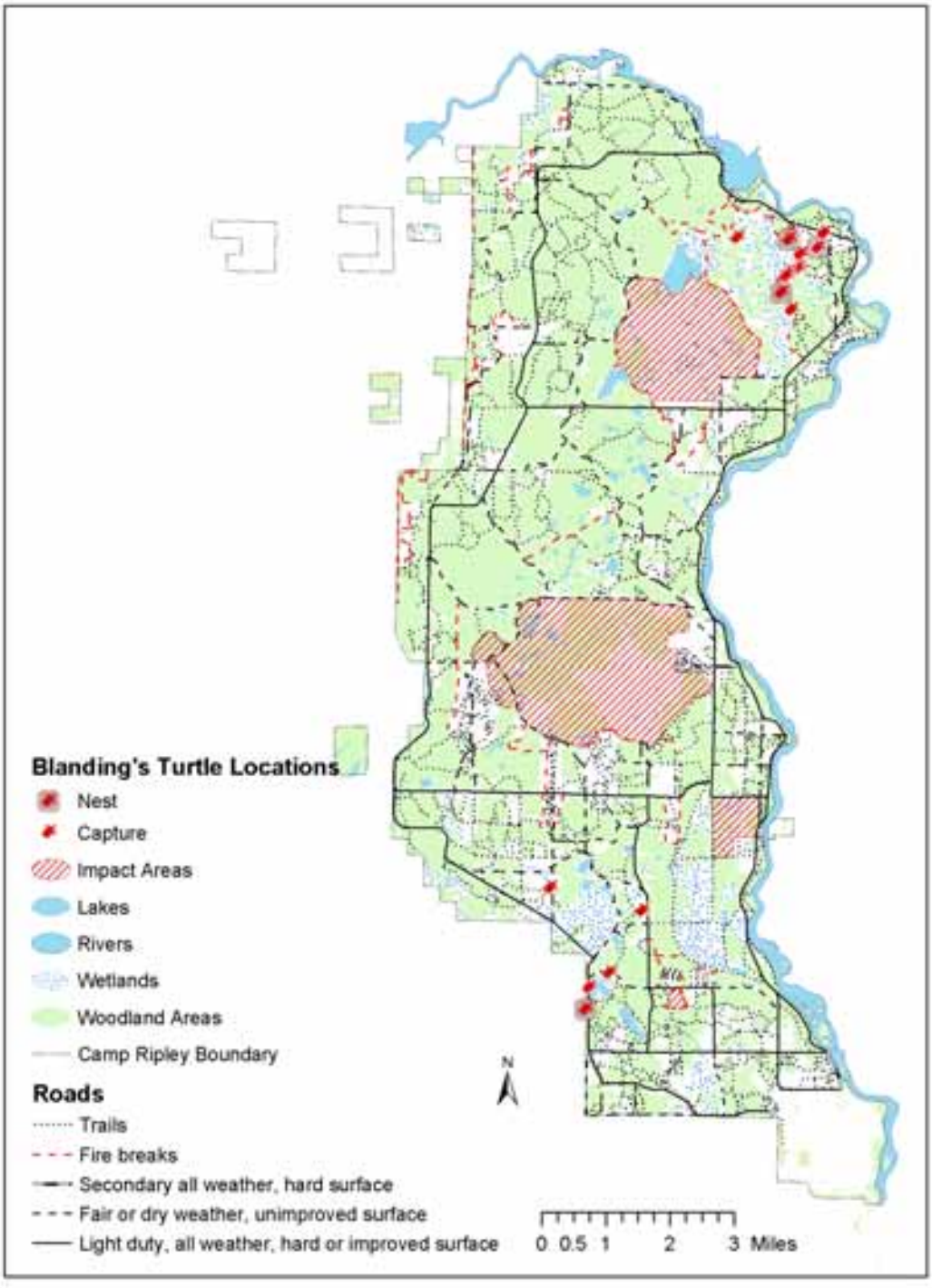


Table 7. Data from turtles captured during June of 2002 at Camp Ripley.

Turtle ID	New or Old Capture	Age	Sex	Nest Protected?
ABHI	Old	>25	Female	No
ABI	Old	>25	Female	No
ABX	Old	?	Female	Yes
BCD	New	>17	Female	No
BDO	New	16	Female	No
BDP	New	15	Female	Yes
BDQ	New	20	Female	No
BDU	New	20	Female	No
BDV	New	>19	Female	No
BDW	New	>22	Female	No
BDX	New	8	Male	No
BDY	New	15	Female	No
KL	Old	>25	Female	No
KLN	Old	18	Female	No
NP	Old	>24	Female	No
OP	Old	25	Female	No
OT	Old	>20	Female	No
PW	Old	>20	Female	No
PY	Old	16	Female	No

Anuran Surveys

Anuran surveys have been conducted annually at Camp Ripley since 1993. Frog and toad abundance estimates are documented by the index level of their chorus, following Minnesota Herpetological Society guidelines (Moriarty, unpub.). If individual songs can be counted and there is no overlap of calls, the species gets an index value of 1. If there is overlap in songs the index value is 2, and a full chorus is designated a 3. Anuran surveys are performed at ten stops along two separate routes. The routes are traditionally conducted three times from April to July.

As in past years, the most commonly heard species during the first sampling period of 2002 were spring peepers (*Pseudacris crucifer*), wood frogs (*Rana sylvatica*) and western chorus frogs (*Pseudacris triserata*) (Table 8). In the second sampling period, the most common species were gray treefrogs (*Hyla versicolor*), Cope's gray treefrogs *(Hyla chrysoscelis*), American toads (*Bufo americana*), and spring peepers. Gray treefrogs, Cope's gray treefrogs, green frogs (*Rana clamitans melanota*) and mink frogs (*Rana septentrionalis*) were heard during the third sampling period. Data was sent to the DNR Natural Heritage Program in St. Paul where it will be used in ongoing anuran population monitoring efforts. Anuran surveys will be conducted again in the spring/summer of 2003.

Table 8. Results from anuran surveys conducted at Camp Ripley in 2002.

Survey Period 1	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Wood Frog	*	1.1	2.3	1.1	0.3	0.4	0.5	1.0	1.8	0.5
Western Chorus Frog	*	1.2	1.6	0.6	0.4	0.6	0.6	0.9	1.3	1.0
Spring Peeper	*	2.8	2.2	1.5	2.5	1.6	1.7	2.3	2.0	1.8
Northern Leopard Frog	*	0	0	0.1	0.4	0.5	0.4	0.2	0	0
American Toad	*	0	0	0	0	0	0	0	0	0
Gray Treefrog	*	0	0	0	0	0	0	0	0	0
Cope's Gray Treefrog	*	0	0	0	0	0	0	0	0	0
Mink Frog	*	0	0	0	0	0	0	0	0	0
Green Frog	*	0	0	0	0	0	0	0	0	0
Survey Period 2	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Wood Frog	2.4	0.1	0	0	0	0	0	0	0	0
Western Chorus Frog	0.4	0.1	0.2	0	0	0	0.1	0.2	0.2	0
Spring Peeper	1.9	2.2	2.3	0.2	0	0.9	0.8	0.9	0.6	0.2
Northern Leopard Frog	0	0	0	0	0	0.1	0.1	0.3	0.1	0
American Toad	0.2	0.1	0.8	0.2	0.3	0.1	1.2	0.5	1.0	0.3
Gray Treefrog	0	1.7	1.7	1.4	1.0	0.8	2.3	1.0	2.1	1.6
Cope's Gray Treefrog	0	1.6	0.4	0.5	0.5	0.2	0.4	0.3	0.3	0.6
Mink Frog	0	0	0	0.2	0.1	0.1	0	0	0	0
Green Frog	0	0	0	0.1	0.1	0	0	0	0	0
Survey Period 3	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**
Wood Frog	*	*	0	0	*	*	*	*	0	0
Western Chorus Frog	*	*	0.1	0	*	*	*	*	0	0
Spring Peeper	*	*	0	0	*	*	*	*	0	0
Northern Leopard Frog	*	*	0	0	*	*	*	*	0	0
American Toad	*	*	0	0	*	*	*	*	0	0
Gray Treefrog	*	*	0.2	0	*	*	*	*	0.2	0.3
Cope's Gray Treefrog	*	*	0	0	*	*	*	*	0	0.3
Mink Frog	*	*	0.3	0.4	*	*	*	*	0	0.1
Green Frog	*	*	0	0.3	*	*	*	*	0.3	0.1

ARDEN HILLS ARMY NATIONAL GUARD TRAINING SITE (AHATS)

The Twin Cities Army Ammunition Plant (TCAAP) was one of six Government Owned-Contractor Operated (GOCO) plants built to produce small arms ammunition during World War II. The Minnesota Army National Guard (MNARNG) began leasing its current facility in 1972 and the Organizational Maintenance Shop (OMS) vehicle maintenance buildings were constructed in 1973. In September 2000, MNARNG acquired accountability for a portion of the 2,347-acre installation. That portion of TCAAP is now known as the Arden Hills Army National Guard Training Site (AHATS). Presently, AHATS consists of 1,522.83 acres, which is available for military and subsequently, wildlife management. AHATS lies in the northern portion of Arden Hills, Minnesota, approximately eight miles north of St. Paul city limits and six miles northeast of Minneapolis city limits. Surrounding municipalities include Arden Hills, New Brighton, Mounds View, and Shoreview.

Population studies of flora and fauna will be an ongoing part of the installation's Integrated Natural Resources Management Plan (INRMP), which was completed in November of 2001. The data obtained will be used to help manage the natural resources on AHATS. Thirty-one mammal species, 147 bird species and 298 plant species have been identified at the training site.

Birds

Songbirds

Songbird surveys were conducted on July 1, 2002 in seven grassland and seven woodland LCTA plots (Table 9). This is the second year these plots have been surveyed. A higher number of birds were documented in woodlands (77) than in grasslands (62). Woodland plots also contained a higher species richness (27) than grasslands (21). The five most commonly observed birds in woodland plots were the house wren (*Troglodytes aedon*), black-capped chickadee (*Parus atricapillus*), American robin (*Turdus migratorius*), eastern wood-pewee (*Contopus virens*) and American goldfinch (*Carduelis tristis*). Those five species represented 40% of birds observed in woodland plots. In grassland plots, the five most abundant species represented 56%

of total birds observed. Those were the red-winged blackbird (*Agelaius phoeniceus*), Brewer's blackbird (*Euphagus cyanocephalus*), song sparrow (*Melospiza melodia*), clay-colored sparrow (*Spizella pallida*) and eastern kingbird (*Tyrannus tyrannus*). The large number of blackbirds in grassland plots is largely due to groups of immature birds. A large component of edge species was observed in grassland plots again this year. This may be due to small grassland size and the encroachment of shrubs or trees into grasslands. To manage for grassland birds, these grasslands should be burned regularly, and trees removed.

Table 9. AHATS songbird survey data from 2001 and 2002.

	Grassland Plots		Woodland Plots	
Species	**2001**	**2002**	**2001**	**2002**
American crow	1	0	2	2
American goldfinch	3	3	10	5
American redstart	0	0	1	0
American robin	1	1	6	6
Black-capped chickadee	1	0	4	7
Blue jay	0	1	3	4
Bobolink	0	1	0	0
Brewer's blackbird	0	8	0	0
Brown cowbird	0	0	0	1
Brown thrasher	1	1	1	0
Cedar waxwing	1	0	1	0
Clay-colored sparrow	6	5	0	0
Common yellowthroat	1	0	2	3
Downy woodpecker	0	0	3	2
Eastern bluebird	0	2	0	1
Eastern kingbird	1	5	0	0
Eastern meadowlark	2	2	0	0
Eastern towhee	0	0	6	1
Eastern wood-pewee	0	0	3	6
Field sparrow	3	4	0	1
Grasshopper sparrow	0	3	0	0
Gray catbird	0	0	2	2

Table 9. continued

	Grassland Plots		Woodland Plots	
Species	**2001**	**2002**	**2001**	**2002**
Great-crested flycatcher	0	0	0	1
House sparrow	0	0	0	1
House wren	3	3	11	7
Indigo bunting	2	0	0	1
Mourning dove	1	0	3	2
Northern cardinal	0	0	2	4
Northern flicker	1	1	0	1
Northern oriole	0	0	0	4
Red-breasted nuthatch	0	0	2	0
Red-eyed vireo	0	0	2	0
Red-winged blackbird	0	10	3	3
Rose-breasted grosbeak	0	0	1	1
Red-tailed hawk	0	1	0	0
Savannah Sparrow	2	0	5	0
Sedge wren	5	0	0	0
Sharp-shinned hawk	0	0	1	0
Song sparrow	2	7	2	2
Tree sparrow	0	1	0	0
White-breasted nuthatch	0	1	3	3
Yellow warbler	0	0	1	0
Vesper sparrow	0	1	0	1
Unknown	0	1	4	5
Total	**37**	**62**	**84**	**77**

Osprey

The osprey nesting platform at AHATS was used again in 2002. With the assistance of Environmental Office staff, researchers from the University of Minnesota's Raptor Center placed leg bands on all four 4-5 week-old osprey chicks (Appendix B, Image 6). Blood samples were also taken for future DNA analysis. The adult male was previously banded, and had been hacked from Northern Minnesota 10 years prior to nesting at AHATS.

Hawk Nest Survey

A hawk nest survey was conducted on May 29. Wooded areas in AHATS were walked and two possible hawk nests were documented and marked using GPS.

Trumpeter Swans and other Waterfowl

A pair of trumpeter swans was observed during the summer in Marsden Lake, yet no young were documented. The lake was also scanned for waterfowl pairs and broods on May 29.

Mammals

White-tailed Deer Archery Hunt

The annual archery hunt for white-tailed deer was cancelled in 2002, due to security and logistical reasons. A hunt for 2003 is in the planning process.

Reptiles / Amphibians

Blanding's Turtle

A Blanding's turtle road survey was conducted on June 20, 2002. One Blanding's turtle was observed attempting to nest along the northern boundary road. This was a previously marked turtle (ID = DL) greater than 20 years of age. Upon handling, she released her water and eggs were present. The site was checked later that same evening and the turtle was observed digging a nest. The nest was located and protected the next day with a flat wire mesh. It was later protected with a wire cage, which was destroyed in late summer by a road grader. On September 18, 2002

this nest was checked and there were two undeveloped eggs (just yolks) and one rotten egg with an embryo inside. Not enough evidence remained to determine if the nest had hatched.

Anuran Survey

Steve Kittelson (MN DNR) conducted the AHATS anuran surveys on May 3, June 6 and July 9. The same methods for anuran surveys are used as at Camp Ripley. Frog and toad abundance estimates are documented by the index level of their chorus, following Minnesota Herpetological Society guidelines (Moriarty, unpub.). If individual songs can be counted and there is no overlap of calls, the species gets an index value of 1. If there is overlap in songs the index value is 2, and a full chorus is designated a 3. Anuran surveys are performed at ten stops along two separate routes. The routes are conducted three times from April to July. One species, the western chorus frog, was heard during all three surveys (Table 10). More species were heard during the July survey than in May or June.

Table 10. Results from anuran surveys conducted at AHATS in 2002.

Species	May 3 Survey	June 6 Survey	July 9 Survey
Western Chorus Frog	1.9	0.4	0.2
American Toad		2.5	0.2
Gray Treefrog		2.4	0.1
Cope's Gray Treefrog			0.9
Green Frog			0.2

Butterfly Survey

A butterfly survey was conducted by the St. Paul Audubon Society at AHATS on July 14. This survey is performed on a limited portion of AHATS, and does not represent a count of the entire area. Joan Galli, MN DNR Regional Nongame Specialist at St. Paul coordinated the count. Twenty-four species were observed, including six species that were not observed in 2001 (Table 11). Eastern tailed-Blue (*Everes comyntas),* Common Wood Nymph (*Cercyonis pegala*), and Orange Sulphur (*Colias eurytheme*) were the most commonly observed species.

Table 11. Butterflies observed at AHATS on July 14, 2002.

Common Name	Scientific Name	2001 survey	2002 survey
Black Swallowtail	***Papilio polyxenes***	1	0
E. Tiger Swallowtail	*Papilio glaucus*	4	0
Swallowtail species	species undetermined	1	0
Checkered White	*Pontia protodica*	3	0
Cabbage White	*Pieris rapae*	0	5
"Whites"	*Pieris species*	0	0
Clouded Sulphur	*Colias philodice*	?	2
Orange Sulphur	*Colias eurytheme*	100s	35
Dainty Sulphur	***Nathalis iole***	1	0
American Copper	*Lycaena phlaeas*	0	3
Gray Copper	*Lycaena dione*	9	1
Bronze Copper	*Lycaena hyllus*	0	0
Coral Hairstreak	***Satyrium titus***	2	1
Banded Hairstreak	*Satyrium calanus*	0	0
Striped Hairstreak	*Satyrium liparops*	1	0
Hairstreak species	species undetermined		0
Eastern tailed-Blue	*Everes comyntas*	5	100s
Spring Azure	*Celastrina ladon*	4	1
Variegated Fritillary	*Euptoieta claudia*	1	0
Great Spangled Fritillary	*Speyeria cybele*	12	11
Aphrodite Fritillary	***Speyeria aphrodite***	4	4
Regal Fritillary	*Speyeria idalia*	0	0
Silver-bordered Fritillary	*Boloria selene*	0	0
Fritillary species	species undetermined	17+15	10
Pearl Crescent	*Phyciodes tharos*	11	3
Northern Crescent	*Phyciodes selenis*	0	0
Crescent species	species undetermined	2	
Baltimore Checkerspot	*Euphydryas phaeton*	15	0
Question Mark	*Polygonia interrogationis*	0	1
Mourning Cloak	*Nymphalis antiopa*	2	2
American Lady	*Vanessa virginiensis*	6	2
Painted Lady	*Vanessa cardui*	5	0
Vanessa species	unidentified	1	
Red Admiral	*Vanessa atalanta*	12+	0
Common Buckeye	*Junonia coenia*	7	1
Red-spotted Purple	*Limenitis a. astyanax*	0	0
Viceroy	*Limenitis archippus*	1	2
Northern Pearly-Eye	*Enodia anthedon*	2	4
Eyed Brown	*Satyrodes eurydice*	46	15-20
Little Wood Satyr	*Megisto cymela*	0	0
Common Ringlet	*Coenonympha tullia*	4	0
Common Wood Nymph	*Cercyonis pegala*	150 + dozens	dozens
Monarch	*Danaus plexippus*	11	10
Silver-spotted Skipper	*Epargyeus clarus*	2	2
Least Skipper	*Ancyloxypha numitor*	0	0

Table 11. continued

Common Name	Scientific Name	2001 survey	2002 survey
European Skipper	*Thymelicus lineola*	6	0
Northern Cloudy Skipper	*Thorybes pylades*	0	0
Tawny-edged Skipper	*Polites themistocles*	4	0
Long Dash	*Polites mystic*	0	0
Delaware Skipper	*Atrytone logan*	4	7
Northern Broken -Dash	***Wallengrenia egeremet***	1	0
Mulberry Wing	*Poanes massasoit*	1	1
Hobomok Skipper	*Poanes hobomok*	0	0
Black Dash	*Euphyes conspicua*	0	0
Dun Skipper	*Euphyes vestris*	1	0

RECOMMENDATIONS AND FUTURE RESEARCH

CAMP RIPLEY

1. Continue animal surveys and monitoring as outlined in the Camp Ripley Integrated Natural Resources Management Plan.

2. Helicopter net-gunning will be conducted for wolves and white-tailed deer in January 2003. At that time, two wolves with malfunctioning satellite radio collars will be captured and re-collared with VHF collars. Additional wolves may be radio-collared.

3. Red-shouldered hawk nest surveys will continue in 2003, beginning with checking historic nest locations followed by nest checks and call playback surveys in spring/summer. A University of Minnesota graduate student will assist in these surveys as the beginning of a study that will investigate habitat use and home range of red-shouldered hawks on Camp Ripley. If a qualified student cannot be located in time to participate in the spring surveys, a student will begin project planning in the fall of 2003.

4. Recent information concerning West Nile Virus indicates that the impact to birds may be far greater than previously thought. Therefore, songbird surveys will be conducted on all 90 bird plots each year to more closely monitor the impacts of West Nile Virus.

5. Continue to monitor and record all observations of threatened, endangered, and special concern species on the base. Update GIS databases and maps with new observations, and conduct spatial analyses as necessary.

6. If training schedules permit, conduct searches for hooded and cerulean warbler nests during June. Explore the possibility of mist-netting and banding individuals for recapture studies.

CAMP RIPLEY (cont)

7. Conduct road surveys for Blanding's turtles in June according to methods recommended by the Blanding's turtle study. Identify and protect nests and nesting areas. Possibly implement new radio-telemetry survey in order to locate nests.

8. Create or reestablish Blanding's Turtle nesting habitat by removing vegetation or burning in areas that are traditional nesting areas.

9. Continue bear telemetry. Conduct additional trapping and deploy conventional, GPS, and satellite radio collars as needed.

10. If training schedules permit, locate wolf den and rendezvous sites to determine productivity.

11. The active osprey nesting platform should be moved to another pole nearby, to facilitate banding operations. The second osprey nesting platform should be moved to a location that is more likely to be used.

12. More sophisticated bat survey equipment should be acquired, in order to accurately identify all bat species utilizing Camp Ripley.

AHATS

1. Continue animal surveys and monitoring as outlined in the AHATS Integrated Natural Resources Management Plan.

2. Surveys should be conducted for plains pocket mice, and possible habitat improvements performed.

ACKNOWLEDGEMENTS

The assistance provided by all of the people associated with Camp Ripley and in particular, the Environmental Office was greatly appreciated. We would like to acknowledge Camp Commander Colonel Terry Dorenbush for his appreciation and support of the research being conducted and his vision that Camp Ripley can continue to support environmental education and training. He will truly be missed. Marty Skoglund, Jay Brezinka, and Bill Brown were all instrumental in completing projects; this was truly a team effort. Camp Ripley's GIS specialists, Craig Erickson and Greg Blum, provided GIS related support throughout the year and created the maps for this report. We also thank the entire Range Control staff for their support and tolerance of our activities down range, especially during times of high military use. Thanks to Pam Perry and Jean Forbord for providing administrative and logistical support for all of the projects throughout the year. Thanks also to Joan Galli and Steve Kittelson, for their continued assistance and commitment to the projects at AHATS.

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APPENDICES

Appendix A. Deer Study Report

ASSESSING THE IMPORTANCE OF NUTRITION AND WINTER SEVERITY ON THE USE OF THE JACK PINE COVER TYPE BY WHITE-TAILED DEER IN CAMP RIPLEY, MINNESOTA

Carolin Humpal, Buck Mangipane, and Glenn D. DelGiudice, Ph.D.

BACKGROUND

Management guidelines of the Minnesota Department of Natural Resources (MNDNR) and other land management agencies integrate forest and wildlife management via practices that attempt to maximize timber productivity and yield, while enhancing wildlife habitat quantity and quality. The specific habitat needs of white-tailed deer (*Odocoileus virginianus*) are a consideration when designing timber harvests in north central Minnesota.

In Minnesota's Forest Zone, conifer thermal cover of deer typically includes dense stands of northern white cedar (*Thuja occidentalis*), spruce (*Picea spp.*), and balsam fir (*Abies balsamea*), and in some areas, jack pine (*Pinus banksiana*) and red pine (*P. resinosa*) as well. Current DNR guidelines limit the harvesting of these particular species because of their potential value as winter thermal cover and snow shelter.

Camp Ripley is located in the Transition Zone of the state. Thermal cover at the Camp is quite different than in the Forest Zone and is characterized by mixed stands of jack pine and hardwoods. Far less is known about the relationship between white-tailed deer and the type of thermal cover typically observed at Camp Ripley and elsewhere in the Transition Zone. It is apparent from observations of over browsing on winter ranges of deer at Camp Ripley that jack pine may have a second important value to deer in the Transition Zone--that is as a source of nutrition.

It has been suggested that “food is the basic requirement” of deer, but as sufficient food becomes less available for fulfilling energy requirements, thermal cover becomes physiologically important as a means of reducing energy lost as heat and for maintaining thermal balance. In western Minnesota, it was observed that deer did not seek cover, despite ambient temperatures < 18^{o} C (0^{o} F), when adequate food was available to maintain positive energy balance. Higher digestible energy available to deer from crop residue in agricultural fields juxtaposed to certain peripheral portions of Camp Ripley, compared to that available from natural browse alone in other portions of the Camp, may have a significant influence on how and when deer use the

thermal cover (i.e., jack pine stands) distributed over the Camp's landscape, as well as on aspects of their seasonal migration. In addition to the specific source of the digestible energy, the severity of winter weather conditions may strongly influence nutritional restriction.

The mixed conifer (i.e., jack pine)-hardwood habitat of the deer's winter range at Camp Ripley may have a third important function for deer, that is as a refuge from wolf (*Canis lupus*) predation, thus, contributing to a "balance" between the 2 species. Recently, timber wolves have become re-established within Camp Ripley's boundaries, and preliminary data indicate that their home range is relatively small, possibly due to the high deer densities. Further, there is an inverse relationship between winter severity and the nutritional condition of deer in Minnesota and a direct relationship between snow depth and wolf predation, which may increase the relative importance of the jack pine type to deer during severe winters.

There has been little study of Camp Ripley's deer in recent years, thus reliable information concerning deer-habitat-wolf interactions to serve as a basis for sound management decisions is sparse and sorely needed. It is clear that we must significantly increase our knowledge of the functional relationship that exists between deer and thermal cover in the Transition Zone (e.g., Camp Ripley) under varying environmental conditions to better understand the range of habitats that will fulfill the needs of deer. Important to understanding this relationship, we must become more informed about the interactive roles of nutrition and predation pressure imposed by the recently established wolves.

The goal of this study is to examine the relative influences of winter severity and nutrition on use of the jack pine-hardwood habitat type as winter thermal cover/snow shelter by white-tailed deer in Camp Ripley. Our study approach involves 4 winter field seasons (winters 1998-99 to 2001-02) for data collection. On 2 study sites, one (SW) where deer have access to supplemental feed and crop residue, and another (NW) where such access is limited, specific objectives are to determine the (1) distribution and home ranges of female deer on winter range, (2) their seasonal migration patterns, (3) habitat composition of their winter home ranges and habitat use patterns relative to winter severity, (4) survival and cause-specific mortality rates, and (5) role of nutrition on deer use of conifer cover.

METHODS

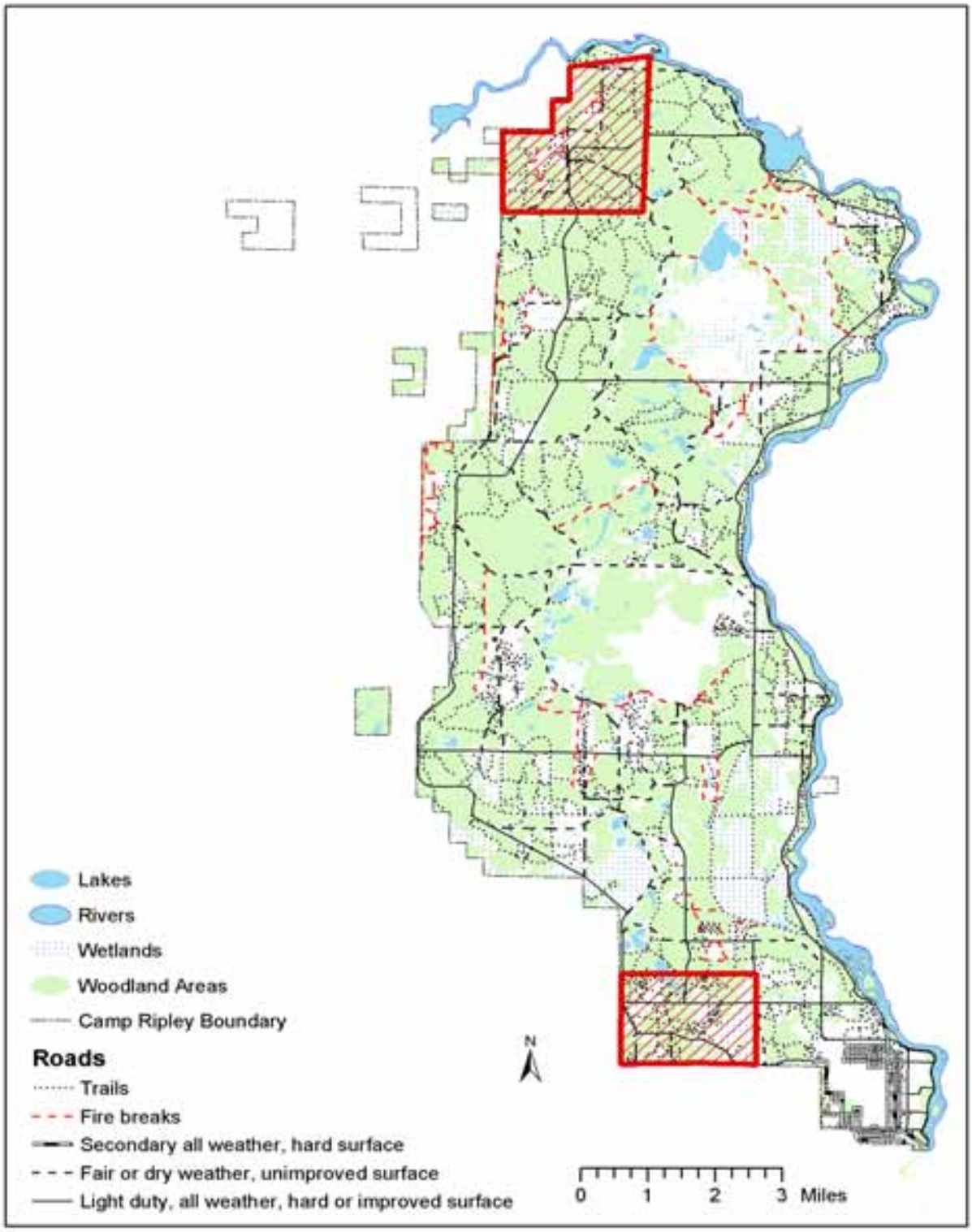
The basic methodological approach includes 2 winter study sites (Figure 1). The SW site, 10 km^2 (6.2 mi^2), is part of a deer winter range located in the southwestern part of the Camp, where deer move out of the Camp on a daily basis during winter to consume crop residue in nearby agricultural fields. The NW site, 15 km^2 (9.3 mi^2), is part of a deer winter range located in the northwestern portion of the Camp and serves as a *control* site. Few deer on this site move to agricultural fields for crop residue or to feeders for supplemental feed, but subsist mainly on natural ground forage and browse.

Winter 1998-99 and 1999-2000

During 2-4 February 1999, 40 female deer were captured by net-gun dispatched from a helicopter (Helicopter Capture Services, Marysvale, UT). Nineteen (18 adults, 1 fawn) and 21 (20 adults, 1 fawn) females were captured and handled on the NW and SW sites, respectively. Male deer were released immediately. All captured females were blindfolded and injected intramuscularly by hand-held syringe with a combination of 100 mg xylazine hydrochloride and 300 mg ketamine hydrochloride. Once induced, rectal temperature of deer was monitored; deer were eartagged, blood-sampled by venipuncture of the jugular vein; and a last incisor was extracted for aging. VHF and global positioning system (GPS) radio collars were fitted on 32 and 8 deer, respectively (Advanced Telemetry Systems, Inc., Isanti, MN), and a broad-spectrum antibiotic preparation was administered intramuscularly. Mean recovery time of deer after intravenous injection of yohimbine was 13 minutes (n = 30).

Capture operations were repeated on 27-28 January 2000 to replace 6 deer that died during the first year, as well as those 8 deer from which we released the GPS collars prior to battery expiration (90-120 days post-capture). One of the deer mortalities was a GPS-collared deer. Eight additional does were captured for a companion study of a new GPS radio collar prototype being conducted by C. Kochanny (Advanced Telemetry Systems, Inc., Isanti, MN). Three adult females, 1 female fawn, and 1 male fawn (handled but released without a radio collar) were captured and handled on the NW site, and 18 adult females were captured and handled on the SW site. All captured deer were handled as described for the first year, except serial blood specimens were collected from chemical induction (baseline) to 45 minutes post-induction at 15-minute intervals to study potential stress effects of the capture technique on the

Figure 1. Study site locations for the deer project, 1998-2002.



deer. Serum samples were analyzed for cortisol, creatine phosphokinase, and lactate dehydrogenase. Conventional VHF collars were fitted on 6 does, and GPS collars were fitted on 16 deer (Advanced Telemetry Systems, Inc., Isanti, MN); 8 of the GPS collars were the new prototype and are auxiliary to the current study. Mean recovery time for these deer was 4 minutes (n = 23, includes 1 male collared at the request of Camp Ripley's Environmental Office).

Survival of all deer has been monitored weekly by radio telemetry. All mortalities of deer are investigated for cause by collecting and examining carcass and site evidence. Survival analysis was conducted using the Kaplan-Meier procedure generalized to accept staggered-entry. Descriptive statistics for causes of mortality are reported.

Ten collared deer on each study site were selected randomly to radio-locate by triangulation 3-4 times per week from capture to 31 March 1999 and 2000. Further, all deer were located on their spring-summer-fall ranges during June and September to establish migration statistics and patterns. All telemetry locations (plotted by UTM coordinates) were used to determine winter home range of deer by the minimum convex polygon method using the Animal Movement extension in Arcview.

Habitat composition of the 2 study sites was determined by air photointerpretation using color infrared air photos (1:15,840 scale), digital orthophotoquads, and confirmation by ground-truthing. Thirteen and 11 habitat types were delineated in the SW and NW sites, respectively. Habitat types were digitized and radio locations of deer imported into a geographic information system (Arc/Info or ArcView) to perform temporal and spatial analyses of habitat compositions of deer home ranges.

Habitat use by deer for each site combining years was examined using Compositional Analysis with the program Resource Selection for Windows. Habitat use was analyzed at the second and third order, which correspond to the home range and location levels of selection. Radio telemetry error can influence the analysis of habitat use data. We used circular buffers to represent telemetry error on locations and home ranges to prevent biases that may result from overlooking this error.

Migration of deer was defined as movement between distinct summer and winter ranges. For animals that were intensely monitored, winter range was determined through home range

estimation. To define summer range, deer were radio-located in June or July when deer had arrived on summer range. This location was treated as the furthest point within the deer's summer range. Circular buffers with radii of 1,000, 798, and 565 m (areas of 314, 200, and 100 ha, respectively), with the summer location at the outermost point and centered on a line connecting the mean winter location and the summer location, were created to represent the deer's summer home range. Using the summer location as the outermost point is a conservative approach to determining if deer are migratory. These areas represent the range of reported summer home range sizes of white-tailed deer in northern forests and agricultural areas. If the summer range did not overlap with the animals' winter range, the animal was determined to be migratory.

Deer that were not frequently located, were monitored weekly for survival. Signal strength and direction from established receiver locations were recorded. This provided information on the deer's distribution within the study area during winter. In 2000, we located these deer by triangulation to establish a reference point from which migration could be based. Migration for these deer was determined if the circular buffers on their summer location did not overlap with the study area, which was defined as the 100% MCP for all deer (1999 and 2000 combined) for that study site.

Distance of migration was determined from the mean location within a deer's winter home range to their summer location. For deer without winter locations, the mean location of all study area deer was used as a starting point for migration. Direction of migration was based on the line created to determine migration distance.

Winter 2000-01 and 2001-02

Capture operations, as described for the previous winters, were conducted on 18-19 February 2001 to replace 8 deer that died during 2000, and to add collared animals to the study cohort should collars deployed in 1999 begin to fail. Thirteen (12 adults, 1 fawn) and 4 (4 adults) females were captured on the NW and SW sites, respectively. One buck was captured on the SW site and fitted with a GPS collar at the request of Camp Ripley's Environmental Office. All captured deer were handled following the same protocol as used in the 1999 capture. Conventional VHF collars were fitted on 10 does; GPS collars programmed to obtain 1 location per hour from winter capture through fall migration were fitted to 7 does (Advanced Telemetry

System, Inc., Isanti, MN). Mean recovery time for immobilized deer was 8 minutes (n = 18). After capture, a total of 46 deer were radio collared (25 and 21 on the NW and SW sites, respectively). All deer were handled and released without injury in 2001.

During 29-30 January 2002 capture operations were again conducted, following the protocols previously described, to replace 12 deer that died during 2001 and add animals to the study cohort. Seven and 13 does were captured and fitted with conventional VHF collars in the NW and SW sites, respectively (Advanced Telemetry Systems, Inc., Isanti, MN and Telonics, Inc., Mesa, AZ). Additionally, one buck was captured and fitted with a GPS collar on the NW study area at the request of Camp Ripley's Environmental Office. Mean recovery time after yohimbine injection was 14.6 minutes (n = 20). One deer was euthanized in 2002 after failure to recover following immobilization and reversal. This deer appeared injured before capture, possibly due to a back wound received during the 2001 hunting season. Approximately 200 observers, including school groups, residents of the community, media, and employees of Camp Ripley, observed and/or participated in deer handling during the capture events each year.
As previously described for winters 1998-99 and 1999-2000, 10 deer from each study area were located 3-4 times weekly during January-March 2001 and 2002. Deer that had been monitored frequently during the previous winters and were still alive were retained. Other deer were selected randomly for intense monitoring from the study cohort to replace mortalities. Eight and 9 deer were added in 2001 and 2002, respectively. The remaining deer were located at least once on winter range. All deer were located on spring-summer-fall range in 2001, and will be located again in 2002, for migration analysis.

Crop residue in the agricultural fields south of Camp is generally depleted by the middle of winter. Deer were supplementally fed to extend the higher nutritional levels throughout winter, and consequently serve as our experimental *treatment*. Orts of 3 feeders in each of 3 fields adjacent to the SW site were measured and recorded every other day, and the feeders were refilled with whole corn kernels. Landowners adjacent to Camp may also have provided supplemental feed, so orts provide an estimate of the minimum amount of corn that was consumed by deer.

Snow-urine specimens (75) were collected after recent snowfalls at intervals ≥2 weeks from January to March. On the SW site, each collection included 15 specimens from each of 3 sampling areas or zones: within the crop fields or immediately adjacent to them (SW1), between

the Camp boundary and 1 km into Camp (SW2), and >1 km from the Camp boundary within the study area (SW3). In the NW site, a 1-km buffer was established around a specific private residence with a deer feeder (NW1); data from 10 specimens/sampling from that area will be considered separately from the 20 specimens/sampling collected from the rest of the study area (NW2) where deer had no access to supplemental feed. Urea nitrogen:creatinine and potassium:creatinine ratios will be determined for these specimens to assess and compare nutritional restriction throughout each winter.

Fresh fecal samples were also collected during snow-urine collections to permit dietary quality assessments on the 2 study sites. Specifically, samples are being analyzed for acid-detergent fiber (ADF), neutral-detergent fiber (NDF), and acid-detergent lignin (ADL). Amounts of ADF and NDF present in deer pellets have indicated the proportion of the deer's diet comprised of crop residue or supplemental feed (i.e., corn). Results of fecal analyses will be examined for spatial and temporal trends. Locations of snow-urine and fecal sample collections were determined by a GPS unit and recorded. Habitat type was also recorded.

PRELIMINARY RESULTS AND PROGRESS

Snow Conditions

Weather conditions of winters 1998-99, 1999-2000, and 2001-02 were mild. Snow depths never reached the 41-cm threshold beyond which mobility becomes energetically costly for deer. Mean snow depths in the jack pine cover type were 27.2, 17.8, and 16. 8 cm in January, February and March 1999, respectively, and were 30.7, 18.3, and 12.1 cm in the open vegetation type for these months. During winter 1999-2000, these mean monthly snow depths were 10.3, 13.3, and 0.7 cm in dense jack pine and 11.3, 14.4, and 0.5 cm in the open. March had only 3 days with measurable snow cover. Mean monthly snow depths in winter 2001-02 were 6.5, 4.1, and 15.0 cm in jack pine cover and 3.0, 2.6, and 13.4 cm in the open.

Weather conditions were "normal" in winter 2000-01. By 8 February 2001, mean snow depths exceeded the 41-cm threshold and remained near or above that threshold until 21 March 2001. Mean snow depths in the jack pine cover type were 25.1, 40.3, and 42.5 cm in January, February, and March, respectively, and were 32.2, 50.5, and 48.3 cm in the open for these months.

Number and Precision of Radio Telemetry Locations

Twenty deer collared with VHF radio transmitters, 10 on each study site, were located 424 times (20-23 locations per deer) between 9 February and 25 March 1999 (Table 1). Locations obtained by triangulation had an average 95% error ellipse of 3.2 hectares as calculated by the program XYLOG. Eight GPS collars were deployed on deer between 2 and 4 February 1999, and were remotely released and retrieved during 12 May-8 June 1999. One collar failed to obtain locations, 2 obtained one location every 4 hours, and 5 obtained one location per hour, 24 hours per day. The functional GPS collars obtained 4,669 locations during the 9 February-25 March 2001 winter monitoring period.

During 19 January-31 March 2000, approximately 780 locations were obtained by triangulation (mean = 45 locations/deer, Table 1). The average 95% error ellipse for triangulated locations was 3.0 hectares. Locations made with this level of precision allow reliable association of deer to jack pine-hardwood cover types, which averaged 8 hectares on the study sites.

Sixteen GPS collars (8 standard and 8 prototype) were deployed on 27 and 28 January 2000. The 8 standard GPS collars were programmed to obtain 1 location per hour, 24 hours per day. Deer fitted with standard GPS collars were also fitted with lightweight VHF radio collars (Advanced Telemetry Systems, Inc., Isanti, MN). The VHF collars allowed us to continue monitoring the deer after the GPS collars were remotely released. Two of the standard GPS collars malfunctioned (i.e., no longer transmitting radio signals), with one being retrieved and the other remaining on the deer. The 8 prototype GPS collars allowed location sampling at variable intervals (i.e., changing the time between locations) so that each deer could be monitored more or less intensely at different times of the year.

Twenty deer were monitored intensively during winter 2000-01; 8 of these were intensively monitored during both winters 1998-99 and 1999-00, and 3 during winter 1999-2000 alone. Nine additional deer were randomly selected from the pool of 34 remaining deer. These twenty intensively monitored deer were located 592 times during 11 January-28 March 2001 (Table 1). Number of locations per animal ranged from 11 to 34, with a mean of 30. The average 95% error ellipse size for triangulated locations was 2.4 ha. An additional 41 locations were obtained for the 25 non-intensely monitored animals and were used in determining migration patterns. Seven GPS collars were deployed on 18-19 February 2001. Six of the 7 GPS collars were successfully retrieved, accounting for 1,000s of additional locations.

Twenty-one deer were intensively monitored during winter 2001-02. Three of these had been monitored intensively during winters 1998-99, 1999-2000, and 2000-01, 2 deer were monitored in both 1999-2000 and 2000-01, and 7 deer were monitored in 2000-01. Nine deer were selected randomly to be monitored intensively from the 29 remaining deer collared after 1999. One deer that was intensively monitored left the SW study area in the second week of February and returned to spring-summer-fall range by 28 February 2002; beginning 15 February, an additional animal was included in the intensively monitored group in the SW to replace the migratory doe. These deer were located 1,029 times between 10 January and 27 March 2002 (Table 1); number of locations per animal ranged from 23 to 60 with a mean of 49. The mean 95% error ellipse for triangulated locations was 2.2 ha. An additional 54 locations of the 31 deer not intensively monitored were also obtained during this period.

Ages and Pregnancy Status

Mean age at capture for 58 of the 61 female deer (3 did not have an incisor removed) handled in the winters of 1998-99 and 1999-00 was 5.0 years old. Ages ranged from 0.5 to 12.5 years old. Mean age at capture for 15 of the 17 deer (2 did not have an incisor removed) handled in late January 2001 was 6.6 years old (range = 0.5-17.5 years old). Mean ages of SW (6.7 years old) and NW (6.5 years old) deer did not differ significantly ($P > 0.05$) in 2001. Age will also be determined for the 20 deer captured in 2002.

Deer were determined to be pregnant when serum progesterone concentrations were >1.8 ng/ml. Thirty-two of 35 (91%) adult (≥1 year old) females captured in 1999 were pregnant; no fawns were pregnant. In 2000 and 2001, 17 of 21 (81%) and 16 of 18 (89%) captured adult females were pregnant; no fawns were pregnant.

Home Range Estimation

There was no difference ($P \geq 0.21$) in the mean 100% home range for deer on the NW and SW sites during winters 1998-99, 1999-00, 2000-01, and 2001-02 (Table 2). Further, there were no differences ($P \geq 0.05$) in home range sizes among winters for deer within the SW site; however, within the NW study area, mean home range size of winter 2001-02 was significantly greater than during winters 1998-99 and 1999-2000. In addition, variability was particularly large during winter 2000-01.

Habitat Use

We analyzed habitat selection at the home range level within the study site (second order) and at the individual location level within the home range (third order). Winters 1998-99 and 1999-00 were combined due to complications with the compositional analysis method, but preliminary analysis showed similar use between years, which supported the pooling of data. On the SW site, deer selection at both levels was not random (second order $X^2 = 71.5$, $df = 12$, $P < 0.001$; third order $X^2 = 42.0$, $df = 12$, $P < 0.001$) (Tables 3 and 4). Selection on the NW site was not random at the second order ($X^2 = 54.2$, $df = 10$, $P < 0.001$) (Table 5), but third order selection was not significantly different from random ($X^2 = 17.7$, $df = 10$, $P = 0.060$). Rankings of SW habitats at the second order were aspen (*Populus* sp.), grassland, oak (*Quercus* sp.), jack pine, brushland, red pine, hardwood, tamarack (*Larix larichina*) , development, water, white spruce (*Picea glauca*), agriculture, and marshlands. The first 4 ranked habitats were not significantly different from each other and were interchangeable (Table 1). All 4 habitats were selected significantly more than hardwood, red pine, white spruce, tamarack, agriculture, development, water, and marshlands. Third order rankings for the SW site were oak, hardwood, jack pine, white spruce, agriculture, aspen, tamarack, grassland, marsh, development, brushland, water, and red pine. Oak, hardwood, and jack pine were not significantly different from each other and were interchangeable, but all were selected by deer over red pine and water (Table 2). The different ranking between orders indicates that selection of habitats occurred differently at large and small scales.

The NW habitat rankings for second order selection were aspen, grassland, jack pine, red pine, brushland, marsh, oak, development, water, hardwood, and agriculture. Aspen was not used significantly more than jack pine or red pine, but was used significantly more than grassland (Table 3). This appeared inconsistent with the habitat rankings derived after excluding missing values (i.e., habitats that were not used by some deer) from calculations. Grasslands were not used significantly more than either red pine or jack pine. Thus, they are interchangeable in the rankings, which helps explain the inconsistency in rankings and pairwise comparisons. Habitat use and selection by deer of the NW and SW sites will be compared between winters 2000-01 and 2001-02 and the historically mild winters of 1998-99 and 1999-00.

Migration

During winter-spring 1999, 16 of 40 (40%) radio collared deer migrated. Twelve of 21 deer (57%) on the SW site and 4 of 19 deer (21%) on the NW site migrated to distinctly different or non-overlapping spring-summer-fall ranges. Mean migration distances in 1999 were 7.4 and 14.3 km for the NW and SW deer. Two deer from each site failed to return to their winter range or the study sites following the summer of 1999. The mild weather of winter 1999-00 may have accounted for this behavior.

Migration was observed in 11 of 39 deer (28%) in 2000. Eight of 22 deer (45%) and 4 of 18 deer (22%) migrated from the SW and NW sites, respectively. In 2000, mean migration distances were 6.0 and 12.3 km for the NW and SW deer. After pooling data for the 2 years, migration distances for the 2 sites did not differ ($P = 0.07$). Mean migration direction for NW and SW deer for both years combined was 61.8^{o} and 197.5^{o}, respectively. Direction of migration was significantly different ($P < 0.001$) between sites. Two deer made notable movements from the SW site. One deer moved 27.2 km, and the other migrated 52.8 km to the northwest in May 1999. The deer that moved 27.2 km returned to its winter range in January 2000, then migrated 40.1 km to the northwest in spring 2000.

During winter-spring 2001, 14 of 44 (31%) radio collared deer migrated. Eight of 19 (42%) and 6 of 24 (25%) deer migrated from the SW and NW sites, respectively. Mean migration distances did not differ ($P = 0.12$) between NW and SW deer (7.8 versus 14.2 km). In 2001, mean directions of migration of NW and SW deer (93.3º versus 160.9º) were not significantly different ($P = 0.07$).

Survival and Cause-Specific Mortality

Overall survival rates were not significantly different ($P = 0.35$) between 1999 ($S = 0.78 \pm 0.08$) and 2000 ($S = 0.86 \pm 0.05$). When year and site were considered, the only combination with a significant difference ($P = 0.04$) was for NW deer ($S = 0.93 \pm 0.07$) versus SW deer ($S = 0.64 \pm 0.12$) in 1999.

Seven mortalities were recorded for radio collared deer in 1999 (Table 6). Two SW deer were killed by vehicles just off Camp. A third mortality occurred on the SW site; although evidence was insufficient to permit a definitive determination of the cause of death, wolves had fed on the carcass. Hunters harvested the other 4 deer, 3 SW deer during the firearm season

outside of Camp Ripley boundaries, and one NW deer during the annual bowhunt within Camp Ripley.

During 2000, 8 mortalities of radio-collared deer occurred (Table 6). On 6 February, a deer was euthanized after becoming entangled in a fence. The other 7 mortalities occurred during the hunting season (4 SW deer and 2 NW deer), with 4 deer killed by hunters and 3 by unknown causes. One of the hunter-harvested deer was taken within the SW during the annual bowhunt. Relative importance of cause-specific mortality for 1999 and 2000 was 13.3% (2 of 15 deer) for automobile deer collisions, 53.3% (8 of 15 deer) for hunter harvest, 6.7% (1 of 15 deer) for accidental mortality, and 26.7% (4 of 15 deer) for unknown causes.

Twelve radio collared deer mortalities occurred in 2001 (Table 6). The first mortality occurred on 22 February in the NW site. Evidence suggested that predation by a cougar (*Felis concolor*) was the cause of death. Predation by domestic dogs or coyotes (*Canis latrans*) was the cause of the second mortality, which occurred on 20 March 2001 on the SW site. A third deer was killed in a collision with a car on 10 April. The fourth mortality occurred on 15 July; cause was unknown, but wolves had fed on the carcass. Seven of the mortalities occurred during the hunting season, with 3 deer (1NW and 2 SW deer) killed during the annual Camp Ripley bowhunt. Predation by either coyotes or domestic dogs was the cause of the twelfth mortality. Relative importance of cause-specific mortality for 2001 was 58% (7 of 12) for hunter harvest, 25% (3 of 12) for predation, 8% (1of 12) for vehicle collisions, and 8% (1 of 12) for unknown causes.

In addition to the 2 collared deer killed between January and March 2001, 10 non-collared deer carcasses were found. Two were found off the study areas, 3 and 5 were located on the NW and SW sites, respectively. Seven of the deer were fawns. Proximate causes of death ranged from apparent undernutrition to predation. However, femurs collected from all 12 deer had a mean marrow fat content of only 57.2 $\pm$ 8.7%, suggesting nutritional restriction may have been a contributing factor in all cases.

Two radio-collared deer mortalities had occurred in 2002 at the time this report was prepared. The first occurred on 4 February on the SW study site. The deer had been captured the previous week. Capture myopathy likely contributed to the mortality, with predation being the proximate cause of death. Predation also was the cause of death for the second mortality,

which occurred on 20 March on the SW study area. Evidence at the scene suggested domestic dogs or coyotes were the predators involved.

Feeders

Supplemental food was provided in 9 feeders located in 3 fields just across the Camp Ripley boundary from the SW site. Each feeder was filled with 10 kg of whole corn every other day throughout winter 2000-01. During 12 January-2 March 2001, 2,977 kg of corn were consumed. About 3,215 kg of corn were consumed during 6 January-26 March 2002. Typically, corn was consumed within 12 hours of being placed in the feeders, and there were signs of heavy deer use (trails and beds) within and near the fields containing the feeders. Landowners also supplied supplemental feed.

Fecal Collections and Analyses

Three collections of fecal specimens were conducted during winter 2000-01: 2-5 February, 26 February–1 March, and 15-17 March 2001. Each collection consisted of 45 samples from the SW site and 30 pellet samples from the NW site. Analyses for fiber content of the 225 fecal specimens collected produced significant results. Each specimen was analyzed for neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL). In general, fecal fiber increased with distance from the feeders, indicating a diet containing an increasing percentage of natural browse. For example, results from Collection 1 illustrate this increase; means of 45.5, 48.0, 49.8, 57.2, and 57.4% ADF were documented for zones NW1, SW1, SW2, SW3, and NW2. Zones closest to the feeders (SW1 and NW1) had fecal samples with the lowest ADF contents, with slight increases in SW2. Similar fiber contents were observed in the furthest zone from feeders on the SW site (SW3) and in Zone NW2. Similar patterns of ADF content were observed in the other 2 collections.

Specimens with fiber content indicative of supplemental feed use were collected up to 2.4 km from the nearest feeder. Significant differences were found for all fiber types (NDF, ADF, and ADL); however, ADF exhibited the greatest potential value for assessing the influence of supplemental feed in all comparisons. Significant differences in fiber content were observed among distance zones, collections, and study areas.

Mild weather in winter 2001-02 required slight changes to the fecal collection protocol. Three fecal collections were conducted: 1-3 February, 23-25 February, and 11-12 March. The first 2 of these collections were made when there was little to no snow cover. Attempts were made to collect the freshest samples available during these collections. The third collection occurred after a recent snowfall, following the protocol of the previous season. Laboratory analyses for fiber contents will be conducted this summer.

Table 1. Number and precision of telemetry locations of adult female white-tailed deer made by ground triangulation, winters 1998-99 to 2001-02, Camp Ripley, Minnesota.

	Intensively monitored deer			
Winter	Total locations	Mean number of locations per deer	Mean error ellipse size (ha)	Number of locations of other radio collared deer
1998-99	424	21	3.2	N/A
1999-00	780	45	3.0	N/A
2000-01	592	30	2.4	41
2001-02	1029	49	2.2	52

Table 2. Mean (± SE) winter home range size and migration behavior of adult (≥1 year old) female white-tailed deer on the Northwest (NW) and Southwest (SW) study areas, winters 1998-99 to 2001-02, Camp Ripley, Minnesota. Home range was determined by the minimum convex polygon method.

	Mean home range size (ha)		Spring migration			
			Percent migratory deer		Mean distance (km)	
Winter	NW	SW	NW	SW	NW	SW
1998-99	73.0 (13.1)	96.0 (22.6)	21	57	7.4	14.3
1999-00	67.0 (16.6)	106.0 (25.5)	22	45	6.0	12.3
2000-01	70.5 (23.4)	57.4 (48.3)	25	42	7.8	14.2
2001-02	117.8 (24.5)	127.7 (38.2)	-	-	-	-

Table 3. Pairwise comparisons of habitat use by adult (≥1 year old) female white-tailed deer at the home range level (availability at the study area level) on the Southwest study area, winters 1998-99 and 1999-00, Camp Ripley, Minnesota. Home ranges were determined by the minimum convex polygon method.

Resource	Aspen	Oak	Hardwood	R. pine	J. pine	W. spruce	Tamarack	Grassland	Brushland	Agriculture	Development	Water	Marsh
Aspen		+	+++	+++	+	+++	+++	+	+++	+++	+++	+++	+++
Oak	-		+++	+++	+	+++	+++	-	+	+++	+++	+++	+++
Hardwood	–	–		-	–	+	+	–	–	+	+	+	+
R. pine	–	–	+		-	+++	+	–	-	+++	+++	+++	+++
J. pine	-	-	+++	+		+++	+++	-	+	+++	+++	+++	+++
W. spruce	–	–	-	–	–		-	–	–	+	-	-	+
Tamarack	–	–	-	-	–	+		–	–	+	+	+	+
Grassland	-	+	+++	+++	+	+++	+++		+++	+++	+++	+++	+++
Brushland	–	-	+++	+	-	+++	+++	–		+++	+++	+++	+++
Agriculture	–	–	-	–	–	-	-	–	–		-	-	+
Development	–	–	-	–	–	+	-	–	–	+		+	+
Water	–	–	-	–	–	+	-	–	–	+	-		+
Marsh	–	–	-	–	–	-	-	–	–	-	-	-	

– means significantly less use
- means less use
+++ means significantly more use
+ means more use

Table 4. Pairwise comparisons of habitat use by adult (≥1 year old) female white-tailed deer at the buffered (100 m) location level (availability at the home range level) on the Southwest study site, winters 1998-99 and 1999-00, Camp Ripley, Minnesota. Home ranges were determined by the minimum convex polygon method.

Resource	Aspen	Oak	Hardwood	R. pine	J. pine	W. spruce	Tamarack	Grassland	Brushland	Agriculture	Development	Water	Marsh
Aspen		-	-	+++	-	-	+	+	+	-	+	+++	+
Oak	+		+	+++	+	+++	+	+++	+++	+	+++	+++	+
Hardwood	+	-		+++	+	+	+	+	+++	+	+++	+++	+
R. pine	–	–	–		–	–	–	–	-	–	-	-	–
J. pine	+	-	-	+++		+	+	+	+	+	+	+++	+
W. spruce	+	–	-	+++	-		+	+++	+	+	+++	+++	+
Tamarack	-	-	-	+++	-	-		+	+++	-	+	+	+
Grassland	-	–	-	+++	-	–	-		+	–	+	+	+
Brushland	-	–	–	+	-	-	–	-		–	-	+	-
Agriculture	+	-	-	+++	-	-	+	+++	+++		+++	+++	+
Development	-	–	–	+	-	–	-	-	+	–		+	-
Water	–	–	-	+	–	–	-	-	-	–	-		-
Marsh	-	-	-	+++	-	-	-	-	+	-	+	+	

– means significantly less use
- means less use
+++ means significantly more use
+ means more use

Table 5. Pairwise comparisons of habitat use by adult (≥1 year old) female white-tailed deer at the home range level (availability at the study area level) on the Northwest study site, winters 1998-99 and 1999-00, Camp Ripley, Minnesota. Home ranges were determined by the minimum convex polygon method.

Resource	Aspen	Oak	Hardwood	R. pine	J. pine	Grassland	Brushland	Agriculture	Development	Water	Marsh
Aspen		+++	+++	+	+	+++	+++	+++	+++	+++	+++
Oak	–		+	-	–	–	-	+	+	+	-
Hardwood	–	-		–	–	–	–	+	-	-	–
R. pine	-	+	+++		-	-	+	+++	+	+++	+
J. pine	-	+++	+++	+		-	+++	+++	+++	+++	+++
Grassland	–	+++	+++	+	+		+++	+++	+++	+++	+++
Brushland	–	+	+++	-	–	–		+++	+	+++	+
Agriculture	–	-	-	–	–	–	–		–	-	–
Development	–	-	+	-	–	–	-	+++		+	-
Water	–	-	+	–	–	–	–	+	-	–	-
Marsh	–	+	+++	-	–	–	-	+++	+	+++	

– means significantly less use
- means less use
+++ means significantly more use
+ means more use

Table 6. Cause-specific mortality of radio collared adult (≥1 year old) female white-tailed deer, 1 January 1999-30 April 2002, Camp Ripley, Minnesota.

		Cause of mortality (percentage)				
Winter	Total Mortalities	Automobile/deer collisions	Hunting	Predator	Accidental	Unknown
1999	7	2 (28.6)	4 (57.1)			1 (14.3)
2000	8		4 (50.0)		1 (12.5)	3 (37.5)
2001	12	1 (8.3)	7 (58.3)	3 (25.0)		1 (8.3)
2002	2	1 (50.0)		1 (50.0)		
Overall	29	4 (13.8)	15 (51.7)	4 (13.8)	1 (3.4)	5 (17.2)

Appendix B. Images

Image 1. Swallow nests

Image 2. Nixalite installed to prevent swallow nesting.

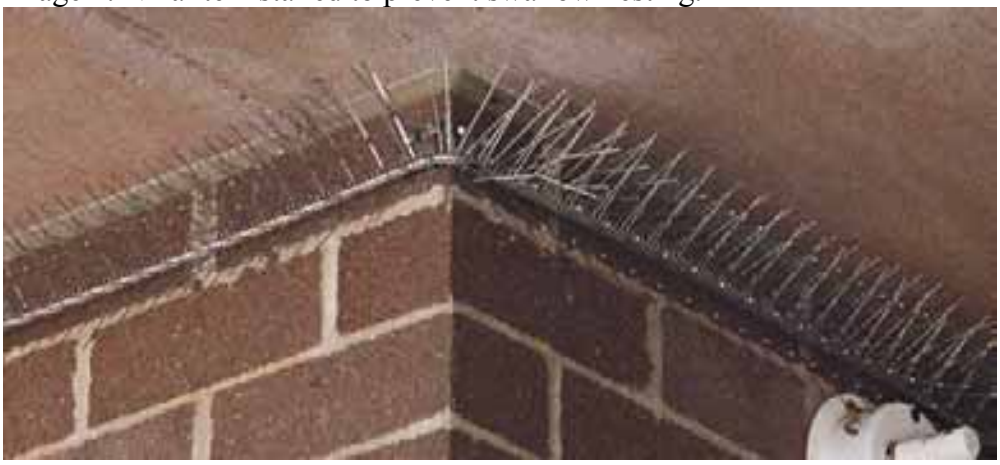


Image 3. White morph turkey observed near Range Control at Camp Ripley in 2002

Image 4. Predator exclusion cage used for Blanding's turtle nest protection

Image 5. Predator exclusion cage for Blanding's turtle nest. The red arrow points to the hatchling exit hole. This nest was dug on a slope, and in very sandy soils. Extra protection was provided around the edge to prevent predators from digging under the cage.

Image 6. Osprey chick banded at AHATS in 2002.