

MINNESOTA ARMY NATIONAL GUARD



CAMP RIPLEY TRAINING CENTER AND ARDEN HILLS ARMY TRAINING SITE 2017 CONSERVATION PROGRAM REPORT

Cover Photography: Monarch (*Danaus plexippus*) caterpillar on common milkweed (*Asclepias syriaca*), Camp Ripley Training Center, August 2017. Photography by Kari Gordon, Intern, Central Lakes College.

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

2017 Conservation Program Report
January 1 – December 31, 2017

Division of Ecological and Water Resources
Minnesota Department of Natural Resources
for the
Minnesota Army National Guard

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MINNESOTA DEPARTMENT OF NATURAL RESOURCES
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TABLE OF CONTENTS

TABLE OF CONTENTS.....	I
EXECUTIVE SUMMARY.....	V
INTRODUCTION.....	1
RESPONSIBILITIES	1
PARTNERSHIPS.....	1
PROGRAM AREAS	2
CAMP RIPLEY TRAINING CENTER	2
<i>Cultural Resources</i>	4
Program Overview	4
Field Survey	4
Partnerships.....	5
Submittals	7
American Indian Tribal Consultations	7
<i>Natural Resources</i>	8
Forestry	8
Reforestation	9
Timber Sales	9
Land Fund.....	13
Fuelwood Permits	13
Insects and Diseases	13
Vegetation Management	18
Prescribed Fire	18
Hazard Reduction.....	18
Training Enhancement	19
Invasive Species	21
Selective Invasive Plant Management.....	22
Water Resources	24
Lake and River Resources.....	24
Miller Lake.....	24
Mississippi River.....	24
Lake Alott	24
Fosdick Lake.....	24
Round Lake	26
Ragoon Lake	26
Ferrell Lake	26
Wildlife	26
Species in Greatest Conservation Need.....	26
Birds.....	27
Christmas Bird Count.....	27
Breeding Bird Monitoring	27
Trumpeter Swan (<i>Cygnus buccinator</i>)	33
Ruffed Grouse (<i>Bonasa umbellus</i>)	34
Osprey (<i>Pandion haleaetus</i>).....	36
Bald Eagle (<i>Haliaeetus leucocephalus</i>).....	36
Golden Eagle (<i>Aquila chrysaetos</i>).....	37
Winter Survey	39
Migration Tracking Project	39

Owl Surveys	40
Eastern Bluebird (<i>Sialia sialis</i>) Nest Boxes	45
Mammals.....	46
Gray Wolf (<i>Canis lupus</i>).....	46
Federal Court Decision.....	46
Wolf Monitoring Background	47
Wolf Status and Movements	47
Black Bear (<i>Ursus americanus</i>).....	51
Research	51
Movement and Reproduction	51
Beaver (<i>Castor canadensis</i>)	52
Bats	54
Northern Long-eared Bat Federal Listing.....	54
Mobile Acoustic Bat Transect Survey	56
Northern Long-eared Bat Research	59
Porcupine (<i>Erethizon dorsatum</i>)	67
Reptiles and Amphibians	67
Blanding's Turtle (<i>Emys blandingii</i>)	67
Anuran Surveys.....	77
Insects	82
Monarch Butterfly (<i>Danaus plexippus</i>).....	82
Bumble Bees	82
Native Bee Transect Surveys.....	83
Fisheries	85
Aquatic Plant Surveys	85
Pest Management	87
Vector-borne Diseases.....	87
Methods.....	87
Results.....	88
Laboratory Results	91
Discussion	92
Describing the Seasonality of Host Infection with <i>Ixodes scapularis</i> Borne Pathogens.....	93
Background	93
Objective	94
Methods.....	94
Results.....	94
<i>Land Use Management</i>	98
Army Compatible Use Buffer (ACUB).....	98
Introduction.....	98
Purpose.....	98
Update	98
The Conservation Fund (TCF)	99
Minnesota Board of Water and Soil Resources (BWSR)	99
Minnesota Department of Natural Resources Summary	99
Camp Ripley Sentinel Landscapes (CRSL)	99
Integrated Training Area Management (ITAM).....	104
Program Overview	104
Range and Training Land Assessment (RTLTA) Program.....	104
Range and Training Land Assessment Results.....	105
Land Rehabilitation and Maintenance (LRAM) Program	106
Land Rehabilitation and Maintenance Results	107
Training Requirements Integration (TRI).....	108
Sustainable Range Awareness (SRA)	108
Geographic Information System (GIS)	108
Data Management	109
End User Support	110
Information Technology Coordination.....	110
<i>Outreach and Recreation</i>	111
Hunting Programs	112
Disabled American Veterans Firearms Wild Turkey Hunt.....	112
Soldiers Firearms Wild Turkey Hunt	113
Disabled American Veterans Firearms Deer Hunt	114

Deployed Soldiers Muzzleloader Deer Hunt.....	115
Military Members Archery Deer Hunt.....	115
Youth Archery Deer Hunt.....	116
General Public Archery Deer Hunt	117
Disabled Veterans and Deployed Soldiers Fishing Event	119
ARDEN HILLS ARMY TRAINING SITE	120
<i>Cultural Resources</i>	120
<i>Land Use Management</i>	121
Land Use Control and Remedial Design	121
<i>Natural Resources</i>	121
Vegetation Management	122
Prescribed Fire	122
Terrestrial Invasive Species Control	122
Wildlife	123
Species in Greatest Conservation Need.....	123
Birds.....	124
Christmas Bird Count.....	124
Breeding Bird Monitoring.....	125
Trumpeter Swan (<i>Cygnus buccinator</i>)	130
Common Loon (<i>Gavia immer</i>)	131
Osprey (<i>Pandion haleaetus</i>).....	131
Bald Eagle (<i>Haliaeetus leucocephalus</i>).....	132
American Kestrel (<i>Falco sparverius</i>).....	133
Sandhill Crane (<i>Grus canadensis</i>).....	135
American Woodcock (<i>Scolopax minor</i>)	135
Common Nighthawk (<i>Chordeiles minor</i>).....	135
Chimney Swift (<i>Chaetura pelagica</i>)	135
Henslow's Sparrow (<i>Ammodramus henslowii</i>)	136
Mammals.....	137
Northern Long-eared Bat Research.....	137
Bat Capture and Processing.....	137
Radio-Tracking/Roost Tree Characterization.....	138
Study Area.....	138
Bat Capture Results.....	138
Radio-Telemetry/ Roost Characterization	140
Discussion	140
Passive Acoustic Bat Survey	141
White-tailed Deer (<i>Odocoileus virginianus</i>) Aerial Survey	142
Beaver (<i>Castor canadensis</i>)	143
Reptiles and Amphibians	144
Blanding's Turtle (<i>Emys blandingii</i>)	144
Anuran Surveys.....	144
Insects	146
Butterfly Survey.....	146
Monarch Butterfly (<i>Danaus plexippus</i>).....	149
Bumble Bees	150
<i>Outreach and Recreation</i>	151
Hunting Programs	151
Soldiers Archery Wild Turkey Hunt	151
Soldiers Archery Deer Hunt.....	153
Volunteer Archery Deer Hunt	153
ACKNOWLEDGEMENTS.....	154
LIST OF PRIMARY CONTRIBUTING AUTHORS.....	155
LITERATURE CITED.....	156

EXECUTIVE SUMMARY

The purpose of this report is to summarize annual accomplishments for the conservation program of the Minnesota Army National Guard (MNARNG) during calendar year 2017. The Camp Ripley and Arden Hills Army Training Site (AHATS) Integrated Natural Resources Management Plans (INRMP) (MNARNG 2003 and MNARNG 2007) provide a comprehensive five-year plan, and document the policies and future desired direction of the conservation programs for the MNARNG. The preparation, implementation and annual updates of INRMPs are required by the Sikes Act (16 USC 670a et seq.), Army policy, and several other federal directives including regulations and guidance issued by the U.S. Department of Defense. An annual review is required to track any changes and evaluate effectiveness of the program with the U.S. Fish and Wildlife Service (FWS), the Minnesota Department of Natural Resources (DNR) and other appropriate state agencies.

The primary goals of conservation program, as established by Camp Ripley, are to maintain ecosystem viability and ensure the sustainability of desired future conditions; to maintain, protect, and improve ecological integrity; to protect and enhance biological communities, particularly sensitive, rare, threatened and endangered species; to protect the ecosystems and their components from unacceptable damage or degradation; and to identify and restore degraded habitats.

The ability to achieve these goals depends directly on the health and condition of the natural resources. Protecting the ecological and biological integrity of the training lands ensures that those lands will continue to provide the vegetation, soil and water resources necessary for sustainable military training. Such protection will also preserve popular outdoor recreational activities at Camp Ripley.

The conservation program must remain flexible if it is to achieve long-term success. The program will achieve and maintain this flexibility by incorporating adaptive management techniques.

Adaptive management is a process by which new information from monitoring data, scientific literature, or both is used to evaluate the success of the management measures currently in place. This information is then used to determine changes in the management approach needed to ensure continued success of the program. The natural resources management program might also be required to adapt to unforeseen changes in military mission and legal requirements.

There has been an ongoing effort by the MNARNG to survey the lands and structures it controls for cultural and archaeological resources in order to accelerate the timeframe of compliance with federal preservation laws. Surveys were conducted in 2016 and 2017 in Maneuver areas J, G and F. An area in Training Area 61 has also been resurveyed. Several construction projects were submitted to the Minnesota State Historic Preservation Office (MNSHPO) as well as tribal consultants for review; all findings concurred that no cultural resources were affected by the proposed activities. An annual American Indian consultation between federally recognized tribes of Minnesota and tribes that have an historical interest in properties now maintained by the MNARNG was held at Camp Ripley Training Center, Minnesota.

Five tracts of timber were prepared for sale and sold, totaling 171 acres. Eleven individuals acquired fuelwood permits allowing harvest of 60 cords of wood. The Minnesota Department of

Military Affairs and Minnesota Department of Corrections worked together to facilitate a fuelwood program for campsites on Camp Ripley. A land fund established by the Minnesota Legislature in 2008 allows the Adjutant General to accumulate timber sale proceeds for the purposes of forest management. Expenditures from the land fund included forest regeneration, forest health, harvest treatment and pine seedling protection.

Prescribed fire was implemented on Camp Ripley with hazard reduction and training enhancement burns occurring on 13,578 acres and 677 acres, respectively. The Department of Biological Sciences at St. Cloud State University conducted large scale terrestrial invasive plant management for spotted knapweed and common tansy. Also native poison ivy (*Toxicodendron radicans*) was treated in locations which posed a threat to the health and safety of training personnel. Extensive search and treatment of common buckthorn commenced in cantonment along with training areas.

Eighty-eight and 63 species in greatest conservation need (SGCN) have been identified at Camp Ripley and AHATS, respectively. Additional research will be directed toward identifying other SGCN species and management or conservation actions that could be implemented to benefit these species. Camp Ripley songbird surveys were conducted on 90 permanent plots; a total 994 birds of 76 different species were recorded. A satellite radio-transmitted female golden eagle again traveled to her summer habitat above the Arctic Circle, where she occupied her nesting territory. Additional species were monitored including osprey, eastern bluebirds, trumpeter swans, bald eagles, owls and ruffed grouse.

Since 2001, Camp Ripley has supported two or three wolf packs. At the beginning of 2017, two radio-collared wolves remained on Camp Ripley. Due to a federal court decision, wolves in the western Great Lakes area (including Michigan, Minnesota and Wisconsin) were relisted under the Endangered Species Act, effective December 19, 2014. Wolves continue to be federally classified as threatened in Minnesota.

Ground and aerial tracking were used to monitor reproductive success, movements and survival of five radio-collared black bears. Camp Ripley also continued to participate in the summer habitat use study of northern long-eared bats, a federally threatened species. Three female northern long-eared bats were captured and radio-transmitted, and thirteen roost trees were identified. In addition, a mobile acoustic bat survey was conducted.

Surveyors again searched Camp Ripley for Blanding's turtles and their nests. Thirty Blanding's turtles were observed and four nests were protected. Eight Blanding's turtle hatchlings were radio-transmitted to determine movements after being directly released into known adult use wetlands. Frog and toad monitoring surveys were conducted. Fisheries management continued within Camp Ripley. In addition, Camp Ripley conducted its first bumble bee survey in collaboration with the Department of Natural Resources.

Camp Ripley was visited by the Minnesota Department of Health four times in an effort to collect blacklegged (deer) ticks and mosquitos to test prevalence of vector-borne diseases. Of the ticks tested, 56.3% and 28.9% of adults and nymphs, respectively, were infected with at least one disease

agent and 15.1% and 12.0% of adults and nymphs, respectively, were coinfecting with disease agents. The Center for Disease Control and Prevention is examining small mammal host infection rates with *I. scapularis* (blacklegged tick) borne pathogens prior to nymphal emergence in the spring, again at the peak of nymphal emergence, and at the end of the nymphal tick season. The ongoing risk of tick borne disease at Camp Ripley underscores the need for employees and visitors to continue taking precautions against tick bites.

Over 220 willing landowners representing over 25,000 acres are interested and waiting to participate in the Camp Ripley's Army Compatible Use Buffer program. ACUB accomplishments are presented in this document. Camp Ripley Sentinel Landscape Partnership leverages broader support to protect and improve the quality of the region's soil and water resources is also discussed.

Also included in this report is a summary of the Integrated Training Area Management program and how its five component programs are used to meet all environmental laws and regulations, and to maintain and improve the condition of natural resources for training at Camp Ripley. A summary of geographic information systems support of conservation program and resource management plans is discussed.

The environmental team gave 61 presentations, tours and briefs to 2,958 people entailing more than 185 staff hours. Camp Ripley hosted the 13th annual Disabled American Veterans (DAV) wild turkey hunt, ninth annual soldiers turkey hunt and the 16th annual youth archery deer hunt. Camp Ripley also held the 11th annual military member archery deer hunt in conjunction with the 26th annual DAV firearms deer hunt. Camp Ripley's general public archery deer hunt, which is one of the largest archery deer hunts in the United States, was again held in 2017.

AHATS has been surveyed for cultural resources in its entirety and no eligible resources are present at this time. The Land Use Control Remedial Design for the New Brighton/Arden Hills Superfund site condition is under review, but at this time, must be honored by the MNARNG relative to long-range planning, land use and land management practices.

No prescribed fire occurred at AHATS in 2017. AHATS was surveyed during the National Audubon Society's annual Christmas bird count. Breeding bird monitoring was conducted on 13 plots. State endangered Henslow's sparrows were documented. One pair of trumpeter swans produced seven cygnets. Osprey chicks were banded again in 2017 and AHATS staff and volunteers continued a kestrel monitoring project. The AHATS white-tailed deer aerial survey did not occur due to the lack of snow cover and poor survey conditions.

No Blanding's turtle survey was conducted. AHATS staff participated in the summer habitat use study of northern long-eared bats, a federally threatened species. No northern long-eared bats were captured; however three little brown myotis were radio-transmitted. Stationary acoustic surveys also occurred.

AHATS staff participated in the statewide frog and toad monitoring survey. A butterfly survey was conducted by the Saint Paul Audubon Society. The DNR staff conducted a bumble bee capture survey, but no rusty patch bumble bees, a federally endangered species, were observed. The 9th annual

soldier archery wild turkey hunt, 12th annual deployed soldier archery deer hunt, and volunteer archery deer hunt were also held at AHATS.

INTRODUCTION

This conservation program report provides Integrated Natural Resources Management Plan (INRMP) accomplishments for the calendar year 2017 for Camp Ripley and Arden Hills Army Training Site (AHATS). It is intended to support and complement the military mission of the Minnesota Army National Guard (MNARNG) while also promoting sound conservation stewardship principles. It is a document that summarizes the activities of the Camp Ripley and AHATS conservation program, and also serves as a component of the annual update to the INRMP. This document can be found in Appendix A of the Camp Ripley (MNARNG 2018a) and AHATS INRMPs (MNARNG 2018b). The INRMP goals and objectives for Camp Ripley and AHATS are updated annually and can be found in Appendix B to the INRMP (MNARNG 2018a).

RESPONSIBILITIES

Camp Ripley Command – Environmental (CRE) personnel are responsible for conservation program planning and implementation for the MNARNG. This includes, but is not limited to, preparing plans, developing projects, implementing projects, conducting field studies, securing permits, geographic information system (GIS) support, preparing reports, and facilitating land use activities between military operations and other natural resource agencies. The environmental personnel who work directly for the Garrison Commander are responsible for MNARNG's conservation programs statewide. Environmental personnel who work directly for the Facilities Management Office have statewide responsibility for MNARNG's compliance, restoration and pollution prevention programs.

PARTNERSHIPS

In the interest of sound conservation, the MNARNG has developed partnerships with a variety of organizations and resource agencies. Some of these partnerships have resulted in formal interagency agreements with the Minnesota Department of Natural Resources (DNR), Divisions of Ecological and Water Resources and Forestry, St. Cloud State University and Central Lakes College in Brainerd, Minnesota. These have been extremely cost effective and beneficial. The MNARNG also relies on expertise of personnel from other state and federal agencies and organizations who contribute significantly to the support of the MNARNG conservation program, including: the Minnesota Board of Water and Soil Resources, U.S. Fish and Wildlife Service, Minnesota Department of Corrections, Minnesota Department of Transportation, Minnesota Department of Agriculture, Minnesota Department of Health, Minnesota Pollution Control Agency, The Nature Conservancy, Morrison Soil and Water Conservation District, Crow Wing Soil and Water Conservation District and Cass County Soil and Water Conservation District. Other partners include the Minnesota Deer Hunters Association, Minnesota State Archery Association and Disabled American Veterans of Minnesota.

The success of the conservation program for the MNARNG is also attributed to a partnership between the environmental and military operations offices, represented by a shared training area coordinator position. This partnership has enabled the MNARNG to provide a quality training experience for its soldiers without sacrificing the integrity of the conservation program.

PROGRAM AREAS

For the purpose of documenting its accomplishments, the conservation program of the MNARNG is divided into the following program areas within each installation: cultural resources, natural resources, land use management and outreach and recreation.

CAMP RIPLEY TRAINING CENTER

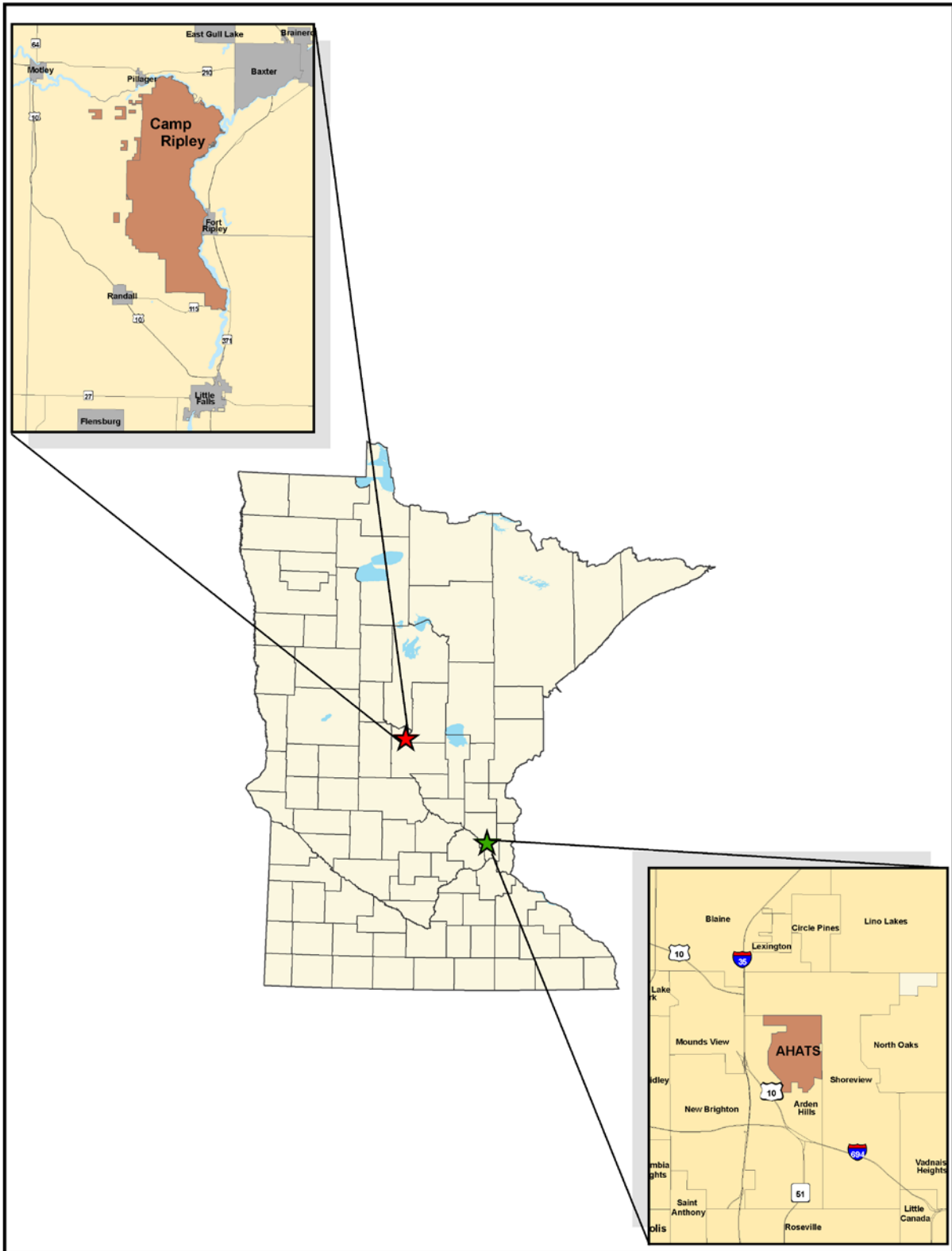
Camp Ripley is located in the central portion of Minnesota approximately 100 miles northwest of the Minneapolis/Saint Paul metropolitan area (Figure 1). According to the 2003 property boundary survey, Camp Ripley occupies 52,699 acres (approximately 82 square miles) within Morrison County and 59 acres within Crow Wing County (52,758 acres total). Camp Ripley is bordered on the north by 11 miles of the Crow Wing River and on the east by 18 miles of 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 Minnesota Power, an ALLETE 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 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 other areas.

Camp Ripley's annual average for military and civilian utilization is 365,000 man-days. Since 2007, more than 3.68 million man-days of training have occurred. Organizations include all branches of the military, many international military units, as well as civilians from a variety of organizations including federal, state and local law enforcement agencies. Camp Ripley supports the federal mission for military 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 state training mission focuses primarily on law enforcement activities, natural resource education, environmental agencies and emergency management activities. The central mission of the natural resources management program is to ensure that the multiple demands for land use can be met without sacrificing the integrity of Camp Ripley's training mission and natural resources.

Inventory and monitoring surveys of flora and fauna are an ongoing part of the installation's INRMP that was completed in December 2003 (MNARNG 2003) with annual updates in 2007 (Dirks et al. 2008), 2008 (Dirks and Dietz 2009), 2009 (Dirks and Dietz 2010), 2010 (Dirks and Dietz 2011), 2011 (MNDNR and MNARNG 2012), 2012 (MNDNR and MNARNG 2013), 2013 (MNDNR and MNARNG 2014), 2014 (MNDNR and MNARNG 2015), 2015 (MNDNR and MNARNG 2016), 2016 (MNDNR and MNARNG 2017) and 2017 (MNARNG 2018a). The data obtained will be used to help manage the conservation program and natural resources of the MNARNG.

Figure 1. Location of Camp Ripley Training Center and Arden Hills Army Training Site (AHATS), Minnesota.



CULTURAL RESOURCES

By Patrick Neumann, Minnesota Department of Military Affairs

Program Overview

Cultural resources management is the identification of culturally, historically, architecturally and archaeologically significant properties, the management of those properties in a manner that is consistent with applicable state and federal laws and regulations, the mission of Army National Guard, and respectful of the intrinsic values of the properties. The MNARNG must comply with federal laws regarding cultural resources if conducting operations considered a federal undertaking. A federal undertaking means a project, activity or program funded in whole, or in part, under the direct or indirect jurisdiction of a federal agency, including those carried out by, or on behalf of, a federal agency; those carried out with federal assistance; and those requiring a federal permit, license or approval. Construction projects, improvements and activities carried out by the MNARNG through federal funding is defined as a federal undertaking requiring compliance with federal historic preservation laws. The primary laws regarding cultural resources management are as follows:

1. The National Historic Preservation Act of 1966 (as amended)
2. The Native American Graves Protection and Repatriation Act
3. The National Environmental Policy Act
4. The American Antiquities Act of 1906
5. The Archaeological and Historic Preservation Act of 1974
6. The American Indian Religious Freedom Act of 1978
7. The Energy Independence and Security Act of 2007

There are also several executive orders, Department of Defense directives, Army regulations, and Army memorandums concerning how the MNARNG executes these laws and manages the cultural resources under its care. The MNARNG also complies with state historic preservation laws which can be found at <https://www.revisor.mn.gov/pubs/>. While this section of the annual update includes revised numbers, totals, and progress toward goals as well as achievements, it is meant to be only an update. For a more complete information regarding the MNARNG cultural resources program and how it is administered please reference the MNARNG Integrated Cultural Resources Management Plan (ICRMP) (Camp Ripley Environmental Office 2009).

Field Survey

There has been an ongoing effort over the last several years by the MNARNG to survey the lands and structures it controls for cultural and archaeological resources. This survey work greatly accelerates the timeframe of compliance with federal preservation laws. A typical survey for historic structures or land for cultural resources can take anywhere from several weeks to several months, depending on the size and complexity of the survey required. The Camp Ripley Command – Environmental (CRE) office of the MNARNG chose to survey the most utilized areas of Camp Ripley as well as its readiness centers across the state (Figure 2). This has led to a greatly reduced turnaround

time for permitting construction projects and other maintenance activities. When a federal undertaking is considered, a consultation must occur between the MNARNG and the Minnesota State Historic Preservation Office (MNSHPO) as well as tribal representatives and other interested parties. If the undertaking occurs on un-surveyed land or historic structures, it could take several months or longer to acquire concurrence from the MNSHPO that the MNARNG's plans do not affect any cultural or historic resources. On surveyed land this is reduced to a 30-day review period barring any concerns by the MNSHPO or interested parties.

Surveys were conducted in 2016 and 2017 in Maneuver areas J, G, and F. Though the field portion of the survey and the report review by the MNARNG Cultural Resources Manager have been completed, the final report is required to be reviewed by the Minnesota State Historical Society as well as MNARNG Tribal partners. This review will be completed shortly and the survey officially completed barring any objections or questions from reviewers.

An area in Training Area 61, known as the crow wing west section has also been resurveyed. This area was included in the no disturbance due to cultural resources category as a result of an early survey citing a high probability of cultural remains. This survey work was included in the Maneuver Areas J, G and F survey and will be reviewed along with it. The results of these contracts are pending.

With the completion of this contract, the Section 110 inventory required by the National Historic Preservation Act for Camp Ripley will be completed. This inventory is invaluable in the planning process in order to identify culturally significant areas at Camp Ripley and to avoid them early in the planning process for projects that may disturb these resources.

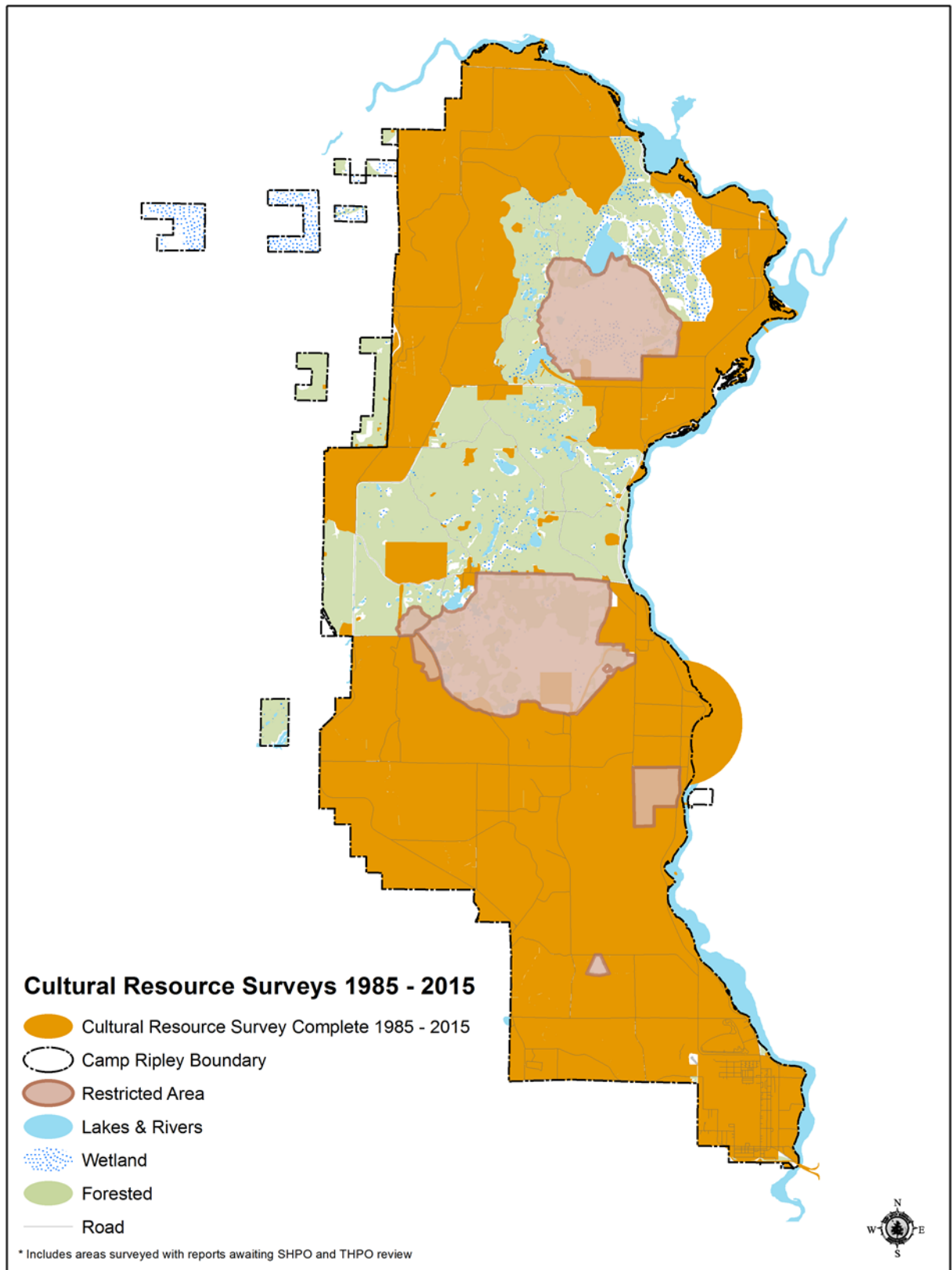
A 30 acre parcel in New Ulm Minnesota was surveyed this year in order to fill the MNARNG cultural resources requirements for a new Field Maintenance Shop that will replace and combine the New Ulm and Northfield shops. The survey located no cultural resources and the project will have no adverse effect on any known resources.

At the end of 2017, approximately 36,533 acres of MNARNG properties have been evaluated for cultural resources or are awaiting review by the MNSHPO and tribes with which the MNARNG consults. All of the data collected in the previous year's survey will be recorded in the cultural resources geographic information system database.

Partnerships

A graduate student from St. Cloud State University will serve an internship at Camp Ripley to gain experience and produce work that will further progress toward a Master of Science degree in cultural resources management. The project chosen by the student in consultation with SCSU professors and the MNARNG is the completion of a National Register Nomination form for the Governor's lodge (Valhalla). The Governor's lodge at Camp Ripley is a log lodge built in the 1930s by the Civilian Conservation Corps as part of the original cantonment construction. It is currently eligible for the register and therefore managed by the MNARNG as an historic structure.

Figure 2. Culturally evaluated areas, Camp Ripley Training Center, Minnesota, 1985 – 2017.



Submittals

Several construction projects have been submitted to the MNSHPO as well as tribal consultants for review in 2016 – 2017. These projects included various earth moving training activities, maintenance of historic structures, as well as downrange construction. All of these projects have been reviewed and MNARNG's finding of no cultural resources being affected received concurrence from MNSHPO and tribal consultants.

Thanks in large part to the previous survey work completed over the last several years, all of the projects were reviewed and found to have no adverse effects in a very short timeframe. Without the early and continuous involvement in the planning stages, the consultation process would have been much longer and much more expensive.

American Indian Tribal Consultations

Face-to-face American Indian consultations are held annually between federally recognized tribes of Minnesota as well as tribes that have an historical interest in properties now maintained by the MNARNG. This year's tribal consultation was held at Camp Ripley on May 31, 2017. The consultation was contracted to be facilitated by Commonwealth Heritage Group, Inc. The decision to hold the consultation at Camp Ripley was made in the previous year's consultation after acknowledging that many of the American Indian Historic Preservation Officers were relatively new and had never seen Camp Ripley. The MNARNG cultural resources management office received replies from six tribes represented by seven individuals in total. The tribes who replied and attended were the Mille Lacs Band of Ojibwe, the Leech Lake Band of Ojibwe, Fond du Lac Band of Lake Superior Chippewa, Bois Forte Band of Chippewa, White Earth Nation, Flandreau Santee Sioux and Shakopee Mdewakonton Sioux. Tribes were invited to discuss the state of the MNARNG cultural resources management program, the conservation program and a way forward for future annual tribal consultation. There was also a tour of some of the cultural resources that are often discussed during consultation, as first hand understanding of the condition of the resource. The meeting was recorded and meeting minutes were provided through contract by Dr. Katie Egan-Bruhy and Mark Bruhy, Commonwealth Heritage Group, Inc.

Tribal consultations are also part of the section 106 submittal process. Tribes are allowed the same 30-day review period allotted to the MNSHPO to address any concerns regarding tribal burials, sacred sites, or archaeological sites. During 2016, there were several instances where tribes did raise concerns about potential impacts, all of which were addressed and found to have no adverse effects to any cultural resources.

The Garrison Commander of Camp Ripley, COL St Sauver, extended an invitation to all of the federally recognized Tribal partners to send the MNARNG their Tribal flags for display. Flags that were received will be displayed at the Camp Ripley town hall along with the flags of other partner nations and states. The flags will also be displayed at events and special occasions where Tribal representatives are present.

NATURAL RESOURCES

Natural resource planning is an integral part of the conservation program for the MNARNG. The MNARNG uses the INRMP as the guidance document for implementing the conservation program. The planning process used in developing the INRMP focuses on using key stakeholders from the MNARNG, Minnesota Department of Natural Resources (DNR), the U.S. Fish and Wildlife Service (USFWS) and other organizations that have an interest in the MNARNG's conservation program. Together, these stakeholders represent the Integrated Natural Resources Management Planning Committee. The primary responsibility of the Planning Committee is to ensure that the INRMP not only satisfies the military mission but also provides a foundation for sound stewardship principles that adequately address the issues and concerns that are raised by all stakeholders. Annually, stakeholders discuss and review the INRMP for Camp Ripley, and present their annual accomplishments and work plans for the next year.

Forestry

The nearly 53,000 acre footprint of Camp Ripley is made up of a variety of cover types with approximately 27,875 acres of forests representing the majority of the land cover. Of these forested areas, oak and northern hardwoods stands represent the majority of the forest. Aspen and birch stands also make up a large proportion of the forest on Camp with interspersed stands of conifer species throughout the installation. Current management strategies maintain an extended age rotation in the forest of Camp Ripley with the majority of stands ranging between 60 and 80 years in age and all forestry activities are done through inter-agency agreement (IAA) with the DNR Division of Forestry.

Projects scheduled in 2017 were primarily focused on forest health and regeneration treatments (Table 1). Hardwood thinning's were prescribed on approximately 160 acres to reduce basal area to approximately 90 square feet per acre. Forest regeneration treatments were largely carried out utilizing clear-cutting with approximately 10% of standing timber reserved in patches throughout the harvest area to take advantage of both coppice sprouting and reseeding by mast trees. These treatments were carried out on approximately 116 acres. Two years' worth of projects were reviewed and identified ample acreage for harvest.

Table 1. Scope of work for forest development, Camp Ripley Training Center, Minnesota, 2017.

Project Number	Project Description	Estimated Cost
CR-Dev17-001	Forest Regeneration treatment on stand 1934 A55	3,120.00
CR-Dev17-002	Forest health/thinning treatment on stands 1599 O65, 1628 O75	24,000.00
CR-Dev17-003	Forest regeneration/health treatment on stand 1730 O54	4,160.00
CR-Dev17-004	Forest health/thinning treatment on stands 1203 O56, 1166 O59	14,725.00
CR-Dev17-005	Forest regeneration treatment on stand 1132 A54	3,600.00
CR-Dev17-006	Forest regeneration/health treatment on stands 579 A55, 615 JP53	3,700.00
CR-Dev17-007	Forest regeneration/health treatment on stands 209 A54	11,460.00
CR-Dev17-008	Provide browse protection to planted jack pine seedlings on site	600.00

Table 1. Scope of work for forest development, Camp Ripley Training Center, Minnesota, 2017.

Project Number	Project Description	Estimated Cost
CR-Dev17-009	Provide browse protection to planted pine seedlings on site 2162	450.00
CR-Dev17-010	Provide browse protection to planted pine seedlings on site 233	500.00
CR-Dev17-011	Provide browse protection to planted pine seedlings on site 3006	525.00
CR-Dev17-012	Provide browse protection to planted pine seedlings on site 2722	1,350.00
CR-Dev17-013	Provide browse protection to planted pine seedlings on site 637	925.00
CR-Dev17-014	Plant and provide browse protection on site 14 COA	2,500.00
CR-Dev17-015	Plant and provide browse protection on site 28 UG	2,500.00
CR-Dev17-016	purchase and install fencing for seedling protection on site 1357	2,500.00
CR-Dev17-017	Evaluate and develop projects to improve white pine stands	700.00
CR-Dev17-018	Supplies: paint, flagging for timber sale development	1,200.00
CR-Dev17-019	Develop and inventory 2000 acres in 2017	8,000.00
CR-Dev17-020	Develop 2 year stand exam list for 2018 – 2019	2,500.00
FOREST DEVELOPMENT TOTAL		\$86,515.00

Reforestation

By Jake Kitzmann, Minnesota Department of Military Affairs

Browse protection was applied at eight sites covering 70 acres on Camp Ripley Training Center (CRTC) to protect recently planted seedlings from deer browsing. These sites were planted with a variety of conifer species including red pine (*Pinus resinosa*), white pine (*Pinus strobus*), and jack pine (*Pinus banksiana*) at densities ranging from 350 to 800 trees per acre. For many of the sites this is the third year of browse protection being applied and these applications will continue until the trees have reached approximately 48” in height. This ensures that the terminal bud is out of easy reach of white-tailed deer.

Timber Sales

By Jake Kitzmann, Minnesota Department of Military Affairs

In September, the annual timber auction was conducted by the DNR, Division of Forestry, at Range Control. Five tracts were prepared for sale and sold. The auction results are listed in Table 2 and Figure 3.

The status of existing permits on Camp Ripley is listed below (Tables 3 – 4).

Table 2. Auction timber sales, Camp Ripley Training Center, Minnesota, 2017.

Permit #	Acres	Biomass (tons) ^a	Cords/Species	Revenue	Successful Bidder
B013725	12.6	275	420 Oak Species 13 Mixed Hardwoods	\$13,501.77	Hennen Enterprises LLC
B013726	9.0	120	215 Aspen 28 Paper Birch 12 Mixed Hardwoods	\$4,028.64	Minnesota Timber LLC
B013727	78.5	275	305 Oak Species 45 Aspen 42 Paper Birch 35 Maple 15 Mixed Hardwoods	\$6,622.27	Hennen Enterprises LLC
B013728	21.6	275	320 Aspen 120 Red Oak 105 Jack Pine 24 Mixed Hardwood	\$22,549.91	Shawn Fletcher Trucking
B013729	49.5	155	105 Aspen 67 Oak 54 Maple 28 Paper Birch 1 Ash	\$3,175.36	Minnesota Timber LLC
2017 TOTAL	171.2	1100	1,954 cords	\$49,877.95^b	

^a Biomass is not totaled into final cords due to different units and whether it is included or added in to sale.

^b Amount is for only the sold sales and does not include unsold wood.

Figure 3. Location of timber sales, Camp Ripley Training Center, Minnesota, 2017.

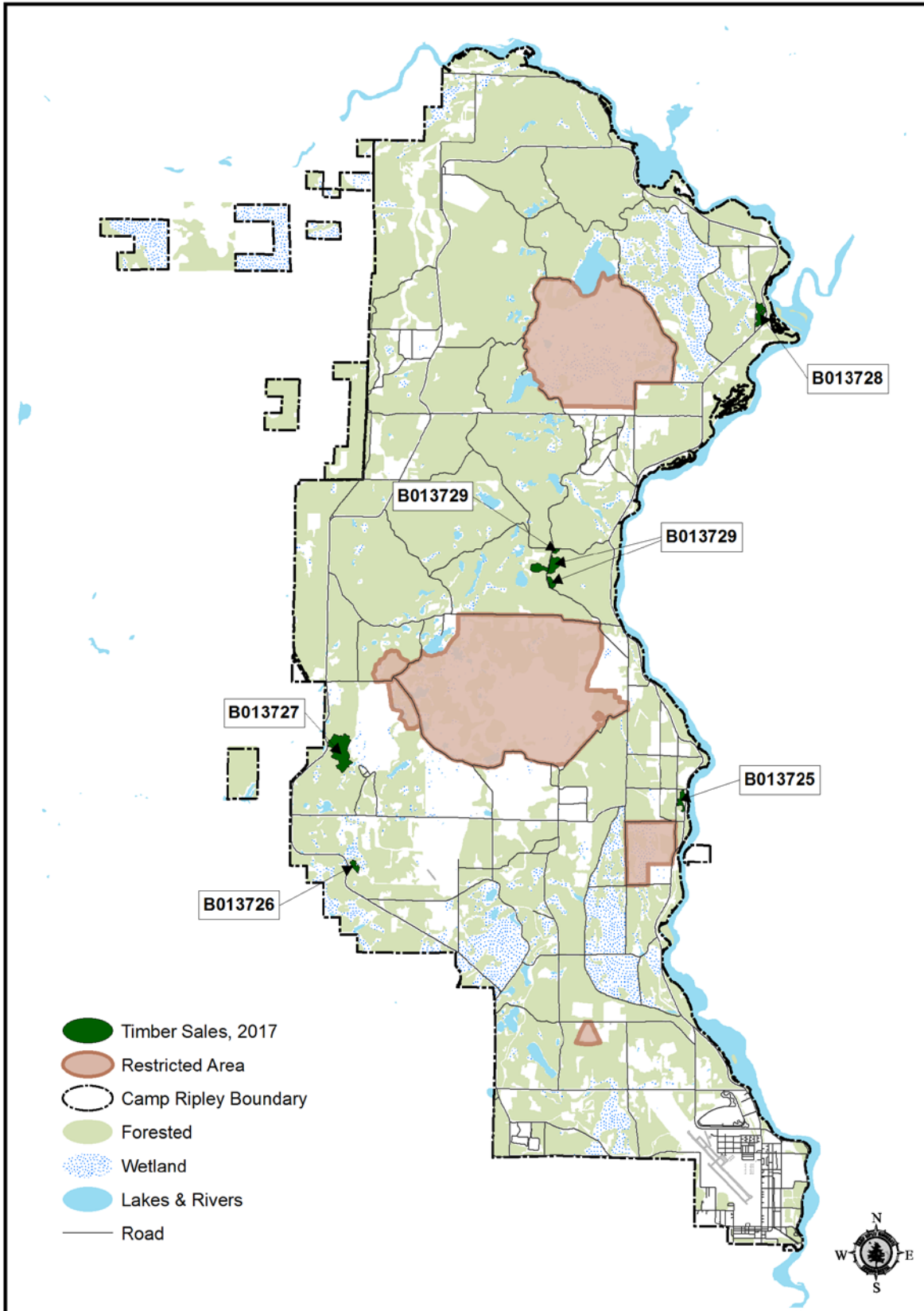


Table 3. Timber sales, Camp Ripley Training Center, Minnesota, 2007 – 2017.

Year	2007	2008	2009	2010	2011	2012	2013	2014 ^a	2015	2016	2017
Acres	188	641	402	237	340.5	168.8	190.8	338.2	266.2	252.1	171.2
Volume	3,624 cds.	12,893 cds.	6,482 cds.	5,505 cds.	6,893.5 cds.	3,452 cds	2,676 cds	4,362 cds	5,340 cds	6,271 cds	1,954 cds
Appraised Value	\$67,140.00	\$206,326.00	\$87,895.00	\$78,846.30	\$88,648.05	\$64,564.55	\$35,129.10	\$124,195.17	\$102,054.39	\$97,237.62	\$32,327.60
Sold Value	\$125,483.56	\$406,703.38	\$99,786.36	\$124,909.25	\$98,893.20	\$63,291.00	\$6,385.75	\$116,429.62	\$133,305.34	\$229,493.95	\$49,877.95
Type of Harvest	Regenerate Aspen (138 ac.) Pine Thinning (40 ac.) Military Tactical Training Base (TTB) Development (10 ac.)	Regenerate Aspen (133 ac.) Military Corridor Development (43 ac.) Range Development (464 ac.)	Regenerate Aspen (258 ac.) Military Corridor Development (83 ac.) Pine Thinning (61 ac.)	Regenerate Aspen (32.5 ac.) Digital Multipurpose Training Range (Center Range) (204.5 ac.)	Regenerate Aspen (80.7 ac.) Digital Multipurpose Training Range (Center Range) (228.3 ac.) Remove Aspen from Oak Overstory (31.5 ac.)	Regenerate Aspen (71.6 ac.) Regenerate Jack Pine and Aspen (62.3 ac.) Harwood Thinning (34.9 ac.)	Regenerate Aspen (56.7 ac.) Military Corridor Development (56.2 ac.) Reoffered Sales (77.9 ac.)	Regenerate Aspen (57.9 ac.) Pine Thinning (248.8 ac.) Timber Stand Improvement (31.5 ac.)	Regenerate Aspen (125.5 ac.) Regenerate Jack Pine and Aspen (39.0 ac.) Pine Thinning (56.2 ac.) Variable Density Thinning (45.5 ac.)	Regenerate Aspen (66.4 ac.) Regenerate Jack Pine and Aspen (89.3 ac.) Military Development (96.4 ac.)	Regenerate Aspen (9.0) Regenerate pine and aspen (21.6) Regenerate Oak (12.6) Hardwood thinning (128.0)

^aOnly includes sold stands.

Land Fund

By Jake Kitzmann, Minnesota Department of Military Affairs

During the 2008 session, the Minnesota Legislature enacted legislation (MS 190.25 subd. 3A; Appendices H and I in Dirks and Dietz 2010) to allow the Adjutant General to appropriate funds from a special revenue fund. The land fund was created to accumulate the proceeds resulting from timber sales on Camp Ripley for the purpose of forest development. The legislation provides a funding source for forest management activities, including timber harvest and reforestation on Camp Ripley.

Receipts for timber sales beginning in 2008 are displayed in Table 4. The encumbrances since 2008, 2017 forest development projects and expenditures from the land fund are outlined in Table 5.

Fuelwood Permits

By Tim Notch, Minnesota Department of Military Affairs

For the permit period from April 1 – December 31, there were 11 individuals that acquired fuelwood permits (ten-5 cord; one-10 cord), totaling \$300.

In October, Sentence to Serve (STS) crew leaders returned to Camp Ripley for annual chainsaw training. The STS crew felled trees within Training Area 61 along the river that sustained insect damage in previous years.

Insects and Diseases

By Jake Kitzmann, Minnesota Department of Military Affairs

During the 2014 – 2015 field seasons, jack pine budworm (*Choristoneura pinus*) was identified in jack pine (*Pinus banksiana*) stands in the northwestern and northeastern corners of Camp Ripley. In healthy stands these infestations are generally not fatal, and further monitoring will be performed during the coming seasons to determine if treatment is necessary. Further infestation by bark beetles has been noted in the stand in the northeast. The combined infestation has led to widespread mortality in this stand. Current infestations, however, have not spread beyond the fringes of this isolated stand. Furthermore, the first case of oak wilt was identified in Morrison County in 2014; it has not yet been detected on Camp Ripley. In 2016, this diseased stand was sold and aggressive thinning of the stand occurred in 2017. The few remaining trees will be monitored in the coming years.

Table 4. Land fund timber sales receipts, Camp Ripley Training Center, Minnesota, 2008 to October 2017.

Year	Permit #	Expires	Status	Sold Value	Bid Guarantee	Security	Added Timber	Over/Under Run	Final Amount
2008									
	X011138	Mar-2011	Closed	\$17,532.00				\$3,521.95	\$21,053.95
	X011139		Closed	\$15,231.78				\$662.10	\$15,893.88
	X011140		Closed	\$34,940.50				\$0.00	\$34,940.50
	X011141		Closed	\$32,530.10				(-\$9,993.74)	\$22,536.36
	B010655		Closed	\$157,773.00				(-\$38,572.28)	\$119,200.72
	B010656		Closed	\$153,830.43				\$7,735.90	\$161,566.33
								2008 Subtotal	\$375,191.74
2009									
	B011023	Mar-2011	Closed	\$6,332.45				(-\$642.62)	\$5,689.83
	B011024	Mar-2011	Closed	\$14,913.60				\$0.00	\$14,913.60
	B011025	Mar-2012	Closed	\$14,046.74				(-\$865.02)	\$13,181.72
	B011026	Mar-2011	Closed	\$16,214.00				\$0.00	\$16,214.00
	B011027	Mar-2011	Closed	\$3,687.90				\$0.00	\$3,687.90
	B011028	Mar-2011	Closed	\$33,424.40				(-\$2,995.56)	\$30,428.84
	B011029	Mar-2012	Canceled	\$11,167.17					\$0.00
								2009 Subtotal	\$84,115.89
2010									
	B011349	Mar-2012	Closed	\$61,231.90				\$5,282.17	\$66,514.07
	B011350	Mar-2012	Closed	\$49,233.65				\$5,485.46	\$54,719.11
	B011351	Mar-2012	Closed	\$5,825.30				\$0.00	\$5,825.30
	B011353	Mar-2012	Expired	\$8,618.40					\$1,101.00
								2010 Subtotal	\$128,159.48
2011									
	B011608	May 31-2013	Expired	\$10,245.40					\$2,356.44
	BO11685	May 31-2013	Closed	\$10,438.95				\$0.00	\$10,841.92
	BO11686	May 31-2012	Closed	\$60,650.40				\$0.00	\$60,650.40
	BO11687	May 31-2013	Closed	\$9,695.35				\$0.00	\$9,695.35
	BO11688	May 31-2013	Closed	\$7,863.35				\$0.00	\$7,863.35
								2011 Subtotal	\$91,407.46

Table 4. Land fund timber sales receipts, Camp Ripley Training Center, Minnesota, 2008 to October 2017.

Year	Permit #	Expires	Status	Sold Value	Bid Guarantee	Security	Added Timber	Over/Under Run	Final Amount
2012	BO12053	March 31, 2014	Closed	\$27,140.15				(-\$3,825.50)	\$23,314.65
	BO12054	March 31, 2014	Closed	\$6,654.75				(-\$769.97)	\$5,884.78
	BO12055	March 31, 2014	Canceled	Unsold					
	BO12056	March 31, 2014	Canceled	Unsold					
	BO12057	March 31, 2014	Closed	\$29,496.10				(-\$6,522.22)	\$23,636.88
								2012 Subtotal	\$52,836.31
2013									
	BO12438	March 31, 2015	Closed	\$3,905.00				\$109.30	\$4,014.30
	BO12439	March 31, 2015	Canceled	Unsold					
	BO12440	March 31, 2015	Canceled	Unsold					
	BO12441	March 31, 2015	Canceled	Unsold					
	BO12442	March 31, 2015	Canceled	Unsold					
	BO12443	March 31, 2015	Closed	\$2,480.75				(-\$172.92)	\$2,307.84
	BO12444	March 31, 2015	Canceled	Unsold					
								2013 Subtotal	\$6,322.14
2014									
	BO12744	May 31, 2019	Sold	\$3,055.25		\$458.29			
	BO12745	May 31, 2016	Closed	\$8,242.25				\$1,834.01	\$10,076.26
	BO12746	May 31, 2019	Active	\$2,995.30		\$1,914.5	420.25		
	BO12747	May 31, 2016	Closed	\$62,954.91					\$62,954.91
	BO12748	May 31, 2016	Closed	\$13,913.20				\$3,276.11	\$17,789.31
	BO12749	May 31, 2016	Closed	\$18,372.60			\$594.75	\$878.50	\$19,845.85
	BO12750	May 31, 2016	Unsold	Unsold					
	BO12751	May 31, 2016	Closed	\$12,484.66			\$5,194.60		\$14,655.25
								2014 Subtotal	\$125,321.58
2015									
	BO13112	May 31, 2017	Closed	\$36,186.92			\$1,005.90	\$6,385.35	\$43,578.17
	BO13113	May 31, 2018	Sold	\$14,063.97		\$2,109.60			
	BO13114	May 31, 2017	Closed	\$30,918.70				\$6,902.04	\$37,820.74
	BO13115	May 31, 2017	Closed	\$21,878.25			\$429.97	(-\$1,404.52)	\$20,903.70
	BO13116	May 31, 2017	Closed	\$30,257.50				\$16,339.05	\$46,608.30

Table 4. Land fund timber sales receipts, Camp Ripley Training Center, Minnesota, 2008 to October 2017.

Year	Permit #	Expires	Status	Sold Value	Bid Guarantee	Security	Added Timber	Over/Under Run	Final Amount
								2015 Subtotal	\$148,910.91
2016									
	B013380	May 31, 2017	Closed	\$101,337.63			\$1,455.00	\$3,232.49	\$106,160.10
	B013381	May 31, 2018	Closed	\$26,243.35			370.30	\$4,839.50	\$31,453.15
	B013382	May 31, 2018	Sold	\$26,860.45	\$1,928.82	\$2,100.25			
	B013383	May 31, 2018	Sold	\$5,632.10		\$844.82			
	B013384	May 31, 2018	Closed	\$69,420.42			388.50	\$7,081.87	\$76,890.74
								2016 Subtotal	\$214,503.99
2017									
	B013725	May 31, 2019	Sold	\$13,501.77		\$1,317.15			
	B013726	May 31, 2019	Sold	\$4,028.64		604.30			
	B013727	May 31, 2019	Sold	\$6,622.27		\$993.34			
	B013728	May 31, 2019	Active	\$22,549.91		\$22,549.91	302.50		
	B013729	May 31, 2019	Sold	\$3,175.36		\$476.30			
								2017 Subtotal	\$0.00
SUBTOTALS					\$1,928.82	\$33,368.46			\$1,226,769.50
Subtotal for Closed 2008 – 2016 Auction Sales									\$1,226,769.50
Subtotal received to date for Closed Sales + Bid Guarantees + Securities+ Added Timber									\$1,262,066.78
Informal Sales									
	F010327	5/15/2009	Canceled	\$65.64					\$65.64
	F010358	11/30/2009	Closed	\$2,541.00					\$2,541.00
	F010384	11/30/2009	Closed	\$440.00					\$440.00
	F010385	11/30/2009	Closed	\$600.00					\$600.00
	F010431	1/13/2010	Closed	\$6,819.00					\$6,819.00
	F010486	3/15/2010	Closed	\$165.00					\$165.00
	F010656	May-2011	Closed	\$5,154.00					\$5,154.00
	F010657	May-2011	Closed	\$143.00					\$267.35
	F011082	3/31/2015	Closed	\$3,119.30				\$944.72	\$4,064.02
	F011171	3/31/2014	Closed	\$3,038.54			\$420.75		\$3,400.50
	F011172	3/31/2014	Closed	\$4,504.33					\$4,004.71
	F011214	4/15/2014	Closed	\$50.00					\$50.00

Table 4. Land fund timber sales receipts, Camp Ripley Training Center, Minnesota, 2008 to October 2017.

Year	Permit #	Expires	Status	Sold Value	Bid Guarantee	Security	Added Timber	Over/Under Run	Final Amount
	F011299	5/31/2015	Closed	\$2,936.94					\$2,936.94
	F011414	5/31/2015	Closed	\$7,321.06				\$184.88	\$7,505.94
	F011417	5/31/2016	Closed	\$1,988.30				\$1,392.62	\$3,380.92
	F011781	5/31/2018	Active	\$1,147.00		\$1,147.00			
	F011782	5/31/2018	Active	\$5,087.40		\$5,087.40			
Informal Sales Subtotal									\$41,395.02
Fuelwood Permits (9/25/08 - 12/31/17)									
	215 (5 cords)	\$25/each							\$5,375.00
	67 (10 cords)	\$50/each							\$3,400.00
Fuelwood Permits Subtotal									\$8,775.00
GRAND TOTAL RECEIPTS									
(9/1/2008 to 10/30/2017)									\$1,576,639.52

Table 5. Land fund encumbrances, Camp Ripley Training Center, Minnesota, 2009 – 2017.

Land Fund Encumbrances			
Date	Description ^a	Category	Amount
5/6/2009	IAA with DNR–Forestry	Professional services	\$20,000.00
8/13/2009	IAA with DNR–Forestry	Professional services and trees	\$12,700.00
8/20/2009	Supplies	Forestry supplies	\$ 3,492.88
1/14/2010	Supplies	Forestry supplies	\$ 68.00
3/25/2010	Supplies	Forestry supplies	\$ 52.74
7/29/2010	IAA with DNR–Forestry	Professional services	\$59,740.00
11/10/2010	IAA with DNR–Forestry	Professional services (2011)	\$59,930.00
10/4/2011	IAA with DNR–Forestry	Professional services (2012)	\$73,600.00
3/2/2011	IAA with DNR–Forestry	Professional services	\$46,240.00
7/3/2013	IAA with DNR–Forestry	Professional services (2013)	\$69,000.00
4/01/2014	IAA with DNR–Forestry	Professional services (2014)	\$100,230.00
2014	Adjusted Encumbrances	Canceled tree plantings	-\$8,752.00
2015	IAA with DNR–Forestry	Professional services (2015)	\$89,462.00
2016	IAA with DNR–Forestry	Professional services (2016)	\$80,900.00
2017	Wildland fire equipment	200 gal. Slip-on unit.	\$20,040.00
2017	IAA with DNR–Forestry	Professional services (2017)	\$86,515.00
TOTAL			\$713,555.62

^aIAA – Interagency Agreement

Vegetation Management

Prescribed Fire

By Timothy Notch, Minnesota Department of Military Affairs

Camp Ripley uses prescribed fire as a management tool to enhance the military training environment, also known as mission-scape. Prescribed fire target objectives include native prairie grass enhancement, woody encroachment prevention, seed production, brush control, fuel-hazard reduction, forest management and habitat improvement for species in greatest conservation need (SGCN). The management strategy for prescribed fire on Camp Ripley is provided within the Integrated Wildland Fire Management Plan (MNARNG 2009a).

Two types of prescribed burns are conducted at Camp Ripley: hazard reduction and training enhancement.

Hazard Reduction

Two of the burn units on Camp Ripley are designated as impact areas. These areas are burned every spring along with 14 other firing ranges to reduce hazardous fuel loads and minimize wildfires due

to military training exercises. These are categorized as hazard reduction burns and as such, receive priority in scheduling and implementation (Table 6 and Figure 4).

The fire team completed 17 hazard burn units for a total of 13,578 acres. The unburned unit is Area 10 totaling 612 acres, but an additional hazard burn, Miller Airfield, was completed in the fall. Some of the hazard burns started as wildfires, and fire suppression units responding completed the burns under controlled conditions.

Training Enhancement

The training enhancement burns (Table 7 and Figure 4)

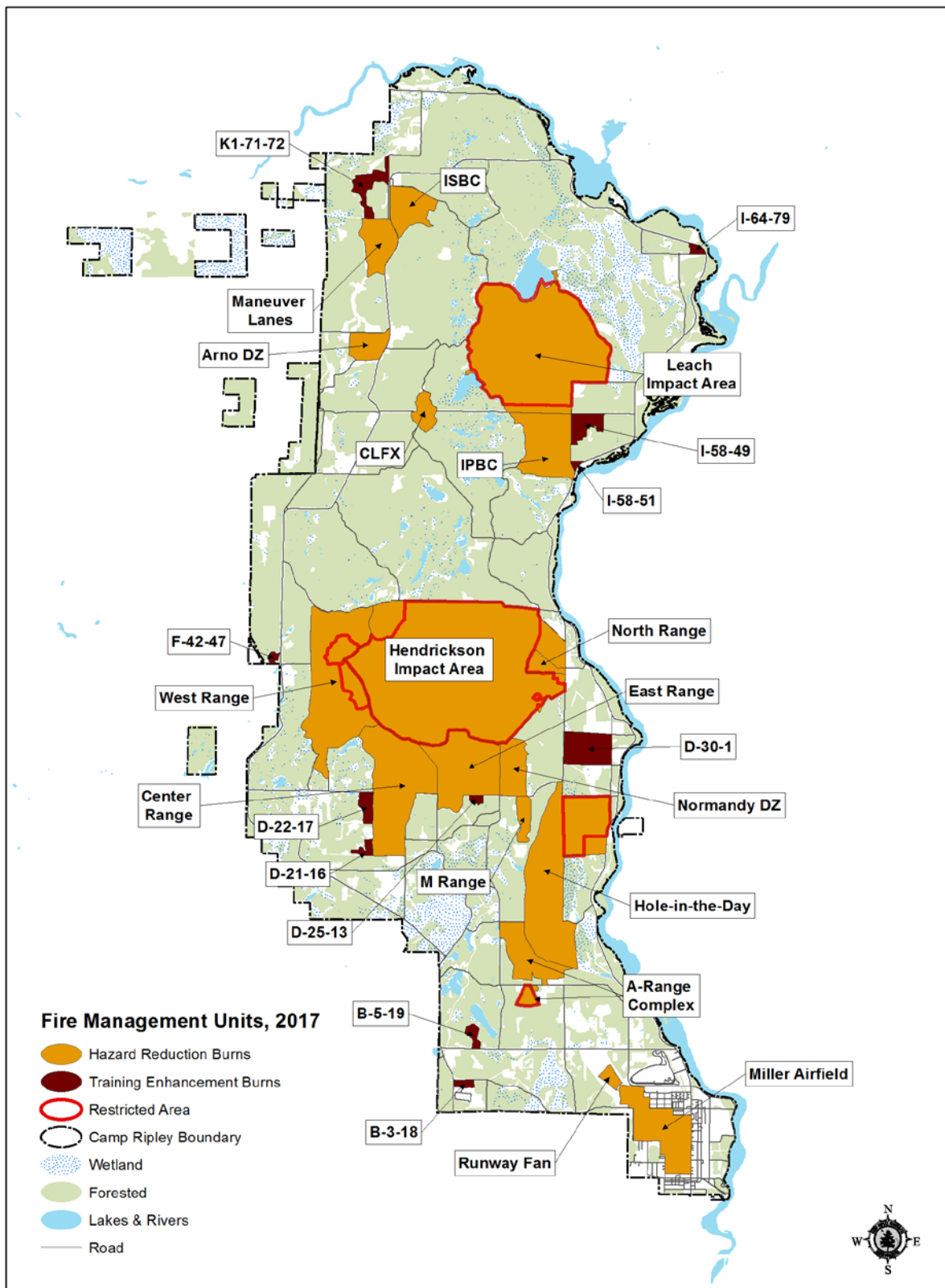
were completed by CRE staff with assistance from Department of Public Works (DPW) and Fire and Emergency Services (FES). Training enhancement burn units were categorized by highest use for military activities and ecological benefits. These burns are scheduled over a five-year rotation. As Camp Ripley continues to expand and new ranges are developed, existing burn units have conflicted with construction of ranges. Some areas became low priority and were dropped from the fire rotation. The training enhancement burns are of particular importance to the conservation program since the reintroduction of fire is critical to native vegetation management on the installation. Nearly all of Camp Ripley is a fire dependent ecosystem and managing vegetation with fire to meet military objectives also meets ecological management goals. It is of utmost importance to manage native vegetation with an historical fire regime to promote a healthy and thriving ecosystem that can withstand the human demands of the area.

Camp Ripley consists of 11 maneuver areas divided into 80 training areas of which 70 contain designated burn units. These burn units are dynamic in respect to size and shape but are directly related to military land use. Burn plans are prepared for each burn unit, reviewed and permitted by the DNR Division of Forestry prior to execution of the burn. Camp Ripley FES partnered with CRE and DPW staff to implement prescribed fire on these units.

Table 6. Hazard reduction burns, Camp Ripley Training Center, Minnesota, 2017.

Burn Date	Department	Unit Burn	Acres
3-28-17	DPW/FES/ENV	A–Ranges	362
5-04-17	DPW/FES/ENV	Maneuver Lanes	267
3-29-17	DPW/FES/ENV	Hole-in-the-Day Marsh	1,738
4-04-17	DPW/FES/ENV	Hendrickson Impact Area	3,840
3-27-17	DPW/FES/ENV	East Tank Range	643
5-09-17	DPW/FES/ENV	CLFX	118
Not completed	DPW/FES/ENV	Area 10	612
5-04-17	DPW/FES/ENV	ISBC	189
3-21-17	DPW/FES/ENV	West Range	1,116
4-11-17	DPW/FES/ENV	Airfield Overrun	40
4-05-17	DPW/FES/ENV	IPBC	503
4-06-17	DPW/FES/ENV	Center Tank Range	991
3-11-17	DPW/FES/ENV	North Range	80
3-28-17	DPW/FES/ENV	Leach Impact Area	2,705
3-21-17	DPW/FES/ENV	M–Range	93
3-27-17	DPW/FES/ENV	Normandy Drop Zone	235
3-20-17	DPW/FES/ENV	Arno Drop Zone	158
10-11-17	DPW/FES/ENV	Miller Airfield	500
Total Burned			13,578
Total Unburned			612

Figure 4. Training enhancement and hazard reduction units burned, Camp Ripley Training Center, Minnesota, 2017.



The 2017 prescribed burn units in the original design were not conducive to quality management of time and resources. The units were, in some cases, combined with adjacent units to form a larger burn unit that could be managed from roadways and trails. This process eliminated the need for break installation (e.g., mineral or mowed) and better suits the need for reducing encroachment in grasslands by allowing fire to run through transition zones into forested areas. Enlarging and combining burn units into one larger unit saves money by reducing the amount of staff time for maintenance of fire breaks. Many burn units are surrounded by a road 33 feet in width which improves crew safety and time management.

Table 7. Training enhancement burns, Camp Ripley Training Center, Minnesota, 2017.

Training Enhancement Units			Grass Acres	Forest Acres	Total Acres	Actual Burn Date
Maneuver Area	Training Area	Unit Name				
B	3	18	23		23	04-08-2017
B	5	19	36		36	04-11-2017
B	8	13	13	3	16	
D	21	16	18		18	05-03-2017
D	22	17	56	6	62	04-06-2017
D	25	13	18		18	03-27-2017
D	30	1	36	206	242	04-17-2017
F	42	47	16		16	05-03-2017
I	58	49	107		107	04-08-2017
I	58	51	11		11	05-09-2017
I	64	79	22		22	04-28-2017
K1	71	72	103	19	122	05-09-2017
K1	79	71	87	40	127	
K2	78	69	6		6	
Total Burned			446	231	677	
Total Unburned			106	43	149	

All goals and objectives were achieved on completed burn units which demonstrates the effectiveness of phenological timing of the burn events. The 2018 planned training enhancement burns are found in Camp Ripley INRMP (MNARNG 2018a).

Invasive Species

By Jason Linkert, Minnesota Department of Military Affairs

Invasive species are non-native species that harm economic, environmental or human health. These species are a threat to the ecological function of areas around the world due to their capability to change the biotic and abiotic characteristics of their environment (U.S. Department of Agriculture 2009). The MNARNG is required by state and federal regulations to prevent the introduction of invasive species; detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; monitor invasive species populations accurately and reliably; provide for restoration of native species and habitat conditions in ecosystems that have been invaded; conduct research on invasive species and develop technologies to prevent introduction and provide for

environmentally sound control of invasive species; and promote public education on invasive species and the means to address them.

In 2017, an interagency agreement was established between St. Cloud State University (SCSU) and the Minnesota Department of Military Affairs for invasive species management. Graduate and undergraduate interns work closely with CRE staff in combating terrestrial and aquatic invasive species.

Twenty-five terrestrial invasive plant species have been identified at Camp Ripley (Table 8 and MN Department of Agriculture 2017). Three of these species, leafy spurge (*Euphorbia esula*), common tansy (*Tanacetum vulgare*) and spotted knapweed (*Centaurea maculosa*) are considered prohibited noxious weeds and were the priority for control treatments. Additional invasive species targeted for treatment included European buckthorn (*Rhamnus cathartica*), baby's breath (*Gypsophila paniculata*), plumeless thistle (*Carduus acanthoides*), bull thistle (*Cirsium vulgare*), Canada thistle (*Cirsium arvense*) and Siberian elm (*Ulmus pumilla*).

Selective Invasive Plant Management

Extensive search and treatment of common buckthorn commenced in cantonment along with training areas downrange using a handheld GPS device to track the species and basal bark application of the herbicide triclopyr to eliminate seed-bearing mother trees. This treatment proved to be the most effective at removing isolated individual plants while being the least labor intensive in comparison with cut stump treatments. A total of 35 populations were documented with six receiving basal bark treatments.

In response to a request from Range Control, SCSU interns treated areas to control native poison ivy (*Toxicodendron radicans*) in locations which posed a threat to the health and safety of training personnel. The A-13 Expert Medical Field Badge Litter Obstacle Course was treated with the herbicide triclopyr. All exterior barrier gates and downrange propane tanks were treated with triclopyr to control the threat of poison ivy. In addition, SCSU interns treated poison ivy on the Valhalla White Pine Walking Trail to reduce the risk to visiting school groups during environmental briefs.

Leafy spurge was located in cantonment in 2017 just south of Range Control. A one-half acre plot was treated with the restricted use pesticide picloram and monitored for re-growth and spread.

Table 8. Invasive plant species, Camp Ripley Training Center, Minnesota.

Family	Scientific Name	Common Name	Minnesota Department of Agriculture Noxious Weed Listing (MNDA 2016)
Brassicaceae	<i>Berteroa incana</i>	Hoary alyssum	Not currently listed
Poaceae	<i>Bromus inermis</i>	Smooth brome	Not currently listed
Asteraceae	<i>Carduus nutans</i>	Musk thistle	Prohibited noxious weed
Asteraceae	<i>Carduus acanthoides</i>	Plumeless thistle	Prohibited noxious weed
Asteraceae	<i>Centaurea maculosa</i>	Spotted knapweed	Prohibited noxious weed

Table 8. Invasive plant species, Camp Ripley Training Center, Minnesota.

Family	Scientific Name	Common Name	Minnesota Department of Agriculture Noxious Weed Listing (MNDL 2016)
Asteraceae	<i>Chrysopsis villosa</i> var. <i>foliosa</i>	Golden aster	Not currently listed
Asteraceae	<i>Cirsium arvense</i>	Canada thistle	Prohibited noxious weed
Asteraceae	<i>Grindelia squarrosa</i>	Gum weed	Not currently listed
Asteraceae	<i>Cirsium vulgare</i>	Bull thistle	Not currently listed
Asteraceae	<i>Tanacetum vulgare</i>	Common tansy	Prohibited noxious weed
Cannabaceae	<i>Humulus japonicus</i>	Japanese hops	Prohibited noxious weed
Caryophyllaceae	<i>Gypsophila paniculata</i>	Baby's breath	Not currently listed
Caryophyllaceae	<i>Euphorbia cyparissias</i>	Cypress spurge	Not currently listed
Euphorbiaceae	<i>Euphorbia esula</i>	Leafy spurge	Prohibited noxious weed
Guttiferae	<i>Hypericum perforatum</i>	St. Johnswort	Not currently listed
Fabaceae	<i>Melilotus alba</i>	White sweet clover	Not currently listed
Fabaceae	<i>Melilotus officinalis</i>	Yellow sweet clover	Not currently listed
Poaceae	<i>Phalaris arundinacea</i>	Reed canary grass	Not currently listed
Poaceae	<i>Phragmites australis</i>	Common reed	Prohibited noxious weed
Rhamnaceae	<i>Rhamnus cathartica</i>	Buckthorn	Prohibited noxious weed
Rhamnaceae	<i>Rhamnus frangula</i>	Glossy buckthorn	Prohibited noxious weed
Caryophyllaceae	<i>Saponaria officinalis</i>	Bouncing bet	Not currently listed
Anacardiaceae	<i>Toxicodendron radicans</i>	Poison ivy (native)	Specially regulated noxious weed
Ulmaceae	<i>Ulmus pumila</i>	Siberian elm	Not currently listed
Lythraceae	<i>Lythrum salicaria</i>	Purple loosestrife	Prohibited noxious weed
Euphorbiaceae	<i>Euphorbia cyparissias</i>	Cypress spurge	Not currently listed
Apiaceae	<i>Daucus carota</i>	Queen Anne's lace	Not currently listed
Iridaceae	<i>Iris pseudacorus</i>	Yellow iris	DNR invasive plant

Large Scale Invasive Plant Management

Large scale management included the treatment of 68 acres of spotted knapweed and common tansy. A tractor-mounted boom sprayer mixed with the selective herbicides metsulfuron-methyl and aminopyralid coupled with a surfactant was foliar applied by CRE staff and SCSU interns. Treatments were streamlined by tank mixing herbicides allowing multiple species to be treated with one tank mix per day. High priority areas were targeted from areas that received the highest troop use and presented the highest risk of infestation. Roadways and ditches were the primary target areas on Cassino, Normandy, East and West Boundary roads as these presented the highest risk of spread. Field habitats with heavy tank traffic where all-terrain vehicle access was limited were treated utilizing the tractor mounted boom sprayer.

Water Resources

Camp Ripley is home to an outstanding array of water bodies including small inland lakes, wetlands and streams, which make up 1,054 acres of Camp Ripley's 53,000 acres. Eighteen miles of Mississippi River frontage and 12 miles of Crow Wing River frontage also form the eastern and northern borders of Camp. Most of these waters are not subject to active management by CRE personnel, however water control structures and mitigation have been conducted at some sites and others are managed for recreational access.

Lake and River Resources

By Jake Kitzmann, Minnesota Department of Military Affairs

Miller Lake

Miller Lake is a 27-acre basin with a 1,405 acre watershed that drains via Broken Bow Creek into the Mississippi River. Miller Lake's culvert (#376) was replaced in November 2012 and a water control structure was added. CRE staff maintained the water level control system in accordance with the plan approved by the DNR Fish and Wildlife Division and the DNR Nongame Wildlife Program (MNDNR 2013a). The managed water level has been maintained at approximately 1211.95' in elevation. Between 2012 and the fall of 2014 beaver activity had become an issue. Beavers had raised the water levels to about 20 inches above optimal levels. No nuisance beaver activity was noted in Miller Lake during 2017.

Mississippi River

Four picnic and camping areas are maintained along the river (Figure 5) which allow for access to the excellent fishing opportunities found in the Mississippi. This pristine stretch of river is home to a number of popular game fish species including muskellunge (*Esox masquinongy*), northern pike (*Esox Lucius*), walleye (*Sander vitreus*) and smallmouth bass (*Micropterus dolomieu*).

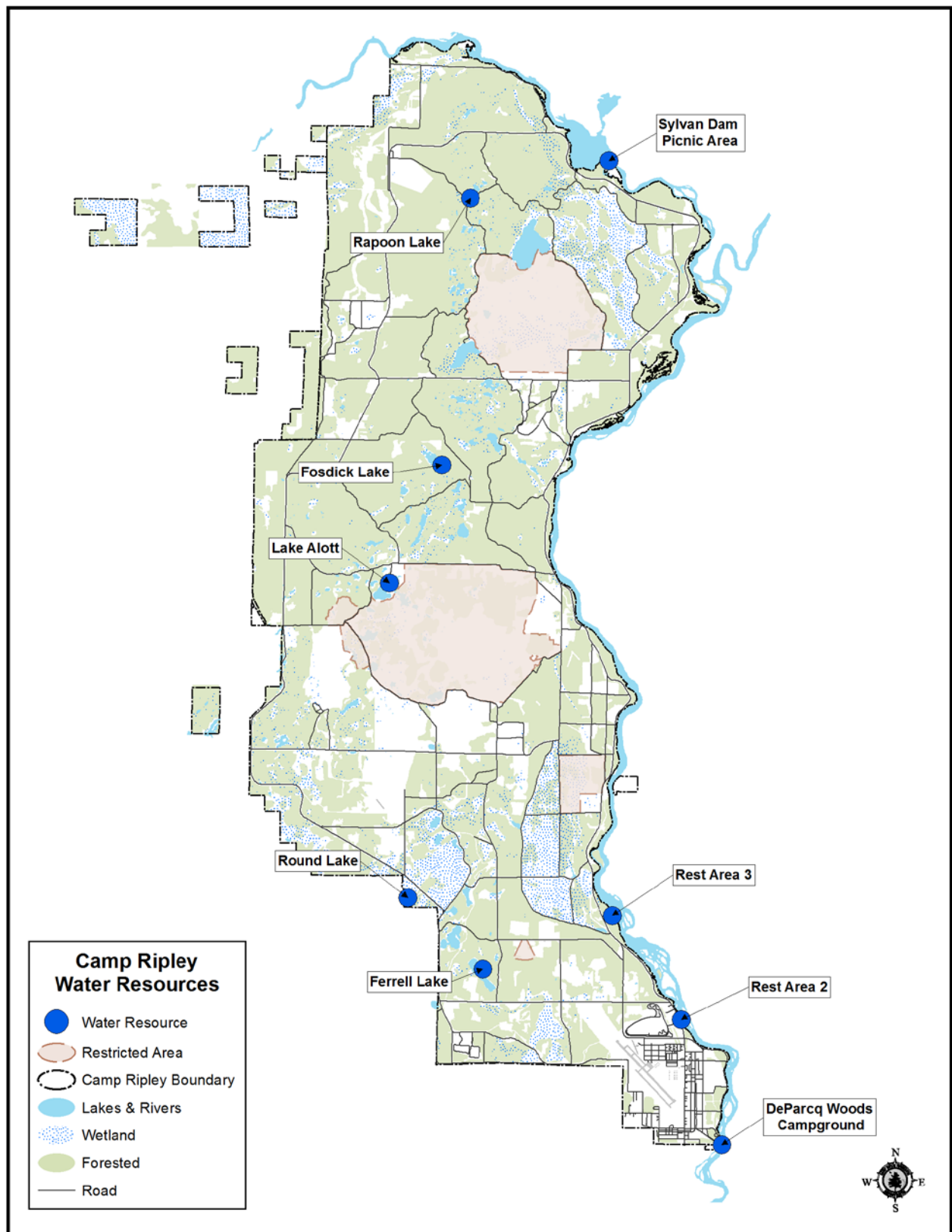
Lake Alott

This 40 acre lake located in Training Area 36 (Figure 5) has a fishing access with boat ramp and dock maintained on the north side. Small boats are stored at this landing for use by soldiers. With a maximum depth of 30 feet Lake Alott is home to a number of popular game fish species including northern pike, walleye, bluegill (*Lepomis macrochirus*) and black crappie (*Pomoxis nigromaculatus*).

Fosdick Lake

This 26 acre lake located in Training Area 50 (Figure 5) has a fishing access with a dock maintained on the northeast side. With a maximum depth of about 10 feet Fosdick is home to a number of popular game fish species including walleye, largemouth bass (*Micropterus salmoides*) and black crappie.

Figure 5. Selected water resources, Camp Ripley Training Center, Minnesota.



Round Lake

This 127 acre lake located on the western edge of Camp Ripley (Figure 5) has a fishing access with a boat ramp and a dock maintained on the east side. Boats and camp sites are also maintained at this land site for use by soldiers. There is also a public water access maintained by the DNR on the west side of the lake. With a maximum depth of about 19 feet, Round Lake is home to a number of popular game fish species including walleye, muskellunge, northern pike, largemouth bass and black crappie.

Rapoon Lake

This 16 acre lake located in Training Area 75 (Figure 5) has a fishing access on the northeast side. With a maximum depth of about 24 feet, Rapoon is home to a number of popular game fish species including walleye, muskellunge and smallmouth bass.

Ferrell Lake

This 51 acre lake located in Training Area 5 (Figure 5) has a fishing access with boat ramp and dock maintained on the southwest side. Small boats are stored at this landing for use by soldiers. With a maximum depth of about 10 feet, Ferrell is home to a number of popular game fish species including northern pike, walleye, bluegill and black crappie.

Wildlife

By Nancy J. Dietz and Brian J. Dirks, Minnesota Department of Natural Resources

Species in Greatest Conservation Need

“Minnesota defines species in greatest conservation need (SGCN) as native animals, nongame and game, whose populations are rare, declining or vulnerable to decline and are below levels desirable to ensure their long-term health and stability. Also included are species for which Minnesota has a stewardship responsibility. Stewardship species are those for which populations in Minnesota represent a significant portion of their North American breeding, migrating or wintering population, or species whose Minnesota populations are stable, but whose populations outside of Minnesota have declined or are declining in a substantial part of their range” (MNDNR 2015a).

One of the federal requirements of the Comprehensive Wildlife Conservation Strategy is to manage SGCN by developing a wildlife action plan. “Minnesota’s Wildlife Action Plan, 2015 – 2025” (MNDNR 2015a) is Minnesota’s response to the congressional mandate. The goal of the wildlife action plan is to 1) ensure the long-term health and viability of Minnesota’s wildlife, with a focus on species that are rare, declining or vulnerable to decline; 2) enhance opportunities to enjoy SGCN and other wildlife and to participate in conservation; and 3) acquire the resources necessary to successfully implement the Minnesota Wildlife Action Plan. Additional surveys, monitoring and research will be directed toward identifying other SGCN species on Camp Ripley, and management or conservation actions that could be implemented to benefit these species.

Of the over 2,000 known native wildlife species in Minnesota, 346 species from all major taxonomic groups meet the definition of species in greatest conservation need. All federal and state endangered, threatened and special concern species are included on the SGCN list. Five taxonomic groups have one-third or more of their total species found in Minnesota as SGCN, they are mammals (38%), reptiles (50%), amphibians (36%), tiger beetles (46%) and mussels (60%) (MNDNR 2015a). Eighty-eight SGCN species have been identified on Camp Ripley, including 63 bird species of which 31 are songbirds.

Birds

Christmas Bird Count

The Christmas Bird Count (CBC) has been coordinated by the National Audubon Society since 1900, and is the oldest continuous nationwide wildlife survey in North America (Sauer et al. 2008). Counts occur within predetermined 15-mile diameter circles located across North America, Mexico and South America. The northwest portion of Camp Ripley is within one of these circles (CBC census code: MNPL) (Figure 6). Each count is conducted during a single calendar day within two weeks of Christmas (December 14 – January 5). For example, the 2017 CBC occurred on January 1, 2018. The Pillager CBC was started in 1999, and the census has occurred 19 times (Minnesota Ornithologists' Union 2018a). CBC data is primarily used to track winter distribution patterns and population trends of various bird species.

The Pillager CBC occurred on January 1, 2018, and was conducted by the DNR staff. The count lasted 3.75 hours. The skies were clear. The temperature ranged from -7° to 2° Fahrenheit, with winds of 6 miles per hour (Weather Underground 2018a). The Crow Wing River was free of ice from Sylvan Dam downstream about 1.7 km. The total number of birds counted and diversity of species was the fourth largest (Table 9) since 2001. The 322 trumpeter swans (*Cygnus buccinator*) observed were the second highest number recorded since 2001. Other notable observations were a belted kingfisher (*Megaceryle alcyon*) and northern shrike (*Lanius excubitor*).

Breeding Bird Monitoring

Camp Ripley provides important breeding and migratory habitat for 63 birds that are species in greatest conservation need (SGCN). Thirty-two SGCN birds including water birds, raptors and songbirds are known to breed on Camp Ripley. Of these SGCN birds 15 are often heard during point count surveys.

Breeding bird surveys have been conducted on permanent plots throughout Camp Ripley since 1991. The full breeding bird survey includes 90 plots that are surveyed as part of long-term population monitoring. The number of plots surveyed each year varies according to training, weather and survey strategy. Development of new ranges on Camp Ripley along with increased military and civilian training can limit access to most permanent survey points. Additionally, certain plots are no longer surveyed due to complete habitat alterations due to gravel pit expansion or development, and installation or expansion of military training ranges and parking lots.

Figure 6. Christmas bird count area within Camp Ripley Training Center, Minnesota, since 2002.

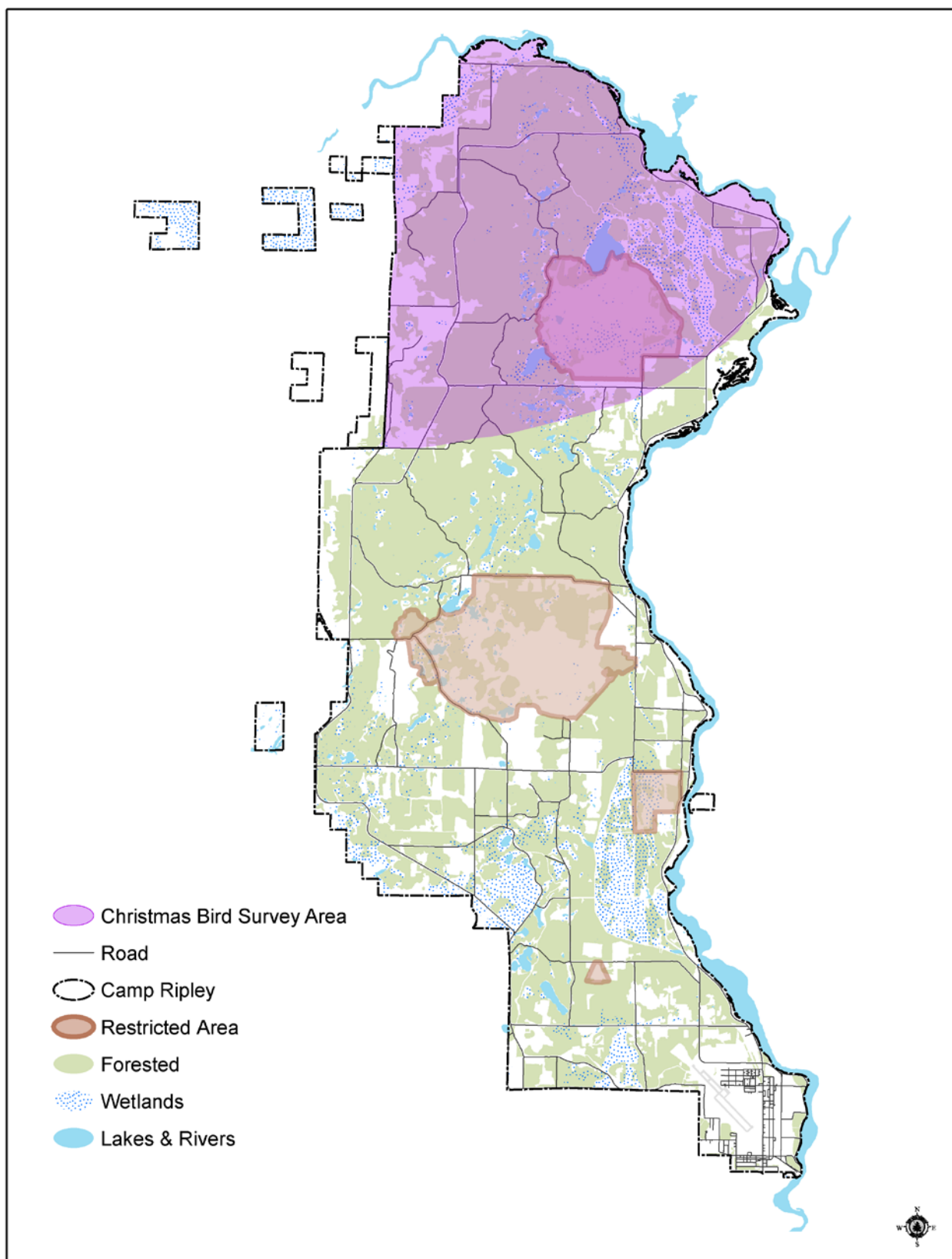


Table 9. Christmas bird count data, Camp Ripley Training Center, Minnesota, 2004 – 2017 ^a.

Species	Scientific Name	Count Year											
		2004	2005	2006	2007	2009	2011	2012	2013	2014	2015	2016	2017
Cackling goose	<i>Branta hutchinsii</i>	0	0	0	0	7	0	0	0	0	0	0	0
Canada goose	<i>Branta canadensis</i>	81	2	4	11	0	18	9	0	0	42	0	3
Trumpeter swan	<i>Cygnus buccinator</i>	28	26	49	60	69	73	145	201	89	500	33	322
Mallard	<i>Anas platyrhynchos</i>	0	20	0	0	0	0	110	0	0	40	0	12
Common merganser	<i>Mergus merganser</i>	0	4	12	0	0	2	4	31	12	51	5	11
Ruffed grouse	<i>Bonasa umbellus</i>	2	0	0	0	0	0	0	0	0	0	0	0
Wild turkey	<i>Meleagris gallopavo</i>	5	0	0	0	11	0	0	2	3	0	0	0
Bald eagle	<i>Haliaeetus leucocephalus</i>	3	4	11	0	0	8	0	0	2	7	1	4
Northern goshawk	<i>Accipiter gentilis</i>	2	0	0	0	0	0	0	0	0	0	0	0
Red-tailed hawk	<i>Buteo jamaicensis</i>	1	0	0	0	0	0	0	0	0	0	0	0
Rough-legged hawk	<i>Buteo lagopus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Golden eagle	<i>Aquila chrysaetos</i>	1	0	0	0	0	0	0	0	0	0	0	0
Unidentified eagle		0	0	0	0	0	0	0	0	0	1	0	0
Barred owl	<i>Strix varia</i>	0	0	0	0	0	0	0	0	0	2	0	0
Belted kingfisher	<i>Megaceryle alcyon</i>	1	0	0	0	2	0	0	0	0	0	0	1
Red-headed woodpecker	<i>Melanerpes erythrocephalus</i>	0	0	0	0	0	0	0	0	0	1	0	0
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Downy woodpecker	<i>Picoides pubescens</i>	0	1	0	0	0	0	0	1	0	2	0	1
Hairy woodpecker	<i>Picoides villosus</i>	0	0	0	0	0	0	0	0	0	2	0	0
Pileated woodpecker	<i>Dryocopus pileatus</i>	0	1	0	0	1	0	1	1	0	0	0	1
Northern shrike	<i>Lanius excubitor</i>	1	0	0	0	0	0	0	0	0	0	0	1
Blue jay	<i>Cyanocitta cristata</i>	1	3	0	0	1	0	11	0	0	6	0	2
American crow	<i>Corvus brachyrhynchos</i>	3	2	3	3	6	0	12	1	0	10	7	1
Common raven	<i>Corvus corax</i>	0	0	0	0	1	0	0	2	1	2	0	2
Black-capped chickadee	<i>Parus atricaillus</i>	9	12	1	1	2	0	0	0	2	3	0	3
Red-breasted nuthatch	<i>Sitta canadensis</i>	3	1	0	0	0	0	0	0	0	0	0	1
White-breasted nuthatch	<i>Sitta carolinensis</i>	0	3	0	0	0	0	0	0	0	3	0	0
Bohemian waxwing	<i>Bombycilla garrulus</i>	0	0	0	0	0	0	0	0	0	0	0	0
Cedar waxwing	<i>Bombycilla cedrorum</i>	0	0	0	0	0	0	0	0	0	0	0	0
American tree sparrow	<i>Spizella arborea</i>	0	0	0	0	9	0	0	0	0	0	0	0
Dark-eyed junco	<i>Junco hyemalis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Northern cardinal	<i>Cardinalis cardinalis</i>	0	0	0	0	0	0	0	0	0	0	0	0
Common redpoll	<i>Acanthis flammea</i>	32	0	0	0	0	0	225	0	0	0	0	0
Unidentified siskin/redpoll/finch		0	0	0	0	0	0	0	0	0	4	0	0
# Observers		3	4	3	2	2	1	1	1	1	3	2	2
TOTAL # INDIVIDUALS		171	79	80	75	109	101	517	239	109	677	46	365
TOTAL # SPECIES		15	12	6	4	10	4	8	7	6	16	4	14

^a Due to unsafe road conditions and/or extreme cold weather, no Christmas Bird Count was conducted on Camp Ripley during the 2008 and 2010 count years.

The 2017 songbird survey documented 994 individual birds of 76 species on 90 survey plots (Table 10). Eight of the most common species recorded during breeding bird surveys were red-eyed vireo (*Vireo olivaceus*), ovenbird (*Seiurus aurocapillus*), American redstart (*Setophaga ruticilla*), veery (*Catharus fuscescens*) (SGCN), chestnut-sided warbler (*Setophaga pensylvanica*), scarlet tanager (*Piranga olivacea*), eastern wood-pewee (*Contopus virens*) (SGCN) and song sparrow (*Melospiza melodia*). Note that two of these most common Camp Ripley species are also SGCN.

Camp Ripley's long-term songbird monitoring is helpful in determining population trends for species of concern such as SGCN and other species considered for federal Endangered Species Act listing, such as the golden-winged warbler (Figure 7). Due to this warbler's population decline, in February 2010, the U.S. Fish and Wildlife Service (USFWS) was petitioned to list the golden-winged warbler as threatened or endangered under the ESA. The USFWS has reviewed the petition and issued a "positive finding" that triggers a thorough review of all available information to determine if the golden-winged warbler status warrants protection (USFWS 2017a). Eighty percent of the global breeding population resides in the forests surrounding the Great Lakes. Minnesota was estimated to support 47% of the continental population in 2013 (Pfannmuller et al. 2017a). Golden-winged warblers have been slightly increasing on point count surveys since 2000 (Figure 7) and incidental, auditory observations have increased throughout Camp Ripley in the past ten years.

In the past, we focused on red-eyed vireos populations because they were much more numerous than any other species detected on survey plots. Six plots identified in previous years as being undisturbed sites with high numbers of red-eyed vireos were surveyed. However, the number of red-eyed vireos per plot and the total number on all plots have continued to decline (by more than 70%) since 2000. The number of red-eyed vireos on the six surveyed plots has dropped from a total of 30 – 33 through 2005 to 9 in 2009, 2011 and 2014, 12 in 2012, 13 in 2013 and 16 in 2017. This drop is very noticeable in the field when counts changed from 4 to 8 red-eyed vireos on each plot in prior years, to 1 to 2 on each plot (Figure 8). Although red-eyed vireos are not a SGCN or special concern species, the change in numbers is concerning because the federal Breeding Bird Survey in Minnesota, 1967 – 2015, indicates a nonsignificant stable population trend but tending toward an increase (Pfannmuller et al. 2017a). In addition, other species that use similar habitat, such as ovenbirds, have shown large increases on Camp Ripley during the same time period (Figure 9).

Long-term monitoring will continue on Camp Ripley to monitor songbird population trends and to determine if this is a permanent drop in the number of red-eyed vireos nesting on Camp Ripley or a natural fluctuation or population adjustment from an unusually high number in the 1990s.

Table 10. Songbird survey data, Camp Ripley Training Center, Minnesota, 2000 – 2014 and 2017.

Year	Field Surveyor/s	Number of Permanent Plots Surveyed	Total Number of Birds Documented	Total Number of Species Documented	Average Number of Birds per Plot	Average Number of Species per Plot
2000	Dirks/Brown	92	1,002	66	10.89	6.43
2001	Dirks/Brown	31	316	46	10.19	5.77
2002	Dirks/Brown/ DeJong	30	258	42	8.6	5.83
2003	Dirks/Brown/ DeJong	90	823	68	9.14	5.37
2004	Dirks/Brown/ Burggraff	107	1,129	64	10.55	6.14
2005	Dirks/Brown/ DeJong	89	897	61	10.08	6.20
2006	Dirks/Brown/ DeJong	88	802	64	9.11	5.84
2007	Dirks/Brown/ DeJong	91	994	71	10.92	7.02
2008	Dirks/Brown	89	875	70	9.83	6.60
2009	Dirks	57	563	63	9.87	7.26
2010	Dirks	11	122	25	*	*
2011	Dirks	42	383	51	9.12	6.45
2012	Dirks	6	66	16	*	*
2013	Dirks	61	688	68	11.28	8.18
2014	Dirks	8	95	23	*	*
2017	Montgomery	90	994	76	11.04	8.23

* Not calculated due to low number of plots surveyed in 2010, 2012 and 2014 due to plot access limitations. No breeding songbird surveys were conducted in 2015 – 2016.

Figure 7. Selected songbirds of greatest conservation need, Camp Ripley Training Center, 2000 to 2013, 2017*.

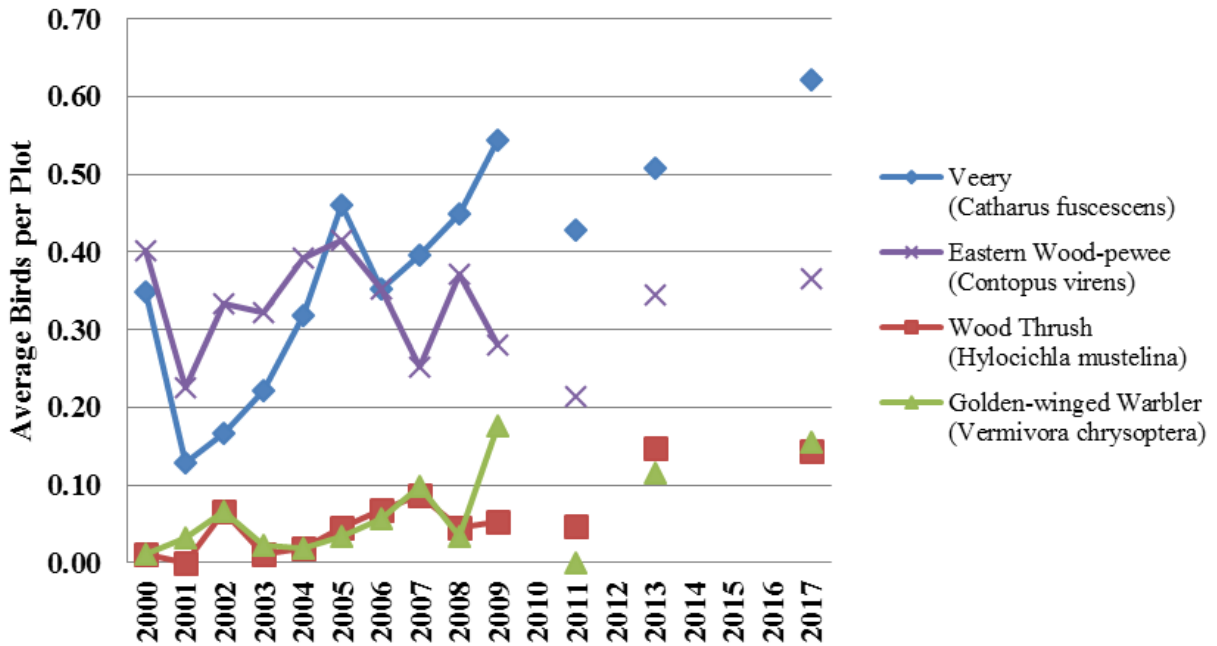
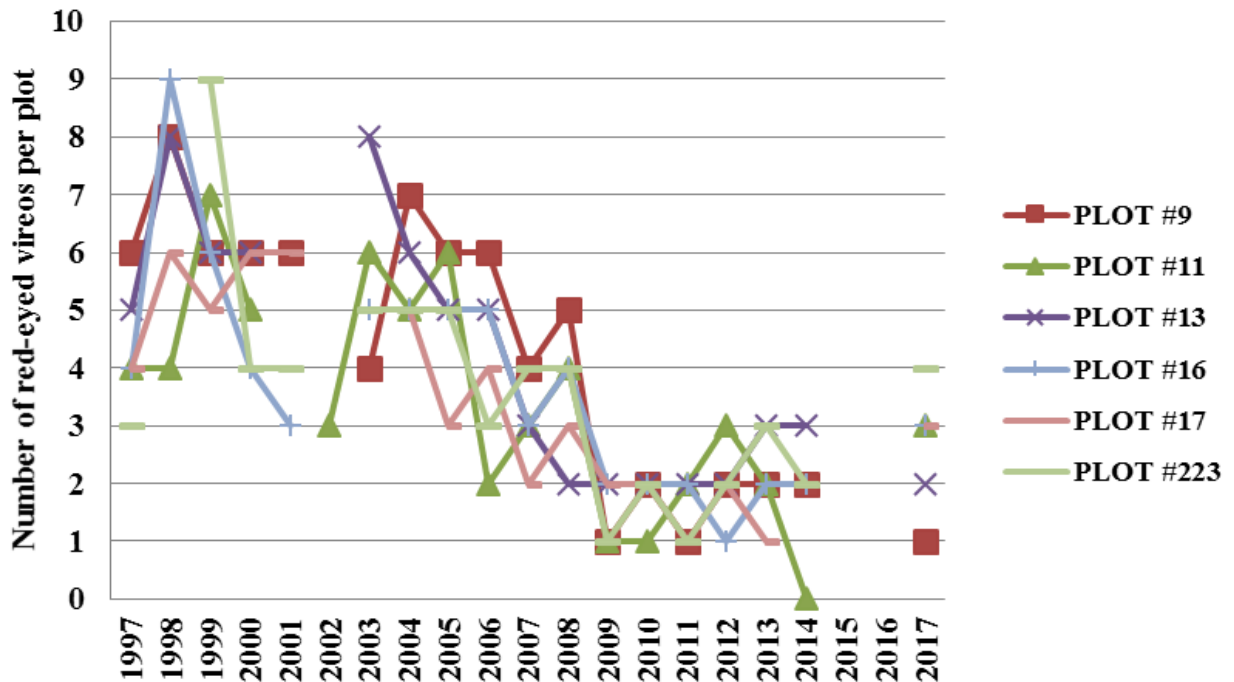
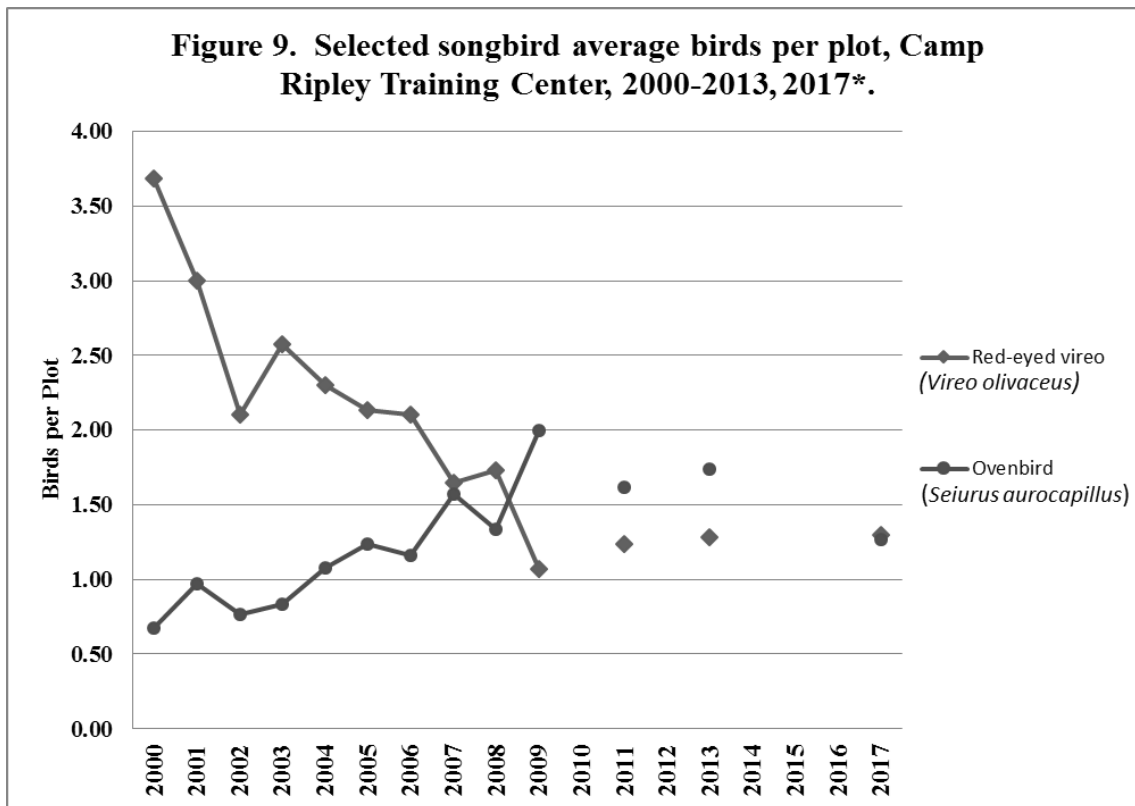


Figure 8. Red-eyed vireos (*Vireo olivaceus*) per plot, Camp Ripley Training Center, 1997-2014*, 2017.





* In 2001 and 2002 only 31 and 30 plots were surveyed respectively.

* In 2010, 2012 and 2014 only 11, 6 and 8 permanent plots were surveyed, respectively; therefore the data is not included.

Trumpeter Swan (*Cygnus buccinator*)

Trumpeter swans were a common breeding bird in western Minnesota until the mid-1800s; the last historical record of breeding in the wild was in 1885. Trumpeter swans were considered extirpated in the state. However, reintroduction and recovery efforts, including listing the species as state threatened in Minnesota in 1996, have resulted in more than 5,300 free-flying birds in Minnesota. Due to population increases, trumpeter swans are now a special concern species, a SGCN, and are monitored each year (Dirks et al. 2010) through aerial flights and ground observations by field staff.

The first record of trumpeter swans breeding on Camp Ripley occurred in 1990 when an active nest was located in a wetland north of Normandy Road (Dorff and Nordquist 1993). Trumpeter swans have continued to be documented at various lakes throughout Camp Ripley (1991, 1992, 2009 – 2017) but successful reproduction had not been documented in more than

Table 11. Trumpeter swan production, Camp Ripley Training Center, Minnesota, since 1990.

Year	Cygnets Raised
1990	2
2009	Unknown
2010	4
2011	1
2012	8
2013	4
2014	8
2015	5+
2016	Unknown
2017	10
Known Total	37

ten years until 2010. In late-June and late-July 2017, breeding pairs were observed on Miller Lake (n=3 cygnets), Goose Pond (n=4 cygnets), Marne Marsh (n=3 cygnets), Lookout Lake and F Range pond. No pairs were observed on Mud Lake, Ferrell Lake, Frog Lake, Fosdick Lake, Rapoon Lake or the unnamed pond on the south side of Cassino Road (Table 11).

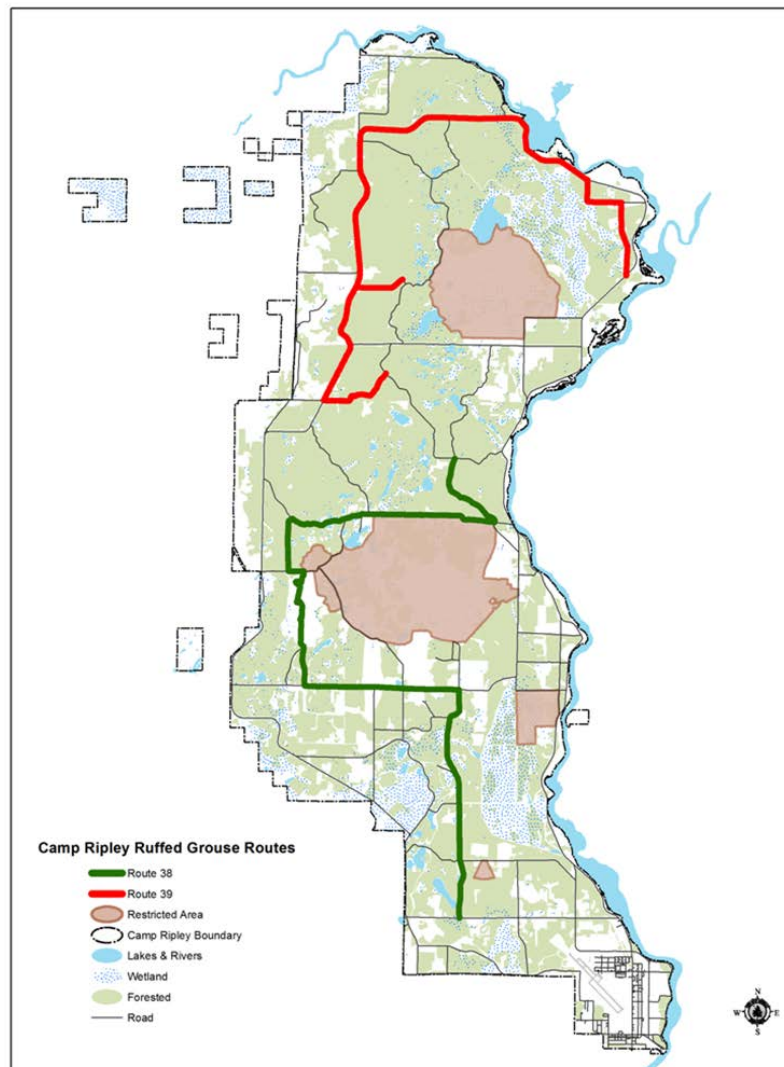
Ruffed Grouse (*Bonasa umbellus*)

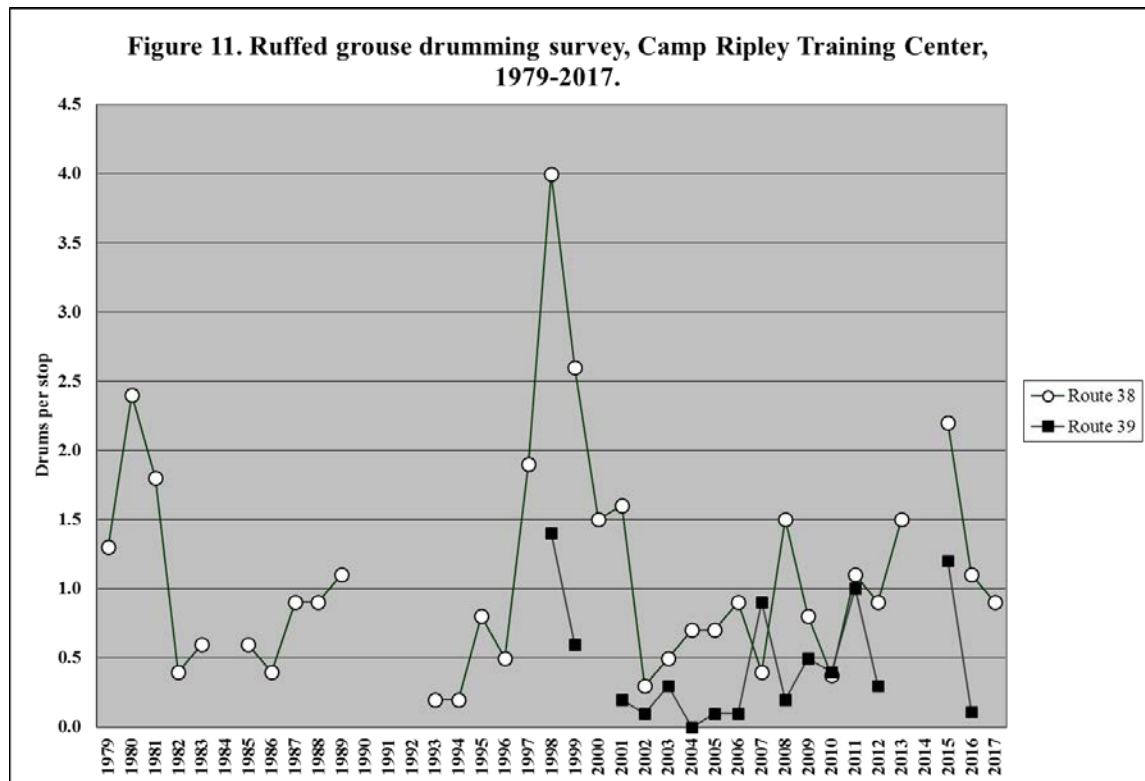
Ruffed grouse drumming counts are conducted on two survey routes (#38 and #39) as part of the DNR's statewide survey throughout ruffed grouse range. The data is used as an index to monitor changes in densities of grouse over time. Route #38, the DNR's official survey route, has been run since 1979. Route #39 was added by Camp Ripley in 1998 (Figure 10) but was not run in 2017. Drumming counts are conducted for four minutes at ten points along each route.

The official count for route #38 occurred on May 3. Nine drums were heard, which is a 20% decrease in drums from 2015 and a 40% decrease from 2013 (Figure 11). Camp Ripley's ruffed grouse population decreased after its most recent high in 1998, but began to rebound in 2003. However, the DNR's two other Little Falls area ruffed grouse routes had decreases in drums per stop since the spring of 2010 (Figure 12).

Although Camp Ripley is not managed specifically for ruffed grouse, habitat is generally stable. Aspen stands of varying age classes provide the best ruffed grouse habitat along both routes. Aspen stands that had been clear-cut along both of these routes have been maturing. Ruffed grouse will benefit as timber harvest for forest management continues in order to maintain a wide range of age classes of aspen.

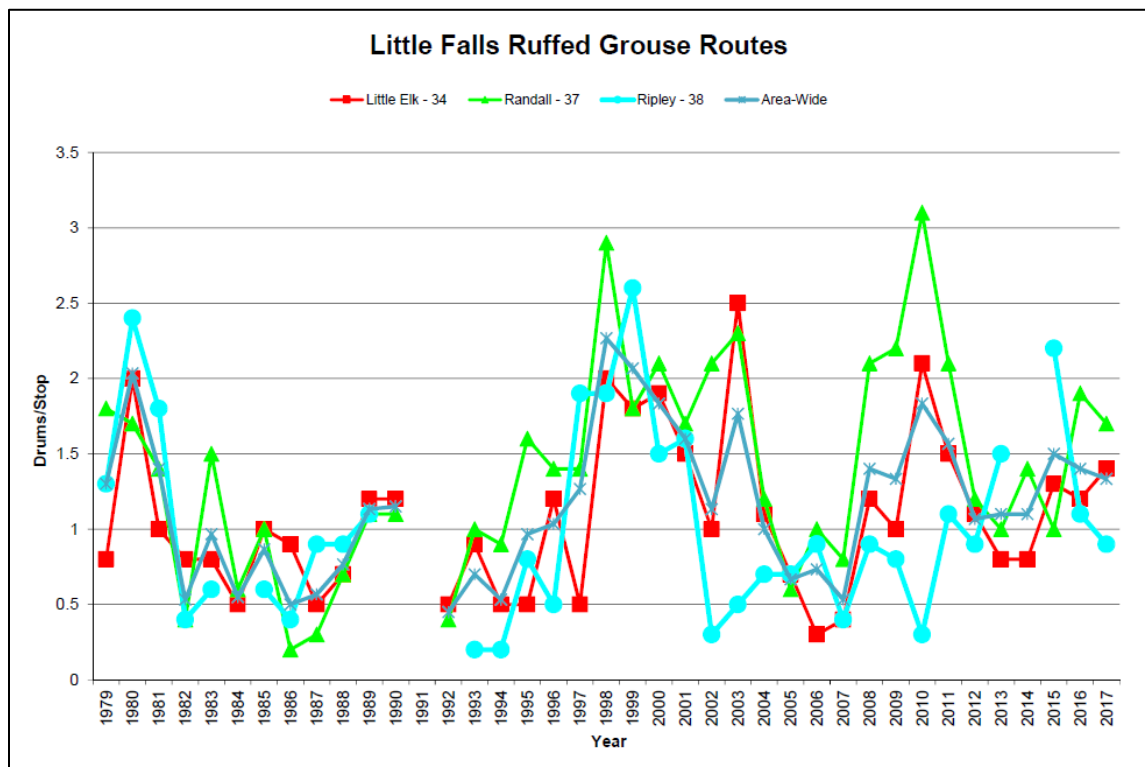
Figure 10. Ruffed grouse spring drumming survey routes, Camp Ripley Training Center, Minnesota, since 1979.





*Gaps in the graph indicate years when the survey was not conducted. Route #38 had only six stops in 2008 and five stops in 2015.

Figure 12. Ruffed grouse drumming surveys in the DNR Little Falls area, Minnesota, 1979 – 2017.



Osprey (*Pandion haleaetus*)

No ospreys were observed using the Crow Wing River nest platform which was established in 2011. A bald eagle (*Haliaeetus leucocephalus*) pair (Pusan) established a nest in a neighboring tree in the fall of 2014, so it is unlikely that an osprey pair will use the platform in close proximity to an active bald eagle nest. The nest blew down from the platform on Sylvan Reservoir in 2013. In 2014 – 2017, ospreys did not nest on the Sylvan Reservoir platform but nested on the Sylvan Dam platform and raised two young in 2014 – 2015 and one in 2016 – 2017.

Bald Eagle (*Haliaeetus leucocephalus*)

In the lower 48 states, Minnesota has the most nesting pairs of bald eagles at approximately 1,300 (USFWS 2016a). Bald eagles are protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both of these acts prohibit killing, selling or otherwise harming or disturbing eagles, their nests or eggs. The U.S. Fish and Wildlife Service (USFWS) released Bald Eagle Management Guidelines for people who are engaged in recreation or land use activities around bald eagles. These guidelines provide information and recommendations regarding how to avoid disturbing bald eagles. Camp Ripley will continue to monitor and protect active or alternate bald eagle nests with no disturbance buffers during breeding and nesting seasons as required by the National Guard Bureau's Eagle Policy Guidance (Dirks and Dietz 2009), Bald and Golden Eagle Protection Act (USFWS 2008a), and Bald Eagle Management Guidelines (USFWS 2007).

Bald eagles are closely monitored at Camp Ripley (Dirks et al. 2010). Since 1991, two to ten territories have been monitored within Camp Ripley, fledging from one to nine young annually (Table 12). Territory size is variable but are spaced apart to ensure sufficient food resources for chicks and to raise young with minimal disturbance from other eagles. Eagle pairs can have more than one nest within a territory.

Table 12. Bald eagle territories and fledglings, Camp Ripley Training Center, Minnesota, 1991 – 2017.

Year	Number of Active Territories	Number of Young Fledged
1991–1992	4	?
1993	2	4
1994	3	5
1995	3	4
1996	3	4
1997	3	6
1998	2	4
1999	3	3
2000	4	8
2001	4	8
2002	2	1
2003	3	4
2004	3	4
2005	5	5
2006	6	1*
2007	5	9
2008	5	5
2009	4	2*
2010	6	3
2011	7	4
2012	6	5
2013	7	6
2014	6	6*
2015	9	9
2016	9	5*
2017	10	7*

* Not all active nests checked for nest success due to military training.

In late March, bald eagles occupied ten territories throughout Camp Ripley (Figure 13). In addition to recent new nests, Pusan and Frog Lake, that were discovered in 2015 and Lake Alott discovered in April 2016. Two additional nests were discovered in 2017, West Range and Fort Ripley. North Range, East Boundary and Fort Ripley nests each fledged one chick. Pusan and Tamarack Lake fledged two chicks. The Mud Lake, Prentice Pond and Frog Lake territories were active but unsuccessful. The Lake Alott and West Range territories were active but productivity was unknown. Rest Area 3 territory was inactive.

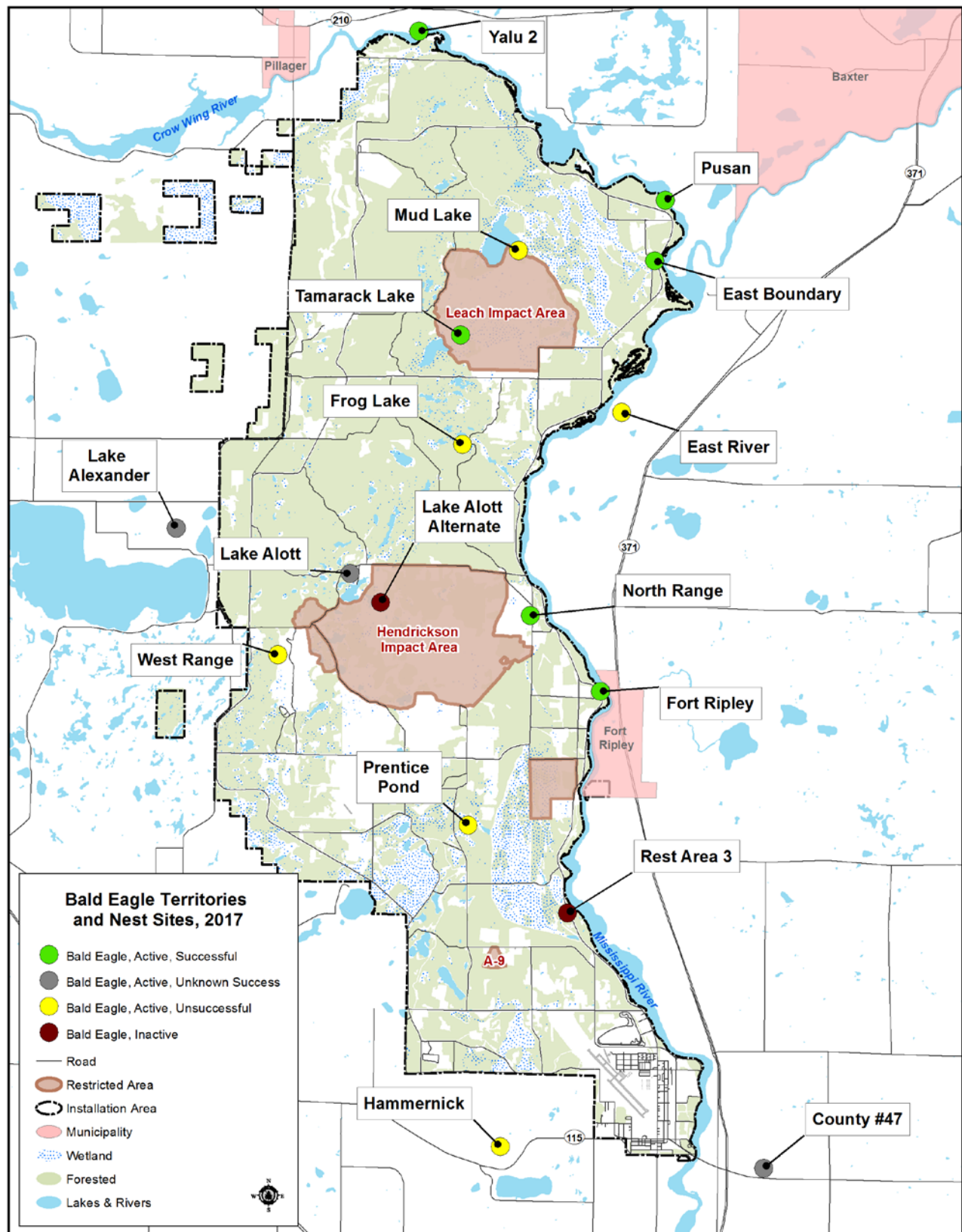
Due to aircraft maneuver training needs during the active bald eagle nesting season, the MNARNG applied for a USFWS bald eagle disturbance permit for nests on Camp Ripley. This was requested by MNARNG helicopter pilots due to the 200 meter horizontal and 300 meter above ground level no disturbance buffers around eagle nests, conflicts with range safety danger zones, and restrictions that do not allow flying low level maneuvers off the installation.

Five eagle territories within one mile of the Camp Ripley boundary were also monitored. The Yalu territory was active and fledged one chick. The Yalu territories' Camp Ripley nest fell in 2014 but was rebuilt on the north side of the Crow Wing River in 2015. The Hammernick nest was rebuilt in the fall 2014. The nest fell during the winter of 2015 but was rebuilt in a different nest tree during 2016. This territory was active but unsuccessful. The East River, County 47 and Lake Alexander territories were active but productivity was unknown.

Golden Eagle (*Aquila chrysaetos*)

Golden eagles in North America are primarily found in Western States and Western Canada. Golden eagles are protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both of these acts prohibit killing, selling or otherwise harming or disturbing eagles, their nests or eggs. Golden eagles do not breed in Minnesota, the nearest population of breeding golden eagles is found in Western North Dakota. Golden eagles have been known to use the state for fall migration needs (annually fall counts record 115 – 200 golden eagles at Hawk Ridge Bird Observatory, Duluth, Minnesota) but had not been thought of as a regular winter visitor in the state. However, recent surveys by the National Eagle Center in Wabasha, Minnesota have discovered a regular winter population between 130 – 150 golden eagles along the Mississippi River valley in southeast Minnesota (National Eagle Center 2017).

Figure 13. Bald eagle territories and nest status at and near Camp Ripley Training Center, Minnesota, 2017.



Winter Survey

In 2010, the National Eagle Center began a wintering golden eagle survey in the bluffs region along the Mississippi River in Minnesota, Wisconsin and Iowa. The project was implemented to document regular wintering populations of golden eagles. Golden eagles were previously not considered regular winter inhabitants of the region. Camp Ripley was added as a survey area in 2016. The survey occurred on January 16, 2016 and January 21, 2017. The primary survey observers in 2016 were Brian Dirks, DNR, and Dr. William Faber, CLC Natural Resources Instructor, with two volunteer observers added. Both Camp Ripley DNR staff conducted the survey in 2017. In 2016 and 2017, no golden eagles were observed (Table 13).

Table 13. Golden eagle wintering survey, Camp Ripley Training Center, Minnesota, since 2016.

Species	Scientific Name	Count Year	
		2016	2017
Bald eagle	<i>Haliaeetus leucocephalus</i>	0	3
Northern goshawk	<i>Accipiter gentilis</i>	0	0
Red-tailed hawk	<i>Buteo jamaicensis</i>	0	2
Rough-legged hawk	<i>Buteo lagopus</i>	0	1
Golden eagle	<i>Aquila chrysaetos</i>	0	0
Unidentified eagle		1	0
# Observers		2	4
Observer Hours		8	12
TOTAL # INDIVIDUALS		1	6
TOTAL # SPECIES		1	3

Migration Tracking Project

The National Eagle Center implemented the Golden Eagle Project to 1) understand habitat needs and prey requirements of golden eagles using the bluffs of Southeast Minnesota, Western Wisconsin and Northeast Iowa, 2) determine breeding origins and migration patterns for this population of golden eagles, 3) encourage conservation of critical winter habitats in the bluffs region, and 4) to educate the public about golden eagles (National Eagle Center 2017).

In 2012, the DNR Camp Ripley staff used road-killed deer at baited, remote camera stations to aid in estimating winter gray wolf populations. Staff recorded multiple golden eagles at bait stations in February and March. In subsequent years, staff continued to record golden eagles at bait stations. The DNR staff worked with the DNR Nongame Wildlife Program, Audubon Minnesota and the National Eagle Center to participate in the Golden Eagle Project and to set aside a solar, satellite, backpack transmitter for use on a Camp Ripley wintering golden eagle. In 2015, three baited remote camera stations were used to determine golden eagle presence on Camp Ripley; once a golden eagle began to feed regularly at a station trapping began. On March 10, 2015, a remotely triggered bow-net trap was used to capture a sub-adult female golden eagle (4 year old; #54 - Ripley). An Argos/GPS solar powered, backpack transmitter (Microwave Telemetry) was fit to the eagle by Mark Martell, Audubon Minnesota.

The transmitter was programmed to take multiple GPS locations every day which provides more accurate locations than the backup satellite (Argos) locations. The Argos system is used to relay

downloads of the GPS locations. On her spring 2017 migration Ripley left her winter area on March 4 and traveled from Minnesota to Nunavut Territory, Canada, arriving on her summer habitat on April 8. She spent approximately 188 days on her summer habitat, then began her fall migration on October 12 returning to Camp Ripley area on December 10. She spent several days on Camp Ripley then moved southwest of Camp for the winter. Her northern migration, a 1,800 mile journey to her summer habitat, took about 36 days and her southern migration back to her winter habitat in Minnesota took 60 days (Figure 14 and 15).

Ripley's capture as a four year old in 2015 meant that she could potentially breed in 2016. In contrast to Ripley's 2015 summer locations which covered a much broader area, her 2016 locations were concentrated in one area which indicated that she was occupying her first nesting territory. In 2017, she occupied the same small area, which showed that she was nesting in this area for a second time. About 35 – 40% of this female, golden eagle's annual life cycle is spent in migration, therefore conservation of migratory habitat is equally as important as conserving summer and winter habitats.

Owl Surveys

Owl surveys at Camp Ripley began in 1994 and continued annually until 1999. These surveys were placed on a four-year rotation in 2000, but with the threat of West Nile Virus occurring in owl populations, the survey is now conducted every year. Data from these surveys is also used to monitor state and regional owl population trends.

In the past, owls were surveyed at 26 points along one designated route (Route #1) in the spring to determine presence and abundance of owl species (Figure 16). The survey was conducted four times during specified survey periods (March 12 – 24, March 25 – April 6, April 7 – 19, April 20 – May 2). A three minute passive listening period was used at each point. An additional survey route (Route #2) was added in 2004, which covers the interior portion of Camp Ripley. This route was surveyed with similar survey protocol as Route #1.

In 2009, Camp Ripley's survey protocol was changed to reflect protocol designed by the Western Great Lakes Region (WGLR) owl monitoring survey (Grosshuesch 2008). Until 2014, this project was a collaborative effort between Hawk Ridge Bird Observatory, Natural Resources Research Institute, Minnesota Department of Natural Resources and Wisconsin Department of Natural Resources but is now being sponsored solely by the Hawk Ridge Bird Observatory (2017). This survey was developed as a large scale, long-term owl survey to monitor owl populations in the WGLR. It was designed to increase understanding of the distribution and abundance of owl species in the region since few species of owls are adequately monitored using traditional avian survey methods such as breeding bird surveys, songbird point counts or Christmas Bird Counts. Survey protocol uses existing anuran (frog and toad) survey routes, of 10 stops per route, to conduct roadside surveys in Minnesota and Wisconsin. In 2008, the number of survey periods was reduced from three to one period (April 1 – 15) with a five minute passive listening period. The (WGLR) survey analysis of seasonal calling activity data suggested one survey period in April is adequate to detect all species of interest for monitoring purposes. For comparison purposes with the WGLR owl survey the existing Camp Ripley owl survey routes are used and the number of routes at Camp Ripley is based upon 10 stops per route.

Figure 14. Satellite transmitted golden eagle (Ripley) locations, Camp Ripley Training Center, Minnesota, 2017.

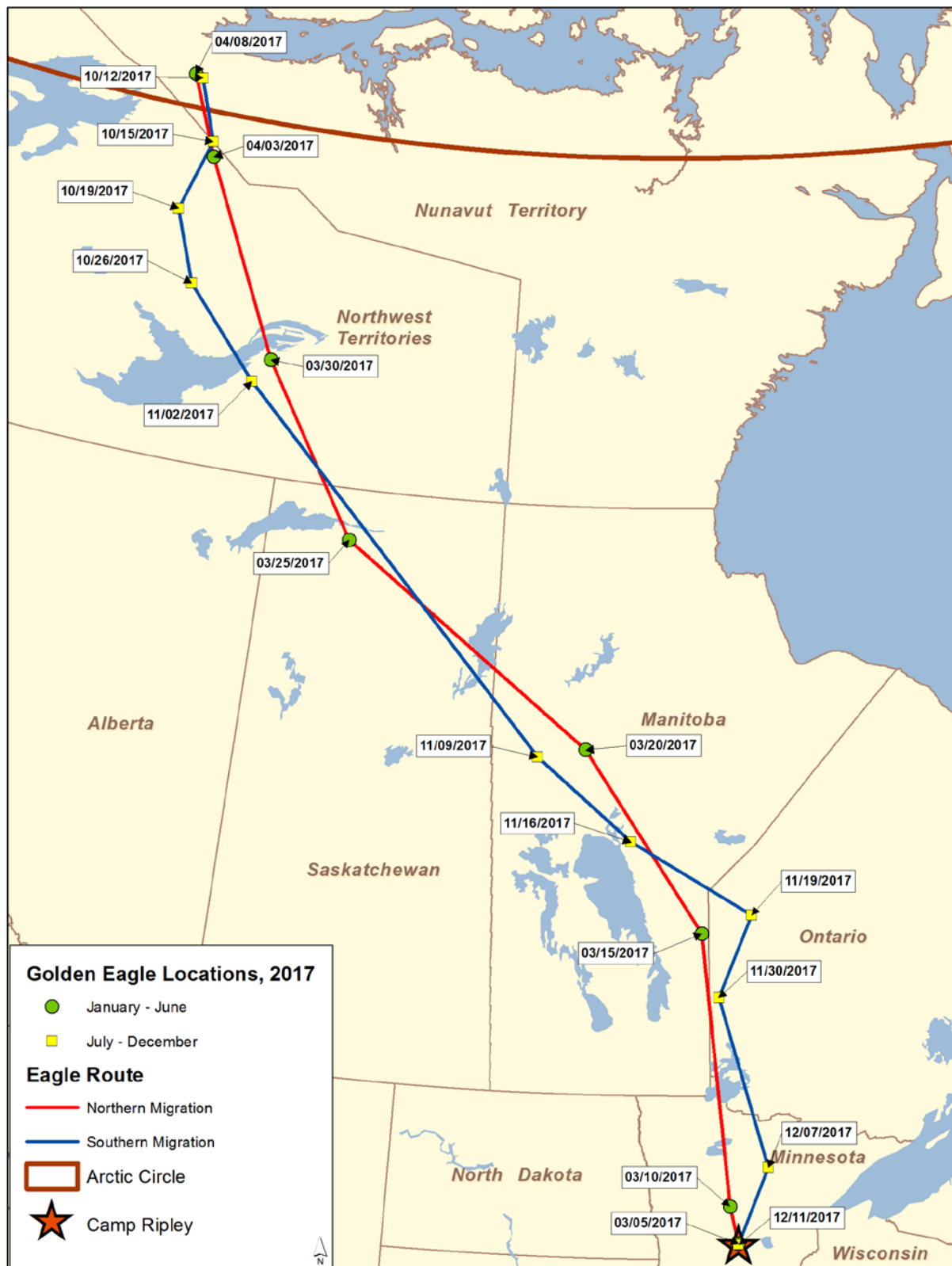


Figure 15. Satellite transmitted golden eagle (Ripley) migration routes, Camp Ripley Training Center, Minnesota, 2015 – 2017.

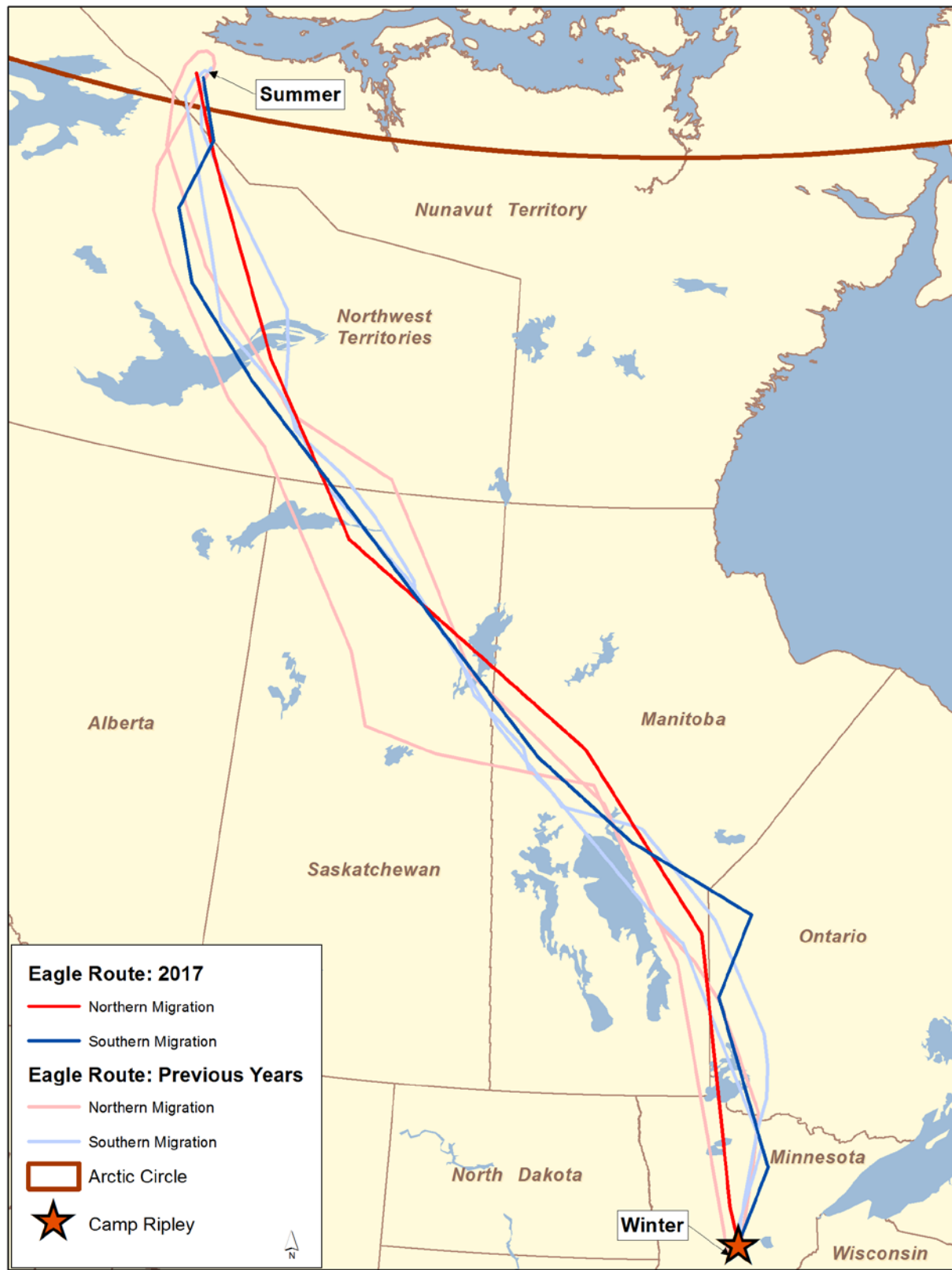
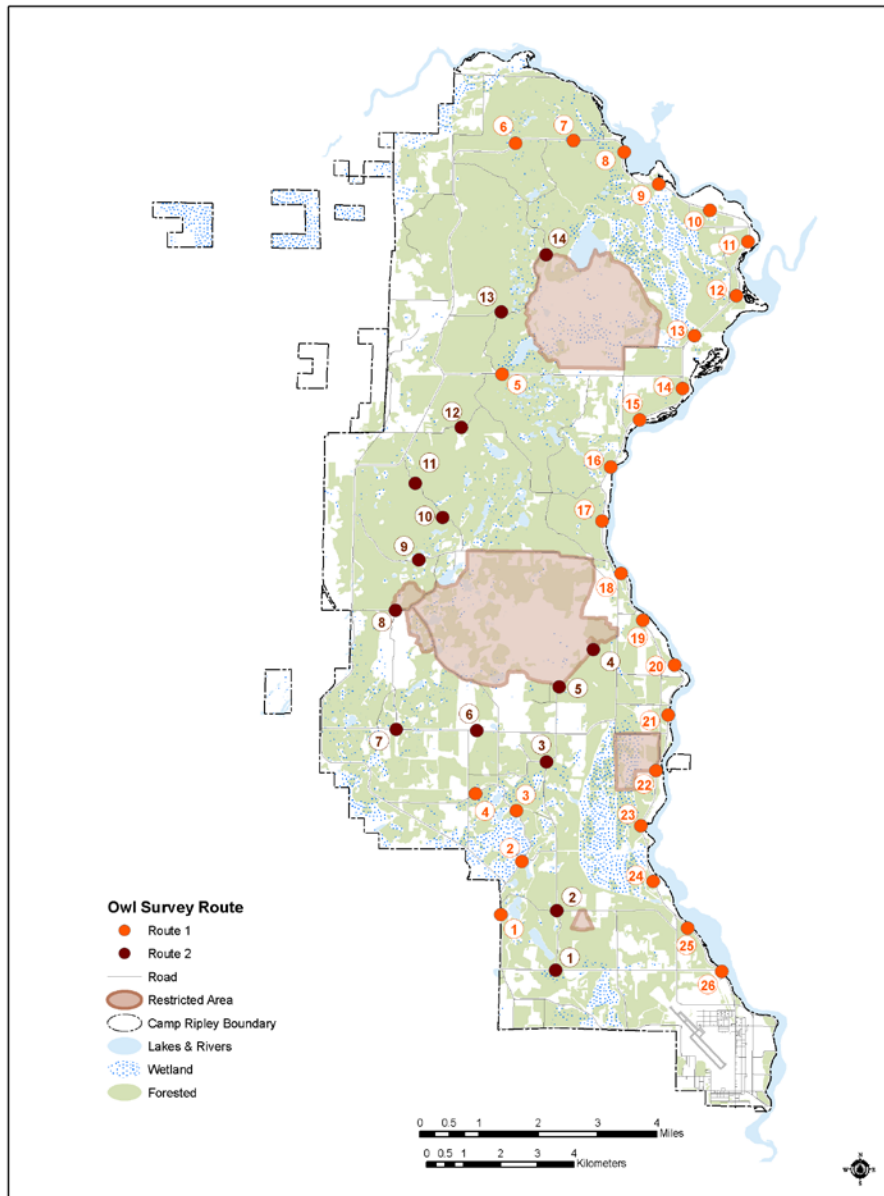


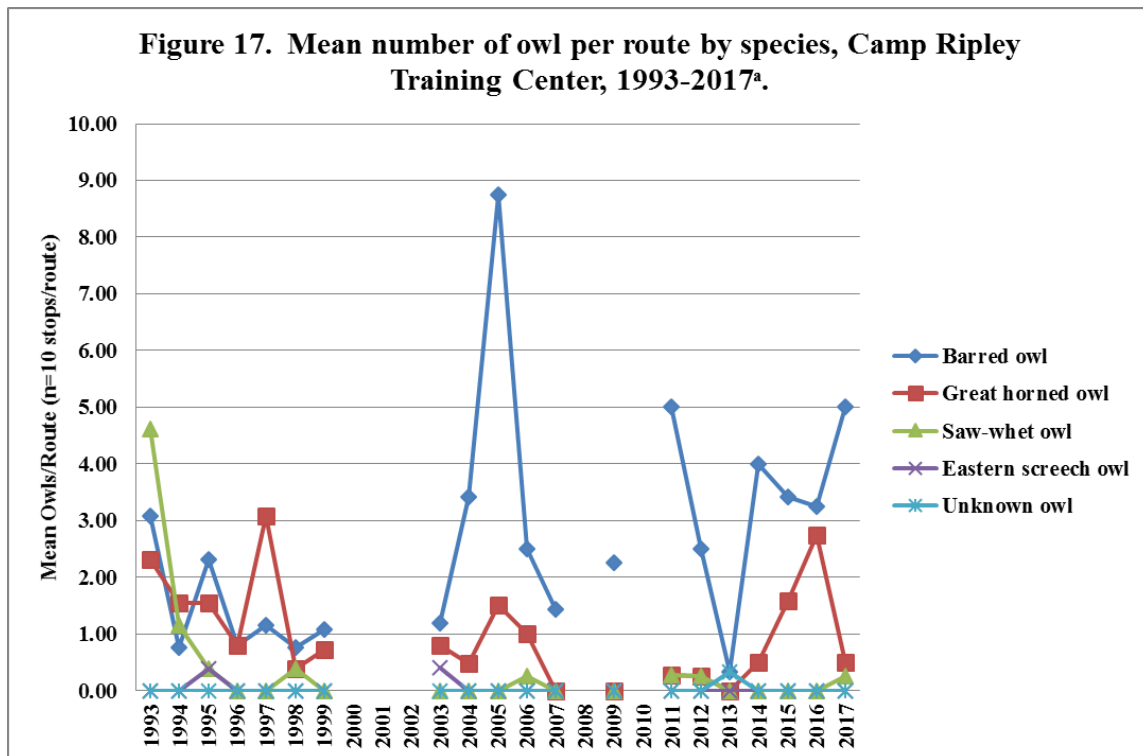
Figure 16. Owl survey routes, Camp Ripley Training Center, Route #1 since 1993 and Route #2 since 2004.



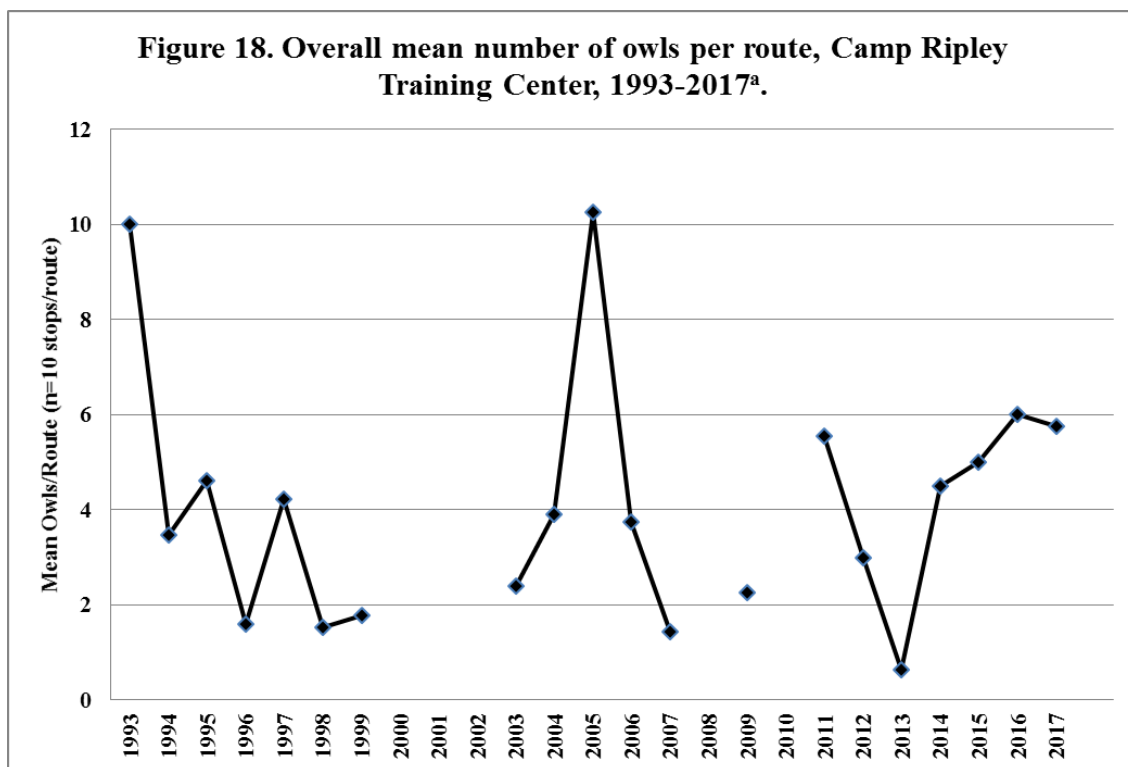
The owl survey for Route #1 and Route #2 (Figure 17) was conducted on April 4. A total of 24 owls were detected during the surveys (4.0 routes). The mean for barred owls (*Strix varia*) was 5.0 owls/route, the third highest since 1993 (Figure 16). The mean for great horned owls (*Bubo virginianus*) was 0.5 owls/route, down significantly from 2.75 in 2016 (Figure 17). One northern saw-whet owl (*Aegolius acadicus*) and no eastern screech-owls (*Megascops asio*) were heard. The overall mean of 5.75 owls/route (Figure 18) is the fourth highest mean during the 19 year history of the survey. And, it is above the Camp Ripley long-term survey mean of 4.08 owls/route.

In 2017, Camp Ripley had two and half times as many mean owls/route (5.75)

compared to Minnesota's WGLR survey's mean of 2.15 owls/route in 2014 (Grosshuesch and Brady 2015), the most recent information available. In addition, on a neighboring route in east-central Morrison County the barred owl count was zero owls/route in 2014, whereas Camp Ripley's survey averaged 5.0 barred owls/route in 2017 (Figure 17). Camp Ripley's mean owls per route has been either similar to Minnesota's WGLR survey number or has exceeded it since 2005 (Grosshuesch and Brady 2015). Minnesota's WGLR owl survey results are pending for 2015 – 2017.



^aSurvey data presented with a three minute passive listening period. No surveys were conducted in 2000 – 2002 and 2007, 2008 and 2010.



^aSurvey data presented with a three minute passive listening period. No surveys were conducted in 2000 – 2002 and 2007, 2008 and 2010.

Eastern Bluebird (*Sialia sialis*) Nest Boxes

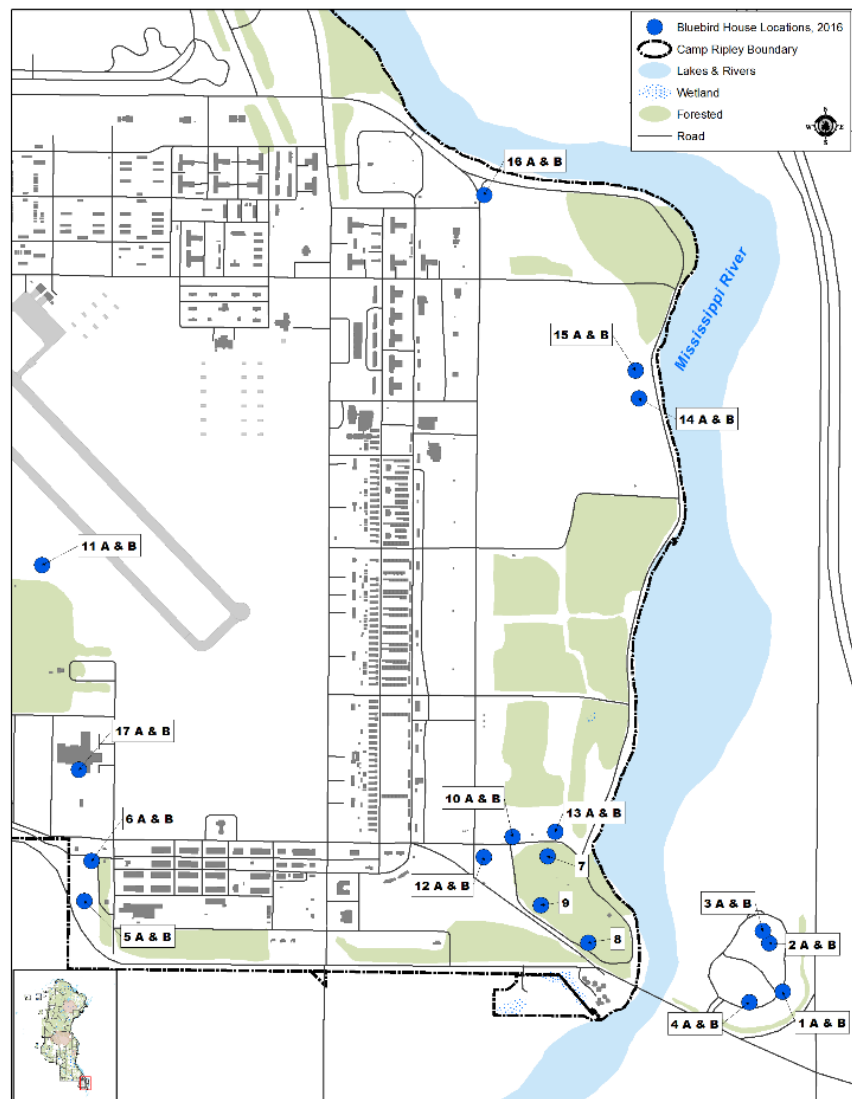
Eastern bluebird populations declined significantly from the 1930s to 1960s due to loss of habitat and competition from other cavity nesting birds particularly non-native European starlings (*Sturnus vulgaris*) and house sparrows (*Passer domesticus*) (MNDNR 2017a). Because of this population decline, nationwide bluebird recovery efforts began with the North American Bluebird Society in 1977 (North American Bluebird Society 2017a) and in 1979 statewide recovery efforts were initiated by the Audubon Chapter of Minneapolis Bluebird Recovery Program of Minnesota (Bluebird Recovery Program of Minnesota 2017a) in cooperation with the Nongame Wildlife Program of the DNR. These recovery efforts provided artificial nest boxes for eastern bluebirds.

Camp Ripley established artificial nest boxes in 1994 at the Minnesota State Veterans Cemetery and along the Camp Ripley cantonment fence in 2007 to aid in the eastern bluebird recovery. In addition, the nest boxes at the Minnesota State Veterans Cemetery provide visitors viewing enjoyment.

In 2008, nest boxes were replaced with Gilbertson PVC artificial nest boxes (North American Bluebird Society 2017b). Bluebird nest box pairs were located in open areas close to scattered trees, at least 300 feet from brush, and more than 500 feet apart. Placing boxes away from brush areas minimizes nest box use by house wrens (*Troglodytes aedon*). These locations have been effective and eliminated use by house wrens from 2009 to 2017.

Thirty-one Gilbertson PVC bluebird nest boxes (Figure 19) were monitored regularly

Figure 19. Location of eastern bluebird houses, Minnesota State Veterans Cemetery and Camp Ripley Training Center cantonment area, since 2016.



during the breeding season (April to August) by Mike Ratzloff, Minnesota Department of Natural Resources volunteer. Sixteen boxes were occupied by bluebirds, six by tree swallows (*Tachycineta bicolor*), one by black-capped chickadees (*Poecile atricapillus*) (Table 14) and none by house wrens. No successful nesting attempts were made by invasive house sparrows. Only two bluebirds fledged from the

Table 14. Bluebird and tree swallow fledging production, Camp Ripley Training Center, Minnesota, since 2009.

Year	Veterans Cemetery			Cantonment		
	# Nest Boxes	# Bluebirds Fledged	# Tree Swallows Fledged	# nest boxes	# Bluebirds Fledged	# Tree Swallows Fledged
2009	8	17 (5 boxes)	10 (3 boxes)	21	79 (12 boxes)	6 (1 box)
2010	8	17 (5 boxes)	11 (2 boxes)	23	79 (16 boxes)	13 (4 boxes)
2011	8	13 (3 boxes)	19 (4 boxes)	23	53 (11 boxes)	10 (4 boxes)
2012	8	7 (3 boxes)	18 (5 boxes)	23	82 (13 boxes)	1 (2 boxes)
2013	8	16 (4 boxes)	10 (2 boxes)	23	53 (14 boxes)	10 (3 boxes)
2014	8	16 (3 boxes)	9 (2 boxes)	21	79 (13 boxes)	6 (1 box)
2015	8	5 (1 box)	10 (3 boxes)	20	66 (10 boxes)	6 (2 boxes)
2016	8	5 (2 boxes)	17 (3 boxes)	23	43 (12 boxes)	26 (6 boxes)
2017	8	2 (1 box)	14 (3 boxes)	23	54 (11 boxes)	15 (3 boxes)

nest boxes at the Minnesota State Veterans Cemetery and 54 fledged from nest boxes within the cantonment area. Additionally, 29 tree swallows and six black-capped chickadees successfully fledged. Camp Ripley's bluebird production has been lower in the past three years; however, the long-term mean (2009 – 2017) of 2.5 bluebirds fledged per nest box is higher than the statewide long-term (2005 – 2015) mean of 2.12 (Bluebird Recovery Program of Minnesota 2017b). Regular bluebird house maintenance and monitoring greatly improves the success of bluebird houses.

Mammals

Gray Wolf (*Canis lupus*)

Federal Court Decision

Through federal action and by encouraging the establishment of state programs, the 1973 Endangered Species Act provided for the conservation of ecosystems upon which threatened and endangered species of fish, wildlife and plants depend (USFWS 2008b). The first federal Endangered Species Preservation Act was passed in 1966, and in 1967 gray wolves were classified as endangered and provided limited protection. In 1974, gray wolves were afforded full protection under the federal Endangered Species Act (ESA) of 1973 (MNDNR 2016a). During the mid- to late-1970s the DNR estimated the wolf population at about 1,000 to 1,200; based on 2003 – 2004 and 2007 – 2008 surveys, the population had grown and stabilized at approximately 3,000 animals. The 2016 – 2017 survey estimated that the current population is stable at 2,856 wolves (Erb et al. 2018).

In a proposed rule issued on May 5, 2011, the U.S. Fish and Wildlife Service proposed to remove gray wolves in the Western Great Lakes Distinct Population Segment — which includes Minnesota, Michigan, Wisconsin and portions of adjoining states — from the Federal List of Endangered and Threatened Wildlife because wolves had recovered in this area and no longer required the protection of the Endangered Species Act (USFWS 2011a). The Final Rule to remove Endangered Species Act protection for gray wolves in this area took effect January 27, 2012 (USFWS 2011b). However, due to a federal court decision, wolves in the Great Lakes region were relisted under the Endangered Species Act, effective December 19, 2014 (USFWS 2015). Wolves reverted to the federal protection status they had prior to being removed from the endangered species list in the Great Lakes region. This means wolves are currently federally classified as threatened in Minnesota and endangered elsewhere in the Great Lakes region (MNDNR 2015b).

Wolf Monitoring Background

Besides serving as a National Guard training center, Camp Ripley is also a Minnesota Statutory Game Refuge. Wolves were first documented on Camp Ripley in 1993. Camp Ripley provides good quality habitat for wolves on the southern edge of the Minnesota gray wolf range. In the past 22 years, 51 wolves have been radio-collared and/or ear tagged on Camp Ripley to determine pack size, movements, causes of mortality and possible effects of military training (Table 15).

Comparing survival rates of wolves on and off Camp Ripley may provide additional insight into the effects of delisting and now relisting wolves. Research has demonstrated that military training activities on Camp do not negatively affect wolves and the presence of wolves on Camp has not resulted in any loss of training capabilities. In fact, evidence obtained from this study confirmed that wolves that move off Camp are moving into a more hostile environment where they are exposed to illegal and accidental caused mortality.

Wolf Status and Movements

Since 2001, Camp Ripley has supported two or three wolf packs. In 2017, three wolf packs used Camp Ripley as most or part of their home range. The amount of time each pack spends on Camp varies. The North Pack, which occupies the north half of Camp, usually stays in this area, while only part of the South Pack's territory is on Camp. In addition, pack sizes vary each year and by time of year. Winter 2016 – 2017 pack estimates from remote cameras and track counts indicate that only three to four wolves were in the South Pack while the North and Miller Lake packs each contained eight wolves. This estimate is similar with the number of wolves in Camp Ripley packs in recent years.

At the beginning of 2017, the only two radio collared wolves on Camp Ripley were in the North Pack. Plans to snare and radio collar additional wolves in January-March 2017, were thwarted because of insufficient snow depth. At one time the breeding female of the North Pack, wolf #40 was originally captured by helicopter and radio collared in February, 2010. She was caught again as an incidental catch during a wolf trapping/collaring project in May 2011. Because of wolf #40s age and condition she was not recaptured in 2015; however, she has continued to be located by remote camera and tracking her failing radio collar. Even though her radio-collar eventually failed in 2017, she was observed twice early in the year during aerial radio tracking (Figure 20) The other collared wolf (#50) has been the breeding male in the North Pack since before he was radio-collared in February 2015.

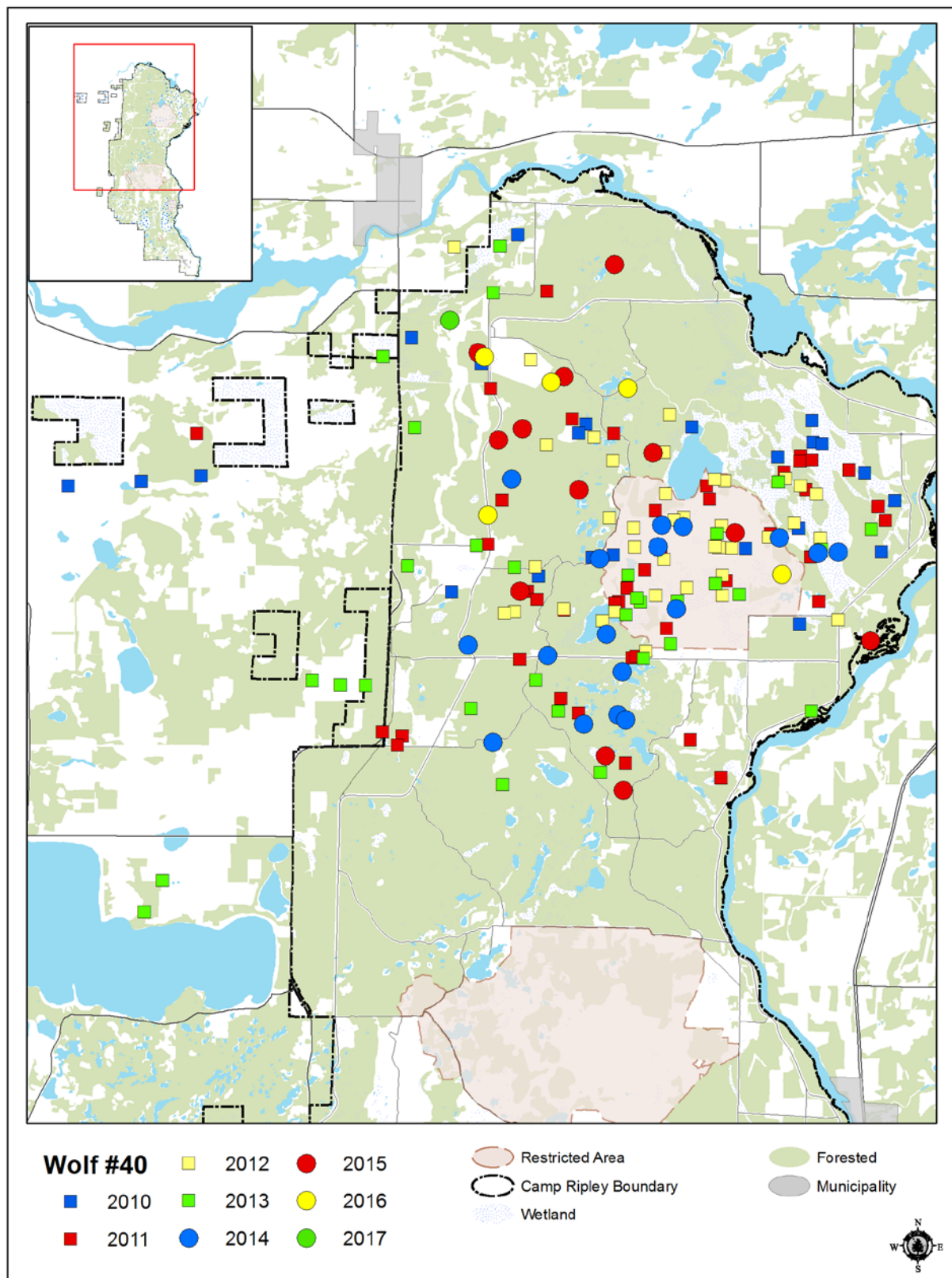
Table 15. Gray wolves captured, Camp Ripley Training Center, Minnesota, since 1996. (**Bold = wolves monitored in 2017**)

Wolf#	Sex	# of Captures	Age at 1 st Capture	Date of 1 st Capture	Date of Last Capture	Weight (lbs.) at Last Capture	Ear Tag Color & Number (Left/ Right)	Fate	Comments
1	F	1	Yearling	9/10/1996	9/10/1996	57		dead	Illegally trapped/shot in Cass County (8/1997)
2	F	2	Pup	9/19/1996	8/29/1997	42		dead	Illegally shot-poacher
3	F	1	Yearling	9/20/1996	9/20/1996	80		dead	Poisoned
4	M	2	Yearling	9/23/1996	1/31/1998	79		dead	Hit by car
5	F	1	Yearling	2/21/1997	2/21/1997	55		unknown	Dropped collar for data retrieval
6	F	3	4–5 years	2/21/1997	7/24/1998	90		dead	Hit by car
7	M	3	10 month	2/21/1997	2/1/1998	55		dead	Illegally shot-poacher
8	F	1	10 month	2/21/1997	2/21/1997	50		unknown	Dropped collar for data retrieval
9	M	2	3–4 years	2/21/1997	2/3/1998	90		unknown	Pillsbury State Forest
10	M	1	Pup	8/29/1997	8/29/1997	20		dead	Starved? (9/23/2007)
11	F	4	Pup	10/31/1997	2/4/1999	59		dead	Illegally shot in Hillman area? Collar found in swamp
12	M	2	Yearling	11/4/1997	2/3/1998	60		dead	Killed by ADC in Pine County (7/26/1999)
13	M	1	Yearling	2/3/1998	2/3/1998	88		unknown	Dropped collar for data retrieval
14	F	3	Yearling	9/14/1998	1/30/2002	76		unknown	Collar failed –2003
15	M	3	>3 years	2/2/1999	1/17/2001	107		dead	Found dead on Camp (7/2001)
16	F	1	1–2 years	1/18/2001	1/18/2001	65		dead	Found dead in Michigan– Illegally shot (9/2002) (Sue)
17	M	2	1–2 years	9/26/2001	2/4/2004	88		unknown	Missing
18	M	3	3–4 years	11/15/2001	2/25/2003	95		dead	Struck by car on Hwy 371 (Lucky)
19	F	2	1–2 years	1/30/2002	12/13/2002	76		dead	Illegally shot south of Camp
20	F	2	>3 years	1/30/2002	1/30/2006	79		dead	Found dead west of Camp Unk. (8/2007) (Lady)
21	F	1	1–2 years	2/25/2003	2/25/2003	68		dead	Found dead in cornfield (Shot?)
22	M	1	2–3 years	2/4/2004	2/4/2004	100		dead	Killed by ADC 4/24/2004 in Cass County
23	M	2	1–2 years	2/4/2004	1/30/2006	72		dead	Illegally shot during firearms deer season (11/2007) (Smokey)
24	M	1	1–2 years	2/4/2004	2/4/2004	78		unknown	Collar failed
25	M	1	1–2 years	2/4/2004	2/4/2004	83		unknown	Collar chewed off
26	M	1	3–4 years	1/30/2006	1/30/2006	85		dead	Illegally shot during firearms deer season (11/2008) (Sly)
27	M	1	2 years	1/30/2006	1/30/2006	85		dead	Struck by car on Hwy 371
28	M	1	4–5 years	1/30/2006	1/30/2006	103		dead	Illegally shot – was North Pack breeding male (Big Foot)
29	F	1	2 years	1/30/2006	1/30/2006	67	Orange 1/Blue 11	unknown	Collar chewed off –11/2009 North Pack
30	F	1	3 years	1/31/2006	1/31/2006	85		dead	Found during helicopter capture (2/08) killed by wolves (Shep)
31	M	1	4–5 years	3/22/2008	3/22/2008	75		dead	Illegally shot (11/2011) South Pack

Table 15. Gray wolves captured, Camp Ripley Training Center, Minnesota, since 1996. (**Bold = wolves monitored in 2017**)

Wolf#	Sex	# of Captures	Age at 1 st Capture	Date of 1 st Capture	Date of Last Capture	Weight (lbs.) at Last Capture	Ear Tag Color & Number (Left/ Right)	Fate	Comments
32	F	2	2–3 years	3/22/2008	9/13/2011	76		dead	Illegally killed (arrow) south of Camp Ripley (October 9, 2012)
33	F	1	2 years	3/22/2008	3/22/2008	76		dead	Killed by depredation trapper in Manitoba, Canada (7/2008)
34	M	1	4–5 years	3/22/2008	3/22/2008	92		dead	Illegally shot near Staples, MN on 11/12/2009 (Techno)
35	M	1	Pup	10/6/2009	10/6/2009	55	Metal 2117/2466	unknown	North Pack; VHF collar (Trickster); Collar chewed off Jan. 2010
36	M	1	3 years	2/2/2010	2/2/2010	63	Yellow 34/Yellow 46	dead	Lake Alexander Pack – illegally shot in February 2014 near Cushing, MN
37	M	1	4–5 years	2/3/2010	2/3/2010	77		dead	Killed by wolves in adjacent pack in February 2012
38	F	1	Pup	2/3/2010	2/3/2010	56	Blue 21/Orange 15	unknown	South Pack – satellite collared, failed May 2010
39	M	1	8–10 years	2/3/2010	2/3/2010	97		dead	Died of natural causes February 2012
40	F	1	4–6 years	2/3/2010	5/20/2011	69	Orange 24/Yellow 29	ALIVE	North Pack – past breeding female – collar failed 2017
41	M	1	Pup	9/25/2011	9/25/2011	50	Blue 16/Blue 25	Unknown	Moved to Fergus Fall, MN area from Miller Lake Pack Last location January 2016
42	M	1	Pup	9/26/2011	9/26/2011	40	Yellow 50/Blue 17	unknown	North Pack – not radio-collared
43	F	1	Pup	9/26/2011	9/26/2011	39	Orange 23/Blue 23	unknown	North Pack – not radio-collared
44	M	1	3 years	2/14/2013	2/14/2013	87	Yellow 35/Blue 7	dead	Unknown Pack – illegally shot in early November 2013 near Little Elk WMA
45	F	1	3–4 years	2/14/2013	2/14/2013	77	Orange 8/Orange 20	dead	Unknown Pack – legally harvested during wolf season NE of Rice, MN
46	M	1	1 year	2/27/2015	2/27/2015	65	Yellow 26/Blue 20	DEAD	South Pack – illegally shot December 2015 Rice Lake WMA south of Staples, MN
47	M	1	2–3 years	2/27/2015	2/27/2015	70	Green 7/Green 8	Unknown	South Pack – USGS GPS/Satellite collar programmed to drop off in late February 2016
48	M	1	2–3 years	2/27/2015	2/27/2015	70	White 4/Green 1	unknown	Miller Lake Pack – Missing since June 2015
49	M	1	2–3 years	2/27/2015	2/27/2015	74	Green 2/White 3	Unknown	Miller Lake Pack – USGS GPS/Satellite collar programmed to drop off in April 2016
50	M	1	5–6 years	2/27/2015	2/27/2015	70	Orange 3/Orange 5	ALIVE	North Pack – breeding male
51	M	1	7 years	2/27/2015	2/27/2015	85	White 1/White 2	unknown	Collar chewed off –10/2015 – North Pack

Figure 20. Wolf #40 locations, North Pack, Camp Ripley Training Center, Minnesota, 2010 – 2017.



Black Bear (*Ursus americanus*)

Research

A telemetry-based study of black bears was initiated at Camp Ripley in 1991. The current study is part of a statewide research project conducted by the DNR designed to monitor the body condition, movements and reproductive success of bears in the northern, central and southern parts of Minnesota's bear range. Camp Ripley lies along the southern edge of bear range in Minnesota. The principal objectives of this study include 1) continued monitoring of reproduction and cub survival, 2) additional (improved) measurements of body condition, heart function and wound healing, 3) examination of habitat use and movements with GPS telemetry, 4) investigation of female dispersal near the southern fringe of the expanding bear range (Garshelis et al. 2004), and 5) monitoring the incidence of nuisance bears and in particular any conflicts with soldiers and military training.

Movement and Reproduction

In 2017, ground and aerial tracking were used to monitor reproductive success, movements and survival of five radio collared black bears (Table 16). Researchers are now focusing more on reproductive success and survival than movements and habitat use; therefore most bears on Camp Ripley were located less frequently in 2012 – 2017 than in the past. However, bear 2079 wore a GPS/satellite collar (Telonics) that collected thousands of locations during the year.

Originally radio-collared in June of 2004 as a two year old, Bear 2079 (15 years old in 2017) was fit with a variety of VHF, GPS and satellite collars throughout her life. The thousands of locations obtained from her radio collars provided detailed information on her home range and movements. Although bear 2079 was originally captured on Camp Ripley, and in her early years denned there, she eventually moved south of Camp only returning for short visits most years (Figure 21). Bear 2079's territory covered both sides of U.S. Highway 10 which is a major divided highway. Over her lifetime she successfully crossed Hwy 10 numerous times, but on July 31, 2017 she was hit and killed by a vehicle north of Little Falls, MN. Bear 2079 had 15 cubs, eleven of which lived to be yearlings, and raised one orphaned cub over her lifetime.

All of the four remaining radio-collared bears spent most of the year on Camp Ripley. A total of ten cubs were born to these bears and all of the cubs survived to den in the fall. Bear 2081 (18 years old in 2017) had two cubs in 2017; both were in the den with her during a December den visit. Bear 2124 (eight years old in 2017) has taken up residence within her mother's (bear 2063) former home range in the northeast portion of Camp. She had two cubs in January 2017 and that fall both cubs were observed before she denned in Training Area 64. Bear 2130 (13 years old in 2017) was first collared during den visits in February 2012. She had three cubs in 2017 and all were observed in late fall. Bear 2154 (seven years old in 2017) was first discovered in her den in the winter of 2013 – 2014 and was collared in February 2014. She had two cubs in 2017 which were also observed in late fall.

Table 16. Black bears monitored, Camp Ripley Training Center, Minnesota, 2017.

Bear ID	Sex	Age as of Jan. 2017	Year of First Capture	Age at First Capture	Weight at Last Capture (lbs.)	Ear Tag Color & Number (Front/Back Left/Front/Back/Right)*	Status
2079	F	15	2004	2 yrs.	324 (3/2017)	P-P 301 / P-P 320	DEAD Vehicle Collision
2081	F	18	2004	5 yrs.	247 (3/2017)	R-R 265 / B-B 369	ALIVE
2092	F	12	2005	Cub	235 (2/2014)	B-B 295 / O-O 231	ALIVE collar recovered 11/2014. Photo 7/2016 (2079's cub)
2124	F	8	2009	Cub	194 (3/2017)	Red 273 / White 327	ALIVE (2063's cub)
2130	F	13	2012	8 yrs.	264 (3/2017)	W-W 333 / B-B 368	ALIVE
2154	F	7	2014	4 yrs.	225 (3/2017)	Lt. Blue 351 / Lt. Blue 298	ALIVE

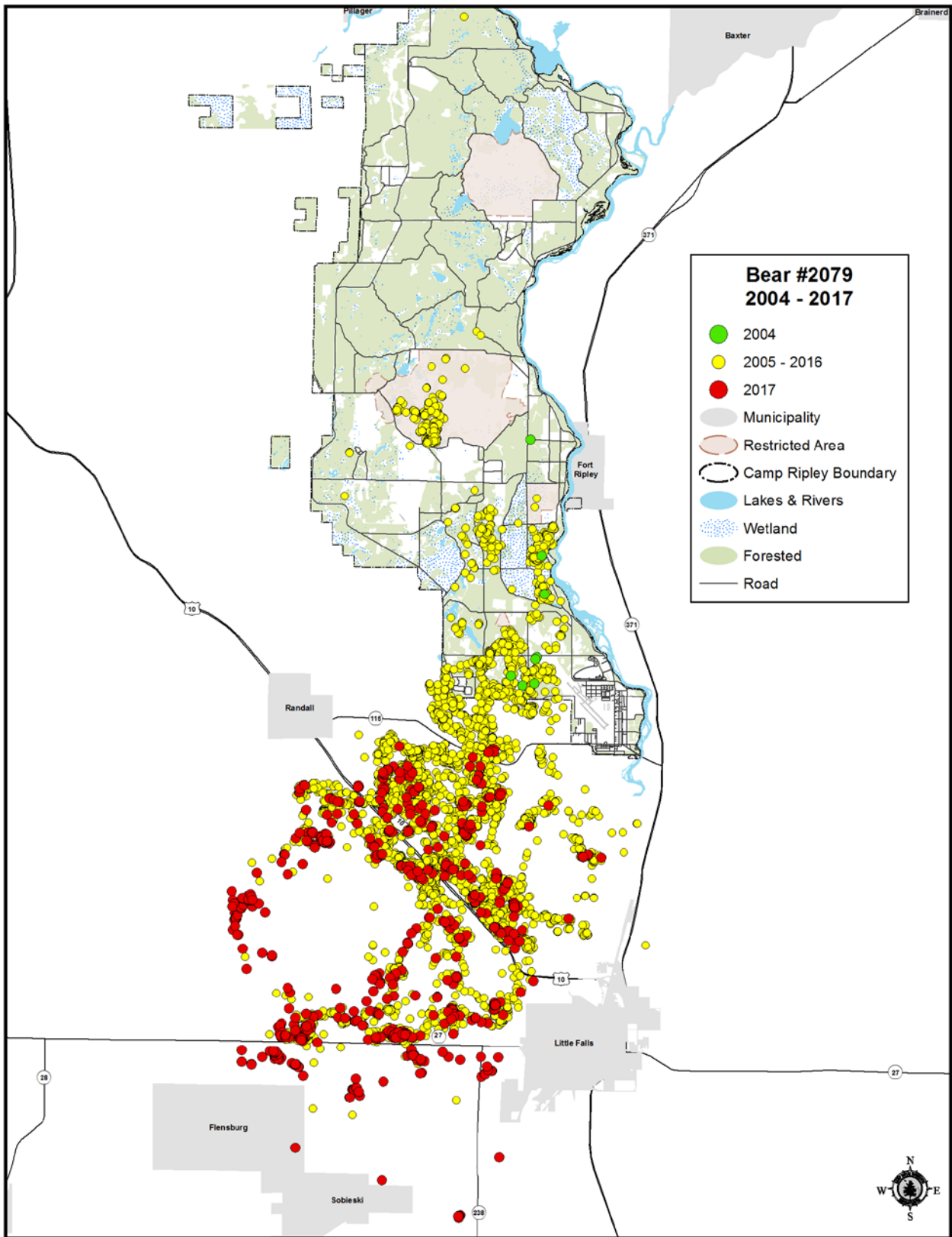
*Y=Yellow; W=White; O=Orange; R=Red; P=Pink; Pu=Purple; B=Blue

Beaver (*Castor canadensis*)

Beaver are an important part of the natural ecosystems at Camp Ripley. This species can have a large effect on the environment in which it lives. In a natural system, beavers create or enlarge wetland areas which trap nutrients and help to reduce flooding by holding and slowly releasing water. However, problems occur in localized areas of Camp Ripley when beavers plug road culverts, flooding and damaging roads. When this occurs, a cooperative effort between the Camp Ripley – Environmental (CRE) office, the DNR and Camp Ripley Department of Public Works (DPW) is initiated to identify problem areas and implement solutions.

All problem areas are inspected by CRE staff, and possible solutions are provided to Camp Ripley's DPW. Some areas require the removal of beaver through trapping. Trapping permits are issued by a local DNR conservation officer. Camp Ripley beaver removal is conducted by the DNR and nuisance beaver trappers at the direction of the DNR staff. During the spring, 43 beavers were removed from problem areas and two during fall. Weather conditions in the fall did not provide good trapping conditions. Beaver removal occurred in the following areas: Marne and Cunningham road intersection (culvert #374; n=10), Luzon Road (n=1) West Range (multiple culverts; n=14), Cody Road (culvert #136; n=1), Rest Area 3 (culverts #78 & #80; n=4), Mississippi River (culverts #45 – #48; n=4) and Yalu Road (culverts #345 & #346; n=9). Beaver trapping will continue in the spring of 2018.

Figure 21. Black bear #2079 locations, Camp Ripley Training Center, Minnesota, 2004 – 2017.



Many problem areas can be addressed through the use of damage control structures, such as Clemson levelers and beaver deceivers. These devices have been used successfully at Camp Ripley in the past, and additional sites are targeted for these devices each year. However, these devices do require maintenance and eventually fail and/or need to be replaced. In 2016, an additional beaver leveler was installed on Yalu Road alongside a working leveler through culvert #346. The existing levelers through the Yalu Road culvert (#346) and neighboring beaver dam were replaced in 2017. Beaver levelers were replaced at Chorwan Road culvert #332 and Mud Lake outlet culvert #348. New levelers were installed in culverts at Fort Greely Road culvert #344 and Normandy Road culvert #166.

Beaver ponds throughout Camp Ripley provide habitat for Blanding's turtles, a state threatened species, and numerous other reptiles and amphibians; as well as provide feeding areas for a variety of wildlife and habitat for waterfowl and other birds. Therefore, it is important that these wetlands not be permanently drawn down or drawn down in fall or winter in order to install these devices. Installation should occur after a temporary draw down in spring or summer, or during natural low-water levels. Research in East-Central Minnesota investigated the effects of a controlled draw down on Blanding's turtle populations. The incidence of mortality was high after the draw down due to predation, road mortality and winterkill (Dorff Hall and Cuthbert 2000).

Bats

"Bats are a critical component of Minnesota's ecosystems. A single bat may eat 1,000 insects per hour, and the state's bats likely provide many millions of dollars in pest control each year (Boyles et al. 2011)" (Swingen et al. 2016). Eight species of bats have been documented in Minnesota: little brown myotis (*Myotis lucifugus*, MYLU), northern long-eared bat (*Myotis septentrionalis*, MYSE), big brown bat (*Eptesicus fuscus*, EPFU), tricolored bat (*Perimyotis subflavus*, PESU), silver-haired bat (*Lasionycteris noctivagans*, LANO), eastern red bat (*Lasiurus borealis*, LABO), hoary bat (*Lasiurus cinereus*, LACI) and evening bat (*Nycticeius humeralis*, NYHU). Four of Minnesota's bat species hibernate in caves and mines (northern long-eared bat, tricolored bat, little brown myotis, and big brown bat) during the winter, and disperse widely across the state in spring, summer, and fall. Very little is known about the summer habitat use of these species" (Swingen et al. 2016 and 2018).

Camp Ripley is home to three bats that are designated state special concern species and SGCN: northern long-eared bat, little brown myotis and big brown bat. Three additional bats are SGCN only: silver-haired bat, eastern red bat and hoary bat. Past stationary acoustic bat surveys have identified all of these bat species occurring on Camp Ripley (Dirks and Dietz 2010).

Northern Long-eared Bat Federal Listing

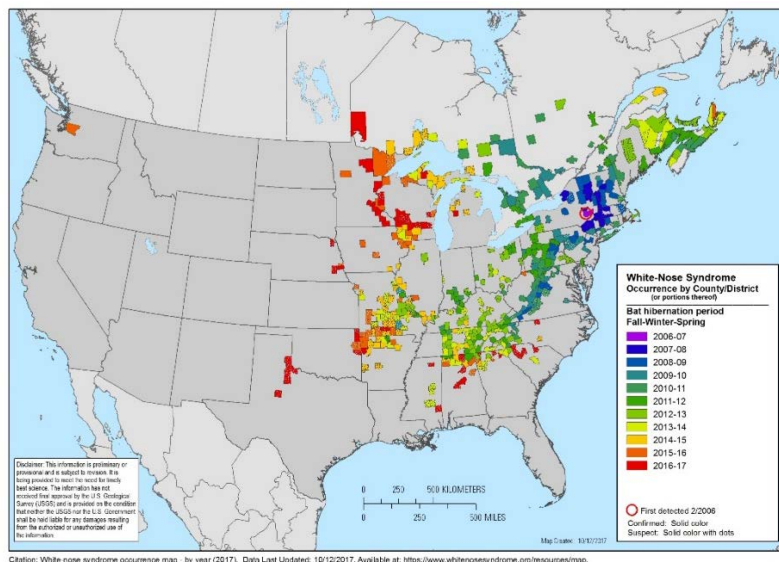
In January 2010, the U.S. Fish and Wildlife Service (USFWS) received a petition from the Center for Biological Diversity requesting that the northern long-eared bat be listed as threatened or endangered under the Endangered Species Act and to designate critical habitat. The USFWS announced on October 2, 2013 (USNARA 2013), that listing the northern long-eared bat was warranted and proposed to list it as endangered throughout its range, which includes Minnesota.

However, the USFWS listed the northern long-eared bat as “threatened” under the federal Endangered Species Act in April 2015, largely due to the impact of white-nose syndrome on bat populations. A threatened species is an animal or plant that is likely to become endangered within the foreseeable future throughout all or a significant portion of its range. On April 27, 2016, the USFWS determined that designating critical habitat for northern long-eared bat was not prudent (USFWS 2016b, 2016c).

White-nose syndrome is threatening bat populations in the eastern United States. “White-nose syndrome (WNS) is caused by the fungus *Pseudogymnoascus destructans* (Pd) that leads to increased winter activity and extremely high mortality rates of cave-hibernating bats (Frick et al. 2010)” (Swingen et al. 2016). Since 2006, WNS has spread from a single central New York cave southward into Alabama; northwestward into Wisconsin, Iowa and Minnesota; and was recently discovered in Texas, Nebraska and Washington (Figure 22). WNS is a fungus that has killed more than 7 million hibernating bats since 2006 in North America with new range expansions of WNS occurring every year (MNDNR 2016b, 2016c, Turner et al. 2011 and White-nose Syndrome 2017; Figure 22). “*P. destructans* was detected in Minnesota in 2013, and bat mortalities from WNS were first recorded during January 2016 at Lake Vermilion – Soudan Underground Mine State Park, near Soudan, Minnesota (MNDNR 2013c, 2016a)” (Swingen et al. 2016).

The northern long-eared bat is known to occur on Camp Ripley (Dirks and DeJong 2007) and has been designated as a state special concern species since 1984. While no winter habitat is known to occur on Camp Ripley, summer and migratory habitat is available. Northern long-eared bats are associated with forested habitats, especially around wetlands (MNDNR 2013b) and roost singly or in colonies underneath bark, in cavities or in crevices of both live and dead trees. Northern long-eared bats begin feeding at dusk by flying through the understory along forested hillsides and ridges feeding

Figure 22. White-nose syndrome (WNS) occurrence in the eastern United States, by county and year, as of April 3, 2017 (White-nose Syndrome 2017).



on insects that they catch in flight using echolocation. The primary threat to northern long-eared bats is WNS. Other threats are loss and degradation of summer habitat, human disturbance of hibernacula, wind turbine operations, timber harvest and forest management (USFWS 2013).

Due to WNS threats to Minnesota's bat populations, including SGCN, the DNR staff developed a mobile acoustic monitoring protocol in 2010 to examine possible bat population changes, has conducted passive acoustic bat surveys and participates in the statewide study of *Endangered Bats, White-Nose Syndrome, and Forest Habitat*. In 2015, the Minnesota legislature approved the statewide project with Environment and Natural Resources Trust Fund funding. The goal of the project is to collect data on the distribution and habitat use of the northern long-eared bat in Minnesota. This project is being conducted by the Minnesota Department of Natural Resources, the University of Minnesota Duluth – Natural Resources Research Institute, and the USDA – Forest Service.

Mobile Acoustic Bat Transect Survey

A mobile acoustic bat transect survey protocol was established in 2010 (Figure 23). The purpose of the mobile survey is to obtain quantitative data about bat populations and to monitor multiple species simultaneously in advance of WNS outbreaks in Minnesota and neighboring states. However, the mobile acoustic transect methodology has several limitations; one of which is it does not work well for all species of bats, including northern long-eared bats, as the route does not travel within forest understory habitats. Therefore, in 2014 and 2015, survey work also included use of stationary acoustic surveys in habitats suited for northern long-eared bats to better identify locations where they occur (MNDNR and MNARNG 2015, 2016). The project's goal is to assess the impacts of WNS on summer distribution of bats by examining changes in bat distribution and activity over successive years.

The DNR staff established a 30-mile mobile transect on Camp Ripley (Figure 23) that passes through common habitat types and could be easily sampled in successive years. Survey protocol (Britzke and Herzog 2009) requires that the acoustic survey be conducted while bats are on maternity range, generally between June 1 and July 15. To record bat echolocations monitoring is conducted on nights with low wind, no rain or fog, and suitable temperatures for bat activity. The Camp Ripley survey was conducted using an ANABAT II (zero crossing) (2010, 2012 – 2013) bat detector mounted on the top of the vehicle, with the microphone pointing straight up. In 2014 – 2017, an ANABAT SD2 (zero crossing) with mobile microphone was used. Surveys were conducted on July 8, 2010, June 26, 2012, July 11, 2013, July 9, 2014, July 8, 2015, June 29, 2016 and July 2, 2017, and the echolocations recorded were analyzed by Christi Spak, DNR Biological Survey (2010 – 2015) and Nancy Dietz, DNR Camp Ripley (2016 – 2017).

The highest number of bat echolocations recorded since the mobile survey began occurred in 2015 (n=132) which was similar to 2010 (n=130) with slightly fewer in 2016 (n=120) and more than 55% greater than what was recorded in 2014 (n=58) and 2017 (n=56) (Figure 24). Of the total bat calls recorded in 2017, the proportion of big brown /silver-haired bat echolocations was similar to 2010 and 2016 but greater than in 2012 – 2015. And, the proportion of red bat echolocations increased from 2010 but decreased from 2013 to 2016 (Figure 25). Examining the five years of survey data, the variable number of total survey echolocation calls, the proportion of big brown/silver-haired bat calls,

Figure 23. Mobile acoustic bat transect survey route, Camp Ripley Training Center, Minnesota, 2010, 2012 – 2017.

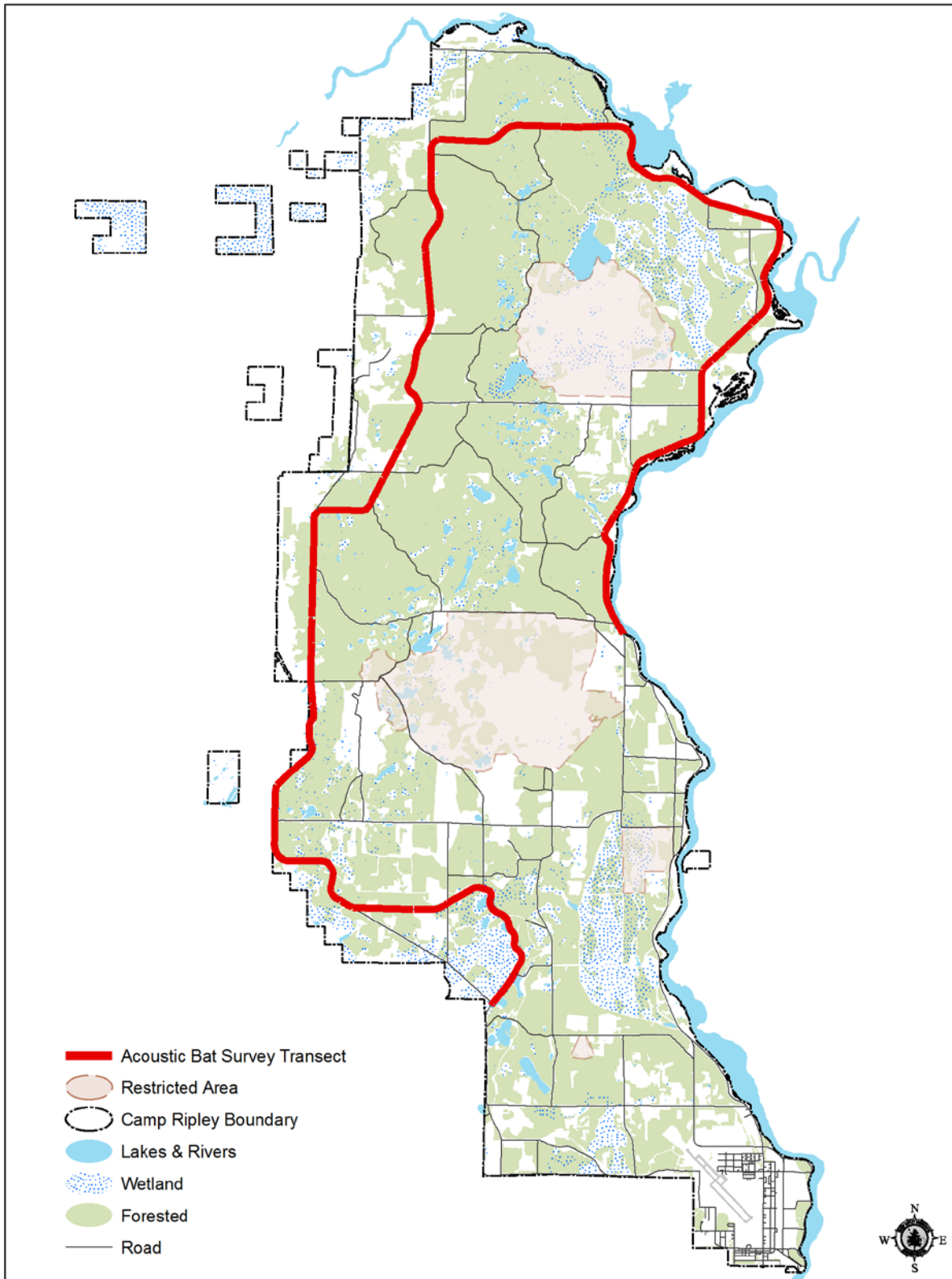


Figure 24. Mobile transect survey number of acoustic bat echolocations recorded, Camp Ripley Training Center, 2010, 2012-2017.

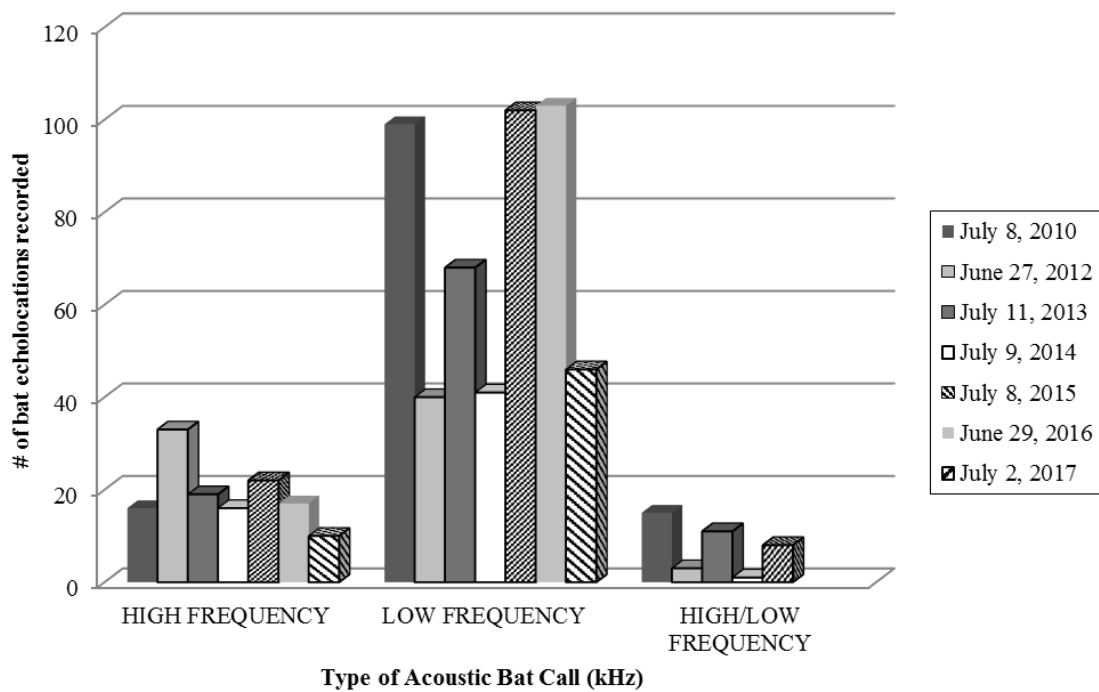
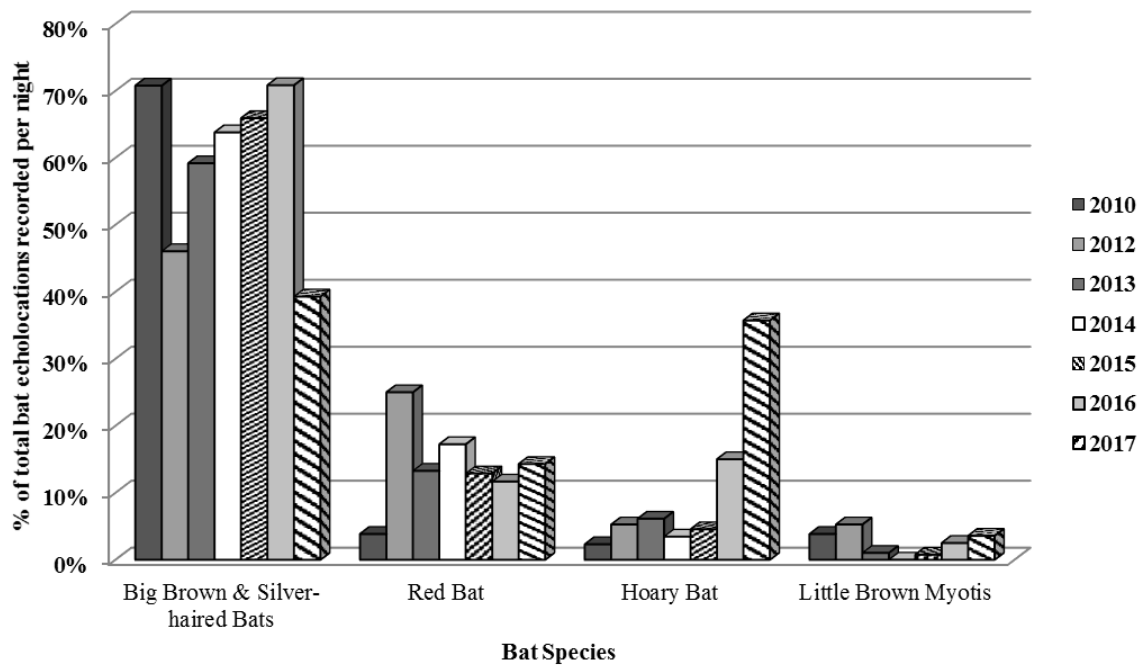


Figure 25. Mobile acoustic transect survey proportion of acoustic bat species echolocations recorded, Camp Ripley Training Center, 2010, 2012-2017.



and the increase in red bat calls do not indicate extensive population declines of these species, at this time. DNR staff plans to continue to sample the mobile transect one to three times annually and additionally set up stationary locations to monitor bat population trends and to measure any impacts of WNS.

Northern Long-eared Bat Research

By Brian Dirks, Nancy Dietz, Morgan Swingen and Dr. Ron Moen, NRRI, UMN–Duluth

Maintaining reproductive success will be critical to the viability of Minnesota's bat populations as WNS spreads in Minnesota. Obtaining knowledge about maternity roosts before a population decline occurs will be critical for future efforts to reduce negative impacts of forest management and provide high quality habitat to support recovery of bat populations. Even if mortality rates can be reduced, there is still likely to be a drastic reduction in bat populations. Implementing management strategies that minimize mortality will be important as WNS continues to affect Minnesota bats.

Bat Capture and Processing

Fine mesh mist-nets (Avinet Inc., Dryden, NY, USA) were set up along forested roads that could act as travel corridors for bats. Each night, 2–4 mist-nets were set up within 200 m of a central processing location. Mist-nets were opened after sunset, and checked every 15 minutes for 2–5 hours, depending on capture rates and weather conditions. Captured bats were placed in cloth bags until processing.

We identified each captured bat to species by morphology, and determined sex, age, and reproductive condition by physical examination. Each captured bat was weighed and measured, and the wings were inspected for damage as per Reichard and Kunz (2009). Each bat was then fitted with an individually-numbered lipped aluminum wing band (Porzana Ltd., Icklesham, United Kingdom).

Radio-transmitters (A2414 from Advanced Telemetry Systems Inc., Isanti, MN, USA) were attached to pregnant or lactating adult female northern long-eared bat (MYSE) that did not have significant wing damage (wing score < 2). We trimmed a small section of hair in the center of the back and attached the transmitter to the skin using surgical adhesive (Perma-Type, Permatype Company Inc., Plainville, CT, USA). Bats were released at the capture site after processing.

Tracking and Roost Tree Characterization

Bats with radio-transmitters were tracked to their roosts each day until the transmitter failed or the transmitter fell off. Data recorded at each roost included roost type, tree species and decay stage. At dusk, crews returned to the roosts to conduct emergence surveys. During an emergence survey, personnel watched the roost from 30 minutes before sunset to 1 hour after sunset. During the emergence survey we recorded the number of bats emerging in each 10-minute interval, the location of the exit point, and whether or not the bat with the transmitter left the roost.

Crews returned to each roost tree to conduct a more detailed characterization of the roost tree after bats left. This included measuring diameter at breast height (DBH), tree height, decay stage,

canopy closure, slope, aspect and recording details about the vegetation surrounding the roost tree. All roost trees were marked with a numbered aluminum tree tag.

Study Area

Bats were captured for the large-scale study at 12 locations around the state of Minnesota in 2017, including Camp Ripley Training Center (CRTC). CRTC covers approximately 53,000 acres of land in Morrison and Crow Wing Counties, including mature pine and hardwood forests. CRTC is also bordered by two major rivers: the Crow Wing River to the north, and the Mississippi River to the east.

Bat Capture Results

We mist-netted bats at nine sites at CRTC on the nights of June 5 – 8, 12, 19 – 20, 22 and 26, 2017 (Figures 26 and 27). We captured and processed 86 bats over 168.3 total net-hours. We captured bats of five species, including northern long-eared bats (Table 17). All of the bats captured were adults, and 41 of the 56 females captured were pregnant at the time of capture. Seventy-seven of the 86 bats captured (89.5%) showed some minor wing damage consistent with that caused by WNS, but none had severe damage.

We attached radio-transmitters to three female northern long-eared bats, one of which was captured at “Trout Pond” on June 7, and two which were captured along the Crow Wing River on June 12.

Table 17. Bats captured by species and sex, Camp Ripley Training Center, Minnesota, June 2017.

SPECIES and CODE									
Sex	Big Brown Bat (EPFU)	Red Bat (LABO)	Hoary Bat (LACI)	Silver- haired Bat (LANO)	Little Brown Myotis (MYLU)	Northern Long-eared Bat (MYSE)	Evening Bat (NYHU)	Tricolored Bat (PESU)	Grand Total
Male	25	3	0	1	1	0	0	0	30
Female	34	5	0	11	3	3	0	0	56
Grand Total	59	8	0	12	4	3	0	0	86

Figure 26. Map of bat mist-netting sites at Camp Ripley Training Center, Minnesota, June 2017. The pie chart at each net site indicates the proportion of species captured at that site, and the size of the pie chart represents the total number of bats captured at that site relative to other sites. The sites with zero captures are marked with a black dot.

Camp Ripley Training Center - 2017 Bat Mist-Netting Sites

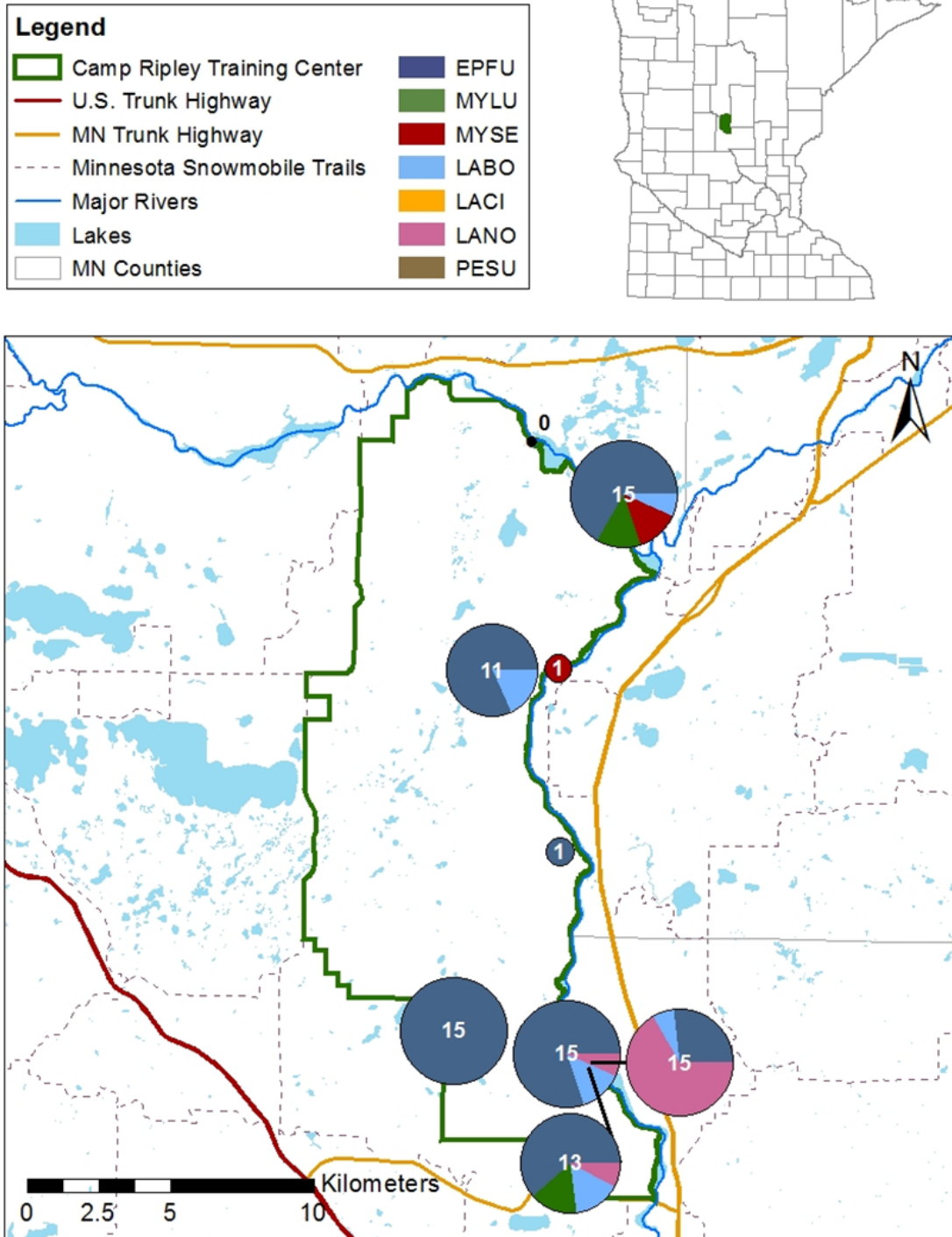
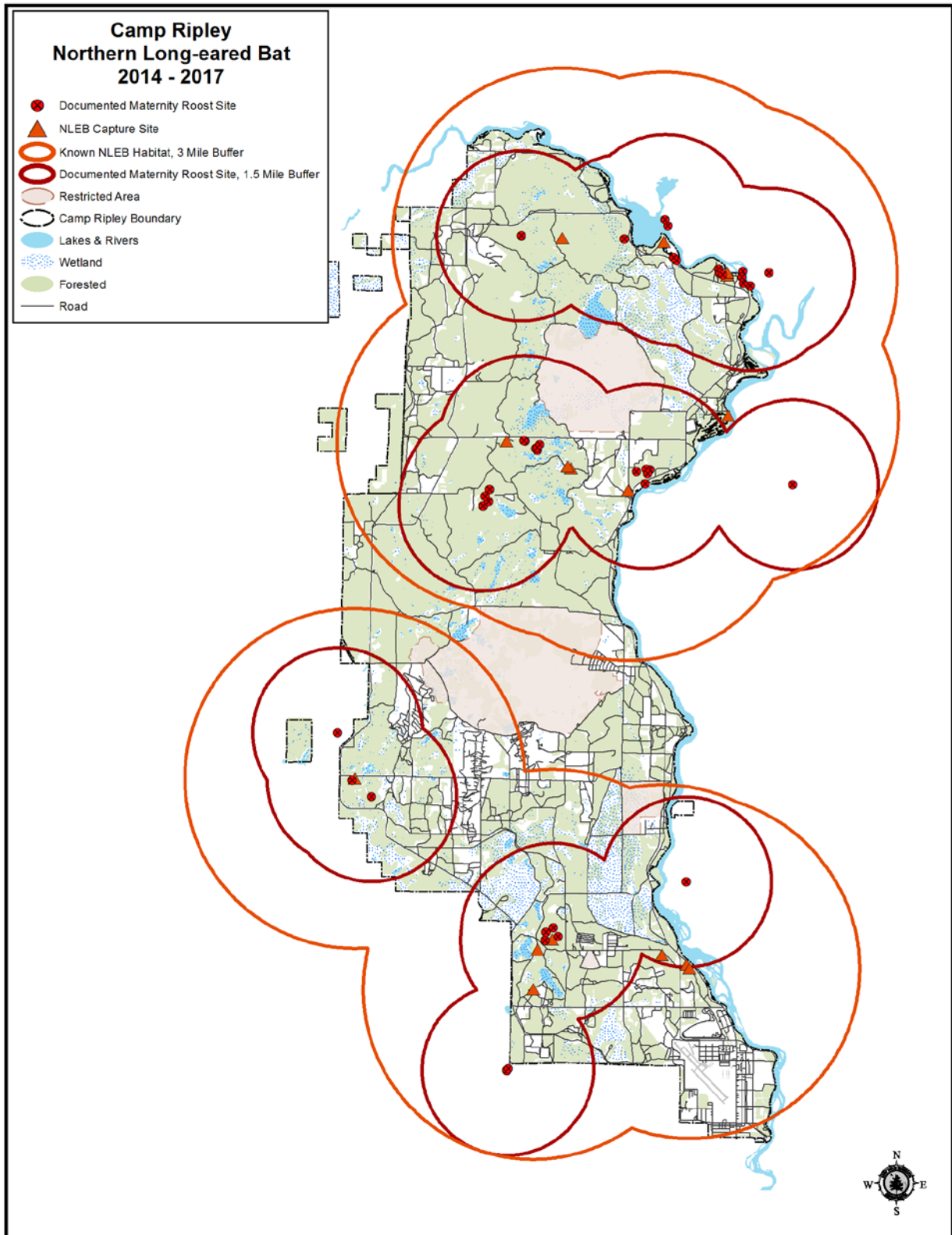


Figure 27. Locations of female northern long-eared bat captures and maternity roosts, Camp Ripley Training Center, Minnesota, 2014 – 2017.



Radio-Telemetry and Roost Characterization

The bats with the radio-transmitters were tracked until the transmitter fell off, which was after 6–8 days. We tracked the bats with the radio-transmitters to thirteen unique roost trees, of ten tree species (Figures 28 and 29). A detailed map of movements between roost trees by the bats with the transmitters are in Figures 30 and 31.

Figure 28. Histogram showing the number of northern long-eared bat roosts by tree species at Camp Ripley Training Center, Minnesota, June 2017. Thirteen total roost trees were identified.

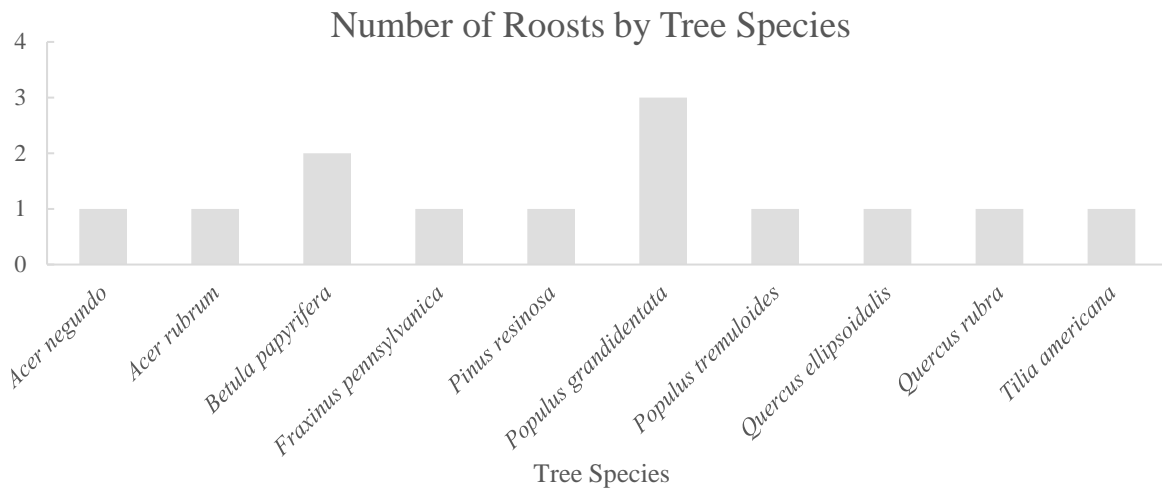


Figure 29. Photos of three roost trees of different species, Camp Ripley Training Center, Minnesota, June 2017. From left to right: paper birch (*Betula papyrifera*) snag, green ash (*Fraxinus pennsylvanica*) snag, and live red pine (*Pinus resinosa*).

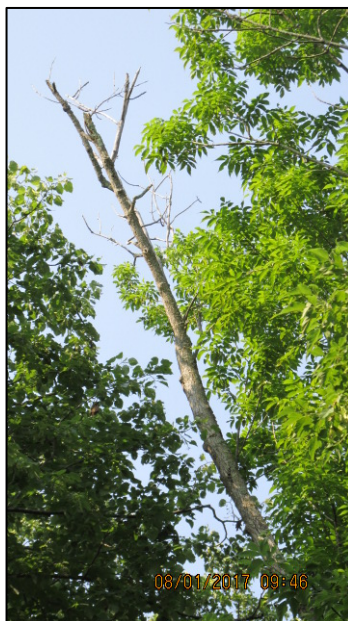


Figure 30. Radio-transmitted (165.783) female northern long-eared bat (MYSE) movements and roost tree locations, Camp Ripley Training Center, Minnesota, June 2017.

Camp Ripley Training Center - 2017 Bat Roosts

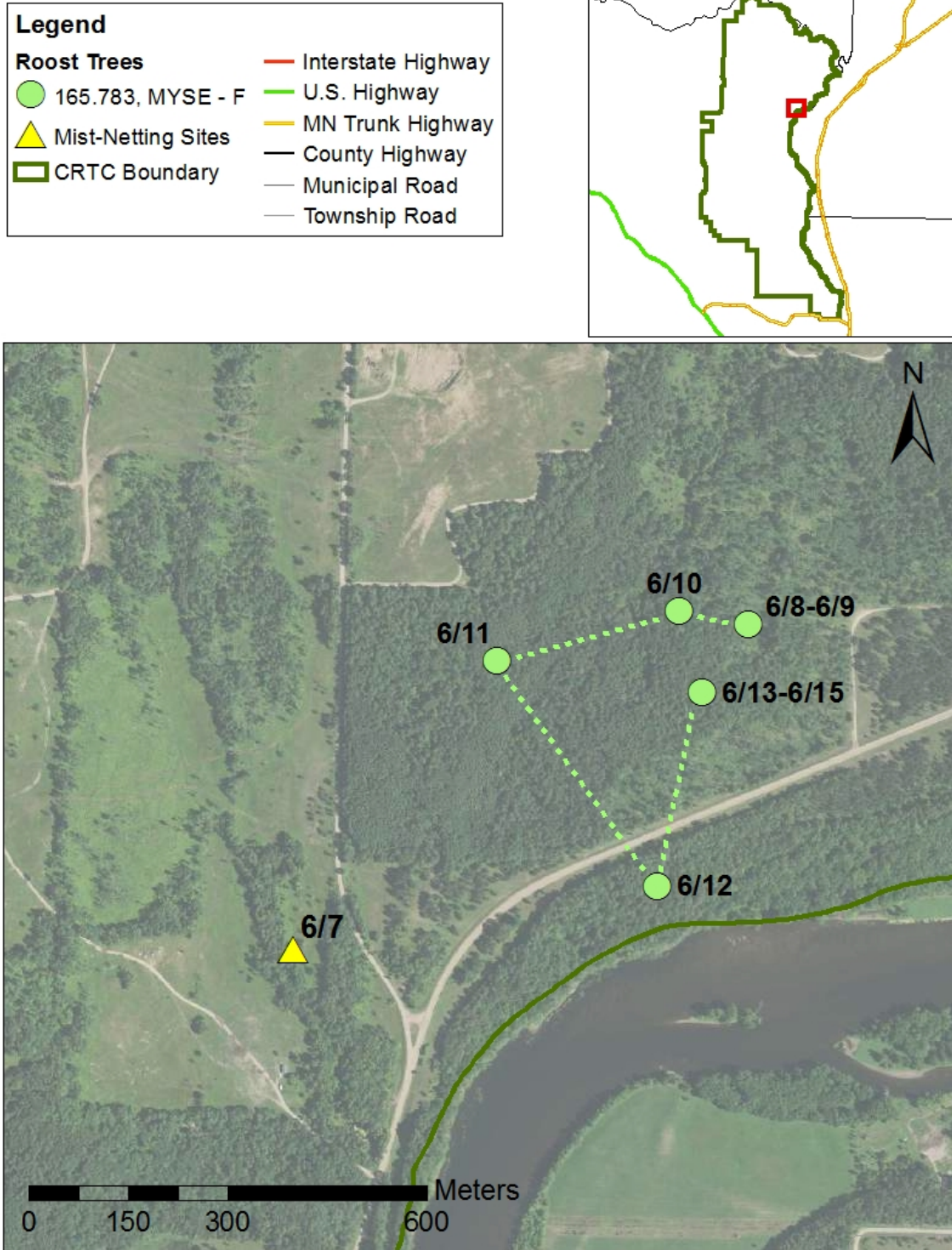
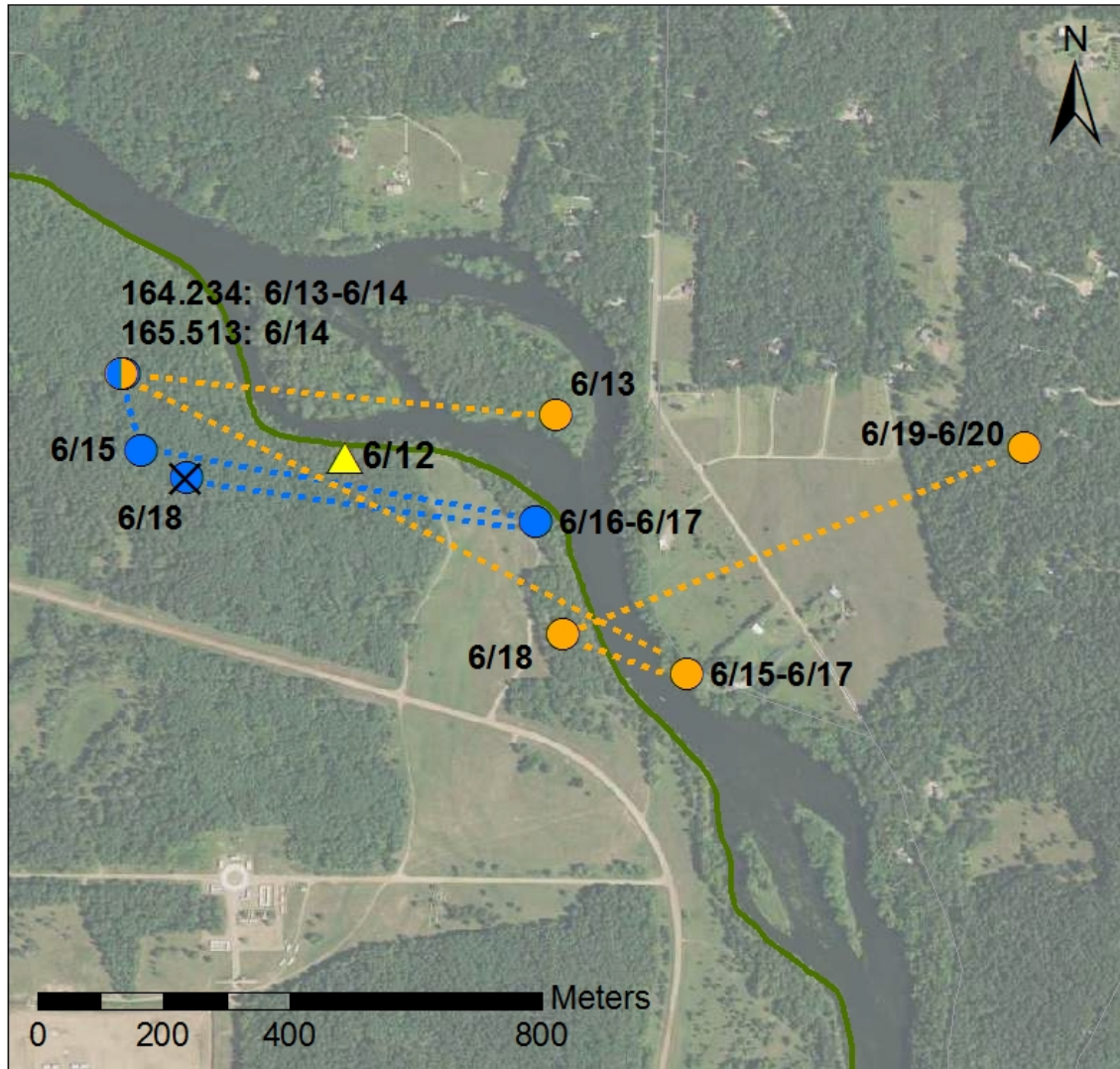
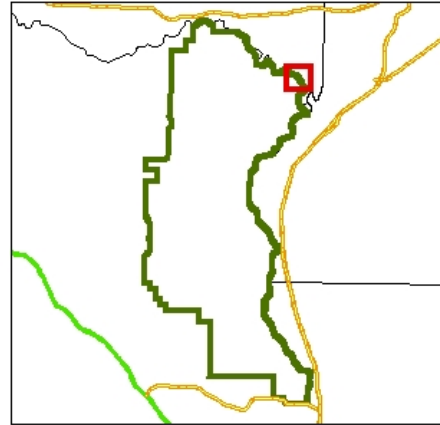
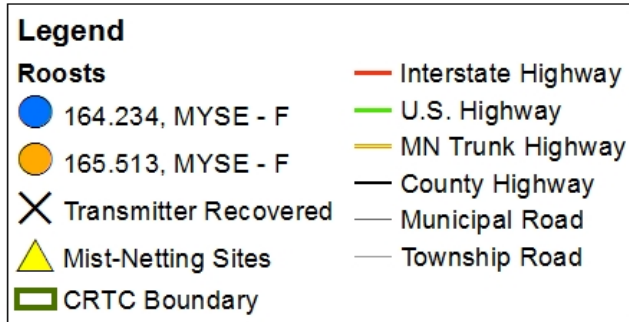


Figure 31. Two radio-transmitted (164.234 and 165.513) female northern long-eared bats (MYSE) movements and roost tree locations, Camp Ripley Training Center, Minnesota, June 2017.

Camp Ripley Training Center - 2017 Bat Roosts

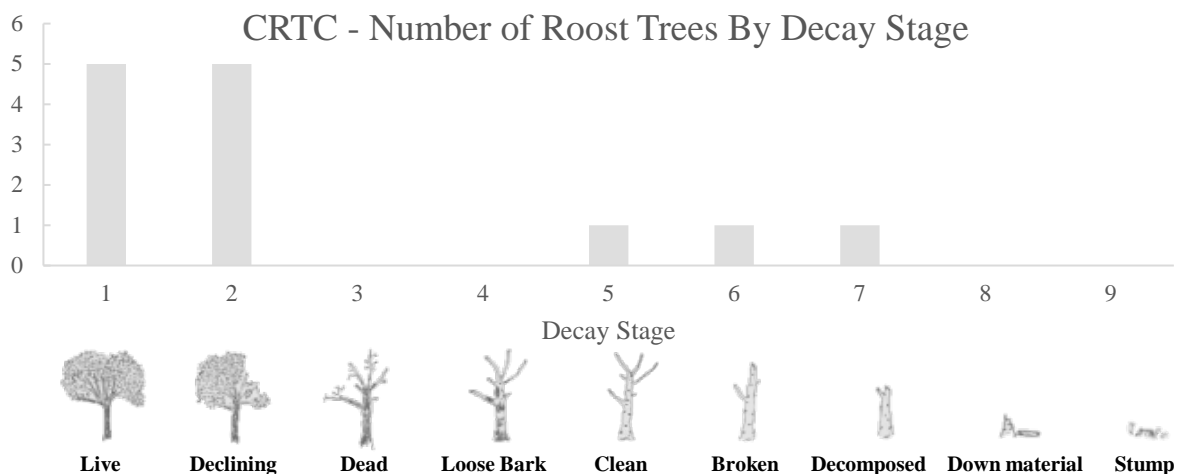


The average distance from the capture location to the first roost was 523 m (range 247 – 857), and the average distance moved between consecutive roosts was 466 m (range: 107 – 1,013). An average of 4.7 roosts were identified for each bat, and these three bats spent an average of 1.4 days (range 1 – 3) in each roost (of those roosting events with known start and end dates).

The roost trees varied in size from 18.7 – 63.8 cm in diameter at breast height (DBH), with an average DBH of 32.9 cm. Roosts were located in both live and dead trees of varying decay stages (Figure 32). Roost tree height ranged from 3.8 m to 20.6 m with an average height of 15.4 m.

Field crews conducted 14 emergence counts on 12 of the 13 identified roost trees. The one roost tree that was not surveyed was located on private land, and crews were not given permission to conduct emergence surveys. Bats were observed exiting the roost tree in 11 of the 14 emergence counts conducted. Colony size (number of bats observed in an emergence count) ranged from one to nine in those 11 emergence counts.

Figure 32. Histogram showing variation in decay stage among 13 northern long-eared bat roost trees identified at Camp Ripley Training Center, Minnesota, June 2017.



Discussion

The three northern long-eared bats tracked at Camp Ripley Training Center used a variety of tree species and moved often, consistent with previous findings in this study and others across the northern long-eared bat range. Under the Endangered Species Act, there are restrictions on tree harvest within 150 feet of known, occupied roost trees between June 1st and July 31st. For more details on these restrictions, please visit the website of the U.S. Fish and Wildlife Service (<https://www.fws.gov/Midwest/endangered/mammals/nleb/index.html>). We intend to use the data collected in this project to inform future management decisions regarding the northern long-eared bat as WNS continues to spread across the United States.

Capture rates (# of bats captured per net-hour) at CRTC in 2017 (0.51) were higher than in 2016 (0.43) and 2015 (0.23), although average capture rates across the state declined in 2017

(Swingen et al. 2015, Dirks et al. 2016). Many factors may have influenced capture rates including net placement, temperature, insect activity, and moon illumination (Ciechanowski et al. 2007). It is also possible that the cave-roosting bats present at CRTC during the summer hibernate in a cave or mine that has not yet been affected by high mortality from WNS. Winter surveys conducted by the DNR in early 2017 observed a 73% decline in bats counted at Soudan Underground Mine, although declines at other surveyed hibernacula were as low as 31% (MNDNR 2017).

This is one of 13 site-level reports from the 2017 field season. A report summarizing and discussing the results from all 2017 locations will be available in early 2018.

Porcupine (*Erethizon dorsatum*)

Porcupines are the second largest member of the rodent family. While most rodents have a high rate of reproduction along with a high rate of mortality, porcupines have neither. Female porcupines have one litter per year, with usually only one pup. Their winter diet consists of the inner bark of trees and their summer diet consists of a variety of woody and herbaceous vegetation, primarily at ground level (Hazard 1982). Fishers are effective predators of porcupines.

Porcupines can be a nuisance when they gnaw on wooden objects, tires and plastic tubing. Camp Ripley has obtained a porcupine nuisance permit from the DNR since 2008. Porcupines are taken only on problem areas identified by Range Control. Ten nuisance porcupines were taken under the DNR permit in 2017.

Reptiles and Amphibians

Blanding's Turtle (*Emys blandingii*)

By Arika Nyhus, St. Cloud State University Graduate Student and Nancy Dietz, DNR

The Blanding's turtle is a semi-aquatic freshwater turtle commonly known for its bright yellow chin (Congdon and Keinath 2006). This species is found in most parts of the upper Midwest and southeastern Canada, with isolated populations existing in Eastern states and provinces (Congdon et al. 2008). The species is considered threatened or endangered across most of its range and has been listed as state threatened in Minnesota since 1984. A species is considered state threatened if it is likely to become endangered within the foreseeable future throughout all or a significant portion of its range within Minnesota. In 2012, the USFWS was petitioned to include Blanding's turtles as threatened or endangered under the federal Endangered Species Act. The USFWS determined, in July 2015, that the petition presented substantial information that federal listing of Blanding's turtles may be warranted. Therefore, a status review has been initiated and a determination will be made whether to propose Blanding's turtle listing under the Endangered Species Act (USFWS 2016d).

Due to the status of the Blanding's turtle, the DNR has implemented management strategies for the conservation of the species and Camp Ripley has three priority areas (Figures 33 and 34) for

conservation management. This species depends upon a variety of wetland types and sizes, and uses sandy upland areas and roadways for nesting. Minnesota's State Wildlife Action Plan promotes the implementation of best management practices. Major threats impacting the Blanding's turtle include road mortality, habitat degradation and collection for trade (Congdon and Keinath 2006; Compton 2007; Beaudry and Hunter 2009). Additionally, the Blanding's turtle is a slow-maturing species (ages 14 – 20) that experiences low reproductive success and high nest predation (Congdon and Keinath 2006). In Michigan, Congdon et al. (1983) reported that nest predation accounted for 82% of nest mortality, with 42% of predation occurring within the first 24 hours. In addition, habitat loss and degradation exacerbate the threats above (MNDNR 2015a).

Since the early 1990s, several management practices have been executed in attempts to conserve the species at Camp Ripley Training Center. These management practices include 1) soldier education and outreach regarding the conservation of the Blanding's turtle 2) Blanding's turtle crossing signs in high concentration areas 3) mark recapture of females during nesting season via road surveys, and 4) nest protection with the use of metal cages. After nest emergence, hatchling turtles are direct released into the nearest wetland known to support adult turtles. However, it is uncertain what happens to the hatchlings after they are released. The goal for 2017 was to continue mark recapture of adult females during nesting season and protect known nests via road surveys; as well as determine the survival and spatial ecology of hatchlings released in adult habitat.

A St. Cloud State University graduate student, Arika Nyhus, was recruited to further examine the effectiveness of CRTC's conservation efforts, population status of Blanding's turtle on Camp Ripley and to determine movements of direct release hatchlings.

Preliminary trapping was conducted from April 24 to May 25 in an attempt to capture young juveniles to assess recruitment and to determine the age structure of the population. Hoop traps were obtained from the DNR Fisheries in Little Falls. Traps were distributed in areas known to inhabit adults and were set in several wetlands where hatchlings were released after nest emergence from 2009 – 2016. Trapping was conducted during April and May because spring has proven to be the most effective season for trapping success (Sajwaj et al. 1998). Eight single-frame hoop traps were set in several wetland complexes in the Goose Lake area from April 24 to May 9. Ten traps were then distributed from May 9 to May 25 in Marne Marsh and Range Marsh. Traps were baited with 0.25 kg of frozen smelt. Bait was placed in plastic cups with holes drilled in them to allow for scent dispersal but did not allow for distribution of bait. Traps were checked daily and bait was replaced approximately every week. During the first two weeks of trapping, 105 trap nights (number of traps X days set) were recorded; during the second two weeks, 187 trap nights were logged. A total of four Blanding's turtles were captured during 292 trap nights. Remarkably, all of the turtles captured were unmarked. Each turtle was assigned a unique alpha code to help aid in future identification (AJN, ANW, AJO, AJD). Two males approximately 15 years of age (ANW, AJO) and one 19-year-old female (AJN) were found in Marne Marsh. The oldest turtle captured during trapping was a 22+ male

Figure 33. Blanding's turtle locations, nest locations and the DNR priority areas for the north portion of Camp Ripley Training Center, Minnesota, 2017.

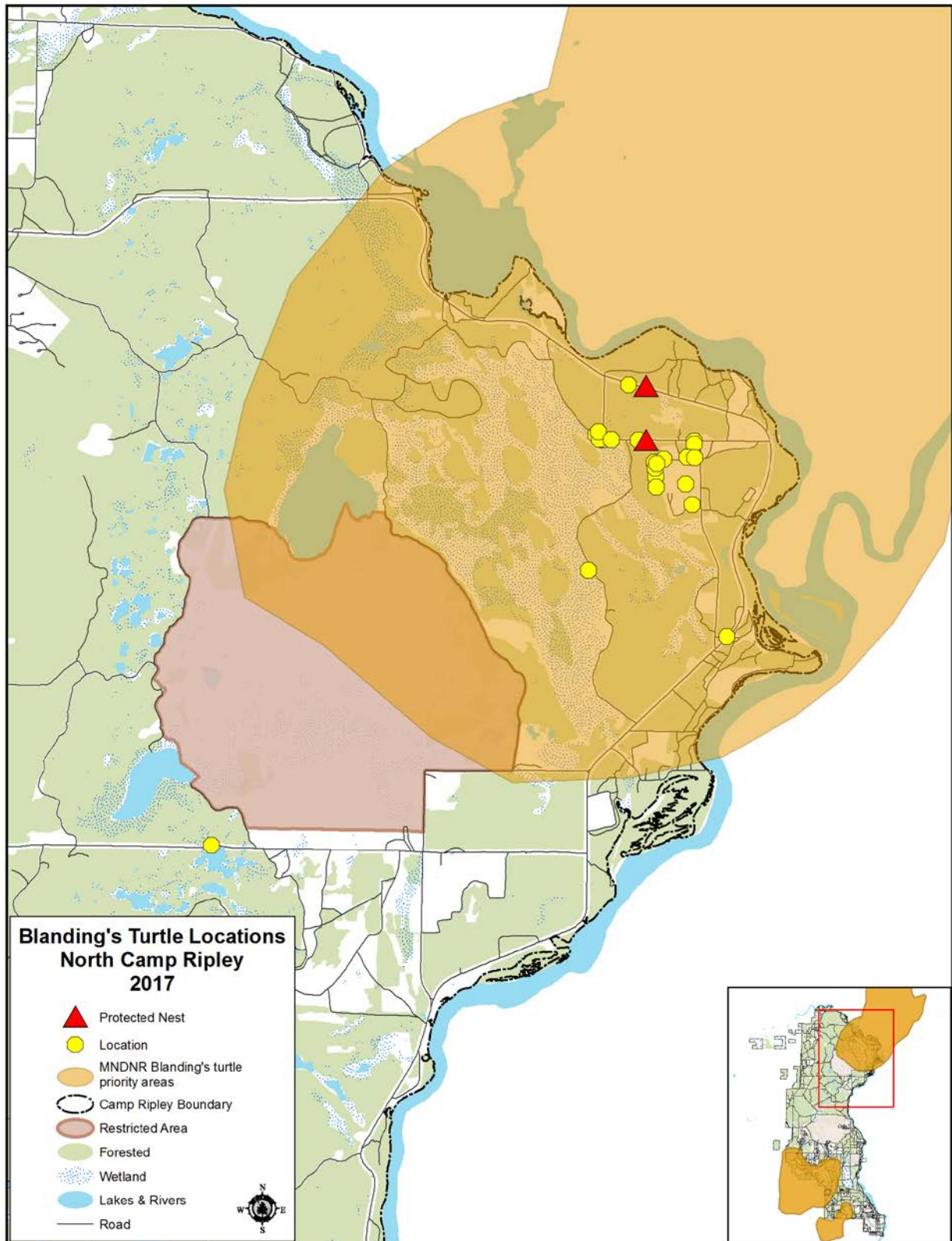
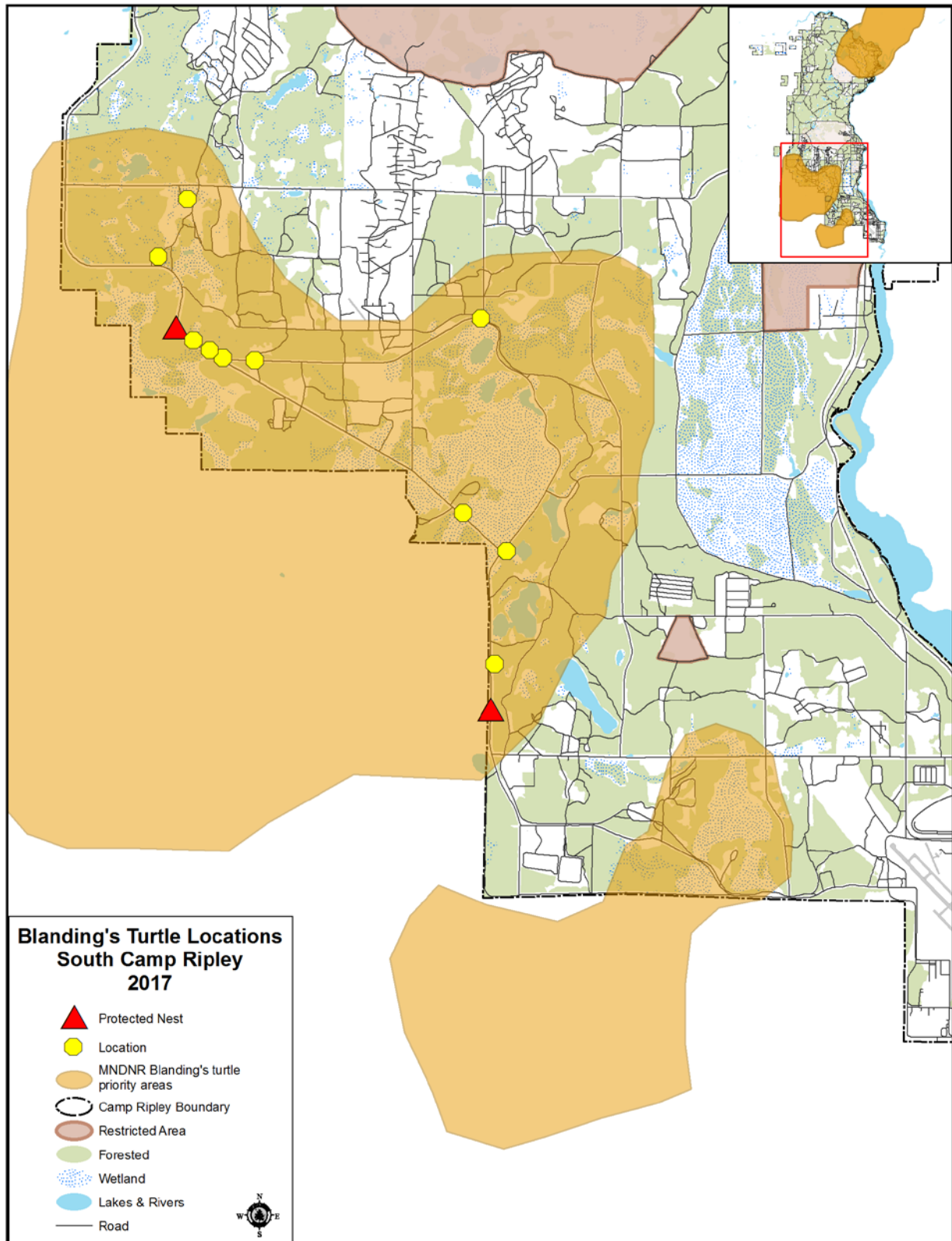


Figure 34. Blanding's turtle locations, nest locations and the DNR priority areas in the south portion of Camp Ripley Training Center, Minnesota, 2017.



located in Range Marsh. Unfortunately, an accurate assessment of recruitment nor an age structure of the population was achieved due to the obscurity of the Blanding's turtle.

Roadside surveys were conducted from June 1 to June 24, 2017. Nesting seasons generally range from early-May to mid-July (Congdon et al. 1983). At Camp Ripley, nesting females are typically observed from June 2 through July 2. Surveys began just prior to the start of nesting season and terminated after two to three days of no turtle sightings. Roads were surveyed by conducting vehicle searches through areas of known nesting activity as well as in areas for potential nesting activity. One to two trucks ran circular routes on the south and north end of Camp Ripley. Any observed tracks were investigated in efforts to locate the turtle and areas away from roads were occasionally checked for nesting females. Periodic road closures due to military training season often limited daily coverage. Thirty Blanding's turtle observations were recorded (Table 18), with the first sighting occurring on June 2 (ACW). Eight of these females were marked (ACW, ??W, AKY, AJK, BDO, BDJ, ABX, PW) while three were unmarked. It was unknown whether the remaining observed turtles had been previously marked. Standard protocol is to watch the turtle and determine if it is nesting. If the female is nesting, surveyors wait until nest completion and identify the turtle. If the female is not nesting, the surveyor may continue road surveys and return to check the status of the female. Unfortunately, none of the unmarked or the unknown turtles were seen again.

Table 18. Summary of Blanding's turtle nest search surveys, Camp Ripley Training Center, Minnesota, 2000 – 2017.

<i>Year</i>	<i>Survey Period</i>	<i>First Female Blanding's Observed</i>	<i>First Blanding's Nest Found</i>	<i>Last Blanding's Observed</i>	<i>Number of Survey Hours</i>	<i>Number of Turtles Observed</i>	<i>Average Temperature (°F) during Survey Period*</i>	<i>Average Temperature (°F) during March to May*</i>
2000	May 31–June 23	June 5	No nests	June 14	91.5	11	60	56
2001	June 6–?	June 15	No nests	June 27	79	9	66	41
2002	June 7–June 25	June 11	June 11	June 22	75	19	67	36
2003	June 6–June 22	June 9	June 11	June 17	129.5	10	65	41
2004	June 2–July 2	June 14	June 14	July 2	225	12	61	42
2005	June 6–June 23	June 10	June 12	June 17	225	18	68	44
2006	June 2–June 30	June 2	June 8	June 20	158	10	66	47
2007	June 1–June 21	June 3	June 7	June 20	189	19	68	45
2008	June 4–July 1	June 14	June 18	June 27	243	33	64	39
2009	June 11–June 28	June 11	June 13	June 27	205	17	68	41
2010	June 2–June 24	June 8	June 16	June 19	203	10	64	48
2011	June 3–June 29	June 6	June 13	June 29	208	44	64	40
2012	May 31–June 18	June 2	June 3	June 17	155	46	65	49
2013	June 17–July 5	June 19	June 25	July 5	198	37	71	37
2014	June 9–June 27	June 11	June 20	June 22	113	12	69	41
2015	June 10–June 24	June 10	NA	June 19	24	2	64	43
2016	June 1–June 23	June 1	June 2	June 21	198	16	64	45
2017	June 1–June 24	June 2	June 2	June 20	151	30	65	42

*Weather Underground online – Brainerd Airport (Weather Underground 2018b)

In the southern region, two nests were protected in 72 hours of effort (ACW, AKY) (Figure 34) and two nests were protected in the northern region in 79 hours of effort (PW, unknown) (Figure 33). After data collection, a 1 X 1 m metal cage was placed over the center of where the eggs were laid and the cage was dug into the ground about three to four inches to prevent predation. Two yellow posts with reflective tape were then positioned to face oncoming traffic to eliminate vehicle disturbance.

Nests were protected and monitored through mid-November and were excavated when no evidence of hatchling emergence existed by late-October to mid-November. Typically, hatchlings emerge 75 – 110 days after the date of nest completion (Congdon et al. 1983). Nest incubation ranged

Figure 35. Blanding's turtle hatchling plastron abnormalities, Camp Ripley Training Center, Minnesota, 2017.



from 93 to 171 days from the date laid to the date of hatching or nest chamber excavation. Fifty percent of protected Blanding's turtle nests had hatched, with a total of 18 hatchlings for the year. Twelve hatchlings were produced on the north end of Camp Ripley (PW) and six eggs hatched successfully on the south end of Camp (AKY). Fourteen eggs from this nest started to progress but stopped at about 80% development. All of the six hatchlings that emerged possessed mild to severe abnormalities to the carapace and the plastron (Figure 35). Standing et al. (2000) reported similar developmental abnormalities in hatchlings from a population in Nova Scotia. One nest (unknown) remained unhatched on the north end of camp as well as one (ACW) on the south. A clutch size of at least eight was found in the northern nest, with one egg containing a hatchling about 80% developed. Unfortunately, the ground was too frozen at the time of excavation to get an accurate clutch size for this nest. However, eighteen eggs $\leq 50\%$ developed were excavated from the nest on the south end of camp.

Embryonic development in the Blanding's turtle has been found to be positively correlated with temperature (Standing et al. 1999). It is believed that the cohort of hatchlings in 2017 were affected due to cooler temperatures during the incubation period. In 2016, nest failure was logged as 22.2% while nest failure for 2017 was recorded at 50%. The average temperature during incubation (June – November) in 2016 was approximately 14.17° C whereas the average temperature in 2017 was 12.3° C. Additionally, the nest of ACW was often found flooded from recent rainfall when doing nest checks. Standing et al. (1999) found that flooding of nests was positively correlated with nest failure. Thus, average temperatures and nest site selection play a critical role in the successful completion of embryonic development and reproductive success. Preventative actions for flooding will be implemented next year by drilling small holes in the 5-inch barriers inside the metal cages.

Following the nest emergence of hatchlings on September 18 and October 5, individuals from each clutch were stored in a 10-liter bucket for data collection. Turtles were measured for midline length and width on the carapace and plastron to the nearest mm using a digital caliper. Mass of the hatchlings was determined using a 20-gram weight limit Pesola scale. Hatchlings were then assigned a number that was attached to the carapace using temporary construction tape. After data was collected from the clutch, hatchlings were separated by weight categories. The weight categories included hatchlings from 7.5-8.5 g, 9-9.5 g, 10-10.5 g, and 11 g or greater. Eight hatchlings were then chosen to be affixed with transmitters using a random number system (Damon and Harvey 1987). Each hatchling affixed with a transmitter was given a unique turtle identification. The identification assigned to each hatchling was related to the identification that was provided to the adult maternal female followed by a consecutive number. The H in front of each identification represents “hatchling” to differentiate between the mothers and the offspring. The unique identifications assigned for 2017 include H_PW01, H_PW02, H_PW03, H_PW04, H_PW05, H_PW06, H_AXY01, H_AXY02.

Transmitters used on the selected hatchlings were model R1614 (Advanced Telemetry Systems, Isanti, Minnesota, USA; 0.3 g) (Figure 36). Each transmitter weighed no more than 5% of the hatchlings’ body mass and transmitters had a maximum battery capacity of 24 days (30 ppm). Transmitters were affixed using a fast drying (5 minutes) epoxy compound. Prior to fitting the transmitter, the carapace of the hatchling was cleaned using water, and time was allowed for the carapace to dry to assure the transmitter set properly. The epoxy was applied to the carapace approximately midway down the turtle between the dorsal line and the marginal scutes. The turtles were then set in buckets individually to allow the epoxy to set. Though the recommended wait time to allow the epoxy to set was 5 minutes, turtles were held for approximately one hour prior to release. Six hatchlings were subsequently escorted to two wetland complexes that support adult conspecifics and where previous cohorts were released: Range Marsh and Goose Lake. From the hatchlings chosen to be tracked, three hatchlings were randomly (Damon and Harvey 1987) selected to be distributed in Goose Lake (H_PW02, H_PW03, H_PW04) and three hatchlings were spread throughout Range Marsh (H_PW01, H_PW05, H_PW06). The remaining two hatchlings were released at the nest site as a pilot study for 2018 (H_AKY01, H_AKY02).

Figure 36. Blanding’s turtle hatchling with radio-transmitter, Camp Ripley Training Center, Minnesota, 2017.



Following the release of hatchlings at the nest site, Goose Lake and Range Marsh, individuals were located every one to three days using a three-element Yagi antenna and a R4100 Scanning Receiver (Advanced Telemetry Systems). After an individual was located, microhabitat data were

collected using a 1 X 1 m PVC quadrat frame (Derivation of Daubenmire 1959). Data collected within this frame included total ground cover, detritus cover, emergent vegetation cover, woody vegetation cover, dominant plant species, and water depth. Total ground cover was calculated by estimating the percent of the quadrat frame that had vegetation cover as opposed to water. Detritus cover was documented by evaluating how much dead material laid within the quadrat. Emergent vegetation and woody vegetation cover was calculated by dividing the amount of emergent and woody vegetation present by the total vegetation cover. The dominant plant species was assessed by dividing the cover of species by the total plant cover. Water depth was documented using a meter stick or ruler. Additionally, wetland location, the UTM coordinate of the hatchling, and distance moved was recorded. Wetland location was verified using radio telemetry. The UTM coordinate and distance moved were found by using a GPS unit.

Of the six hatchlings released in Goose Lake and Range Marsh, five retreated to different habitat within the first 48 hours. Only one of the hatchlings (H_PW05) released in Range Marsh

Figure 38. Radio-transmittered Blanding's turtle hatchling H_PW06 concealed in soil substrate, Camp Ripley Training Center, Minnesota, 2017.



remained in this wetland complex.

H_PW05 traveled at least 130.06 m into Range Marsh in the 25 days of monitoring (September 18 – October 13) (Figure 37). The other hatchlings escorted to Range Marsh (H_PW01 & H_PW06) moved to the edges of a shrub swamp habitat west of their release points. H_PW01 was located 53.31 m away of the release site in the first 72 hours. From there, the hatchling gradually moved south, traveling a minimum of 123.40 m from September 18 to October 13 (Figure 37). H_PW06 traveled at least 95.06 m south from the date of release to September 25. After 22 days of monitoring, a second transmitter was affixed to the hatchling which was observed for a total of 50 days (September 18 – November 7). It is presumed that the hatchling was tracked to its overwintering site where it remained under 2 cm of mud (Figure 38) from October 5 to November 7, 51.69 m west of its release site (Figure 37).

All of the hatchlings released in Goose Lake also moved to different habitat. H_PW02 was tracked to a tamarack swamp west of the release site. The hatchling traveled at least 203.92 m from September 18 to September 28. H_PW02 then moved east 65.74 m, where it resided on the edge of the tamarack swamp in *Sphagnum* for the duration of the transmitter battery life (September 30 – October 13) (Figure 39). H_PW04 retreated to a sedge swamp known as West Goose Marsh, 450.70 m south of

Figure 37. Locations of Blanding's turtle hatchling H_PW01, H_PW05 and H_PW06 direct released at Range Marsh, Camp Ripley Training Center, Minnesota, 2017.

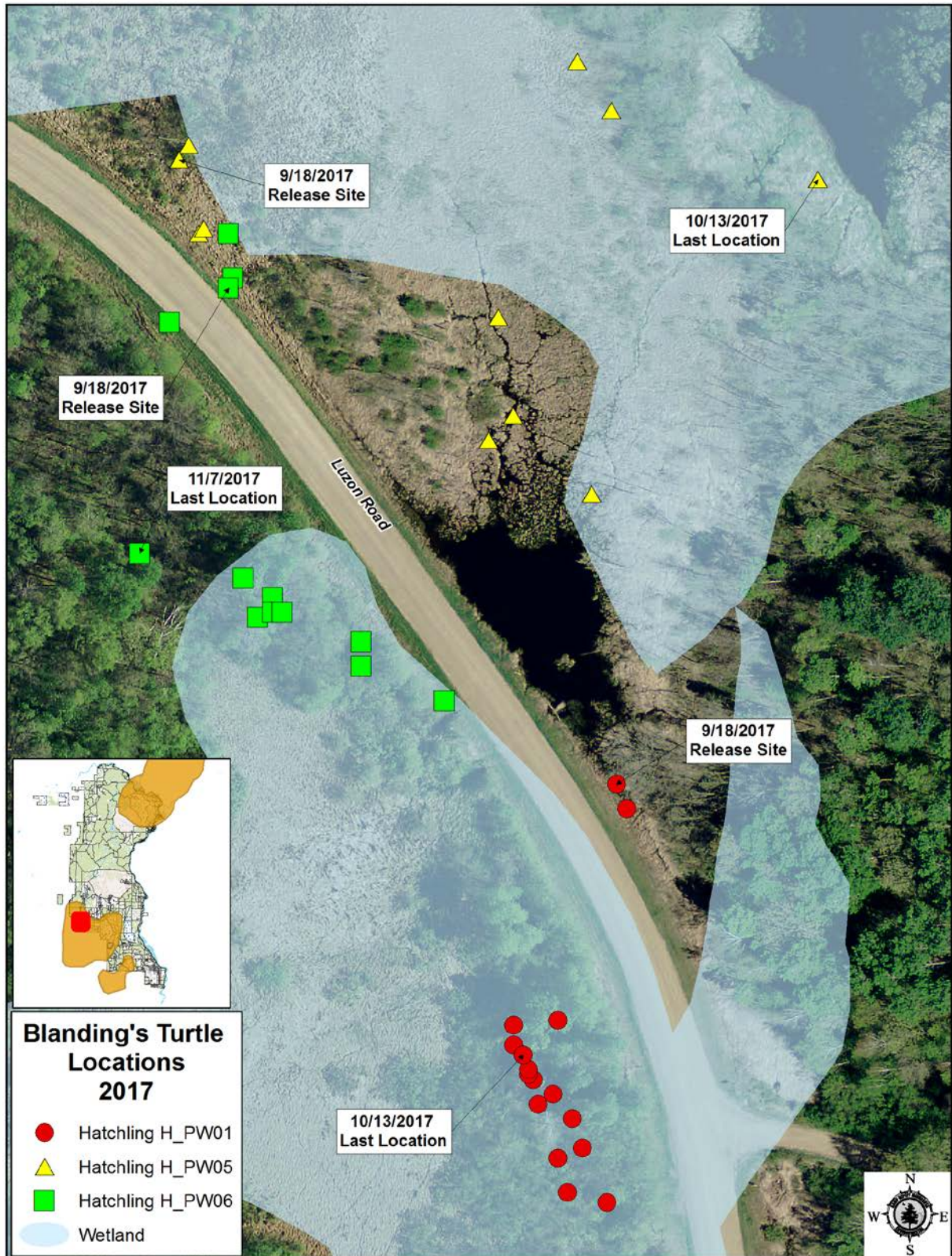
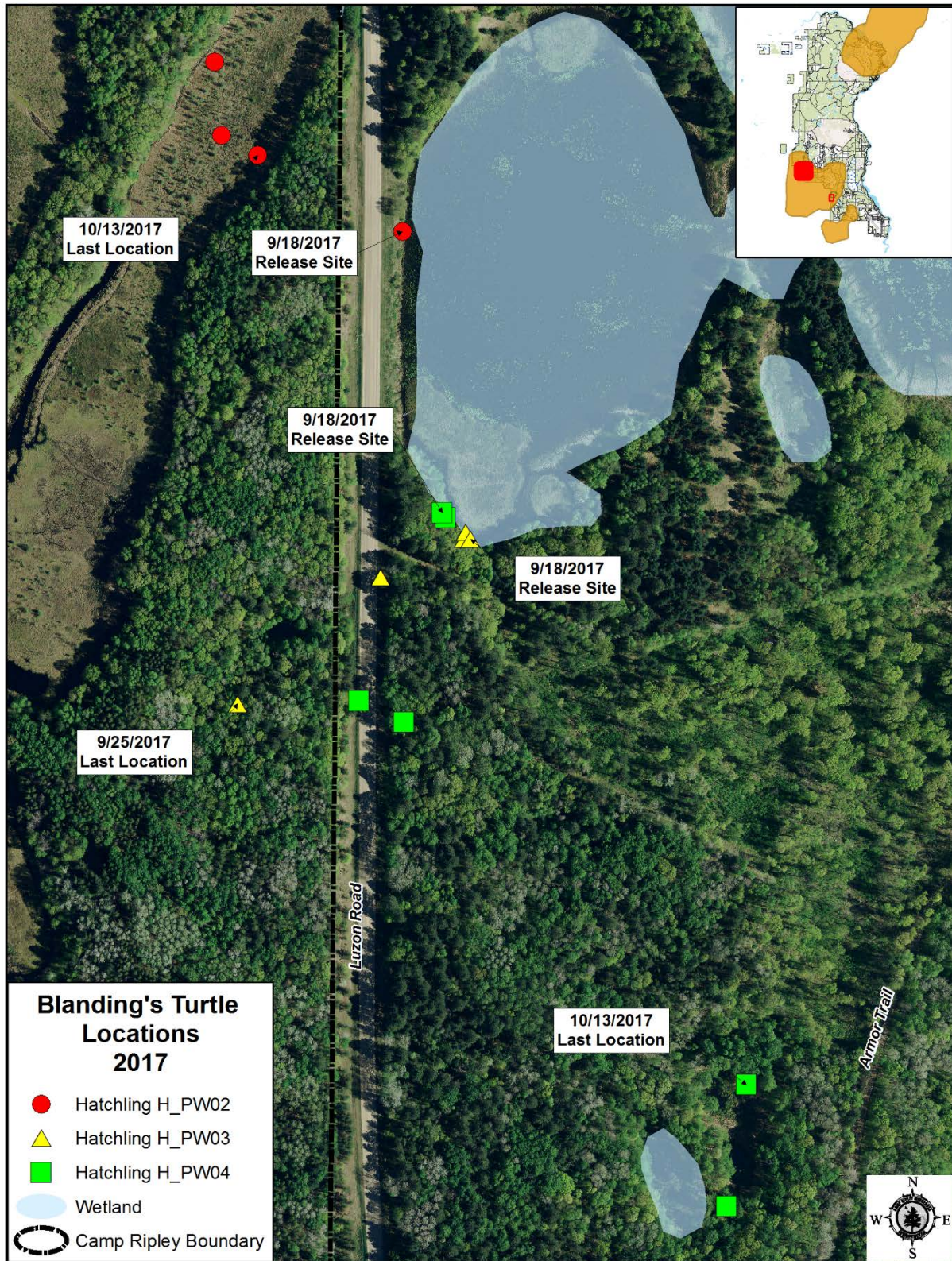


Figure 39. Locations of Blanding's turtle hatchlings H_PW02, H_PW03 and H_PW04 direct released at Goose Lake, Camp Ripley Training Center, Minnesota, 2017.



the release point. The hatchling gradually moved north to the edge of the wetland, where it took cover under leaf litter in seven cm of water for the last two weeks of monitoring (September 30 – October 13) (Figure 39). Interestingly, on the last day of observation, H_PW04 was located on land 5.38 m away from the recurrent location. The third hatchling (H_PW03) also left Goose Lake and headed 172.93 m west, however, the transmitter fell off of the hatchling after four days of tracking (September 18 – September 22) (Figure 39).

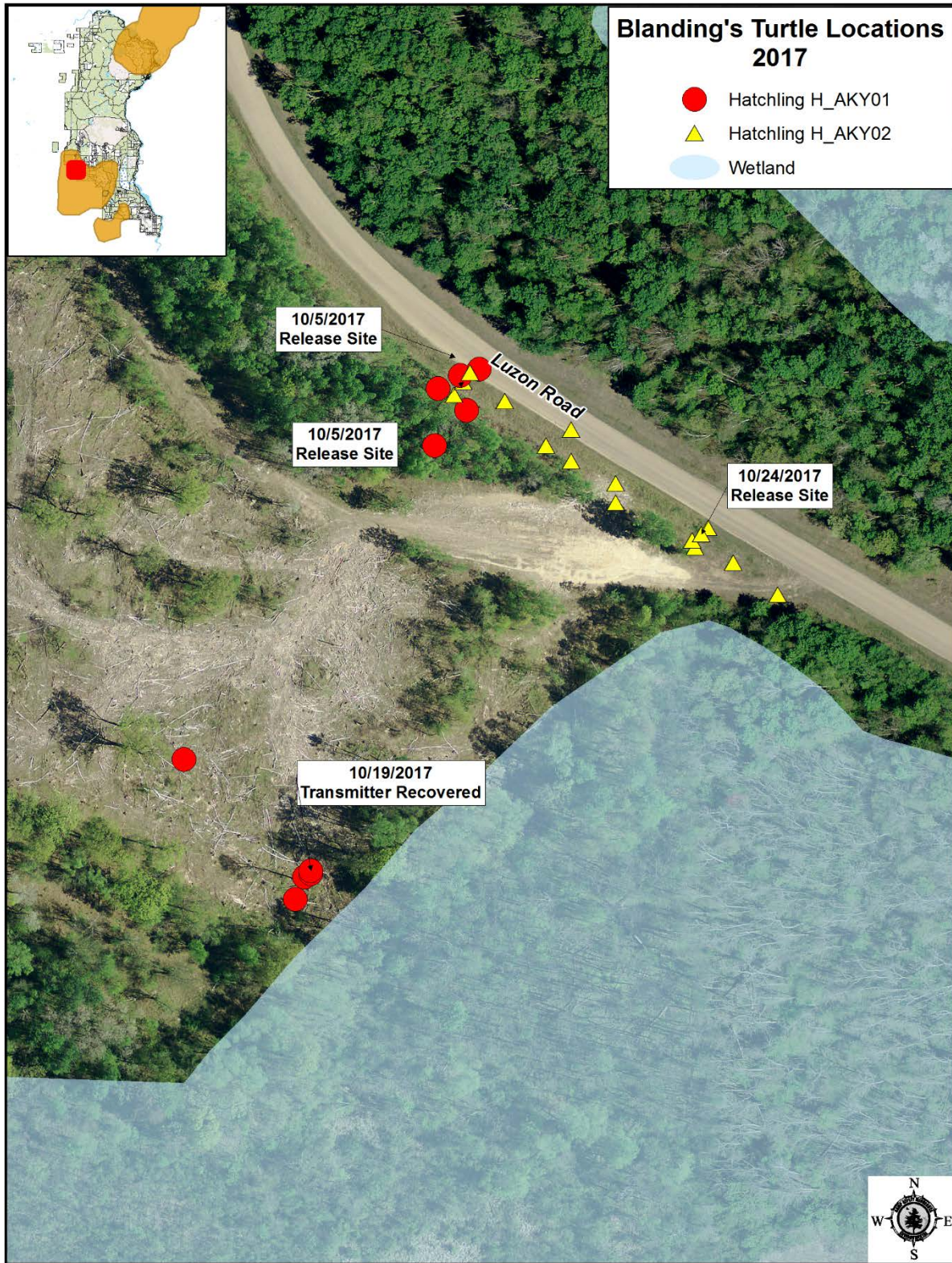
H_AKY01, a hatchling released at the nest site, was tracked 163.88 m west of the release point. From October 11 to October 13, this hatchling traveled at least 126.66 m. This transmitter fell off the turtle and was only observed for ten days (October 5 – October 19) (Figure 40). The other hatchling released at the nest site, H_AKY02, traveled south alongside the road in a continuous depression for 19 days. Following the 19 days of monitoring, a second transmitter was applied to the hatchling. This individual continued to travel south for five more days until it resided in a clump of vegetation for the rest of the duration of the study (October 29 – November 7) (Figure 40). Interestingly, the hatchling was observed in the same location on November 27 when visiting the field site. A metal cage was positioned over the hatchling and will be removed in the spring of 2018.

Historically, it has been thought that hatchlings face high mortality rates from predators and automobiles due to the long overland journey to a wetland habitat (Congdon et al. 1983; Piegras and Lang 2000). Therefore, direct release of hatchlings in nearby adult wetland habitat was adopted in 2009. This study was intended to determine what happens to the hatchlings once they are released in adult wetland habitat. Our findings suggest that the habitat selected for hatchling release may not be preferable, as all but one hatchling retreated from the release sites. Additionally, all hatchlings survived the duration of the study while traveling across roads and facing the possibility of predation. Four of the six hatchlings released in wetland complexes retreated to the edge of a swamp and were often found concealed in Reed canary grass (*Phalaris arundinacea*), *Sphagnum*, and leaf litter. Additionally, hatchlings resided in water depths ≤ 40 cm with water depths reducing to 0-7 cm the last week of monitoring. H_AKY02, a hatchling released at the nest site, was found to overwinter on land in a clump of vegetation. Due to these results, it is our goal for 2018 to radio-track hatchlings that are released at the nest site. By releasing hatchlings at the nest site, we can evaluate the current conservation efforts of direct release and modify actions to incorporate the best management practices to assure a long-term stable population.

Anuran Surveys

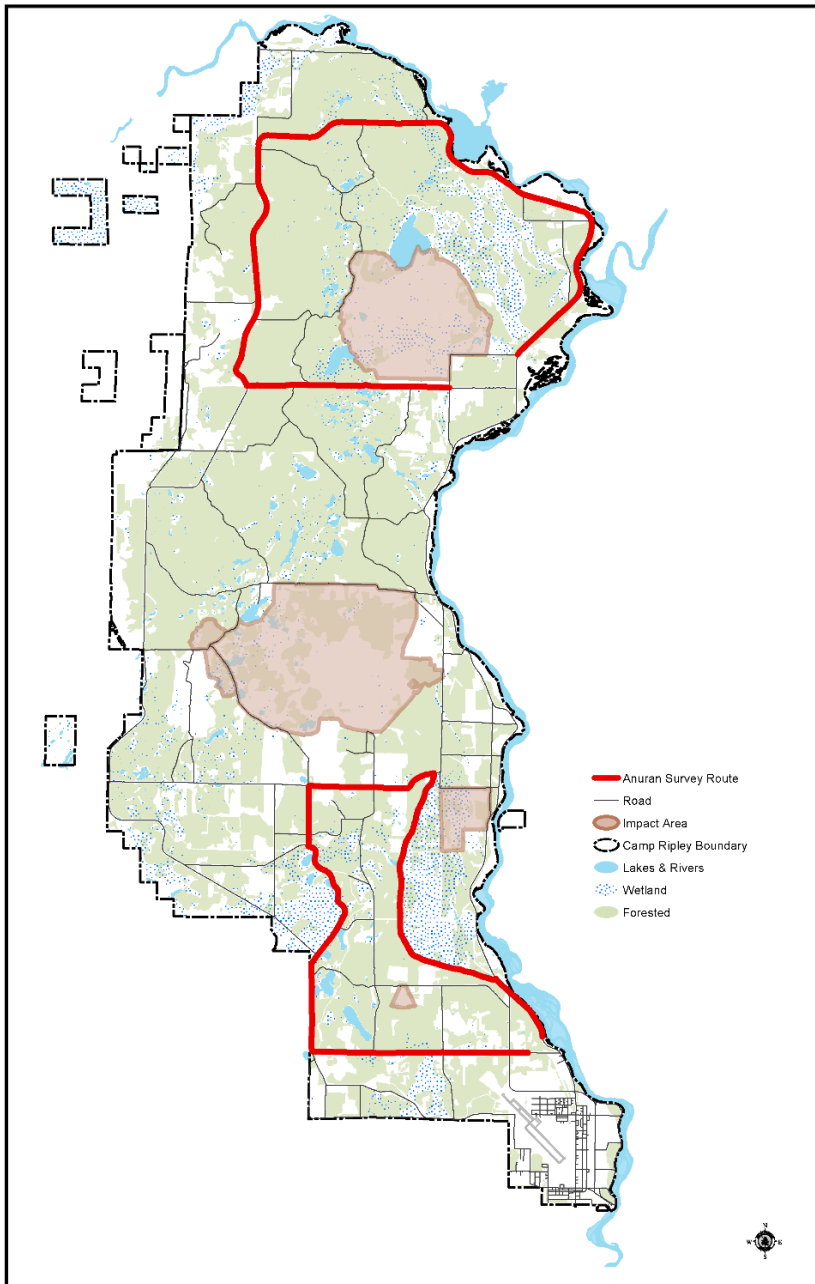
Frog and toad calling surveys are conducted as part of a larger statewide survey, and have been conducted at Camp Ripley since 1993. The statewide survey began due to growing concern over declining amphibian populations worldwide. Frog and toad abundance estimates are documented by the index level of their chorus, following Minnesota Herpetological Society guidelines (Moriarty, unpublished). If individual songs can be counted and there is no overlap of calls, the species is assigned an index value of one. If there is overlap in calls the index value is two, and a full chorus is designated a three. Anuran surveys are performed at 10 stops along two separate routes at Camp Ripley. The routes are surveyed three times from April through July (Figure 41).

Figure 40. Locations of Blanding's turtle hatchlings H_AKY01 and H_AKY02 direct released at Goose Lake, Camp Ripley Training Center, Minnesota, 2017.



Both routes were surveyed in 2017, during all three time periods. Surveys were conducted by DNR staff and volunteer Adam Kremer (#50295, 2nd time period only) on the south (#50195) and north (#50295) routes on April 24, May 25 and June 29. During the first survey period, (April 15 – 30) spring peepers (*Pseudacris crucifer*) were near the 24 year high point that occurred in 1994. Several northern leopard frogs (*Rana pipiens*) were also heard (Figure 42 and Table 19). Boreal chorus frog (*Pseudacris maculata*) index values were slightly above their all-time low in 2015 and wood frogs

Figure 41. Anuran survey routes, Camp Ripley Training Center, 1993–2017.



(*Rana sylvatica*) had the eleventh highest index recorded since 1994. During the second survey period (May 15 – June 5), spring peeper's and gray treefrog's (*Hyla chrysoscelis*) index values were both the third highest since 1993 and Cope's gray treefrog's was second highest. American toads (*Anaxyrus americanus*) were also heard calling during the second survey period (Figure 43 and Table 19). The third survey period included calls from northern leopard frog, American toad, gray treefrog, Cope's gray treefrog, mink and green frogs (Table 19). Statewide results, between 1998 and 2015, indicate a marginally-significant increase ($p = 0.06$) in the proportion of routes where Cope's gray treefrogs were heard; and, a significant increase ($p = 0.03$) in the proportion of routes where green frogs were heard. No statewide trends were detected in the other 12 species of frogs and toads in Minnesota, indicating overall populations of these species

are stable (Larson 2017).

Figure 42. Average anuran index value during the first survey period, Camp Ripley Training Center, Minnesota, 1994 – 2017. Surveys were not conducted during 2008.

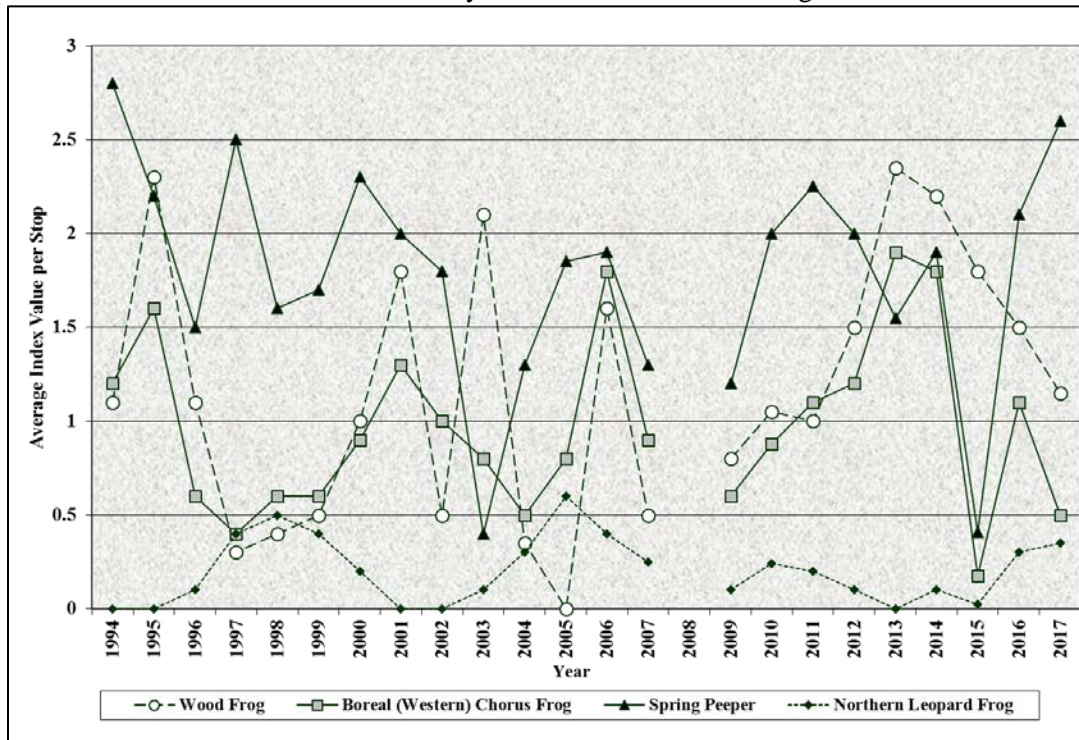


Figure 43. Average anuran index value during the second survey period, Camp Ripley Training Center, Minnesota, 1993 – 2017. Surveys were not conducted during the second survey period in 2005 and 2008.

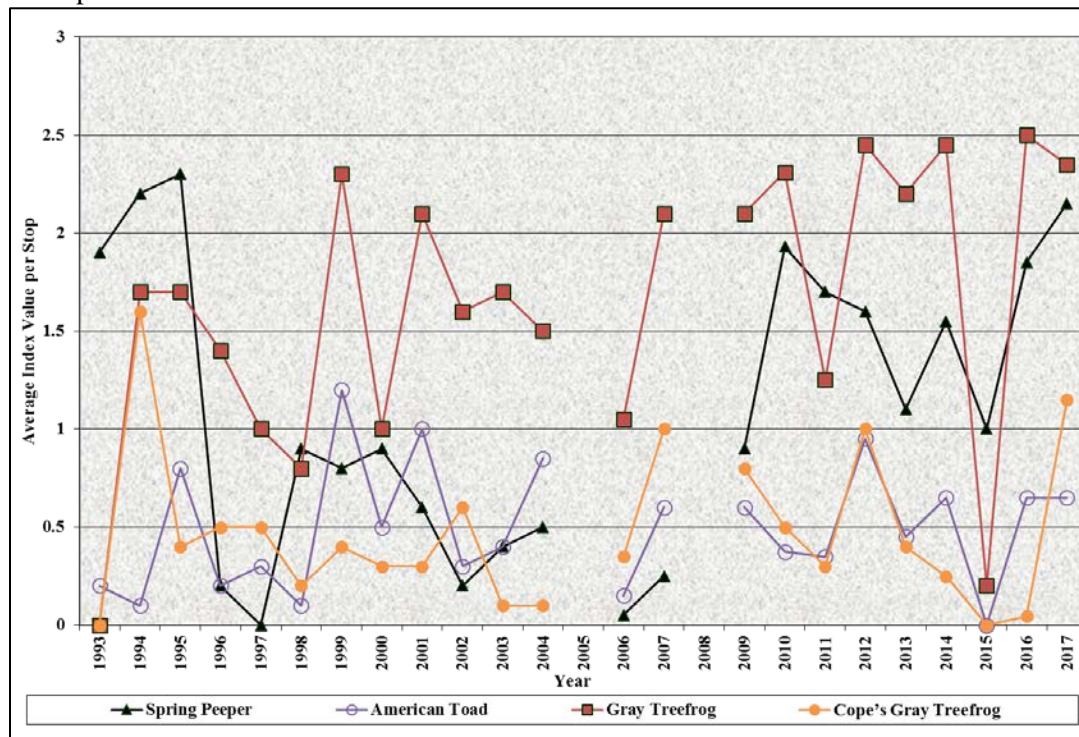


Table 19. Anuran survey index data, Camp Ripley Training Center, Minnesota, 1993 – 2017.

Survey Period 1	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Wood frog	*	1.1	2.3	1.1	0.3	0.4	0.5	1	1.8	0.5	2.1	0.35	0	1.6	0.5	*	0.8	1.05	1.0	1.5	2.35	2.2	1.8	1.5	1.15
Boreal (Western) chorus frog	*	1.2	1.6	0.6	0.4	0.6	0.6	0.9	1.3	1	0.8	0.5	0.8	1.8	0.9	*	0.6	0.88	1.1	1.2	1.9	1.8	0.18	1.1	0.5
Spring peeper	*	2.8	2.2	1.5	2.5	1.6	1.7	2.3	2	1.8	0.4	1.3	1.85	1.9	1.3	*	1.2	2.0	2.25	2.0	1.55	1.9	0.41	2.1	2.6
Northern leopard frog	*	0	0	0.1	0.4	0.5	0.4	0.2	0	0	0.1	0.3	0.6	0.4	0.25	*	0.1	0.24	0.2	0.1	0	0.1	0.02	0.3	0.35
American toad	*	0	0	0	0	0	0	0	0	0	0	0	0.8	0	0	*	0	0	0	0	0	0	0	0	0
Gray treefrog	*	0	0	0	0	0	0	0	0	0	0	0	1.35	0	0	*	0	0	0	0	0	0	0	0	0
Cope's gray treefrog	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0	0	0	0
Mink frog	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0	0	0	0
Green frog	*	0	0	0	0	0	0	0	0	0	0	0	0	0	0	*	0	0	0	0	0	0.05	0	0	0
Survey Period 2	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Wood frog	2.4	0.1	0	0	0	0	0	0	0	0	0	0	*	0	0	*	0	0	0	0	0	0	0	0	0
Boreal (Western) chorus frog	0.4	0.1	0.2	0	0	0	0.1	0.2	0.2	0	0.2	0.2	*	0	0.05	*	0.3	0.56	0.5	0.9	0.7	0.8	0.6	0.25	0.7
Spring peeper	1.9	2.2	2.3	0.2	0	0.9	0.8	0.9	0.6	0.2	0.4	0.5	*	0.05	0.25	*	0.9	1.93	1.7	1.6	1.1	1.55	1.0	1.85	2.15
Northern leopard frog	0	0	0	0	0	0.1	0.1	0.3	0.1	0	0.1	0.1	*	0.1	0.05	*	0	0.06	0.1	0.05	0.15	0.05	0.15	0.05	0.15
American toad	0.2	0.1	0.8	0.2	0.3	0.1	1.2	0.5	1	0.3	0.4	0.85	*	0.15	0.6	*	0.6	0.37	0.35	0.95	0.45	0.65	0	0.65	0.65
Gray treefrog	0	1.7	1.7	1.4	1	0.8	2.3	1	2.1	1.6	1.7	1.5	*	1.05	2.1	*	2.1	2.31	1.25	2.45	2.2	2.45	0.2	2.5	2.35
Cope's gray treefrog	0	1.6	0.4	0.5	0.5	0.2	0.4	0.3	0.3	0.6	0.1	0.1	*	0.35	1	*	0.8	0.5	0.3	1.0	0.4	0.25	0	0.04	1.15
Mink frog	0	0	0	0.2	0.1	0.1	0	0	0	0	0	0	*	0	0	*	0	0	0	0	0.1	0	0	0	0
Green frog	0	0	0	0.1	0.1	0	0	0	0	0	0	0	*	0	0	*	0.1	0	.05	0	0	0	0	0.05	0
Survey Period 3	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Wood frog	*	*	0	0	*	*	*	*	0	0	*	*	0	*	0	*	0	0	0	0	0	0	0	0	0
Boreal (Western) chorus frog	*	*	0.1	0	*	*	*	*	0	0	*	*	0	*	0	*	0	0	0	0	0	0	0	0	0
Spring peeper	*	*	0	0	*	*	*	*	0	0	*	*	0	*	0	*	0	0	0	0	0	0	0	0	0
Northern leopard frog	*	*	0	0	*	*	*	*	0	0	*	*	0	*	0	*	0.3	0	0	0	0	0	0	0	0.05
American toad	*	*	0	0	*	*	*	*	0	0	*	*	0	*	0	*	0	0	0.1	0	0	0	0.05	0	0.05
Gray treefrog	*	*	0.2	0	*	*	*	*	0.2	0.3	*	*	0.25	*	0.4	*	0.5	0.05	1.8	1.05	0.6	0.15	0.2	0.5	1.25
Cope's gray treefrog	*	*	0	0	*	*	*	*	0	0.3	*	*	0.1	*	0.12	*	0.3	0	0.45	0.2	0.2	0.05	0	0.25	0.15
Mink frog	*	*	0.3	0.4	*	*	*	*	0	0.1	*	*	0.05	*	0.06	*	0	0.1	0.15	0.05	0.2	0.2	0.05	0.1	0.15
Green frog	*	*	0	0.3	*	*	*	*	0.3	0.1	*	*	0.25	*	0.06	*	0.7	0.25	0.55	0.5	0.25	0.35	0.04	0.56	0.5

*No survey conducted

Insects

Monarch Butterfly (*Danaus plexippus*)

Monarch butterflies are found throughout the United States. Eastern populations migrate vast distances of over 3,000 miles between the United States, Canada and central Mexico from breeding grounds to overwintering locations, across multiple generations each year. Adults in a summer generation live for two to six weeks while migratory generations live up to nine months. Monarchs from northern latitude breeding grounds that emerge after mid-August begin to migrate south towards overwintering grounds where they have never been before. When this migratory generation begins the northward journey into the southern U.S., this generation lays eggs and nectars as they breed and migrate north. The generation that repopulates the northern latitude breeding grounds the next spring is the second and third generation of the previous falls' generation (Monarch Joint Venture 2015).

Populations of monarchs are declining in both the eastern and western portions of their North American range. Monarchs are now being considered for protection under the federal Endangered Species Act (ESA). The USFWS is currently conducting a species status assessment to describe the viability of monarch populations which will support ESA decisions. The USFWS anticipates an ESA listing decision by June 2019. The major population threats are breeding, migration and overwintering habitat losses. Insecticides used to control insects are harmful to monarchs. And, herbicides used to control weeds can affect milkweed populations, the only plant that female monarchs use to lay eggs and the only plant its caterpillars eat (Monarch Joint Venture 2015).

Recent comprehensive surveys for monarch butterflies have not been completed on Camp Ripley. Butterfly surveys in 1994 encountered monarchs numerous times between May 21 and October 2. Larvae were observed on common milkweed (Hansen 1994) and observed in 2017 in Training Area 64.

Best management practices for monarch populations on Camp Ripley should include avoiding mowing ditches when monarch larvae are present, late April to mid-August, particularly locations where common milkweed (*Asclepias syriaca*) is present. In addition, limiting insecticide and herbicide use would be beneficial.

Bumble Bees

Historically about 400 native bee species occurred in Minnesota. However, little is known about bees because the most recent state species list was published in 1919. Bumble bees are a group of insect pollinators. Pollinators are critical to the agricultural economy and natural habitats and ecosystems as 90% of the world's flowering plants rely on animal pollinators. "Pollination happens when wind, water and wildlife carry pollen from the anther (male part) to the stigma (female part) of plants" (MNDNR 2017c and

Hatfield et al. 2012). Threats to bumble bee populations include habitat fragmentation, grazing, pesticide use, genetic diversity, pests and diseases, competition with honey bees and climate change (Hatfield et al. 2012). The economic value of pollination services provided by native insects (mostly bees) is estimated at \$3 billion dollars annually in the United States (USFWS 2017b).

Five bumble bees are listed as SGCN in Minnesota, including rusty patched bumble bee (*Bombus affinis*), Ashton cuckoo bumble bee (*Bombus bohemicus*), yellowbanded bumble bee (*Bombus terricola*) and golden northern bumble bee (yellow bumble bee; *Bombus fervidus*). Rusty patched bumble bee abundance and distribution has decline by 90% since the late 1990s. Recently the rusty patched bumble bee was listed as federally endangered under the Endangered Species Act. None of the single threats noted above is causing the rusty patched population decline, but the threats working in concert are likely causing the decline (USFWS 2017b). Rusty patched bumble bee range includes Camp Ripley. Recent observations of rusty patched and yellowbanded bumble bees have occurred in southeast Crow Wing County (MNDNR 2016d); therefore, it is likely that they are present on Camp Ripley.

Native Bee Transect Surveys

By Crystal Boyd, DNR, Bee Specialist

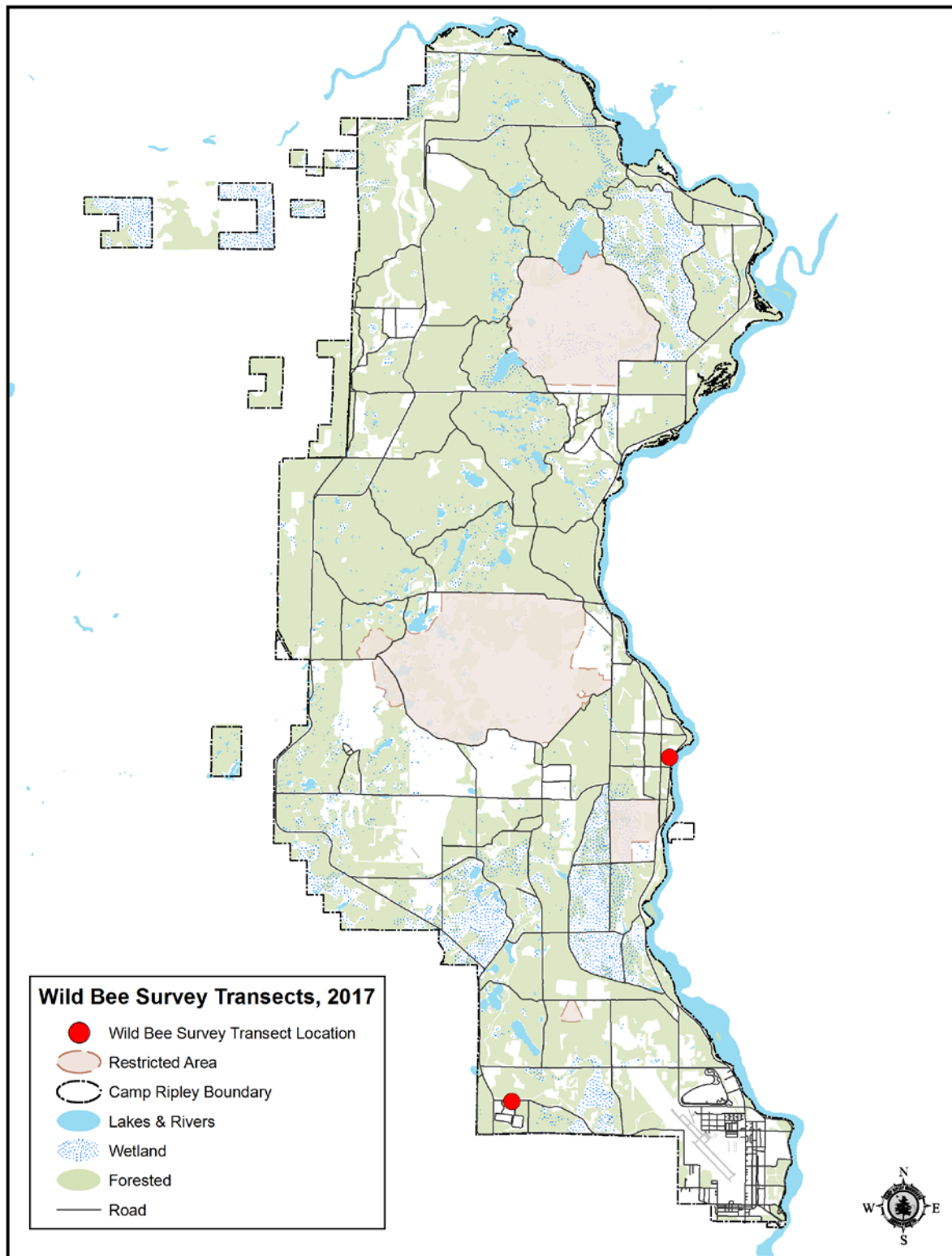
Native pollinators face multiple challenges including habitat loss, pesticides, pathogens and climate change. The Minnesota State Wildlife Action Plan lists five bumble bees as Species in Greatest Conservation Need (SGCNs). In 2017, the rusty patched bumble bee (*Bombus affinis*) was listed as a federally endangered species.

Despite the importance of pollinators, little is known about their distribution in Minnesota. For example, the most recent state species list of bees was published in 1919. To begin filling gaps in knowledge, Crystal Boyd with the DNR's Minnesota Biological Survey (MBS) coordinated native bee surveys at two sites in Camp Ripley during the summer of 2017.

Camp Ripley survey efforts were designed to match the DNR Minnesota Biological Survey methods in other parts of the state. A transect of 24 elevated pan traps was set at each site (Figure 44). The pan traps were filled with water and Dawn dish soap, and bees trapped in the soapy water were collected 24 hours later. In 2017, pan traps were set during the following three events: August 7 – 8, August 22 – 23, and September 21 – 22.

Specimen processing is ongoing. Sorting, pinning, labelling, databasing and identification take place during the off-season. An estimated 200+ specimens were collected during 2017 surveys at Camp Ripley. Species identification from the 2017 surveys on Camp Ripley will be documented in the 2018 conservation report. Data will be archived in the DNR's Observation Database, and specimens will be vouchered with the University of Minnesota Insect Collection (UMSP).

Figure 44. Native wild bee pan survey transect locations, Camp Ripley Training Center, Minnesota, 2017.



Fisheries

By Jake Kitzmann, Minnesota Department of Military Affairs

In 2017, no fish netting or rearing was conducted.

Aquatic Plant Surveys

Surveys of aquatic plant structure were instead conducted on two inland lakes in cooperation with the DNR Ecological and Water Resources staff. On August 14, a survey was conducted of near shore (< 1 m from shore) points on Rapoon Lake and all emergent vegetation was mapped. Rapoon is a 16 acre lake located in Training Area 75. Water clarity is fair with brown staining present. The substrate consists mostly of sand and gravel along with steep gradients along the shoreline. There is no development along its shores with only a small grassy area serving as the launch on the southeast corner. Rapoon Lake has a maximum depth of 24 feet. There were a total of 2.4 acres of floating and emergent plants mapped and 6 species identified (Table 20). This consisted of 2.4 acres of emergent dominated plant communities and no floating leaf plant communities.

Table 20. Floating and emergent taxa, Rapoon Lake, Camp Ripley Training Center, Minnesota, 2017.

Emergent Plants Common Name	Scientific Name	2017 Near Shore Survey
Three-way sedge	<i>Dulichium arundinaceum</i>	X
Arrowhead	<i>Sagittaria</i> sp.	X
Broad-leaf arrowhead	<i>Sagittaria latifolia</i>	X
Emergent Plant Species TOTAL		3
Floating Leaved Plants Common Name	Scientific Name	2017 Near Shore Survey
Floating-leaf burreed	<i>Sparganium</i> sp.	X
Yellow waterlily	<i>Nuphar variegata</i>	X
Floating-leaved Plant Species TOTAL		2
Submerged Plants Common Name	Scientific Name	2017 Near Shore Survey
Narrow-leaf pondweed	<i>Potamogeton</i> sp.	X
Submerged Plant Species TOTAL		1

On September 6, a point intercept survey was conducted on Ferrell Lake. A total of 83 point intercept sample sites at 50 meter intervals and 27 nearshore sites at 100 meter intervals were surveyed and 28 species identified (Table 21). Ferrell Lake is a small lake located within Camp Ripley and has with a maximum depth of approximately 12 feet. This lake has very little military development along its shore and the watershed is dominated by northern hardwood forest. The present development is two cable concrete accesses, one on the southwest side and the other on the northeast side. A dock is located at the southwest access along with a couple row boats for recreational use for soldiers and visitors to the military reservation;

Table 21. Emergent, submerged, floating-leaved and free-floating plant taxa, Ferrell Lake, Camp Ripley Training Center, Minnesota, 2017.

Emergent Plants Common Name	Scientific Name	2017 Lakewide Survey	2017 Near Shore Survey
Spikerush	<i>Eleocharis</i> sp.	1	15
Arrowhead	<i>Sagittaria</i> sp.	1	41
Broad-leaf arrowhead	<i>Sagittaria latifolia</i>		4
Emergent Plant Species TOTAL		2	3
Floating-Leaved Plants Common Name	Scientific Name	2017 Lakewide Survey	2017 Near Shore
Watershield	<i>Brasenia schreberi</i>	35	96
White waterlily	<i>Nymphaea odorata</i>	28	74
Floating-leaved Plant Species TOTAL		2	2
Free-Floating Plants Common Name	Scientific Name	2017 Lakewide Survey	2017 Near Shore
Lesser duckweed	<i>Lemna</i> sp.		11
Free-floating Plant Species TOTAL		0	1
Submerged Plants Common Name	Scientific Name	2017 Lakewide Survey	2017 Near Shore
Hornwort	<i>Ceratophyllum echinatum</i>		11
Muskgrass	<i>Chara</i> sp.	72	22
Needlegrass	<i>Eleocharis acicularis</i>		26
Canada waterweed	<i>Elodea canadensis</i>	67	96
Water stargrass	<i>Heteranthera dubia</i>		4
Quillwort	<i>Isoetes</i> sp.		19
Brown-fruited rush	<i>Juncus pelocarpus</i>		4
Bushy pondweed	<i>Najas flexilis</i>		4
Northern naiad	<i>Najas gracillima</i>	14	93
Small nitella	<i>Nitella tenuissima</i>		7
Stonewort	<i>Nitella</i> sp.		7
Large-leaf pondweed	<i>Potamogeton amplifolius</i>	35	56
Ribbon-leaf pondweed	<i>Potamogeton epihydrus</i>		48
Variable pondweed	<i>Potamogeton gramineus</i>	1	
Illinois pondweed	<i>Potamogeton illinoensis</i>	2	
Narrow-leaf pondweed	<i>Potamogeton</i> sp.	18	63
Robbin's pondweed	<i>Potamogeton robbinsii</i>	1	7
Humped bladderwort	<i>Utricularia gibba</i>	25	56
Minor bladderwort	<i>Utricularia minor</i>	14	11
Greater bladderwort	<i>Utricularia vulgaris</i>	13	44
Wild celery	<i>Vallisneria americana</i>	2	11
Watermoss	Not identified to genus		11
Submerged Plant Species TOTAL		12	19

personal boats are allowed but must be clear of any invasive species. Water clarity is excellent allowing for good aquatic vegetation to grow to a depth of about 10 feet. The southeastern portion of the lake is a large bay that produce a dense mat of lily pads and other various aquatic plants. There is very little structure within the lake other than the natural weed line, a couple beaver lodges and sunken wood debris.

Pest Management

Vector-borne Diseases

By Jenna Bjork, DVM, Minnesota Department Health (MDH)

Vector-borne diseases (i.e., illnesses spread by ticks and mosquitoes) are a complex, dynamic and significant health risk to persons who live, work and travel within Minnesota. Dozens of species of ticks and mosquitoes thrive throughout the state but not all of them bite people and not all of them spread disease. For instance, two ticks of primary public health concern include blacklegged deer tick (*Ixodes scapularis*) and wood (dog) tick (*Dermacentor variabilis*). *Ixodes scapularis* may transmit the pathogens that cause several diseases in humans including but not limited to Lyme disease, human anaplasmosis, and babesiosis. In addition, while human disease transmission from *D. variabilis* is rare within the state of Minnesota, diseases such as Rocky Mountain spotted fever and tularemia can have serious and life-threatening consequences. In regards to mosquito borne diseases, one particular mosquito of primary public health concern here in Minnesota is *Culex tarsalis*, our main vector of West Nile virus disease. Other mosquito species may spread diseases and exotic species (e.g., *Aedes japonicus* and *Aedes albopictus*) may be introduced throughout the state as well. For these reasons, MDH conducts annual surveillance for ticks and mosquitoes in order to better understand and communicate the risks of vector-borne disease in Minnesota.

Since 2005, MDH has collected ticks at Camp Ripley and various Minnesota state parks and other high public use areas as part of ongoing efforts to determine long-term infection prevalence with endemic pathogens in *I. scapularis* throughout the state. In 2017, *D. variabilis* ticks that were incidentally collected during these visits were also submitted for testing of the disease agent that causes tularemia, *Francisella tularensis*. In addition to tick surveillance, in 2017 MDH also received resources through the Upper Midwestern Center of Excellence for Vector-borne Disease to perform surveillance for adult mosquitoes at four sites in Minnesota, one of which was Camp Ripley. The purpose of this effort was to provide an updated assessment of the types of mosquitoes present in Minnesota as well as document (and respond, as needed, to) any exotic mosquito species collected.

Methods

Tick Studies

Camp Ripley was visited four times (5/4/17, 6/1/17, 6/20/17 and 7/13/17) in an effort to collect at least 200 *I. scapularis* (100 adult and 100 nymph life stage ticks). Three sites (Training Areas 1, 20/22, and 29) within the Camp were selected for study based on accessibility and optimal blacklegged tick habitat (i.e.

wooded and brushy mesic areas with at least 50% canopy coverage). All sites were sampled on each of the first three visits while only four transects (two transects each of Training Areas 1 and 29) were sampled on 7/13/17. MDH field staff collected ticks by dragging white canvas cloths over the ground along four 100-meter transects established at each site. Staff also collected any ticks found crawling on themselves while walking along each transect. Ticks were stored in vials containing 70% ethanol. The MDH Public Health Laboratory (PHL) will perform polymerase chain reaction (PCR) testing on *I. scapularis* collected at these sites to detect the genetic material of *Borrelia burgdorferi* (Lyme disease), *Anaplasma phagocytophilum* (human anaplasmosis), *Ehrlichia muris eauclairensis* (ehrlichiosis), *Babesia microti* (babesiosis), *Borrelia miyamotoi* (hard tick relapsing fever), and *Borrelia mayonii* (a recently identified form of Lyme disease). *Ixodes scapularis* adults and nymphs will be tested individually while larvae will be tested in pools of 1 – 10 ticks per pool.

While collecting *I. scapularis* at these sites, MDH staff also incidentally collected *D. variabilis* adult ticks on all of these visits as well. These ticks were submitted to the MDH PHL for PCR testing to detect the genetic material of *F. tularensis* (tularemia) and were tested in pools with a maximum of 10 ticks per pool. The minimum infection rate of ticks was calculated by dividing the minimum number of positive ticks per positive pool (i.e., one tick per positive pool) by the total number of ticks tested.

Mosquito Studies

The mosquito magnet trap was located in Training Area 17 in open grassland on the edge of wooded habitat, surrounded by a large wetland. The mosquito magnet used in this effort was a stationary device that utilizes attractants such as carbon dioxide and octenol to lure a broad population of blood-seeking mosquitoes into a fan that blows mosquitoes into a net until collected by the administrator. In general, samples were collected on a weekly basis during the primary mosquito borne disease risk season (i.e., June through September) with the device running on average for 3 – 4 days during the collection period each week. After collection, mosquito samples were frozen until they could be identified to species by MDH staff.

Results

Tick Studies

Over the duration of the four site visits, a total of 584 *I. scapularis* (436 adults, 84 nymphs, and 64 larvae) ticks were collected at Camp Ripley in 2017. *Ixodes scapularis* ticks were found at all sites that were sampled although most nymphs (42 [50%] of 84) and larvae (54 [84%] of 64) were collected within Training Area 20/22 while most adults (276 [63%] of 436) were collected within Training Area 29 (Table 22). Of the

Table 22. *Ixodes scapularis* ticks collected by collection site and life stage, Camp Ripley Training Center, Minnesota, 2017*.

Training Area	Number of <i>I. scapularis</i> Collected			
	Adults	Nymphs	Larvae	Total
1	52	23	4	79
20/22	106	42	54	202
29	276	18	6	300
Other	2	1	0	3
All Sites	436	84	64	584

* Questing tick density within each site cannot be inferred from the data shown here since sampling was not performed equally among each training area.

584 *I. scapularis* ticks collected, 253 ticks (106 adults, 83 nymphs, and 64 larvae) were randomly selected and submitted for testing by PCR for the previously listed pathogens.

In addition, 265 adult *Dermacentor variabilis* ticks were collected incidentally during this effort and tested by PCR for *F. tularensis*. The 265 ticks were divided by sex and collection date into 29 pools (Table 23).

Minimum infection rate (MIR) ranged between 4.7% and 10.1% and did not vary significantly by sex or collection date. Overall, 19 (65.5%) of 29 pools tested positive for *F. tularensis* with an average MIR of 7.2%.

Table 23. *Dermacentor variabilis* ticks collected by sex and collection date, and tested for the disease agent of tularemia (*Francisella tularensis*), Camp Ripley Training Center, Minnesota, 2017.

	Total Number of Ticks Tested	Number of Positive Pools / Number of Pools Tested (%)	MIR*
Sex			
Male	115	8/13 (61.5%)	7.0%
Female	150	11/16 (68.8%)	7.3%
Collection Date			
5/4/17	59	4/7 (57.1%)	6.8%
6/1/17	99	10/11 (90.9%)	10.1%
6/20/17	107	5/11 (45.5%)	4.7%
Total	265	19/29 (65.5%)	7.2%

*MIR = minimum infection rate

Mosquito Studies

Twelve mosquito samples were collected at Camp Ripley between 6/22/17 and 9/30/17. The average length of sampling per week was 89.7 hours (3.7 days) with a range of approximately 47 – 168 hours. A total of 42,445 mosquito specimens were collected and identified to species. The number of mosquitoes collected each week ranged from 51 to 14,287 mosquitoes with the peak collection date occurring on 7/28/17 followed by declining numbers of collected mosquitoes afterwards (Figure 45). The most frequently collected species included the following: 38,463 *Coquillettidia perturbans*, 1,555 *Aedes cinereus*, 922 *Aedes abserratus*, 651 *Aedes vexans*, 518 *Anopheles walkeri*, 115 *Aedes sticticus* and 109 *Aedes trivittatus* (Figure 46). One-hundred twelve other mosquitoes were identified including two *Aedes triseriatus*, one *Aedes japonicus* and one *Culiseta melanura*. Of note, no *Culex tarsalis*, *Aedes albopictus* or *Aedes aegypti* were collected.

Figure 45. Number of mosquitoes collected by collection week, Camp Ripley Training Center, Minnesota, 2017 (n=42,445).

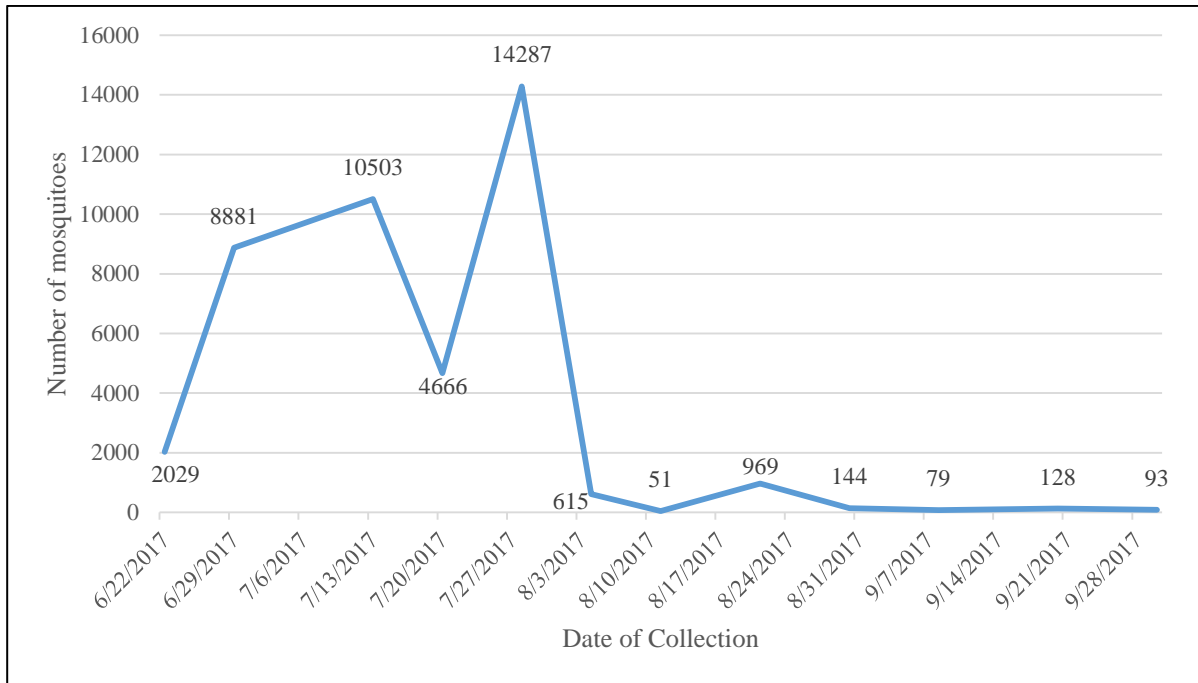
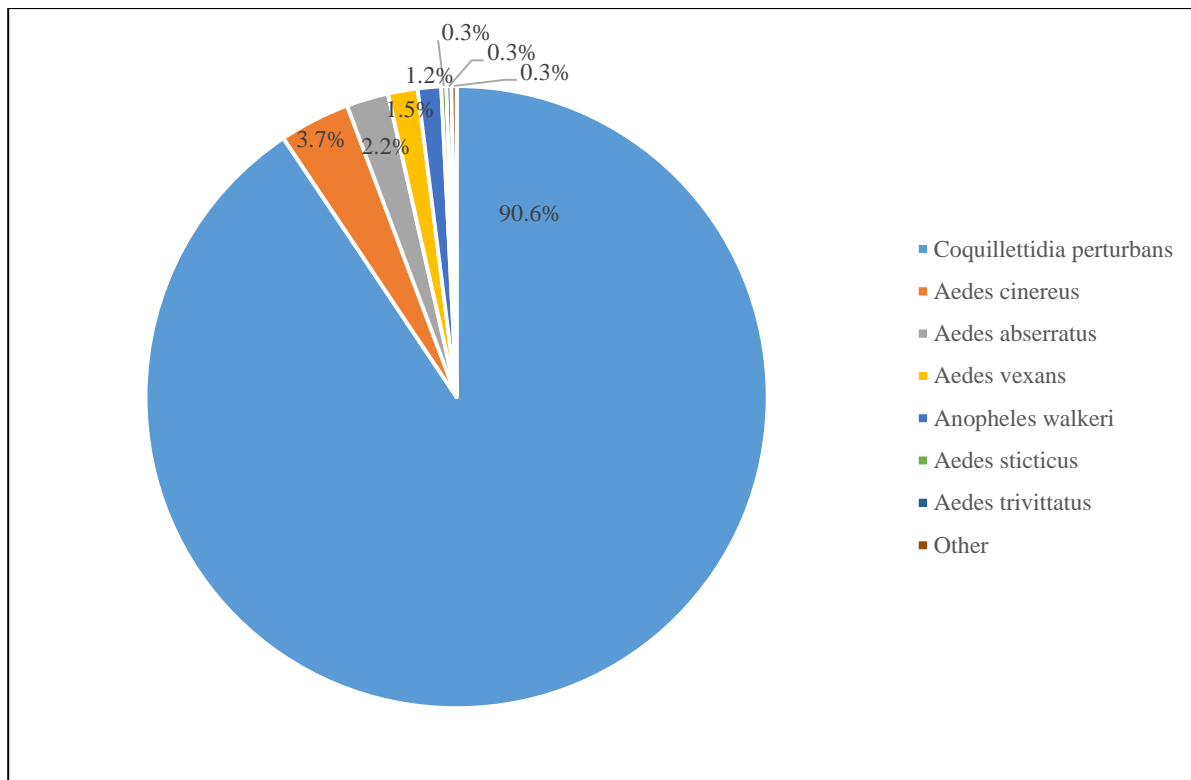


Figure 46. Most frequently identified mosquito species collected, Camp Ripley Training Center, Minnesota, 2017 (n=42,445).



Laboratory Results

Of the 584 *I. scapularis* ticks collected, 253 ticks (106 adults, 83 nymphs and 64 larvae) were randomly selected and tested by PCR for *Borrelia burgdorferi*, *Anaplasma phagocytophilum*, *Ehrlichia muris eauclairensis*, *Babesia microti*, *Borrelia miyamotoi*, and *Borrelia mayonii*. Of the 64 larvae tested, none of the 12 pools (range, 1 – 10 ticks per pool) tested positive for any of the disease agents. Of the 106 adults and 83 nymphs tested, approximately 46.2% of adult ticks and 20.5% of nymphs were infected with *B. burgdorferi* with a much lower infection prevalence found with the other pathogens (Table 24). Of the 189 adult tick and nymphs tested, 84 (44.4%) ticks were infected with at least one disease agent while 26 (13.8%) were coinfecting with at least two disease agents (Table 25). Infection prevalence varied by the life stage and site in which the ticks were collected although it is important to keep in mind the limitation of small sample sizes when comparing between sites (Table 25). These tick infection prevalence results are comparable to what has been found in past years. Of note, *Borrelia mayonii* has been detected in 1 – 4% of adult ticks and 0 – 2% of nymphs tested from Camp Ripley since we started testing for the disease agent in 2014. Failure to detect this particular disease agent in this year's sample of ticks may not necessarily indicate the absence of the organism circulating in the environment; rather, it may more likely be due to a normally low infection prevalence and low sample size of ticks tested.

Table 24. *Ixodes scapularis* infection prevalence by disease agent, Camp Ripley Training Center, Minnesota, 2017.

Disease Agent	Adults # Positive/# Tested (%)	Nymphs # Positive/# Tested (%)
<i>Borrelia burgdorferi</i>	49/106 (46.2%)	17/83 (20.5%)
<i>Anaplasma phagocytophilum</i> *	12/106 (11.3%)	3/83 (3.6%)
<i>Ehrlichia muris eauclairensis</i>	4/106 (3.8%)	2/83 (2.4%)
<i>Babesia microti</i>	11/106 (10.4%)	11/83 (13.3%)
<i>Borrelia miyamotoi</i>	3/106 (2.8%)	3/83 (3.6%)
<i>Borrelia mayonii</i>	0/106 (0%)	0/83 (0%)

*human variant only (excludes other variants)

Table 25. *Ixodes scapularis* infection prevalence* by tick collection site, Camp Ripley Training Center, Minnesota, 2017.

Site	Adults # Positive/# Tested (%)		Nymphs # Positive/# Tested (%)	
	At least 1 Infection	Coinfection**	At least 1 Infection	Coinfection**
Training Area 1	12/19 (63.2%)	2/19 (10.5%)	6/23 (26.1%)	3/23 (13.0%)
Training Area 20/22	15/29 (51.7%)	4/29 (13.8%)	10/42 (23.8%)	2/42 (4.8%)
Training Area 29	33/58 (56.9%)	10/58 (17.2%)	8/18 (44.4%)	5/18 (27.8%)
Overall	60/106 (56.6%)	16/106 (15.1%)	24/83 (28.9%)	10/83 (12.0%)

*Ticks infected with at least one disease agent

**Ticks infected with at least two disease agents

Discussion

As in past years, MDH found evidence of established *I. scapularis* and *D. variabilis* populations at each of the sites visited within Camp Ripley during the 2017 tick collection effort. Within those populations, evidence of several different tick borne disease agents have been documented in the past (see Appendix A for brief descriptions of the vector-borne diseases discussed in this report). Although we don't yet have tick testing results from the *I. scapularis* ticks collected this year, test results from previous years indicate that we should expect to find relatively similar infection prevalence rates in the 2017 cohort of ticks tested. While infection prevalence may vary from year to year and site to site, on average we have found 42% (386/911) of adult *I. scapularis* and 22% (144/655) of *I. scapularis* nymphs collected from Camp Ripley from 2006 – 2016 to be infected with *Borrelia burgdorferi*. Other tick borne disease agents have been regularly found in *I. scapularis* ticks collected from Camp Ripley but at a lower infection prevalence. For instance, anaplasmosis is the second most commonly reported tick borne disease in Minnesota and on average we have found 10% (91/911) of adult *I. scapularis* and 8% (64/655) of *I. scapularis* nymphs to be infected with *Anaplasma phagocytophilum*. We plan to analyze and summarize our many years of tick infection prevalence data in the near future and will share our findings as soon as they are available.

In contrast to testing *I. scapularis* ticks for several different tick borne disease agents, this is the first year that we have tested *D. variabilis* ticks for *F. tularensis*. In addition to Camp Ripley, we collected and tested ticks from six other sites in Minnesota as well. Four of the seven sites had positive tick pools with an average MIR of 4.1% across all positive sites (range, 2.1% to 7.2%). While the MIR varied across our sites, the range of variation was relatively small and the reasons for this variability are currently not understood. Our results may reflect normal variation in infection prevalence over space and time; however, other factors may impact infection prevalence and could include weather conditions (e.g., temperature and relative humidity), host and vector population density, as well as complex biological dynamics within ticks. Further ecologic studies are needed to fully understand the importance of tick species in the maintenance and transmission of *F. tularensis* in Minnesota.

This was also the first year that we collected mosquitoes from Camp Ripley. Species diversity in the samples was fairly good but likely would have been higher if we initiated sampling earlier in the year to catch more snowmelt *Aedes* species, which are potential vectors of Jamestown Canyon virus. Several *Aedes* species were found in decent numbers but *Coquillettidia perturbans* (cattail mosquitoes) overwhelmed everything in July and August (by far the most abundant species in the samples). This species has one brood of eggs emerge each year and is a significant pest mosquito in Minnesota although may also be a bridge vector for transmission of eastern equine encephalitis to humans. Low numbers of *Ae. triseriatus* (tree hole mosquito) and *Ae. japonicus* (Asian rock pool mosquito) were also collected this year. These species may be vectors of La Crosse encephalitis, a rarely reported endemic disease that is primarily found in southeastern Minnesota. Being that these two species of mosquitoes do not fly far (< 200 yards), their presence in our sampling effort likely indicates that small water-holding containers or tree holes are located near the mosquito magnet. We recommend searching for potential mosquito breeding habitat in the area and removing any small pools of standing water (e.g., fill tree holes or remove/tip over small water-holding containers). A single collected specimen was identified as *Culiseta melanura*, which is an interesting (although not necessarily unexpected) finding in that it is a potential amplifying vector of eastern equine encephalitis. This mosquito species is typically found near black spruce/tamarack bogs or hardwood swamps. No *Cx. tarsalis*, our main West

Nile virus vector, were identified in this effort although this species is more commonly found in agricultural and grassland regions of the state. Considering that Camp Ripley is located within this mosquito's flying distance from optimal agricultural habitat, finding *Cx. tarsalis* within the site is certainly possible. Other potential West Nile virus vectors, such as *Culex pipiens* and *Culex restuans*, were collected in low numbers (n=7) from Camp Ripley this year as well. As expected, no tropical disease vectors such as *Ae. albopictus* (Asian tiger mosquito) or *Ae. aegypti* (yellow fever mosquito) were identified. While none of these findings are particularly remarkable at this time, these mosquito records are extremely useful in documenting the types of mosquitoes present throughout Minnesota.

Based on our tick and mosquito findings from this past year as well as tick testing results from previous years, we strongly recommend that staff and visitors at Camp Ripley take precautions against tick and mosquito bites:

- Repellents containing DEET (20 – 30%) or permethrin are safe and effective against both tick and mosquito bites. Other EPA-approved products, such as picaridin and IR3535, are also available.
- Perform thorough and systematic tick checks at least once a day after being in or near wooded or grassy areas. Ticks must be attached for at least 12 hours to spread anaplasmosis or 24 hours to spread Lyme disease so remove ticks as soon as possible, before they have a chance to spread a disease agent.
- Tumble dry clothing in a dryer on high heat for at least 10 minutes (or at least 60 minutes if wet) to kill any blacklegged (deer) ticks remaining on your clothing. Longer dry times may be needed to kill American dog (wood) ticks.
- Watch for signs of vector-borne disease (e.g., rash, fever, headache, muscle/joint aches), especially from May through October, and tell your doctor about your possible exposure to ticks and mosquitoes if you become sick.

Describing the Seasonality of Host Infection with *Ixodes scapularis*-Borne Pathogens

By Tammi Johnson, Centers for Disease Control and Prevention

Background

The blacklegged tick, *Ixodes scapularis*, is the primary vector to humans in the Minnesota of several human pathogens including *Borrelia burgdorferi* sensu stricto (Lyme disease), *Anaplasma phagocytophilum* (anaplasmosis), *Babesia microti* (babesiosis) and the deer tick lineage of Powassan encephalitis virus. In addition to the above pathogens, two newly discovered disease-causing pathogens have been identified in Minnesota, *Borrelia mayonii* and *Ehrlichia muris eauclairensis*. Immature stages, i.e., larval and nymphal, *Ixodes scapularis* are known to feed on numerous species of small to medium sized mammals as well as birds. Many of the tick borne pathogens transmitted by *I. scapularis* are maintained in enzootic cycles in which the host species serves as not only as a food source for the ticks, but remain infectious for extended periods of time and perpetuate infections in ticks feeding on them. The enzootic maintenance of some *I. scapularis*-borne pathogens, i.e. *B. burgdorferi*, are well understood, while other systems require more research. In the eastern United States, several species of small mammals have been shown to contribute to the enzootic maintenance of *Borrelia burgdorferi*. The enzootic maintenance and reservoir contribution is less well understood for other *I. scapularis*-borne pathogens, especially those that may be transovarially transmitted.

Objective

Small mammals were trapped twice in 2016 at Camp Ripley Minnesota. In June 2016, infection prevalence with *Borrelia* in the host population was > 60%, while host infection prevalence with *Borrelia* was just 3% in October. Although, infection prevalence with *Babesia microti* was high (47%). This research is aimed at providing a better understanding of enzootic transmission cycle in Minnesota. We will determine host infection rates with *I. scapularis*-borne pathogens prior to nymphal emergence in the spring, again at the peak of nymphal emergence, and at the end of the nymphal tick season. We will compare host infection prevalence to larval and nymphal infection prevalence. In addition, we will collect ticks by drag sampling on the grid three times in June. The 2017 work will complete the small mammal/tick/pathogen project that began in 2016 to determine how tick infestation with *I. scapularis* larvae and host infection affect nymphal tick abundance the following year. We will also be collecting ticks in 2017 at the four other sites sampled in 2016, i.e. William O'Brien State Park, St. Croix State Park, Itasca State Park and Chippewa National Forest.

Host infection prevalence should be lowest in the spring prior to nymphal emergence when new cohorts of naïve hosts are borne into the population. We expect host infection prevalence to continue to increase throughout the summer and decrease at the end of the nymphal tick season. Infection rates in nymphal ticks will likely remain relatively constant throughout the season, as most of these ticks were infected as larvae. Larval infection rates are expected to be lowest in the spring and increase throughout the season as host infection rates also increase. Comparisons of host, larval and nymphal infection prevalence may also provide insight into the contribution of co-feeding transmission in this system.

Methods

We live trapped small mammals at Circle of Wagons in Training Area 1 in May and June 2017. This was a non-lethal study. Blood and tissue samples were collected a single time from each animal as described in the field protocol (16-009 (Johnson)) approved by the Centers for Disease Control and Prevention Institutional Animal Care and Use Committee. We also collected all ectoparasites infesting each animal, including fleas and ticks.

All blood, tissue and ectoparasite specimens were sent to the Centers for Disease Control and Prevention, Fort Collins, CO, for processing. To date, all ticks have been identified and all *I. scapularis* will be tested for disease causing pathogens including, *B. burgdorferi*, *B. mayonii*, *A. phagocytophilum*, *B. miyamotoi* and *Ba. microti* within the next year. Upon completion of testing, an addendum to this report will be submitted to describe pathogen detection results.

Results

Small mammals were trapped twice in 2017, once from May 16 – 18 and again from June 14 – 16 at Training Area 1 (Circle of Wagons). In May 2017, only 11 individuals were captured, while in June, 31 individuals were captured (Table 26). The majority of captures were eastern chipmunks (*Tamias striatus*). We also captured a single southern flying squirrel (*Glaucomys volans*) and two masked shrews (*Sorex cinereus*).

As expected, animals captured in May had a lower infestation of larval and nymphal ticks than individuals captured in June, at the peak of immature *I. scapularis* emergence. Most individuals were

Table 26. Small mammals collected at Training Area 1 – Circle of Wagons, Camp Ripley Training Area, May and June 2017.

Scientific Name	Common Name	Total No. Collected (No. collected in May 2017)
<i>Peromyscus</i> spp.	Deer mouse or white-footed mouse	3(1)
<i>Clethrionomys gapperi</i>	Southern red-backed vole	4(2)
<i>Blarina brevicauda</i>	Short-tailed Shrew	1(0)
<i>Glaucomys volans</i>	Southern flying squirrel	1(1)
<i>Sorex cinereus</i>	Masked shrew	2(0)
<i>Tamias striatus</i>	Eastern chipmunk	24(4)
<i>Zapus hudsonicus</i>	Meadow jumping mouse	7(3)

infested with ticks and the most ticks were obtained from eastern chipmunks (Figures 47– 50). Ticks were more abundant in 2017 as compared with 2016, both on infesting animals and actively questing. We did not collect any *I. scapularis* nymphs while dragging the trapping grid in 2016, however, 70 nymphs, numerous larvae, and fewer adult ticks were found (Table 27).

Infection data on small mammals or ticks are pending, but we will provide an update when all samples have been analyzed.

Table 27. Ticks collected from drag sampling of the small mammal grid at three different times, Camp Ripley Training Center, Minnesota, Jun 2017.

Species and Life Stage	Visit 1 June 8	Visit 2 June 13	Visit 3 June 20	Total
<i>Ixodes scapularis</i>				
Larva	24	94	47	165
Nymph	8	23	39	70
Adult	6	3	5	14
<i>Dermacentor variabilis</i>				
Adult	3	5	8	16

Figure 47. Infestation of small mammals with larval ticks Training Area 1
– Circle of Wagons, Camp Ripley Training Center, Minnesota,
May 2017.

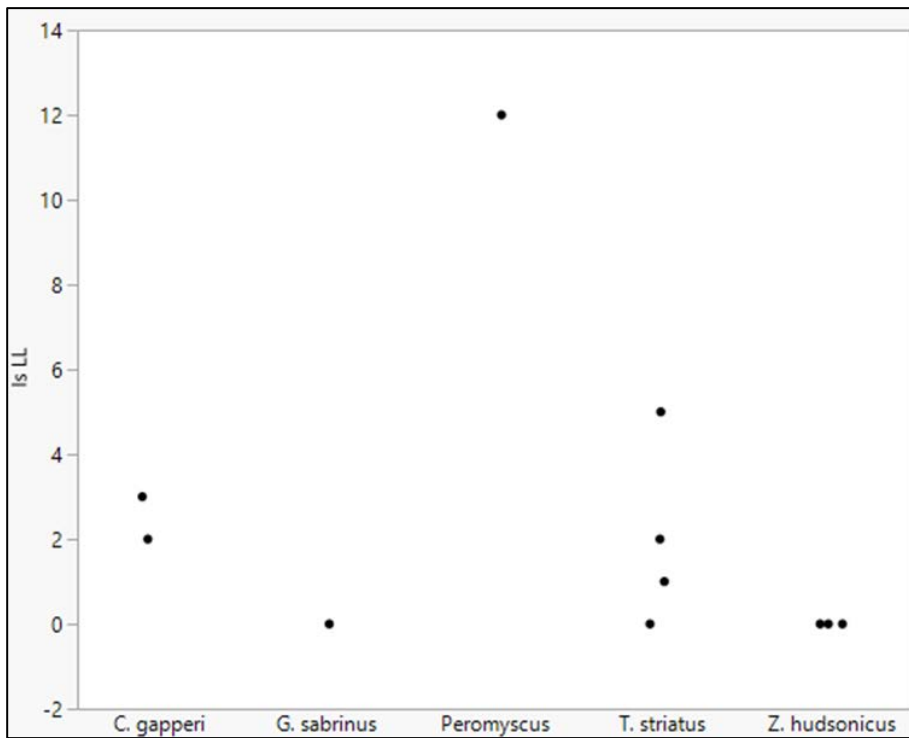


Figure 48. Infestation of small mammals with nymphal ticks in Training Area 1 – Circle of Wagons, Camp Ripley Training Center, Minnesota, May 2017.

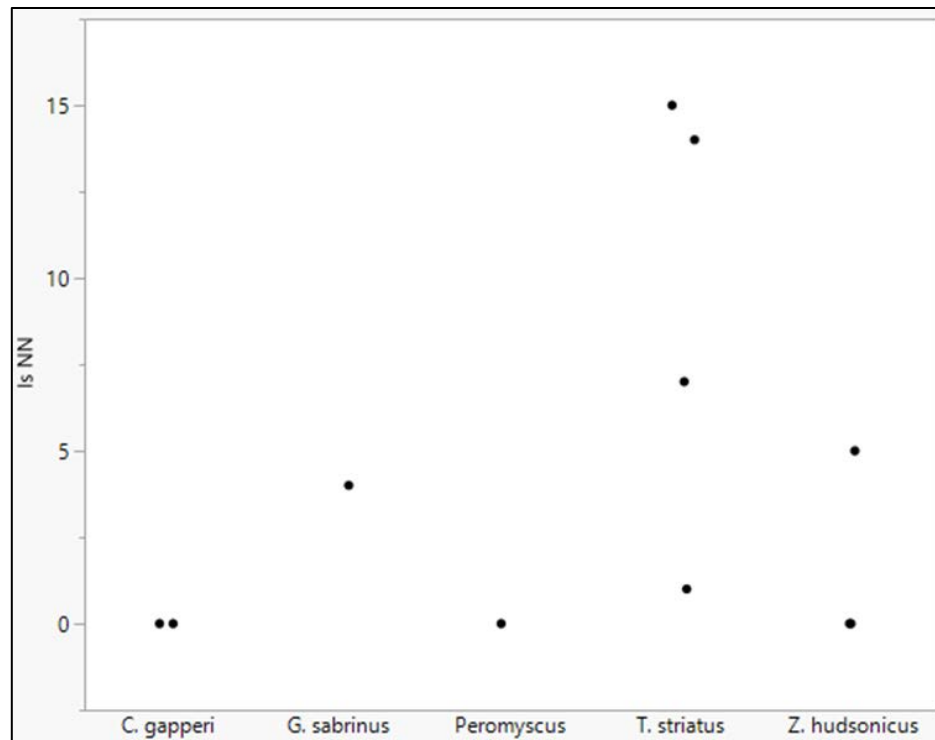


Figure 49. Infestation of small mammals with larval ticks in Training Area 1 – Circle of Wagons, Camp Ripley Training Center, Minnesota, June 2017.

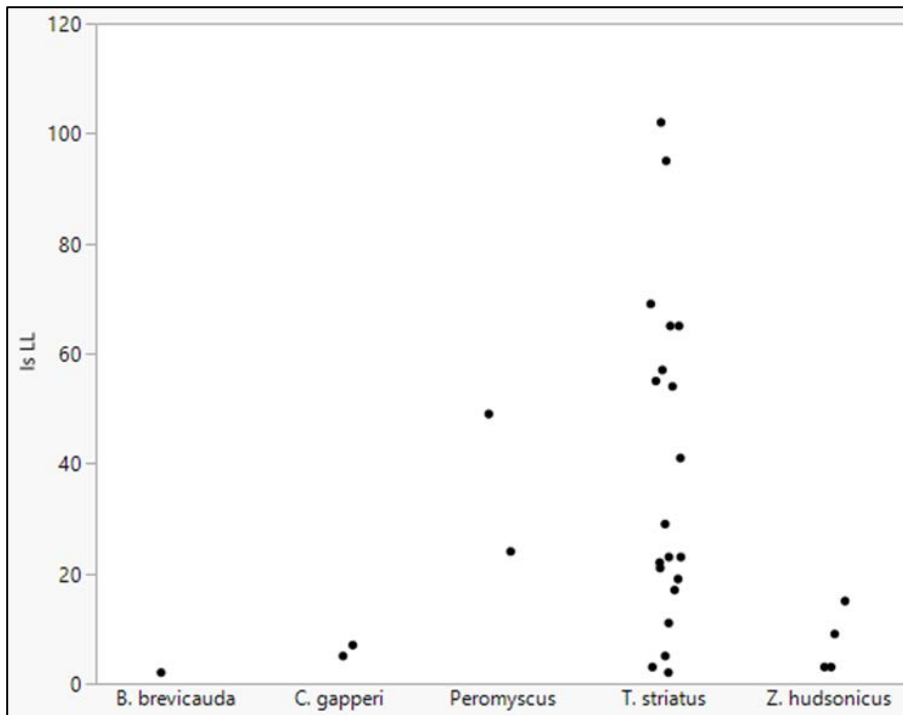
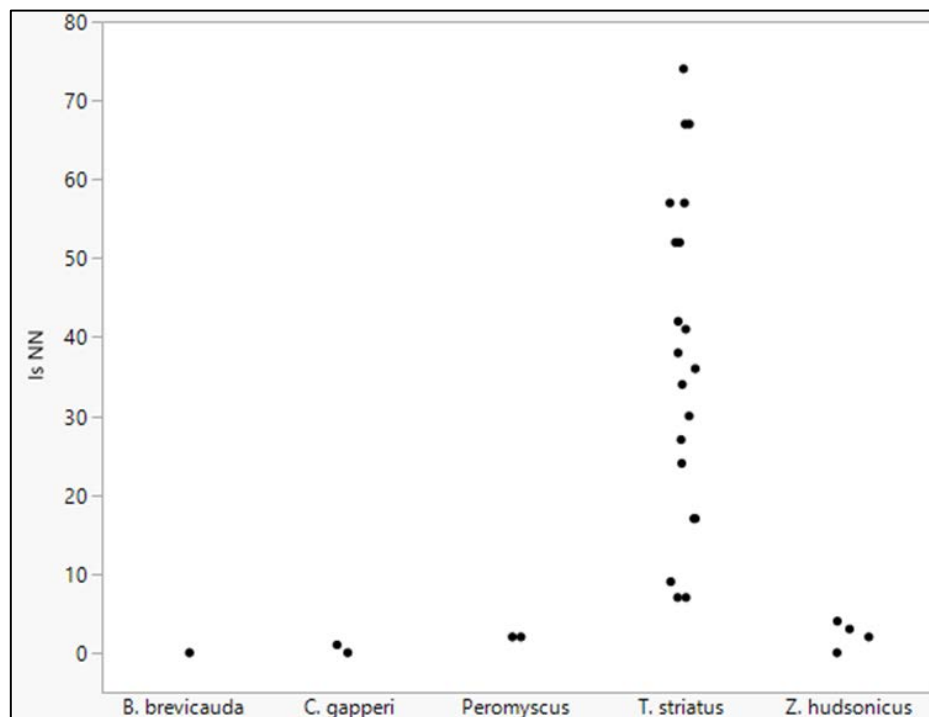


Figure 50. Infestation of small mammals with nymphal in Training Area 1 – Circle of Wagons, Camp Ripley Training Center, Minnesota, June 2017.



LAND USE MANAGEMENT

Army Compatible Use Buffer (ACUB)

By Josh Pennington, Minnesota Department of Military Affairs

Introduction

Section 2811 of the Fiscal Year Department of Defense Authorization Act, passed December 2, 2002, created 10 United States Code (U.S.C.) section mark (§) 2684a, which authorizes a military installation to enter into an agreement with state, local government or private conservation organizations to limit encroachment on lands neighboring the installation. Subsequently, the Headquarters Department of the Army, Director of Training, issued guidance pursuant to a Memorandum dated May 19, 2003, subject: Army Range and Training Land Acquisitions and Army Compatible Use Buffers. The memorandum defines the requirements of an Army Compatible Use Buffer (ACUB) proposal in order for an installation to execute any land acquisition.

Purpose

The purpose of the Camp Ripley Army Compatible Use Buffer (ACUB) program, known locally as “*Central Minnesota Prairie to Pines Partnership...preserving our heritage,*” is to create and enhance a natural undeveloped buffer around Camp Ripley by taking advantage of available opportunities to prevent encroachment and enhance conservation and land management. By securing a buffer, Camp Ripley can continue to offer and provide critically important, high quality military training and operations to ensure combat readiness, as well as mitigate community development encroachment around the Training Center. Through implementation of Camp Ripley’s proposal, Camp Ripley will also be contributing to preserving the local heritage and enhancing a regional conservation corridor.

Update

The desired end state of the Camp Ripley ACUB program is to achieve compatible land use across 83,434 acres within Camp Ripley's 110,000 acre buffer area. To date, more than 25,000 acres have been permanently protected through perpetual easements or fee acquisitions. Other compatible lands include 8,053 acres of lakes and rivers and 8,965 acres of state, county or The Nature Conservancy Land. Camp Ripley currently has 40,266 acres either protected or compatible, representing 48% of our overall goal of 83,434, acres.

Over 220 willing landowners representing over 25,000 acres are interested and waiting to participate in the Camp Ripley ACUB program. This program has completed more than 200 land transactions to permanently protect 24,277 acres in conservation easements. Funding levels in 2017 from federal sources include \$2.2 million from the Office of the Secretary of Defense’s (OSD) Readiness and Environmental Protection Integration (REPI) Program for execution through a new

cooperative agreement with The Conservation Fund and \$6.7 million from the Army National Guard (ARNG) for execution through a cooperative agreement with the Minnesota Board of Water and Soil Resources. State funding leveraged from these federal dollars includes \$1.2 million recommended from the Lessard-Sams Outdoor Heritage Council and \$750,000 recommended through the Legislative Citizens Commission of Minnesota Resources for projects within the ACUB boundary.

The Conservation Fund (TCF)

TCF entered into a formal cooperative agreement with the National Guard Bureau in 2017. The agreement number W9133L-17-2-3088 obligated \$2,252,766.47 of OSD REPI funding in FY17. These funds will be used to target acquisition opportunities within the ACUB boundary. TCF will work with partners and stakeholders to identify long term take out partners for ownership of property that remains compatible with the mission of Camp Ripley. The first project is targeting 200 acres of potlatch property working with the City of Baxter as an extension to Mississippi River Overlook Park.

Minnesota Board of Water and Soil Resources (BWSR)

The cooperative agreement with the BWSR executed 31 easements in FY 17 to protect 2,643 acres (Figure 51); \$2,668,174 was executed with federal ARNG and REPI funding and \$509,542 was executed with MN State LSHOC funding for a total of \$3,178,174 total execution. In FY 17, \$6,667,295 was obligated to BWSR through ARNG funding on modification P17031 on the BWSR Cooperative Agreement.

Minnesota Department of Natural Resources Summary

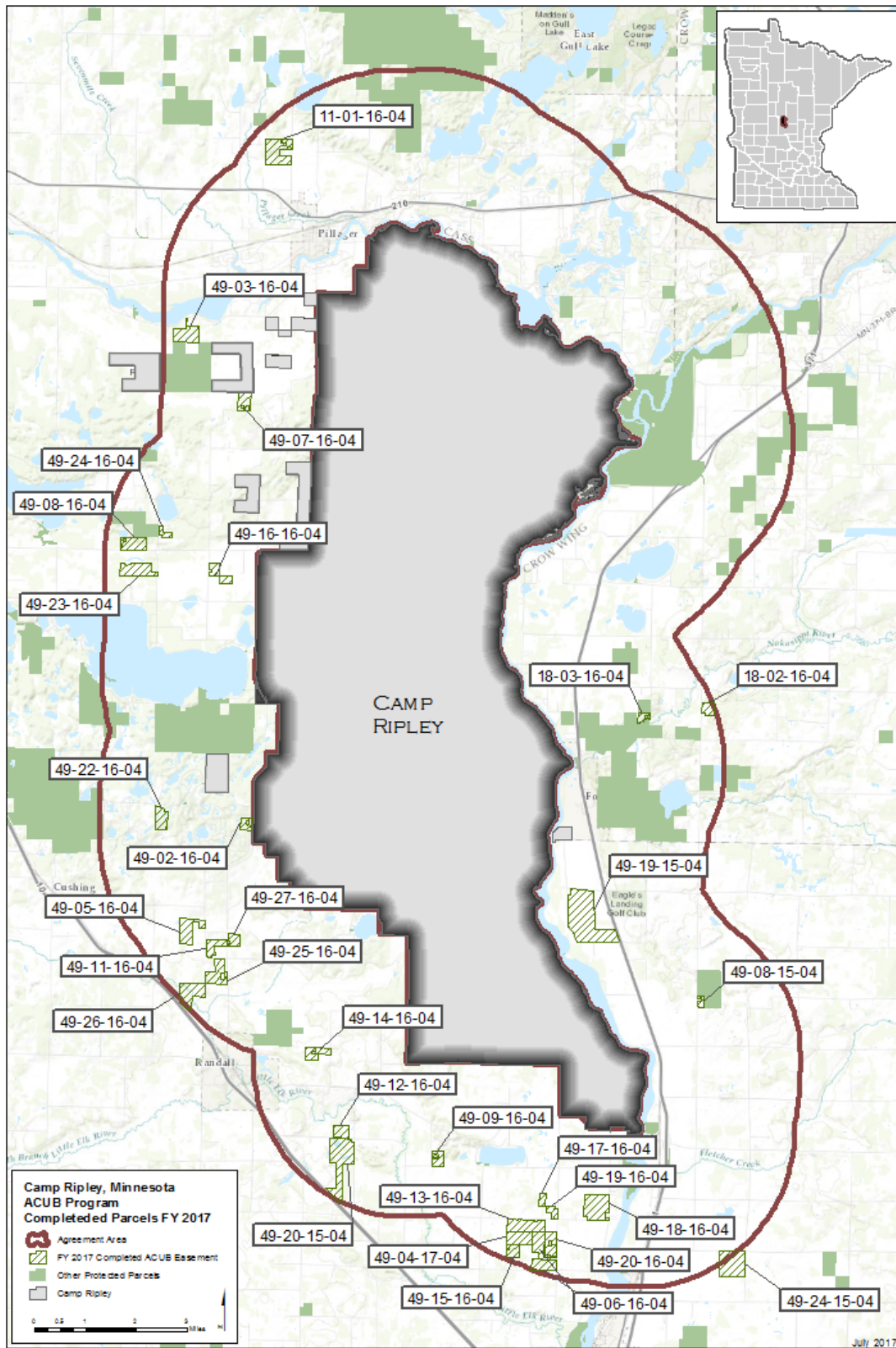
The Minnesota Department of Natural Resources (DNR) no longer maintains an active cooperative agreement with the National Guard Bureau for future funding obligations. The DNR remains an active easement holder in the ACUB boundary and will continue to monitor and enforce easements.

Camp Ripley Sentinel Landscapes (CRSL)

By Josh Pennington, Minnesota Department of Military Affairs

Recognizing the need to protect the Camp Ripley landscape, the Minnesota legislature passed H.F. No. 283, which was signed into law by Governor Mark Dayton in May 2015. Under the law, the adjutant general convened a Sentinel Landscape Coordinating Committee to identify the boundaries of the Camp Ripley Sentinel Landscape and develop a suite of tools and programs that could provide technical and financial assistance to interested landowners within the Sentinel Landscape. With input from local government, stakeholders, and Federal agency partners, the Coordinating Committee identified the desired outcomes of the Camp Ripley Sentinel Landscape partnership: protecting the installation's military training mission and the landscape's wildlife management areas, watersheds, and agricultural resources.

Figure 51. ACUB accomplishments for BWSR, Camp Ripley Training Center, Minnesota, fiscal year 2017.



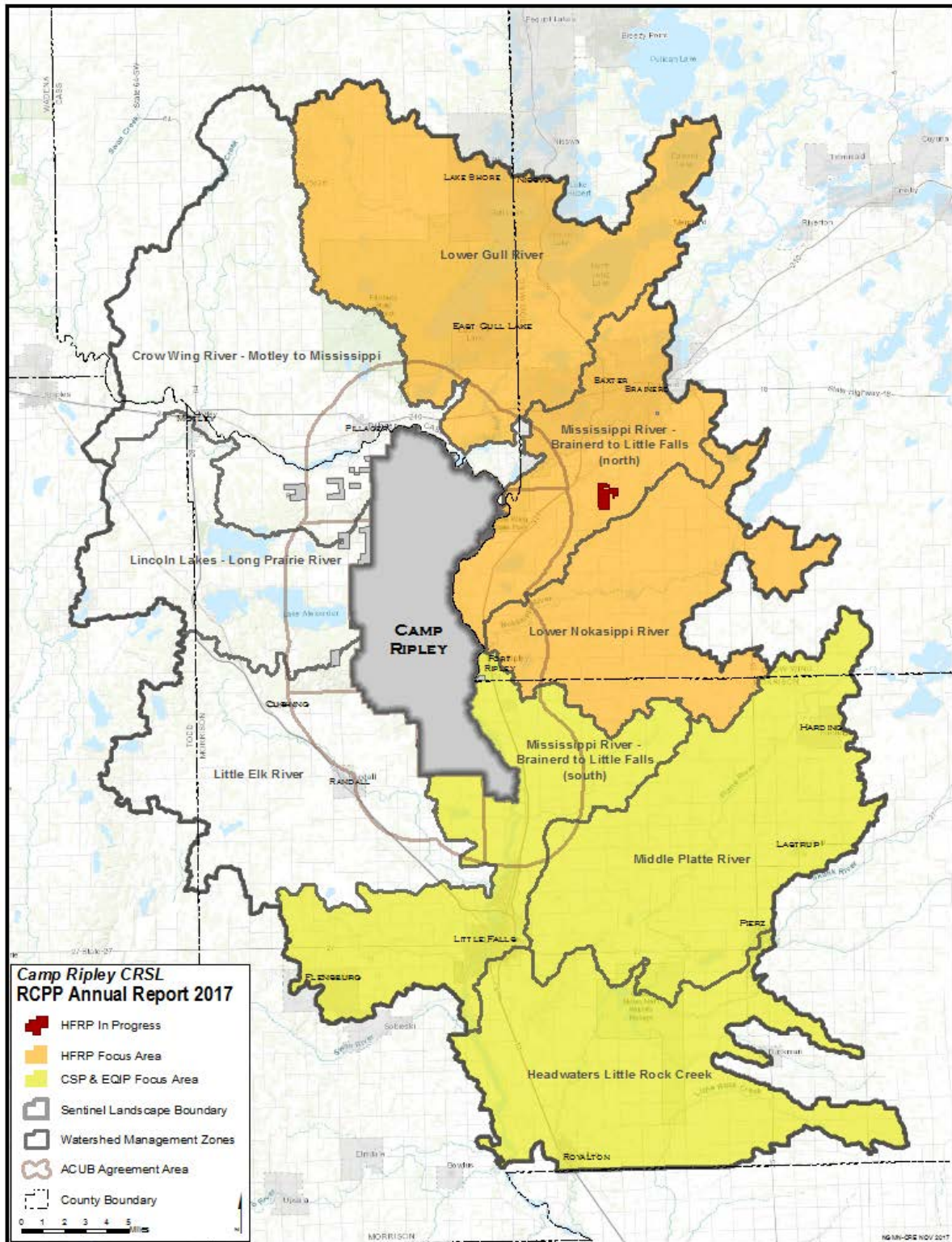
The Camp Ripley Sentinel Landscape includes 34 minor watersheds grouped into 7 sub-watersheds, 40 miles of the Mississippi River, and the Crane Meadows National Wildlife Refuge. Thousands of acres of public and private conservation lands converge on the Camp Ripley Sentinel Landscape, which is also one of the state's most important source water protection areas for drinking water. While coordination across county and city boundaries has long been necessary to protect the quality of cross-border watersheds, the Camp Ripley Sentinel Landscape Partnership is leveraging broader support to protect and improve the quality of the region's soil and water resources. The Minnesota Forest Resource Council is working with landowners to implement forest stewardship plans within the Sentinel Landscape, while Partners for Fish and Wildlife will work with private landowners to restore and enhance fish and wildlife habitat, wetlands and pollinator habitat. These efforts are also resulting in additional opportunities for the community, including expanded trail, water, and natural area access for hunting, fishing and recreation.

The Sentinel Landscape Partnership at Camp Ripley will continue to coordinate and leverage the resources of the Department of Defense Readiness and Environmental Protection Integration Program, USDA's Natural Resources Conservation Service (NRCS), U.S. Fish and Wildlife Service and U.S. Forest Service with state and local partners to advance the goals of the Camp Ripley Sentinel Landscape. Together, these actions will sustain area agriculture, protect the Mississippi River headwaters, and preserve a unique landscape that will allow Camp Ripley to continue to effectively train National Guard members for decades to come. Figure 52 illustrates the boundary of the CRSL.

CRSL was awarded \$2.8 million in FY 17 funding under the NRCS Regional Conservation Partnership Program (RCPP) (Figure 53). The Regional Conservation Partnership Program (RCPP) offers new opportunities for the NRCS, conservation partners and agricultural producers to work together to harness innovation, expand the conservation mission and demonstrate the value and efficacy of voluntary, private lands conservation. This RCPP funding will be directed toward Environmental Quality Incentives Program (EQIP), Conservation Stewardship Program (CSP), and Healthy Forest Reserve Program (HFRP) with the CRSL boundary.

[illegible]

Figure 53. Natural Resources Conservation Service Regional Conservation Partnership Program priority within the Camp Ripley Sentinel Landscape (CRSL), Camp Ripley Training Center, Minnesota, 2017.



Integrated Training Area Management (ITAM)

By Jason Linkert, Timothy Notch, Brian Sanoski, and Adam Thompson, DMA

Program Overview

The increased technology of military weapons and equipment along with the increased operational tempo in support of the global war on terrorism has placed more pressure on training lands. Past and continued degradation of natural resources can have a negative effect on the realism of future training exercises. To meet all environmental laws and regulations, the U.S. Army Construction Engineering Research Laboratory has developed the Integrated Training Area Management (ITAM) program. A report or overview of the ITAM program is documented annually to include all assessments, accomplishments and products purchased or produced from the preceding year. This plan is reviewed annually and revised as mission, accomplishments or environmental changes warrant. Major revisions are formally reviewed every five years to include changes to the introduction, ITAM program, goals and objectives, funding equipment, back log requirements and projected budget.

The ITAM program is a comprehensive tool that consists of five components necessary to maintain and improve the condition of natural resources. Funding requirements to implement the five components identified in the ITAM Work Plan are submitted to National Guard Bureau annually for validation. The five components are:

1. Range and Training Land Assessment
2. Land Rehabilitation and Maintenance
3. Training Requirements Integration
4. Sustainable Range Awareness
5. Geographic Information System

Range and Training Land Assessment (RTLA) Program

The RTLA is the component of the ITAM program that provides for the collecting, inventorying, monitoring, managing and analyzing of tabular and spatial data concerning land conditions on an installation. The RTLA provides data needed to evaluate the capability of training lands to meet multiple use demands on a sustainable basis. It incorporates a relational database and Geographic Information System (GIS) to support land use planning decision processes. This data is intended to provide information to effectively manage land use, natural and cultural resources.

The mission requirements of the military units training on Camp Ripley determine the focus of the RTLA program. It analyzes the training requirements and conducts assessments that evaluate the training lands ability to support those requirements. The results of RTLA provide treatment prescriptions that are forwarded to the LRAM component for execution. The training requirements of Camp Ripley customers are determined using a multi-step process.

1. Review of the Range Facility Management Scheduling System and the Army Range Requirements Model to determine types of units utilizing Camp Ripley

2. Review of current tactics, techniques and procedures being used in theater for which areas soldiers utilize during training
3. Coordinate with units, Range Control and operations to refine and prioritize assessments

The process identified six major types of training conducted on Camp Ripley. While each type of training has its own unique requirements, they do share common characteristics that help form the mission-scape for each training type. The six training types are:

1. Field Artillery
2. Mechanized Maneuver
3. Engineer
4. Patrolling/Convoy Operations
5. Assembly Area/Bivouac
6. Light/Dismounted Infantry

Since the start of the global war on terrorism, added emphasis has been placed on patrol and convoy training by all units that utilize Camp Ripley; while bivouac and assembly area operations have decreased due to the increased reliance on forward operating bases in the theaters of operation and tactical training bases on the installation. As operations overseas are reduced, a return to the ‘traditional’ training seen before the global war on terrorism will increase the importance of assembly area and bivouac operations.

To support the mission-scape requirements, RTLA currently being conducted includes:

1. Annually assess Camp Ripley’s maneuver trails to ensure safe travel by all vehicles (also known as LRAM assessment)
2. Assess the quality and sustainability of artillery firing points
3. Assess woody vegetation and safety hazards in open maneuver areas
4. Assess forest structure and condition for maneuver corridors in Maneuver Area K1
5. Assess site condition and usage of eight observation points
6. Monitor the maneuverability of Camp Ripley’s land navigation courses
7. Assess maneuver training areas for historic and potential training or safety hazards
8. Measure visibility through the underbrush of mature forests
9. Maintain landing zone/pick-up zone for woody encroachment and maneuver damage

Range and Training Land Assessment Results

Maneuver Trails. The south half of Camp Ripley was assessed for maneuver training damage. A total of 115 sites have been identified for repair.

Artillery Points. A total of 24 (Set A) field artillery firing points were assessed. Sites were assessed on ten pre-selected attributes such as encroachment, maximum slope and surface-danger zone training conflicts. Each site was given a red, amber or green rating with green being the most suitable land condition for field artillery. Ten firing points scored red and required immediate treatment to remain serviceable as firing points. To avoid future loss of available lands for artillery training it is recommended that a more frequent prescribed fire regime be implemented and fire treatments be allowed to burn into the forest edge to discourage future encroachment.

Open Maneuver and Helipads. All open maneuver areas (350 acres) are assessed annually for woody encroachment, ingress/egress and maneuver damage. Assessments revealed once a year mowing regime is ample to maintain these open areas.

Maneuver Corridor. Maneuver corridors A, B and C were assessed by Camp Ripley staff. A spring prescribed burn was completed for the grassland portion of the maneuver lanes to invigorate the native vegetation. Maneuver Trails were constructed on the forested edge by ITAM staff due to the steep topography of the corridor and concerns over protecting the integrity of the forested islands from prescribed fire effects. Hazard trees were also removed from the interior maneuver trails. Woody encroachment on the grassland portion of the corridor was also treated using a carbide head and a follow up treatment of the broadleaf herbicide triclopyr.

Observation Points. All observation points were assessed. Completed work included repairing maneuver damage on the ingress and egress roads and trails. Assessments indicated no immediate vegetative repair work or improvements were required to maintain existing observation points.

Land Navigation. AHATS Land Navigation Course was assessed for snag density and ease of traverse. Areas of dense snags and brush are noted along transects randomly distributed throughout the course. Movement throughout AHATS was graded easy (little brush density), and there were no areas of dense snags requiring further mitigation.

Hazards and Artifacts. Maneuver Area G (2,913 acres) was assessed for historical training and farm artifacts. Random transects were traversed in designated training areas to locate any hazard to troop training. Four sites were identified, none of which posed an immediate hazard.

Forest Understory. Training Areas 61, 63, 64 and 77 were assessed using 87 random points. A Visual Signal-17 panel was placed at the assessment points and a photograph taken 50 meters away. Each photograph was rated on a 1–5 scale with 1 indicating the panel was completely obscured and 5 denoting that the panel was fully visible. Twenty-six of the 87 plots were denoted as “1” or completely obscured. Future mitigation of these areas may include chemical or mechanical control of vegetation.

Helipads. Fourteen helipads were reviewed to meet end user requirements for training. Helipads require 1,000 feet by 1,500 feet of open space free of woody vegetation and maneuver damage. Mowing 4 times a year meets training objectives to support end user requirements.

Land Rehabilitation and Maintenance (LRAM) Program

Land Rehabilitation and Maintenance is an ongoing program whereby erosion control measures and good vegetation management practices are employed to maintain and stabilize the soil. LRAM is the component of the ITAM program that provides a preventive and corrective land rehabilitation and maintenance procedure to reduce the long-term impacts of training on Camp Ripley. LRAM uses technologies such as re-vegetation and erosion control techniques to maintain soils and vegetation required to support Camp Ripley’s mission. These specifically designed efforts help to maintain Camp Ripley as a quality military training site and subsequently minimize long-term costs

associated with land rehabilitation. LRAM includes programming, planning, designing and executing land rehabilitation, maintenance and reconfiguration projects based on requirements and priorities identified in the Training Requirements Integration and RTLA components of the ITAM program. A key component of the LRAM program is an annual assessment that is conducted to document LRAM needs attributable to past years activities.

Land Rehabilitation and Maintenance Results

1. The LRAM Program completed work in the following areas:
 1. Repaired all 93 sites identified in the 2016 maneuver trail assessment.
 2. Continued management on prior year firing points in Training Areas 1, 4, 5, 18, 21, 24, 30 and 72. Treatments included 319 acres of: woody encroachment removal, stumping and grubbing, native grassland seeding, erosion control, maneuver damage repair and herbicide treatment. Maintenance is conducted to improve firing point sight to crest.
 3. A total of 305.5 acres of open maneuver lands were mowed using a batwing mower and tractor.
 4. Fourteen helipads were mowed four times during the summer growing season totaling 21.6 acres. And, four helipads received treatment for maneuver damage.
 5. Forty-five acres of the maneuver corridors received chemical application to control woody encroachment. Snags were removed and maneuver trails were constructed on the grassland edges to preserve the integrity of the forested islands for training concealment.
 6. To support battalion level bivouac, 169.2 acres were mowed using a batwing mower and tractor.
 7. Removed 24 hazard trees (snags) identified in the A-11 land navigation survey.
 8. Historical hazard assessments discovered no further mitigation.
 9. Developed four parking areas in 2016 on off-post DMA lands to improve recreation access. Maintenance was provided to these parking areas to sustain access.
 10. Hydro-seeded solar field viewing area, Cassino maneuver trail expansion, Training Area 23 berms and tank ruts and Training Area 14 berms.
 11. Repaired approximately 400 acres of maneuver damage during the summer annual training period.
 12. Harvested 1,350 pounds of native grass seed (big bluestem, little bluestem, indian grass, gramma and switch grass) for future use on disturbed training areas.
 13. Water purification points (Rest Area #3 and Sylvan) 2.1 acres were mowed using the batwing mower and tractor.
 14. Completion of 0.92 miles additional maneuver trail network to provide access to multipurpose training range (East Range) when alternate access falls within the new enhanced performance ammunition round surface danger zone and range is inaccessible.
 15. Removed 1.5 miles of fencing in TA 16 that posed danger to soldiers training.
 16. Restored 4 acres of native grassland on the airfield.
 17. Restored 5.4 acres of brome grass into native pollinator habitat.

Major equipment purchased this year for the LRAM program included:

1. Felling 29' Tiltdeck Trailer
2. Vemeer Stump Grinder
3. F-350 Ford 1 ton 4x4 pickup
4. F-250 Ford ¾ ton 4x4 pickup

Training Requirements Integration (TRI)

Training Requirements Integration is a program developed to integrate the training mission with natural resources requirements. TRI is the component of the ITAM Program that provides a decision support procedure that integrates training requirements with land management, training management and natural and cultural resources management. The integration of all requirements occurs through continuous consultation between operations, range control, natural and cultural resources managers and other environmental staff members, as appropriate. The INRMP and ITAM work plan are documents that require TRI input. The ITAM work plan is a web-based program recorded in the Range Complex Master Plan (RCMP) annually.

Sustainable Range Awareness (SRA)

Sustainable Range Awareness is the component of the ITAM Program that provides a means to develop and distribute educational materials to land users. Materials relate procedures for sound environmental stewardship of natural and cultural resources and reduce the avoidable impacts. The SRA intent is to inform land users of restrictions and activities, to avoid and prevent damage to natural and cultural resources. The SRA component applies to soldiers, installation staff and other land users.

The SRA component purchased 10,000 updated laminated Camp Ripley soldier field cards. The field cards have proven to be very popular with the installations' customers and include information on the back side that supports sustainable land use. Additional field cards will be updated and purchased in 2019 to support map requests and educate end users on Camp Ripley. Annual ITAM accomplishments are published in the local newspaper circular. Purchased 3 educational banners to support educational briefs that are displayed in the Environmental Classroom at Camp Ripley. Additional brochures, pamphlets and maps are produced and distributed annually for further educational uses and per soldier request to support training missions.

Geographic Information System (GIS)

By Craig Erickson and Lee Anderson, Minnesota Department of Military Affairs

As a component of both the Environmental and ITAM programs, GIS is used to support management of those programs and is subsequently used to implement related resource management plans such as the Integrated Natural Resources Management Plan (MNARNG 2003, 2007, 2018a and 2018b), Integrated Cultural Resource Management Plan (Camp Ripley Environmental Office 2009),

Forest Management Plan (MNARNG 2002), Integrated Wildland Fire Management Plan (MNARNG 2017a), Protected Species Management Plan (Dirks et al. 2010), Lake Management Plan (Dirks and Dietz 2009), Range Complex Master Plan (MNARNG 2017b) and the Camp Ripley and Arden Hills Army Training Site Development Plan (MNARNG 2014).

This decision support tool is maintained to adapt with end user needs whether used for data development, maintenance, analysis, display or cartographic production. Continuous coordination with program support personnel, other directorates, departments and external entities are required to ensure the most accurate and complete geospatial data is available.

Program coordination both within MNARNG and Army National Guard are facilitated through working groups. The MNARNG GIS Working Group meets quarterly and consists of GIS and Computer Automated Design staff from Camp Ripley Command and the Facilities Management Office with occasional participation from Range Control, and Department of Public Works (DPW). Joint Operations Center (JOC) staff are also consulted on an as-needed basis. At the federal level the Environmental Advisory Committee (EAC) sponsors a GIS/Automation Committee. This group is made up of ten state GIS representatives, to include a representative from Minnesota, the ARNG-I&E GIS Manager and an EAC representative who functions as the working group chair.

Environmental, ITAM, Facilities Management, Information Technology (J6) and Operations (J3) are the core program areas supporting GIS within the MNARNG. The established coordination between these areas has led to an expanded use of GIS in support of other program areas as well. These areas include family assistance, recruiting and retention, Personnel (J1), logistics and public safety. Although not specific to this document it should be noted that GIS personnel also support those efforts outside primary program areas.

The use of consistent datasets and products across common geographic areas (i.e., Camp Ripley and Arden Hills Army Training Site) as well as the required integration between range management and environmental sustainability initiatives has inherently lead to shared efforts regarding GIS support for the Environmental and ITAM programs. As a result, designating specific efforts between these two program areas is not always clear-cut. Therefore, for the sake of simplified reporting, GIS accomplishments and management efforts listed in this section include support beyond the ITAM program.

Data Management

Several MNARNG GIS goals and objectives are defined by federal, Army and National Guard Bureau regulations that govern management of GIS. These regulations pertain to data standardization and conceptual design of the system. The goal is to coordinate data and GIS structure within the states as well as nationally. This coordination and standardization is necessary to keep state and federal efforts synchronized. In accordance with these regulations, Environmental related data layers within the MNARNG GIS repository are compliant with the Spatial Data Structure for Facilities, Installations

and Environment (SDSFIE) version 3.1 as well as federal Geographic Data Committee metadata standards.

To support visibility and analysis efforts, standardized geospatial data layers are submitted annually to the Department of the Army and Army National Guard. Specific to ARNG–I&E (Army National Guard–Installations and Environment) are the Common Installation Picture (CIP) layers. The Army Sustainable Range Program (SRP) also has requirements for annual data submissions. These requirements initiate a review of current data layers and coordination with subject matter experts to ensure spatial and attribute data is current, accurate, properly documented and compliant with CIP and SRP Quality Assurance Plans (QAP). In addition to those submissions, there is continued development and maintenance of geospatial data layers based upon MNARNG business needs.

End User Support

- Major efforts in 2017:
 - Implementation of GIS Portal
 - GIS web application platform upgrade
 - Army Compatible Use Buffer
 - Sentinel Landscape Initiative
 - Range Complex Master Plan
 - Range reconciliation between Planning Resource Infrastructure Development and Evaluation (PRIDE), Range Facility Management Scheduling System (RFMSS) and GIS
 - Camp Ripley and AHATS events (hunts, fishing, races and other outreach)
 - Plans and reports (Annual Report, Prescribed Fire Plan, Landscape Plan, Norwegian Soldier Exchange)
- Custom maps (hard copy and digital) continue to be the primary GIS product for non-GIS staff.
 - Total maps: 966 (does not include report graphics).
- All production data has been maintained to SDSFIE and QAP (CIP and SRP) standards.

Information Technology Coordination

The J6 (Information Technology) directorate is responsible for the essential components of GIS and include hardware, software and network support for the MNARNG. With improved network security, the ability for general users to manage these components has become increasingly limited. In order to obtain the necessary permissions and priority to maintain core components of the GIS, a member of the Environmental GIS staff has been functioning as a liaison with the J6 Directorate.

Through this relationship the approval of GIS related software for use on the NGMN domain has been expedited. This has also allowed for more timely installs of newly approved software as well as a J6 point of contact for resolving GIS related software issues.

The four production GIS databases (gER, gINST, gIMG and gMN) reside on J6 production servers. In addition, network storage space has been designated as GIS workspace to better organize GIS project files across multiple functional areas and allow for simplified sharing of projects and project specific data. The integration of GIS data and applications onto J6 systems also allows us to take advantage of in-place continuity of operations and fail over procedures. In addition, it reduces the overhead of hardware costs and maintenance for Environmental and ITAM as well as the other program areas using the system.

GIS staff with privileged level permissions are critical for supporting web based applications. The ability to disseminate a web based interface to interact with data from multiple program areas and sources is a powerful capability of this technology and it will continue to expand within the MNARNG. Understanding data sources and limitations are essential for reliable analysis and information sharing through web applications; as are application development capabilities for improvement of tools and interfaces to present data for specific user needs. This will require continued integration and support between J6 and GIS personnel.

OUTREACH AND RECREATION

By Jake Kitzmann, Minnesota Department of Military Affairs

One of Camp Ripley's missions is to add value to the community. The conservation team does this by being active in many special events. Camp Ripley is a valuable asset to the local community and the state of Minnesota. It is important that Camp Ripley, in particular the conservation team, be interactive with the citizens of our community and the state of Minnesota. Over the past year, the conservation team has helped implement activities such as the Morrison County Water Festival, Earth Day and National Public Lands Day.

Earth Day activities were held on April 20, and consisted of activities for Camp Ripley personnel to actively engage with their environment. Activities included litter pick-up, tree planting and clearing of trails.

The Morrison County Water Festival was held on September 19 – 20 and is a partnership between Morrison County, the Morrison Soil and Water Conservation District, the city of Little Falls, DNR, the USFWS and Camp Ripley. This event brings 5th graders from Morrison County to Camp Ripley for a series of educational events hosted by natural resource professionals.

Camp Ripley was awarded \$4,000 from the National Environmental Education Foundation for National Public Lands Day in 2017. On September 30, volunteers from the Minnesota Master Naturalist program assisted in the restoration of a native prairie on 5 acres within the Camp Ripley cantonment area.

Camp Ripley environmental office hosted and participated in several canoeing events on the Mississippi River. The environmental office partnered with the Mississippi River Headwaters Board

for a public event, hosted a private event for Camp Ripley personnel, and hosted the Minnesota Nature Conservancy Board of Directors for canoeing events along the river.

The Camp Ripley environmental office has been a long-term partner with various educational institutions within the state. Camp Ripley's conservation team has been involved in local high school job shadow programs. Partnering with local colleges has not only been beneficial to the students but the conservation program as well.

Camp Ripley is also available for environmental presentations and tours. Using the Martin J. Skoglund Environmental Classroom has been a great way to introduce students to conservation and hands-on science. In 2017, the environmental team gave 61 presentations, tours and briefs to 2,958 people entailing more than 185 staff hours.

Hunting Programs

Disabled American Veterans Firearms Wild Turkey Hunt

Camp Ripley hosted the 13th annual Disabled Veterans turkey hunt May 3 – 5, 2017. Beautiful mid-spring conditions welcomed the hunters this year. The hunt was again organized and conducted by the Veterans

Administration with support from Camp Ripley staff and the DNR. Thirty hunters participated in this year's turkey hunt, harvesting 12 birds (Table 28).

Table 28. Disabled American Veterans spring wild turkey hunts, Camp Ripley Training Center, Minnesota, 2005 – 2017.

Year	Turkeys Harvested	Hunter Success	Permits Issued	Number of Hunters	Dates	Largest Turkey (lbs)
2005	11	58%	22	19	May 3–4	24
2006	12	48%	27	25	April 25–26	22.5
2007	15	52%	31	29	April 25–26	23.5
2008	27	75%	39	36	April 23–24	23.8
2009	23	66%	40	35	April 22–23	23.6
2010	15	40%	40	37	April 21–22	24.6
2011	16	46%	40	35	April 20–21	Unk.
2012	19	50%	40	38	April 25–26	Unk.
2013	12	38%	40	32	April 24–26	Unk
2014	5	14%	40	36	May 4–6	23.5
2015	10	31%	35	31	May 4–6	22.2
2016	14	42%	37	33	May 3–5	Unk
2017	12	40%	38	30	May 3–5	22
Total	212		469	416		
Avg.	15	46%	37	32		

Soldiers Firearms Wild Turkey Hunt

Camp Ripley hosted its ninth annual soldiers turkey hunts on April 24 – 25 and May 15 – 16, 2017. The hunt was organized and conducted by the Environmental Office. This hunt was organized into two, 2-day hunt periods (Table 29).



Table 29. Soldiers spring wild turkey hunt, Camp Ripley Training Center, Minnesota, 2009 – 2017.

Year	Turkeys Harvested	Hunter Success	Permits Issued	Number of Hunters	Dates	Largest Turkey (lbs)
2009	18	64%	45	28	April 27–29	23.8
2010	25	53%	60	47	April 26–28	25.5
2011	27	46%	86	58	April 25–26 April 28–29	23.4
2012	27	53%	86	53	April 30–May 1 May 3–4	23.5
2013	30	57%	92	52	April 29–30 May 2–3	24.86
2014	29	47%	70	62	May 1–2	24.3
2015	22	41%	100	53	April 30–May 1 May 7–8	22.7
2016	26	51%	98	51	April 28–29 May 9–10	23
2017	24	44%	104	54	April 24–25 May 15–16	22.5
Total	228		741	458		
Avg.	25.3	51%	82.3	50.5		

Disabled American Veterans Firearms Deer Hunt

The 26th annual Disabled American Veterans firearms deer hunt on Camp Ripley was held October 3 – 5, 2017. This year 49 hunters participated. The weather was mild and light winds greeted the hunters on the first day of the hunt. Eleven deer were harvested (Table 30).

Table 30. Disabled American Veterans firearms white-tailed deer hunt, Camp Ripley Training Center, Minnesota, 1992 – 2017.

Year	Deer Harvested	Hunter Success	Bucks	Does	Fawns	Permits Issued	Number of Hunters	Dates	Largest Deer (lbs)
1992	7	37%	4	2	1	19	19	Oct. 14–15	152
1993	11	35%	5	4	2	31	31	Oct. 13–14	132
1994	14	35%	3	3	8	42	40	Oct. 12–13	185
1995	6	15%	1	5	0	40	39	Oct. 11–12	142
1996	9	23%	3	4	2	40	39	Oct. 9–10	132
1997	9	23%	2	2	5	40	38	Oct. 8–9	152
1998	11	30%	2	5	4	39	37	Oct. 7–8	129
1999	8	23%	4	3	1	38	35	Oct. 6–7	137
2000	14	37%	5	5	4	40	38	Oct. 4–5	181
2001	4	11%	1	1	2	45	38	Oct. 10–11	123
2002	12	26%	3	8	1	46	46	Oct. 9–10	144
2003	10	20%	4	6	0	50	48	Oct. 8–9	160
2004	15	33%	6	7	2	48	45	Oct. 6–7	184
2005	12	24.5%	3	7	2	52	49	Oct. 5–6	152
2006	9	19.5%	2	6	1	50	46	Oct. 4–5	146
2007	18	31%	7	8	3	59	59	Oct. 3–4	168
2008	9	16%	2	6	1	58	53	Oct. 8–9	180
2009	13	25%	5	4	4	55	52	Oct. 7–8	174
2010	8	12%	2	5	0	60	55	Oct. 6–7	123
2011	12	20%	3	9	0	60	59	Oct. 5–6	170
2012	9	14%	4	3	1	60	56	Oct. 3–4	10 pts, 200 lbs
2013	7	13%	1	5	1	60	54	Oct. 1–2	130
2014	7	15%	2	5	0	55	47	Oct. 7–8	4pts, 117 lbs
2015	7	12%	2	3	2	60	59	Oct. 7–8	132
2016	2	5%	2	0	0	45	42	Oct. 4–6	6 pts
2017	7	14%	4	1	2	54	49	Oct. 3–5	8 pts
Total	250		82	117	49	1,246	1,173		
Avg.	10	23%	3	5	2	50	46		

Deployed Soldiers Muzzleloader Deer Hunt

The seventh annual deployed soldiers' muzzleloader deer hunt at Camp Ripley was held November 27 – 29, 2017. Soldiers that had most recently returned from a deployment were given



priority for hunt permits. Fifty-six of the 79 (Table 31) soldiers selected attended the hunt. Temperatures were above average with high winds gusting to 20 MPH on the first two days of the hunt. The last day of the hunt saw morning temps hovering in the high teens with a large warm up in the afternoon and south winds gusting to 15 mph.



Table 31. Deployed soldiers muzzleloader white-tailed deer hunt, Camp Ripley Training Center, Minnesota, 2011 – 2017.

Year	Deer Harvested	Hunter Success	Bucks	Does	Fawns	Permits Issued	Number of Hunters	Dates	Largest Deer (antler points/lbs)
2011	14	28%	3	7	4	64	49	Nov. 28–30	8 pts, 150
2012	49	86%	15	25	9	73	57	Nov. 26–28	8 pts, 166
2013	34	85%	17	12	5	61	40	Dec. 2–4	11 pts, 178
2014	29	61%	11	14	4	71	47	Dec. 1–3	10 pts, 175
2015	18	40%	15	1	2	60	45	Nov. 30–Dec. 2	15 pts, 161
2016	17	41%	6	7	4	75	41	Nov. 28–30	11 pts, 170
2017	27	48%	13	9	5	79	56	Nov. 27–29	12 pts, 169
Total	188		80	75	33	423	335		
Avg.	27	56%	11.4	10.7	4.7	60	48		

Military Members Archery Deer Hunt

The twelfth annual military member's archery deer hunt was held on October 3 – 5 in conjunction with the Disabled American Veterans firearm hunt on Camp Ripley. Military members were allowed to hunt in any non-restricted areas north of Cassino Road. One hundred fifty permits were available, 106 hunters applied and all were granted a permit to hunt. A total of 55 hunters participated in this year's hunt (Table 32) and three deer were harvested (Table 32).

Table 32. Military members' archery deer hunt, Camp Ripley Training Center, Minnesota, 2006 – 2017.

Year*	Deer Harvested	Hunter Success	Bucks	Does	Fawns	Permits Issued	Number of Hunters	Dates	Largest Deer (lbs)
2006	6	15%	3	3	0	100	39	Oct. 4–5	92
2007	10	17%	1	6	3	123	59	Oct. 3–4	175
2008	14	25%	6	6	2	123	56	Oct. 8–9	141
2009	11	22%	3	7	1	126	51	Oct. 7–8	198
2010	12	13%	5	7	0	135	90	Oct. 6–7	214
2011	2	3%	0	2	0	89	53	Oct. 5–6	Unk.
2012	23	23%	5	12	6	132	96	Oct. 3–4	182
2013	7	6%	2	5	0	150	109	Oct. 1–2	150
2014	8	9%	3	4	1	151	88	Oct. 7–8	10pts/148
2015	10	13%	6	4	0	135	77	Oct. 7–8	10pts/Unk.
2016	3	4%	2	0	1	128	68	Oct. 4–6	Unk.
2017	13	24%	4	Unk.	Unk.	106	55	Oct. 3–5	10 pts/Unk.
Total	119		40	56	14	1,375	841		
Avg.	10	15%	3	5	1	115	70		

*2006–2012 permitted hunters were soldiers who had been mobilized to support the Global War on Terrorism since September 11, 2001.

Youth Archery Deer Hunt

The sixteenth annual youth archery deer hunt was held October 7 – 8, 2017. Like past years the participants were allowed to hunt in any non-restricted areas north of Cassino Road. The hunt was coordinated by the Minnesota Deer Hunters Association, the Minnesota State Archery Association, Camp Ripley and the DNR. In 2017, a total of 75 permits were issued with 41 hunters participating, harvesting four deer (Table 33).

Table 33. Youth archery white-tailed deer hunt, Camp Ripley Training Center, Minnesota, 2002 – 2017.

Year	Deer Harvested	Hunter Success	Bucks	Does	Fawns	Permits Issued	Number of Applicants	Number of Hunters	Dates	Largest Deer (lbs)
2002	13	14.9%	5	3	5	100	267	87	Oct. 12–13	168
2003	10	7.7%	4	5	1	150	216	132	Oct. 11–12	118
2004	9	7.1%	1	7	1	150	217	127	Oct. 9–10	126
2005	20	15%	8	12	0	152	219	133	Oct. 8–9	196
2006	13	9.7%	5	6	2	150	259	133	Oct. 7–8	127
2007	19	14%	6	5	8	150	234	136	Oct. 6–7	141
2008	10	8.1%	3	5	2	150	220	124	Oct. 11–12	114
2009	12	7.5%	2	7	3	150	240	130	Oct. 10–11	120
2010	7	5%	2	5	0	150	250	136	Oct. 9–10	132
2011	9	6%	3	4	2	175	229	153	Oct. 8–9	Unknown
2012	10	7.2%	5	3	2	175	252	139	Oct. 6–7	Unknown

Table 33. Youth archery white-tailed deer hunt, Camp Ripley Training Center, Minnesota, 2002 – 2017.

Year	Deer Harvested	Hunter Success	Bucks	Does	Fawns	Permits Issued	Number of Applicants	Number of Hunters	Dates	Largest Deer (lbs)
2013	10	7.3%	4	3	3	175	273	137	Oct. 12–13	131
2014	5	3%	2	2	1	175	196	134	Oct. 11–12	120
2015	5	7.6 %	3	1	1	175	108	66	Oct. 10–11	135
2016	2	3%	2	0	0	175	86	66	Oct. 8–9	Unknown
2017	3	9.8%	2	1	0	175	75	41	Oct. 7–8	Unknown
Total	157		57	69	30	2,460	3,338	1,868		
Avg.	10	8.5%	3.8	5.1	2.3		217	122		

General Public Archery Deer Hunt

The annual general public archery deer hunt at Camp Ripley continues to be known as one of the largest and most anticipated archery hunts in the nation since its establishment in 1954. This hunt is administered by the Central Lakes College and DNR. Hunters are allowed to apply for one of the two, 2-day seasons in October each year. This year, the hunts were held on October 19 – 20 and October 28 – 29, 2017. Hunters were permitted to use a bonus tag and the one deer limit which was implemented in 2014 was continued in 2017. In 2017, the number of permitted hunters was 2,995. A total of 2,270 hunters participated in the 2016 archery hunts (Table 34) and harvested 113 deer during the two hunts. This near record low number of hunters and associated harvest is in line with current management goals aimed at slightly increasing the deer population on Camp Ripley.



Table 34. General public archery white-tailed deer hunts, Camp Ripley Training Center, Minnesota, 1984 – 2017 (*Years when bonus tags were allowed).

Year	Deer Harvested	Adult Bucks	%	Adult Does	%	Fawns	%	Permits Issued	# of Hunters	Hunter Success	1st Season	2nd Season	Largest Deer (lbs)
1986	257	106	41	83	32	68	26	5,000	3,940	6.5%	OCT. 11–12	OCT. 25–26	243
1987	284	122	43	91	32	71	25	5,000	4,112	6.9%	OCT. 10–11	OCT. 24–25	250
1988	241	91	38	101	42	49	20	5,000	4,090	5.9%	OCT. 8–9	OCT. 22–23	262
1989	215	95	44	75	35	45	21	4,000	3,136	6.9%	OCT. 17–18	OCT. 28–29	226
1990	301	137	46	115	38	49	16	3,500	2,585	11.6%	OCT. 27–28	NOV. 17–18	225
1991	219	87	40	90	41	42	19	4,000	2,217	9.9%	OCT. 19–20	NOV. 30–DEC. 1	232
1992	406	228	56	140	35	38	9	4,500	3,156	12.9%	OCT. 31–NOV. 1	NOV. 21–22	224
1993	287	147	51	82	29	58	20	5,000	4,127	7.0%	OCT. 21–21	OCT. 30–31	237
1994	267	136	51	95	36	36	13	4,000	3,158	8.5%	OCT. 20–21	OCT. 29–30	237
1995	247	102	41	100	41	45	18	4,500	3,564	6.9%	OCT. 19–20	OCT. 28–29	256
1996	160	78	49	55	34	27	17	4,000	3,154	5.1%	OCT. 17–18	OCT. 26–27	248
1997	142	67	47	57	40	18	13	3,000	2,316	6.1%	OCT. 16–17	OCT. 25–26	243
1998	189	116	61	50	26	23	12	3,000	2,291	8.2%	OCT. 15–16	OCT.31– NOV. 1	249
1999	203	100	49	83	41	20	10	3,000	2,335	8.7%	OCT. 21–22	OCT. 30–31	251
2000	375	228	61	109	29	38	10	4,000	3,128	12.0%	OCT. 19–20	OCT. 28–29	247
2001	350	192	55	126	36	32	9	4,500	3,729	9.4%	OCT. 18–19	OCT. 27–28	272
2002	324	186	57	102	31	36	11	4,500	3,772	8.6%	OCT. 17–18	OCT. 26–27	235
2003	318	161	51	120	38	37	11	4,500	3,810	8.3%	OCT. 16–17	OCT. 25–26	247
*2004	484	218	45	206	43	60	12	4,521	3,836	12.4%	OCT. 21–22	OCT. 30–31	235
*2005	477	186	39	218	46	73	15	4,522	3,813	12.5%	OCT.20–21	OCT.29–30	245
*2006	514	165	32	241	47	108	21	5,009	4,351	11.8%	OCT. 19–20	OCT. 28–29	244
*2007	476	150	32	228	48	98	20	5,014	4,294	11.1%	OCT. 18–19	OCT. 27–28	255
*2008	516	183	35	220	43	113	22	5,005	4,167	11.9%	OCT. 19–20	OCT. 26–27	234
*2009	477	190	40	202	42	85	18	5,005	4,126	11.4%	OCT 15–16	OCT 31–NOV 1	265
*2010	507	187	37	228	45	92	18	5,002	4,293	11.8%	OCT 20–21	OCT 30–31	253
*2011	422	153	18	185	32	84	20	5,000	4,305	10.2%	OCT 20–21	OCT 29–30	215
*2012	429	176	41	169	39	84	20	5,003	4,205	9.8%	OCT 18–19	OCT 27–28	215
*2013	308	116	37	130	42	65	21	5,002	4,488	6.8%	OCT 26–27	NOV 2–3	223
*2014	145	55	38	65	45	25	17	3,805	2,966	4.8%	OCT 15–16	OCT 25–26	207
2015	204	56	27	40	20	108	53	3,579	2,723	7.5 %	OCT 15–16	OCT 31–NOV 1	239
2016	113	55	49	13	12	44	40	2,995	2,270	5%	Oct 20–21	Oct 29–30	218
*2017	263	142	54	97	37	24	9	2,570	2011	13.1%	Oct 19–20	Oct 28–29	UNK

Disabled Veterans and Deployed Soldiers Fishing Event

In 2017, Camp Ripley environmental staff with the help of other organizations came together for the sixth annual Trolling for the Troops fishing event. Professional fishing guides are teamed up with disabled and deployed veterans along with those currently serving or retired for a day of fishing. The event was held on June 1 and 2, 2017. The event continues to be supported by the American Legion, Veterans of Foreign Wars, Disabled American Veterans, Minnesota National Guard and Upper Mississippi River Smallie Club. The event continues to be a huge success and a 2018 event is being planned.

ARDEN HILLS ARMY TRAINING SITE

The Twin Cities Army Ammunition Plant was one of six Government Owned–Contractor Operated plants built to produce small arms ammunition during World War II. The MNARNG began leasing its current facility in 1972 and the Organizational Maintenance Shop buildings were constructed in 1973. In September 2000, MNARNG acquired accountability for a portion of the 2,347-acre installation. That portion of the Twin Cities Army Ammunition Plant is now known as the Arden Hills Army Training Site (AHATS) (Figure 1). AHATS consists of 1,500 acres, which is available for military training and environmental management. AHATS is located in the northern portion of the city of Arden Hills, approximately eight miles north of Saint Paul and six miles northeast of Minneapolis. Other surrounding municipalities include New Brighton, Mounds View and Shoreview.

Population and monitoring studies along with management of the flora and fauna is an ongoing part of the installation's Integrated Natural Resources Management Plan (INRMP), which was completed in November of 2001 and updated in 2007 (Dirks et al. 2008), 2008 (Dirks and Dietz 2009), 2009 (Dirks and Dietz 2010), 2010 (Dirks and Dietz 2011), 2011 (MNDNR and MNARNG 2012), 2012 (MNDNR and MNARNG 2013), 2013 (MNDNR and MNARNG 2014), 2014 (MNDNR and MNARNG 2015), 2015 (MNDNR and MNARNG 2016), 2016 (MNDNR and MNARNG 2017) and 2017 (MNARNG 2018b). 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.

CULTURAL RESOURCES

By Patrick Neumann, Minnesota Department of Military Affairs

Arden Hills Army Training Site is a federally owned property leased to the MNARNG. As a federal property overseen by the MNARNG and funded by federal dollars, all of the same laws and regulations exist for managing cultural resources within the boundaries of AHATS that apply for all other MNARNG controlled properties.

AHATS has been surveyed for cultural resources in its entirety and no eligible resources are present at this time. There are also Advisory Council for Historic Preservation program comments regarding existing structures which completes the section 106 process regarding historic structures for the MNARNG at AHATS. Any future construction at AHATS will be submitted to the Minnesota State Historical Preservation Office and consulting partners for review and will comply with all laws regarding cultural resources. Should any unknown cultural materials be encountered during construction, all construction activities in the vicinity will cease until a cultural survey can be completed.

LAND USE MANAGEMENT

Land Use Control and Remedial Design

By Mary Lee, Minnesota Army National Guard

The Operable Unit 2 (OU2) Land Use Control Remedial Design (LUCRD) New Brighton/Arden Hills Superfund Site passed the Consistency Test and was signed on September 27, 2010. Land Use Controls (LUC) are required as part of the remedies for soil, sediment and groundwater at specific areas within OU2. LUCs are needed because the current concentrations of various contaminants within these areas are above levels that allow for unlimited use or unrestricted exposure. There are no LUCs for military training; however some soil caps and digging restrictions are present on AHATS.

The MNARNG, as part of its community responsibility, wants to make AHATS available for nonmilitary users, including those under age 18. The exposure levels for those under 18 are more restrictive. In order to reach the exposure levels the LUCRD must be amended. OU2 LUCRD Revision 3 passed final consistency on March 27, 2015. This revision changed the remaining balance of the cantonment area to 'restricted commercial'. At this time the training area is pending the outcome of soil sampling that was completed during summer 2015. Further amendments will need to be submitted for revisions to the LUCRD to the Minnesota Pollution Control Agency by the Army.

As a result, the conditions of the LUCRD must be honored by the MNARNG relative to their long-range planning, land use and land management practices on AHATS. To ensure compliance with the conditions of the LUCRD, MNARNG is hereby referencing the LUCRD and inserting a copy as an appendix to the AHATS Master Plan/Site Development Plan (MNARNG 2009b) and the AHATS INRMP (MNARNG 2007, 2018b), or by updating this annual report. It is understood that any future revisions to the LUCRD will automatically supersede any earlier editions.

NATURAL RESOURCES

Natural resource planning is an integral part of the conservation program for the MNARNG. The MNARNG uses the INRMP as the guidance document for implementing the conservation program. The planning process used in developing the INRMP focuses on using key stakeholders from the MNARNG, the DNR, the U.S. Fish and Wildlife Service and other organizations that have an interest in the MNARNG's conservation program. Together, these stakeholders represent the Integrated Natural Resources Management Planning Committee. The primary responsibility of the Planning Committee is to ensure that the INRMP not only satisfies the military mission but also provides a foundation for sound stewardship principles that adequately address the issues and concerns that are raised by all stakeholders. Annually, stakeholders discuss and review the INRMP for AHATS, and present their annual accomplishments and work plans for the next year.

Vegetation Management

Prescribed Fire

By Timothy Notch, Minnesota Department of Military Affairs

Prescribed fire is used at AHATS as a management tool, similar to Camp Ripley, to enhance the military training environment (also known as mission-scape) and for ecological purposes. Prescribed fire target areas include native prairie grass enhancement and restoration, reducing woody encroachment, invasive and noxious vegetation management, native plant seed production, brush control, fuel-hazard reduction, oak savanna management and to improve habitat for state threatened and endangered species and species in greatest conservation need (MNDNR 2015). The management strategy for prescribed fire on AHATS is provided within the AHATS INRMP (MNARNG 2007, 2018b).

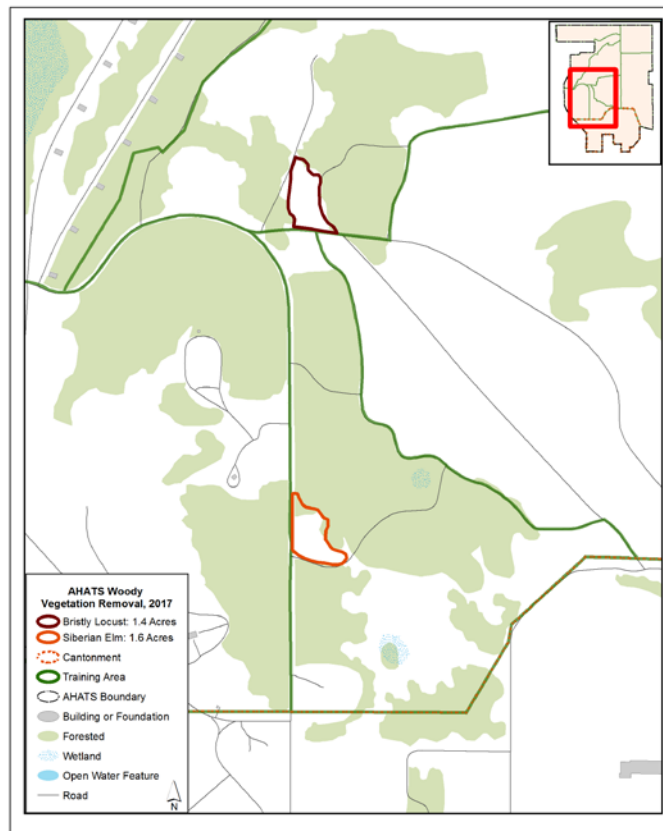
No units were burned in 2017. Continued efforts will be made to coordinate and maintain a fire program on AHATS.

Terrestrial Invasive Species Control

By Jason Linkert, Minnesota Department of Military Affairs

Common buckthorn (*Rhamnus cathartica*) and glossy buckthorn (*Rhamnus frangula*) are restricted noxious weeds according to the Minnesota Department of Agriculture. They are both prolific forest invaders in Minnesota that outcompete and prevent the regeneration of native species such as oak in the forest understory. In 2017, Environmental staff from Camp Ripley and AHATS along with St. Cloud State University (SCSU) interns and members of the MNARNG treated buckthorn over a two-day period. Ten acres of buckthorn regeneration was treated in Training Areas 3 and 6 during the week long project (Figure 54). The herbicide triclopyr coupled with a petroleum based bark oil was tanked mixed in backpacks and foliar applied. This treatment is most effective at removing buckthorn seedlings and not harming existing oak species regeneration. The site

Figure 54. Terrestrial invasive woody vegetation treatment location, Arden Hills Army Training Site, 2017.



will require numerous chemical and mechanical treatments over the next few years to prevent stump sprouting and to restore the native oak savanna ecosystem.

SCSU interns also re-treated areas of the boundary fence line in 2017 to limit woody encroachment on the existing fence line and maintain force protection standards. The selective herbicide triclopyr was tank mixed and applied to wild grape (*Vitus riparia*) re-growth and other woody tree species found encroaching on the fence.

Wildlife

By Nancy J. Dietz and Brian J. Dirks, Minnesota Department of Natural Resources

Species in Greatest Conservation Need

“Minnesota defines species in greatest conservation need (SGCN) as native animals, nongame and game, whose populations are rare, declining, or vulnerable to decline and are below levels desirable to ensure their long-term health and stability. Also included are species for which Minnesota has a stewardship responsibility. Stewardship species are those for which populations in Minnesota represent a significant portion of their North American breeding, migrating or wintering population, or species whose Minnesota populations are stable, but whose populations outside of Minnesota have declined or are declining in a substantial part of their range” (MNDNR 2015a).

One of the federal requirements of the Comprehensive Wildlife Conservation Strategy is to manage SGCN by developing a wildlife action plan. “Minnesota’s Wildlife Action Plan, 2015–2025” (MNDNR 2015a) is Minnesota’s response to the congressional mandate. The goal of the wildlife action plan is to 1) ensure the long-term health and viability of Minnesota’s wildlife, with a focus on species that are rare, declining or vulnerable to decline; 2) enhance opportunities to enjoy SGCN and other wildlife and to participate in conservation; and 3) acquire the resources necessary to successfully implement the Minnesota Wildlife Action Plan (MNDNR 2015a). Additional AHATS surveys, monitoring and research will be directed toward identifying other SGCN species, and management or conservation actions that could be implemented to benefit these species.

Of the over 2,000 known native wildlife species in Minnesota, 346 species from all major taxonomic groups meet the definition of species in greatest conservation need. All federal and state endangered, threatened and special concern species are included on the SGCN list. Five taxonomic groups have one-third or more of the total species found in Minnesota as SGCN, they are: mammals (38%), reptiles (50%), amphibians (36%), tiger beetles (46%) and mussels (60%) (MNDNR 2015a). Sixty-three SGCN species occur on AHATS, including 44 SGCN bird species of which 24 are songbirds.

Birds

Christmas Bird Count

The Christmas Bird Count (CBC) has been coordinated by the National Audubon Society since 1900, and has become the oldest continuous nationwide wildlife survey in North America (Sauer et al. 2008). Counts occur within predetermined 15-mile diameter circles located across North America, Mexico and South America. All of AHATS is found within the Saint Paul, north (CBC census code: MNSP) census circle. Each count is conducted during a single calendar day within two weeks of Christmas (December 14 to January 5). The Saint Paul north census was started in 1967, and the census has occurred 50 times (Minnesota Ornithologists' Union 2018b). CBC data is primarily used to track winter distribution patterns and population trends of various bird species.

The 2017 – 2018 CBC at AHATS occurred on Saturday, December 16, 2017, and was conducted by Craig Mullenbach, Tom and Sue McCarthy, Sharon Stiteler, Jerry Hogeboom, Melissa Allard, Amber Burnette, Bob Holtz, Saint Paul Audubon Society volunteers and Mary Lee, AHATS staff. The temperature was 26 degrees Fahrenheit, with winds of 8 miles per hour, and it was mostly cloudy to overcast with no precipitation (Weather Underground 2018c). Four hundred and forty-three birds of 25 species were counted at AHATS during the annual CBC (Table 35).

Table 35. Christmas bird count data, Arden Hill Army Training Site, winters of 2009 – 2017.

Species	Scientific Name	Dec. 18, 2009	Dec. 18, 2010	Dec. 17, 2011	Dec. 15, 2012	Dec. 14, 2013	Dec. 20, 2014	Dec. 19, 2015	Dec. 31, 2016	Dec. 16, 2017
Canada goose	<i>Branta canadensis</i>	28	20	2	25			8		
Trumpeter swan	<i>Cygnus buccinator</i>	7	2		2					12
Wood duck	<i>Aix sponsa</i>									1
American black duck	<i>Anas rubripes</i>									1
Mallard	<i>Anas platyrhynchos</i>	~1500	~1300	~800	300	625	205	375	35	228
Lesser scaup	<i>Aythya affinis</i>							1		
Canvasback	<i>Aythya valisineria</i>		1							
Common goldeneye	<i>Bucephala clangula</i>		6			1		5		1
Common merganser	<i>Mergus merganser</i>					1				
Bald eagle	<i>Haliaeetus leucocephalus</i>	1		4	4	1	3	1	3	3
Red-tailed hawk	<i>Buteo jamaicensis</i>	6	5	4	4	3	1	3	3	2
Rough-legged hawk	<i>Buteo lagopus</i>	1			1		5			1
Wild turkey	<i>Meleagris gallopavo</i>	13	9	22	17	10		1		
Ring-billed gull	<i>Larus delawarensis</i>				1			1		
Rock pigeon	<i>Columba livia</i>		1	7						2
Mourning dove	<i>Zenaida macroura</i>			13	8	3	5	48	4	1
Great horned owl	<i>Bubo virginianus</i>	1		3	3		3	1	1	1
Barred owl	<i>Strix varia</i>							1		
Red-bellied woodpecker	<i>Melanerpes carolinus</i>	1		1		2	1	4	1	2
Downy woodpecker	<i>Picoides pubescens</i>	1	4	6		6	10	3	3	4

Table 35. Christmas bird count data, Arden Hill Army Training Site, winters of 2009 – 2017.

Species	Scientific Name	Dec. 18, 2009	Dec. 18, 2010	Dec. 17, 2011	Dec. 15, 2012	Dec. 14, 2013	Dec. 20, 2014	Dec. 19, 2015	Dec. 31, 2016	Dec. 16, 2017
Hairy woodpecker	<i>Picoides villosus</i>	1		2	1	3	2	3	1	2
Pileated woodpecker	<i>Dryocopus pileatus</i>				1			3		
Northern shrike	<i>Lanius excubitor</i>		5	1	3	2	1	2		1
Blue jay	<i>Cyanocitta cristata</i>		2	6		50	5	12	1	34
American crow	<i>Corvus brachyrhynchos</i>	25	39	16	45	71	100	29	51	72
Common raven	<i>Corvus corax</i>									1
Black-capped chickadee	<i>Parus atricaillus</i>	9	10	62	11	48	47	13	20	25
White-breasted nuthatch	<i>Sitta corolinensis</i>		2	8	4	5	6	6	2	4
European starling	<i>Sturnus vulgaris</i>							2		1
American tree sparrow	<i>Spizella arborea</i>	3		52	50	6	3	54	10	
Dark-eyed junco	<i>Junco hyemalis</i>				15	2	6	7		5
Northern cardinal	<i>Cardinalis</i>				4	5		7		2
House finch	<i>Carpodacus mexicanus</i>							2		3
American goldfinch	<i>Carduelis tristis</i>		1	20		2		7	3	13
House sparrow	<i>Passer domesticus</i>				20	1		1		
# Observers		Unk.	Unk.	5	3	4	6	8	6	9
TOTAL # INDIVIDUALS		1,597	1,406	1,029	521	847	401	600	138	443
TOTAL # SPECIES		14	15	18	20	20	16	27	14	25

Breeding Bird Monitoring

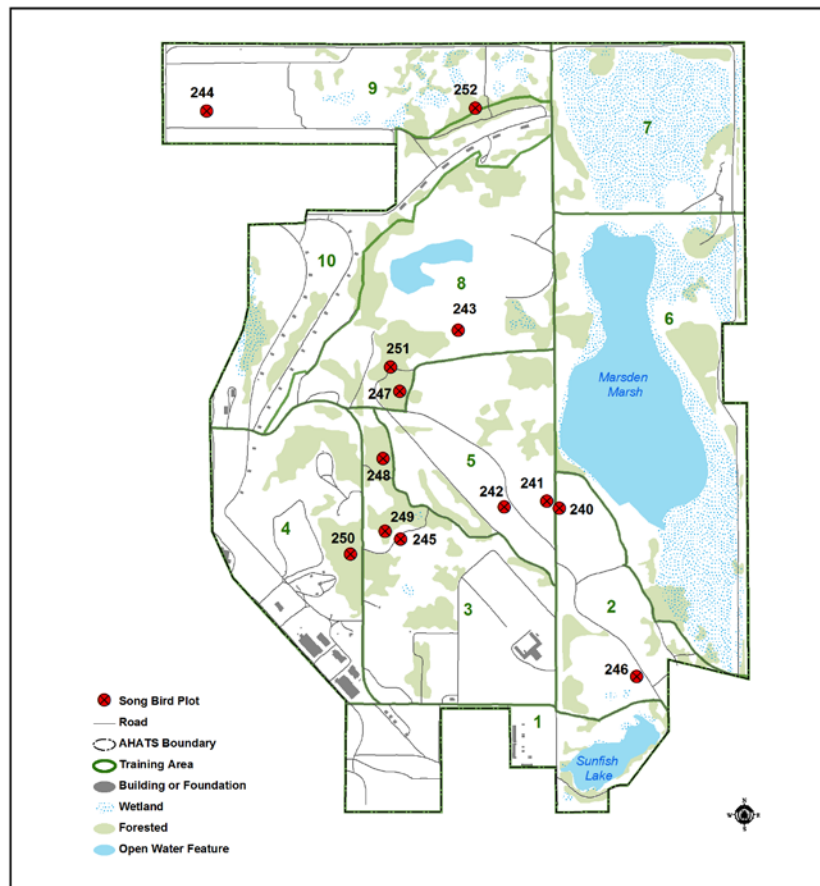
As a natural oasis in a mostly metropolitan area, AHATS provides important breeding and migratory habitat for bird species in greatest conservation need (SGCN). Forty-four SGCN birds have been identified on AHATS (MNDNR 2015a), including 21 known breeding SGCN birds. Four SGCN songbirds (passerines) were recorded during songbird point count surveys in 2017.

Songbird surveys were conducted on 13 permanent plots (Figure 55) on May 31 and June 1, 2017. Surveys have been conducted on these plots since 2001. A total of 167 birds consisting of 44 different species were recorded. Overall, the average number of birds per plot was 12.8 and the average number of species per plot was 10.5 (Table 36 and Figure 56).

Grassland plots ($n=7$) contained 27 bird species and 76 total birds. The highest diversity of songbird species in grassland plots occurred in 2017. The average number of birds found on grassland plots was 10.85 and the average number of species per plot was 8.28 (Table 36 and Figure 56). Population trends of three SGCN grassland songbirds are presented in Figure 57. According to the North American Breeding Bird Survey, Grasshopper sparrow (*Ammodramus savannarum*) populations declined by almost 3% per year between 1966 and 2014, resulting in a cumulative decline of 75%. On

AHATS grasshopper sparrows (a SGCN) had been increasing in abundance since 2001, and were the most abundant grassland plot bird in 2011 but dropped to none in 2012 and 2017. Ten of the past twelve years, clay-colored sparrows (*Spizella pallida*) were the most abundant species recorded on grassland plots (Table 37). Tree and invasive shrub removal is used to limit encroachment of trees and brush into grasslands. Prescribed burning is an important tool to control woody encroachment and to

Figure 55. Permanent songbird survey plots, Arden Hills Army Training Site, Minnesota, 2001–2017.



restore and enhance native grasslands. For the first time since 2012, prescribed fire was used in 2016 to manage grasslands on AHATS; however, no prescribed fire was applied in 2017. Grassland birds benefit from the absence of trees due to the lack of perches for predators and brown-headed cowbirds (*Molothrus ater*), a brood parasite. Brushy grasslands are more suitable for edge species, such as the American goldfinch (*Carduelis tristis*), which was the second most abundant bird in grassland plots in 2017.

An additional grassland SGCN bird, the bobolink (*Dolichonyx oryzivorus*), appeared on AHATS survey plot for the first time in six years.

Bobolink prefer breeding

habitat of moderate to tall vegetation with both grasses and forbs, moderate vegetation densities, absence of woody plants with a moderately developed litter layer (Pfanmuller et al. 2017c). This species population has a statistically valid decline documented, rare or declining habitat and habitat loss hence its SGCN designation. Also, Minnesota's population represents a significant portion of the North American breeding population. Bobolink were present on an AHATS grassland plot in 2002, 2003, 2005, 2008, 2011 and 2017.

Woodland plots ($n=6$) contained 31 species and 91 total birds. The average number of birds found on woodland plots was 15.2 and the average number of species per plot was 13 (Table 36 and Figure 56). The most abundant birds on woodland plots in 2017 were red-eyed vireo (*Vireo olivaceus*), American goldfinch and American redstart (*Setophaga ruticilla*) (Table 37). Invasive shrub removal also benefits woodland species by releasing native understory species, increasing biodiversity and

Table 36. Summary of songbird surveys, Arden Hills Army Training Site, Minnesota, 2001 – 2017.

Woodland Plots						
Year	Field Surveyors	# of Plots Surveyed	Total # of Birds Documented	Total # of Species Documented	Average # of Birds per Plot	Average # of Species per Plot
2001	Dirks	7	81	25	11.57	8.28
2002	Dirks	7	78	28	11.14	9.14
2003	Dirks	6	84	31	14.00	11.0
2004	Dirks	6	88	36	14.66	12.33
2005	Dirks	6	73	28	12.12	9.83
2006	Dirks	6	74	32	12.13	10.5
2007	Dirks	6	90	34	15.00	11.66
2008	Dirks	6	64	25	10.66	9.66
2009	Dirks	6	73	25	12.16	10.5
2010	Dirks	6	67	26	11.2	10.3
2011	Dirks	6	79	29	13.2	11.66
2012	Dirks	6	71	36	11.8	10.33
2013	Dirks	6	69	27	11.5	10.5
2014	Dirks	5	62	28	12.4	11.0
2015	Dirks	6	67	30	11.2	9.8
2016	Dirks	6	68	24	11.3	9.3
2017	Dirks	6	91	31	15.2	13.0
Grassland Plots						
Year	Field Surveyors	# of Plots Surveyed	Total # of Birds Documented	Total # of Species Documented	Average # of Birds per Plot	Average # of Species per Plot
2001	DeJong	7	37	18	5.28	4.28
2002	DeJong	7	62	22	8.86	9.57
2003	DeJong	7	39	17	5.57	4.57
2004	Burggraff	7	41	19	5.86	4.57
2005	DeJong	7	67	23	9.57	9.71
2006	DeJong	7	75	20	10.71	8.85
2007	DeJong	7	66	21	9.43	8.57
2008	Dirks	7	45	26	6.42	6.0
2009	Dirks	7	46	20	6.71	9.28

Grassland Plots						
Year	Field Surveyors	# of Plots Surveyed	Total # of Birds Documented	Total # of Species Documented	Average # of Birds per Plot	Average # of Species per Plot
2010	Dirks	7	45	16	6.43	5.0
2011	Dirks	7	40	19	5.71	4.57
2012	Dirks	7	39	20	5.57	5.0
2013	Dirks	7	62	25	8.86	8.0
2014	Dirks	5	28	15	5.6	5.0
2015	Dirks	7	62	23	8.86	7.2
2016	Dirks	7	54	21	7.71	6.6
2017	Dirks	7	76	27	10.85	8.28

habitat for birds and other animals. Many native plant species can re-establish from existing seed banks and roots if undesirable plants are controlled (University of Minnesota 2017).

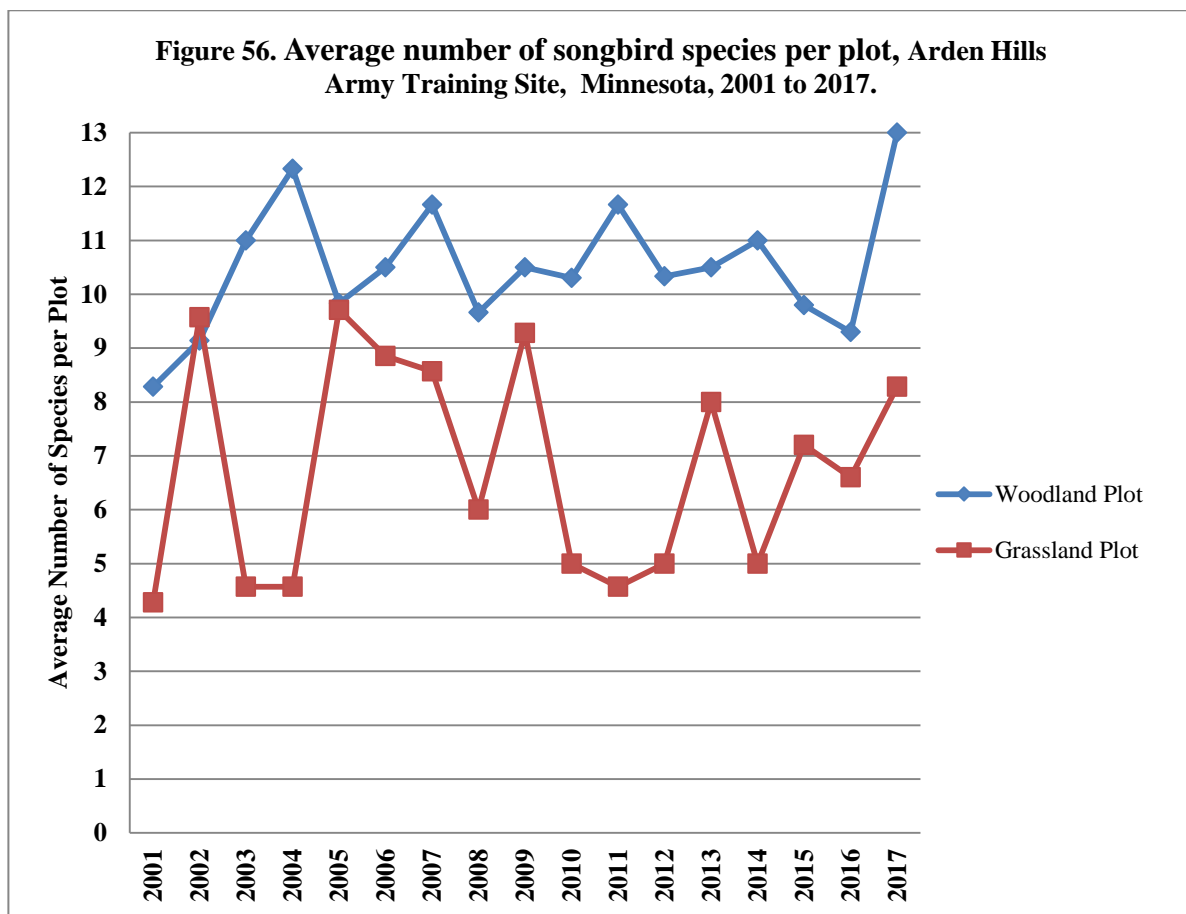


Figure 57. Selected grassland songbird species in greatest conservation need, Arden Hills Army Training Site, Minnesota, 2001 to 2017.

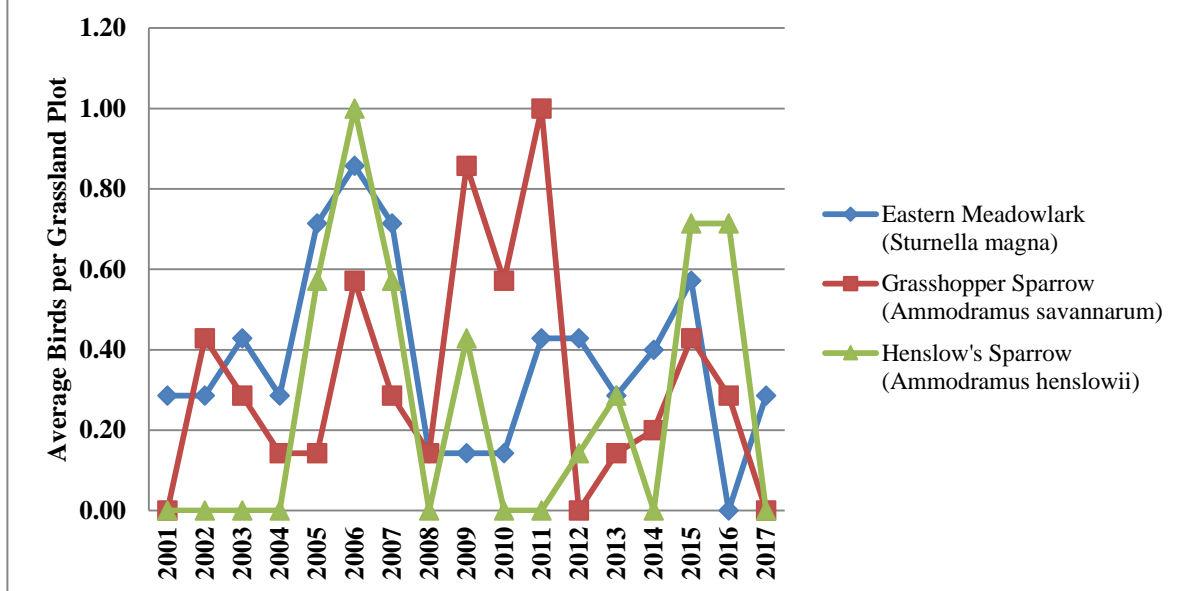


Table 37. Most abundant songbirds observed on plots, Arden Hills Army Training Site, Minnesota, 2006 – 2017. The number of birds documented is indicated in columns.

Grassland Plots (n=7)													
Common Name	Scientific Name	June 2, 2006	June 5, 2007	July 9, 2008	May 29, 2009	May 27, 2010	June 3&14, 2011	June 6, 2012	June 7, 2013	June 6, 2014 ^a	May 27, 2015	June 2, 2016	May 31 & June 1, 2017
Mourning dove	<i>Zenaida macroura</i>			2									
Eastern kingbird	<i>Tyrannus tyrannus</i>		5	2	4				4	2	5		
American crow	<i>Corvus brachyrhynchos</i>												
Tree swallow	<i>Tachycineta bicolor</i>	5			4	5	3		4			4	7
Black-capped chickadee	<i>Poecile atricapillus</i>												
House wren	<i>Troglodytes aedon</i>			4				3					
Sedge wren	<i>Cistothorus platensis</i>							3					
Eastern bluebird	<i>Sialia sialis</i>		5	4	4		3			2			7
Gray catbird	<i>Dumetella carolinensis</i>			2				2					
Clay-colored sparrow	<i>Spizella pallida</i>	8	11	6	6	11	4	4	10	4	8	5	10
Field sparrow	<i>Spizella pusilla</i>			4		4	3	5	6	2	4		6
Vesper sparrow	<i>Poocetes gramineus</i>		4										
Song sparrow	<i>Melospiza melodia</i>												
Henslow's sparrow	<i>Ammodramus henslowii</i>	7	4		3						5	5	
Grasshopper sparrow	<i>Ammodramus savannarum</i>				6	4	7						
Brown thrasher	<i>Toxostoma rufum</i>											4	
Yellow warbler	<i>Dendroica petechia</i>											4	
Common yellowthroat	<i>Geothlypis trichas</i>							3		4	7	5	7
Red-winged blackbird	<i>Agelaius phoeniceus</i>												
Eastern meadowlark	<i>Sturnella magna</i>	6	5				3	3		2	4		
Brewer's blackbird	<i>Euphagus cyanocephalus</i>												
American goldfinch	<i>Carduelis tristis</i>			2		5	3	3	7	3		6	8

Woodland Plots (n=6)													
Common Name	Scientific Name	June 2, 2006	June 5, 2007	July 9, 2008	May 29, 2009	May 27, 2010	June 3&14, 2011	June 6, 2012	June 7, 2013	June 6, 2014 ^a	May 27, 2015	June 2, 2016	May 31 & June 1, 2017
Mourning dove	<i>Zenaida macroura</i>	4											
Tree swallow	<i>Tachycineta bicolor</i>				4								
Great crested flycatcher	<i>Myiarchus crinitus</i>		4	3			6		4	5	4	5	
Eastern wood-pewee	<i>Contopus virens</i>	6	4	3	5		5	4	6	3		5	4
Least flycatcher	<i>Empidonax minimus</i>												4
Red-eyed vireo	<i>Vireo olivaceus</i>				5	5			5		6	4	
Blue jay	<i>Cyanocitta cristata</i>			6	6	6	6		4		7	4	
Black-capped chickadee	<i>Poecile atricapillus</i>		7		3		7	4					
White-breasted nuthatch	<i>Sitta carolinensis</i>			5		5		6	4				
House wren	<i>Troglodytes aedon</i>	5	11		3	6	6	6					
Blue-gray gnatcatcher	<i>Polioptila caerulea</i>									3			
American robin	<i>Turdus migratorius</i>	7		5	6								
Gray catbird	<i>Dumetella carolinensis</i>			3							5		
Rose-breasted grosbeak	<i>Pheucticus ludovicianus</i>												4
Eastern towhee	<i>Pipilo erythrophthalmus</i>			3									
Common yellowthroat	<i>Geothlypis trichas</i>				5		5	5		6	4		5
Yellow warbler	<i>Dendroica petechia</i>				3								
Chestnut-sided warbler	<i>Vermivora ruficapilla</i>											4	4
American redstart	<i>Setophaga ruticilla</i>												6
Chipping sparrow	<i>Spizella passerina</i>									3			
Song sparrow	<i>Melospiza melodia</i>			5									
Northern cardinal	<i>Cardinalis cardinalis</i>	4	4	3	3								
Indigo bunting	<i>Passerina cyanea</i>			3			4		4			4	
Red-winged blackbird	<i>Agelaius phoeniceus</i>	4	5	4	3					3			
Brown-headed cowbird	<i>Molothrus ater</i>			3		5		4					
Baltimore oriole	<i>Icterus galbula</i>				4	5		5	4	3			
American goldfinch	<i>Carduelis tristis</i>		4		4	4	4	4	5	4		4	6

^a Only five grassland and five woodland songbird plots were surveyed in 2014.

Trumpeter Swan (*Cygnus buccinator*)

The DNR introduced a pair of wing-clipped trumpeter swans to Marsden Marsh in 1993, and again in 1994. Seven young free-flying wild swans were observed at the wetland during the summer of 1994, presumably after observing the presence of the introduced pair. A wild pair nested at AHATS in 1995, and subsequently raised two cygnets in the wetland. This made AHATS the first site in Ramsey County in approximately 150 years to support the production of cygnets from wild swans.

In 2017, one pair of trumpeter swans was observed on both Sunfish Lake and Marsden Marsh these pairs fledged six and one cygnet, respectively. Trumpeter swans had been listed as threatened in Minnesota but were reclassified in 2013 to a special concern species. Minnesota's population is a significant portion of the North American population. Each year AHATS is monitored for trumpeter swan presence and reproduction (Dirks et al. 2010) (Table 38).

Common Loon (*Gavia immer*)

Although listed as a SGCN, Minnesota has more loons (roughly 12,000) than any other state except Alaska. Threats to loons include human disturbance and pollutants such as lead and mercury. The DNR monitors loon populations with the help of volunteers to improve understanding of what our state bird needs to maintain a strong, healthy presence here (MNDNR 2011b).

Common loons have nested on AHATS wetlands and lakes in the past; however, no effort was made to document if any of those nesting attempts were successful. In 2017, common loons were observed on Sunfish Lake and one chick was fledged. Also, one pair was observed on Marsden Marsh but no chicks were observed.

Osprey (*Pandion haleaetus*)

During the 2017 nesting season, an osprey pair was observed on the nesting platform at North Hamline Gate (Figure 58), they fledged two chicks and both were banded (Table 39). Marsden Marsh nest was not active. Banding occurred on July 10, 2017, in cooperation with Audubon Minnesota, Xcel Energy and the Three Rivers Park District.

Table 39. Osprey chicks raised, Arden Hills Army Training Site, since 2001.

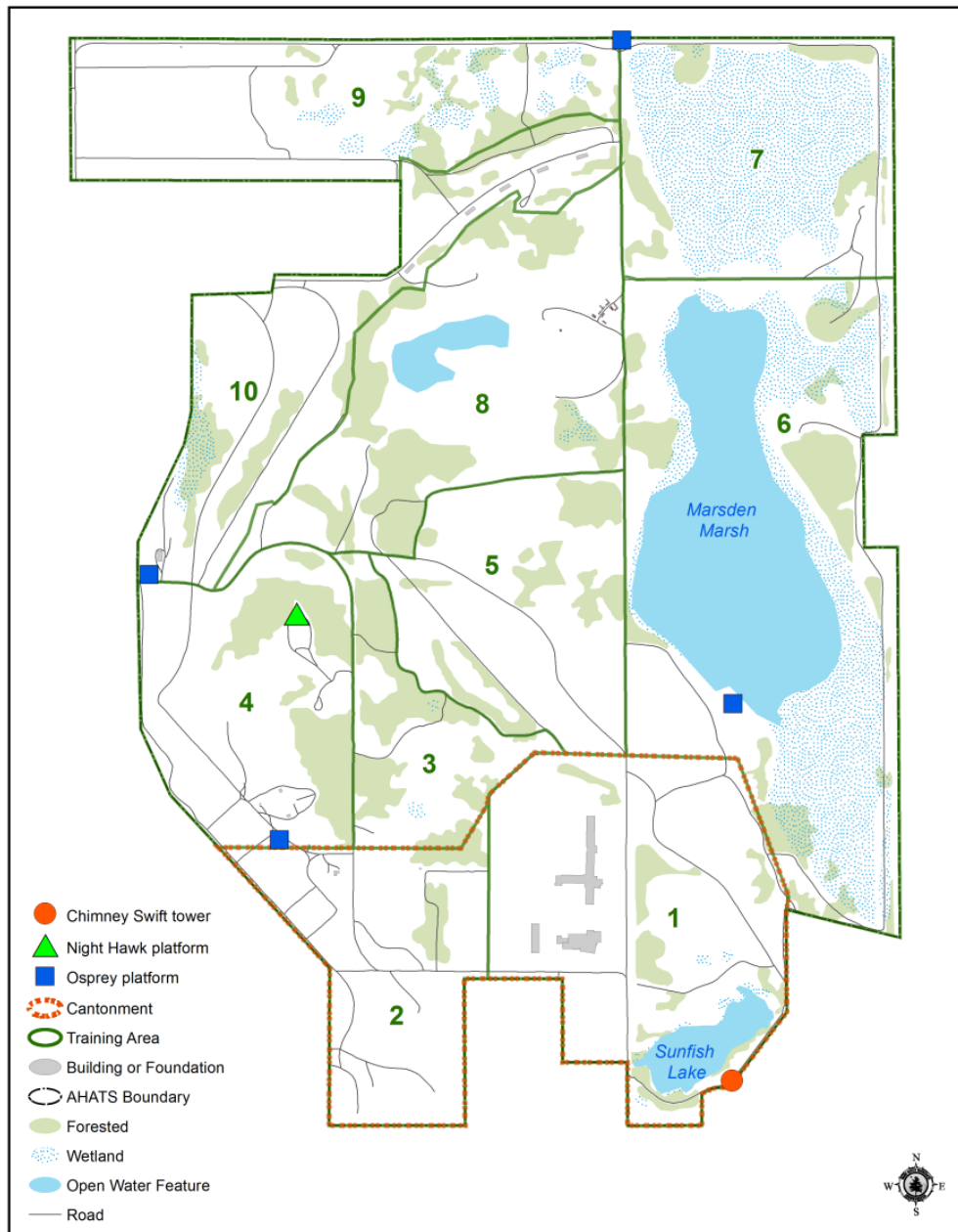
Year	Osprey Fledged
2001	3
2002	4
2009	2
2010	2
2011	2
2012	2
2013	3
2014	2
2015	1
2016	5
2017	2
Total	22

Table 38. Trumpeter swans raised, Arden Hills Army Training Site, since 1995.

Year	Cygnets Fledged
1995	2
1996	3
1997	1
1998	5
1999	6
2000	0
2001	1
2002	0
2003	2
2004	3
2005	2
2006	7
2007	5
2008	6
2009	1
2010	1
2011	1
2012	0
2013	0
2014	5
2015	5
2016	2
2017	7
Total	60

The two new artificial osprey platforms in Training Areas 4 and 10 (Figure 58), both installed in 2013, were not used.

Figure 40. Osprey, chimney swift and common nighthawk nest structures, Arden Hills Army Training Site, since 2013.

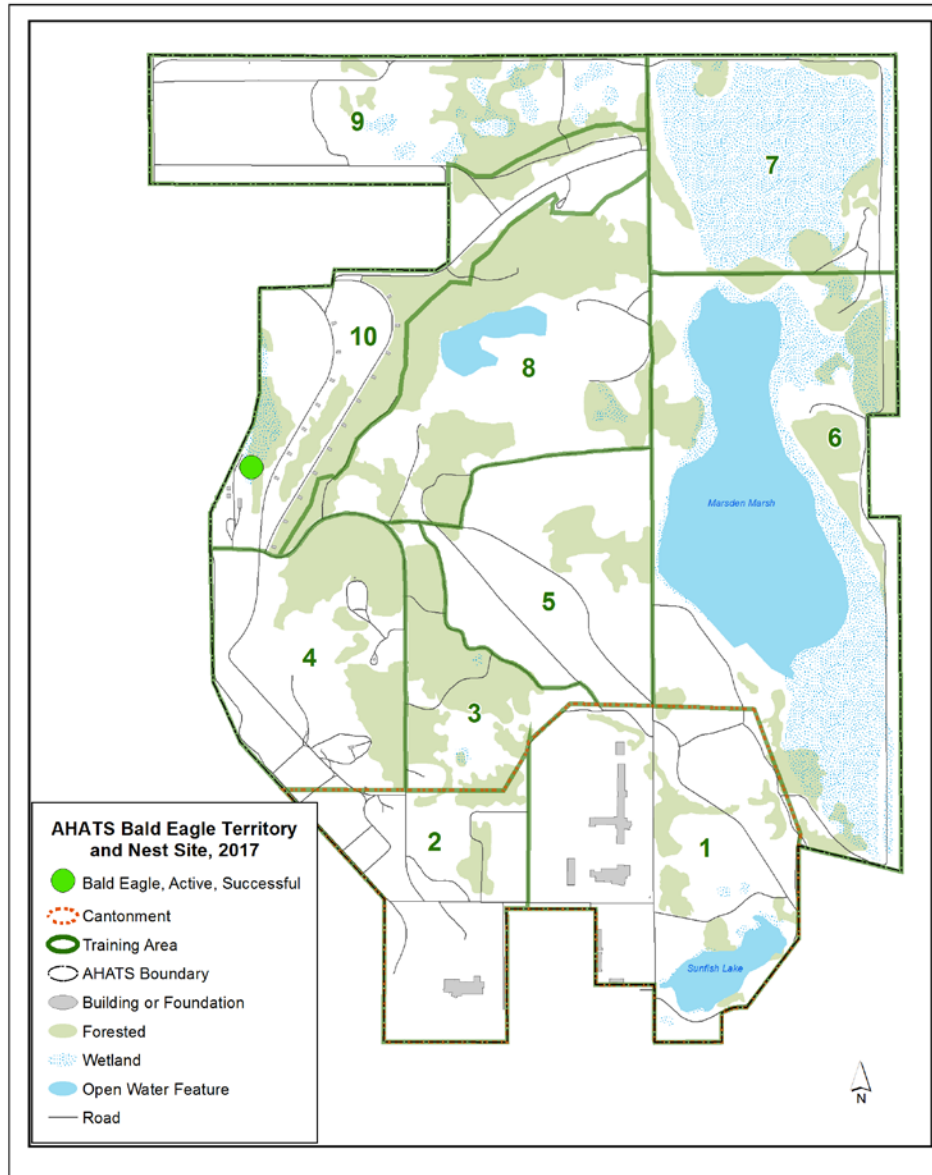


Bald Eagle (*Haliaeetus leucocephalus*)

In the lower 48 states, Minnesota has the most nesting pairs of bald eagles at approximately 1,300. Bald eagle is protected under the Bald and Golden Eagle Protection Act and the Migratory Bird Treaty Act. Both of these acts prohibit killing, selling or otherwise harming or disturbing eagles, their nests or eggs. The U.S. Fish and Wildlife Service (USFWS) released Bald Eagle Management

Guidelines for people who are engaged in recreation or land use activities around bald eagles. These guidelines provide information and recommendations regarding how to avoid disturbing bald eagles. A

Figure 58. Bald eagle territory and nest status, Arden Hills Army Training Site, Minnesota, 2017.



bald eagle nest was discovered on AHATS in the spring of 2017, the territory was active and produced one chick. In addition, recent surveys by the Saint Paul Audubon Society indicate that AHATS does provide winter habitat as bald eagles have been observed during the Christmas Bird Count in eight of nine count years since 2009 (Table 35).

American Kestrel (*Falco sparverius*)

American kestrels, a SGCN, have been observed on AHATS for many years and were listed as common in a 1991 assessment (U.S. Army 1991). However, in recent years, substantial population declines have occurred in Minnesota and across their range (MNDNR 2015a). Artificial nest boxes have

been installed at AHATS in previous years by the Audubon Society and other local groups to enhance American kestrel populations.

Figure 59. Leg banded American kestrel pre-fledging chick, Arden Hills Army Training Site, Minnesota, 2017.



AHATS staff and volunteers began a kestrel project in 2016. The objectives for the study are to determine: 1) if individuals remain in natal (where they were hatched) areas, and if so, for how long after hatching, 2) local movements within and around AHATS and the distance of movement, and 3) if individuals use the same artificial nest box sites annually.

Adult kestrels were captured using bal chatri traps. Each bird was aged, if possible, sex determined, leg banded and measurements taken. Pre-fledging young were removed from artificial nest boxes, leg banded (Figure 59) and returned to the nest box.

Fourteen artificial nest boxes were monitored (Table 40), and six boxes hatched at least one chick. Four nest's eggs did not hatch for unknown reasons. One nest was depredated post juvenile banding.

Table 40. American kestrel monitoring, Arden Hills Army Training Site, 2016 – 2017.

Year	Total Artificial Nest Boxes	Number of Occupied Nest Boxes	Number of Successful Nest Boxes	Adults Banded		Juveniles Banded		
				Male	Female	Male	Female	Unkn.
2016	13	9	8	2	9	14	20	2
2017	14	10	6	6	2	19	7	2
Total	27	19	12	19		64		

Sandhill Crane (*Grus canadensis*)

Sandhill cranes are monitored through a project of the International Crane Foundation. The annual Midwest Crane Count has been conducted since 1976. The purpose of the count is to monitor the abundance and distribution of cranes in the upper Midwest (International Crane Foundation 2010). Mary Lee and volunteer, Amber Burnette surveyed cranes on April 8, 2017 and heard pairs calling from two locations (east Marsden Marsh and County Road I). Two colts were observed near County Road I in 2017.

American Woodcock (*Scolopax minor*)

American woodcock are a forest dwelling shorebird whose breeding distribution is primarily found in the forested regions of the state and along the Minnesota River valley (Pfannmuller et al. 2017b). Successful breeding occurs in shrubland and young forest habitats (McAuley et al. 2013). Woodcock is a Minnesota SGCN and was designated such due to a documented statistically valid population decline (MNDNR 2015a). Population trends are measured using woodcock singing-ground (peenting) surveys on established routes throughout its breeding range. Surveys demonstrated a decline of 0.8 % per year from 1968 – 2012 but surveys from 2002 to 2012 showed no trend (Pfannmuller et al. 2017b).

A woodcock peenting survey occurred on April 6, 2017 from 19:00 to 21:00, several males were observed. During the spring and early summer, Tye Sonney spent approximately 10 hours searching for woodcock nests using the aid of pointing dogs. No nesting woodcock were found but three males were flushed. No chicks were observed.

Common Nighthawk (*Chordeiles minor*)

The common nighthawk is a SGCN in Minnesota. Nighthawks are not well monitored by breeding bird surveys and their populations have been declining. The cause of population decline is unknown but is believed to be related to loss of breeding habitat, pesticide use and nest predation. A wide variety of habitats are used but nesting occurs on the ground on a bare site in an open area (NatureServe 2009). Due to population declines, an artificial common nighthawk structure was constructed and installed in July 2011 (Figure 58). The artificial structure was not used in 2012 – 2017.

Chimney Swift (*Chaetura pelagica*)

Chimney swifts are avian neotropical migrants that are exhibiting a decrease in population. They inhabit rural and urban habitats where suitable roosting and nesting sites are available along with abundant insect populations. These swifts nest primarily in chimneys but will also use the interior walls of silos, barns and uninhabited homes. Natural nest sites include the interior of hollow tree trunks and branches. Recently, populations have become vulnerable as chimney screening and demolition of

buildings historically used for nesting/roosting reduces important habitat. In addition, newly constructed chimneys are lined with metal flue pipe which is too smooth for swifts to cling to and may potentially result in entrapment and cause bird deaths (NatureServe 2011). To help reduce population declines artificial nest/roost structures have been developed. A chimney swift tower was installed at AHATS in May 2011 (Figure 58). The artificial tower was not used in 2012 – 2017.

Henslow's Sparrow (*Ammodramus henslowii*)

Henslow's sparrows, a SGCN, have been observed at AHATS eight of the past twelve years during breeding bird surveys and were recorded again in 2016 (Figure 57). None were observed during 2008, 2010, 2011, 2014 and 2017. However, Henslow's were heard singing during the Audubon butterfly survey on July 8, 2017 in Training Area 5. Henslow's sparrows usually breed in grasslands south and east of Minnesota. However, sightings increased in the Minnesota region during the summer of 2005, the year they were first observed at AHATS. Possible causes for increased sightings may be due to a temporary population increase, a temporary population shift from another area, or a true population increase. However, annual monitoring indicates that Henslow's sparrows are frequently using AHATS during breeding season.

Henslow's sparrows are listed as endangered by the DNR and six other states, but are not listed by the USFWS. The nationwide population of this grassland bird species has declined nearly 80% since 1966, due to habitat destruction and/or reforestation (National Audubon Society 2007). The Army Priority List of At-Risk Species gives Henslow's sparrows a two priority ranking. This priority listing allows the Army to work to prevent species at-risk from being added to the threatened and endangered species list through proactive conservation measures (Balbach et al. 2010).

Management for this species should provide for large areas of suitable habitat, prevention of disturbance during the breeding season, and the control of succession (Herkert 2003). Suitable habitat is tall, dense grass with a deep litter layer and scattered tall forbs for perching. Periodic disturbance, such as prescribed fire, is essential to maintaining suitable habitat; even though it will likely reduce the suitability of the grassland during the treatment year. Trees and shrubs should be eliminated in the center and along the edges of grassland areas to discourage predators and nest parasites such as the brown-headed cowbird. Grasslands where Henslow's are located (Burn Units 1-1, 1-2, 5-2, 5-3, 6-1 and 9-1) should be burned or mowed on a minimum of a five year rotation, since it may take several years for the habitat to regain suitable structure for breeding Henslow's sparrows (Dirks et al. 2010). To allow some Henslow's habitat to remain each year, treatment of any of these grassland burn units should be separated by a minimum of three years. Habitat requirements and management for Henslow's sparrows will be included in the development of future habitat restoration plans.

Mammals

Northern Long-eared Bat Research

By Brian Dirks, Nancy Dietz, and Morgan Swigen, NRRI, UMN–Duluth

”Bats are a critical component of Minnesota’s ecosystems. A single bat may eat 1,000 insects per hour, and the state’s bats likely provide many millions of dollars in pest control each year (Boyles et al. 2011)” (Swingen et al. 2016). Eight species of bats have been documented in Minnesota: little brown myotis (*Myotis lucifugus*, MYLU), northern long-eared bats (*Myotis septentrionalis*, MYSE), big brown bats (*Eptesicus fuscus*, EPFU), tricolored bats (*Perimyotis subflavus*, PESU), silver-haired bats (*Lasionycteris noctivagans*, LANO), eastern red bats (*Lasiurus borealis*, LABO), hoary bats (*Lasiurus cinereus*, LACI) and evening bats (*Nycticeius humeralis*, NYHU). Four of Minnesota’s bat species hibernate in caves and mines (northern long-eared bat, tricolored bat, little brown myotis, and big brown bat) during the winter, and disperse widely across the state in spring, summer, and fall. Very little is known about the summer habitat use of these species” (Swingen et al. 2016 and 2018).

Based upon 2007 and 2015 passive acoustic surveys (Dirks and Dietz 2010; MNDNR and MNARNG 2016), AHATS is home to four bats that are designated state special concern species and SGCN, northern long-eared bat, tricolored bat, little brown myotis and big brown bat. Three additional bats are SGCN only, silver-haired bat, eastern red bat and hoary bat.

The northern long-eared bat is federally listed as a threatened species under the Endangered Species Act. Threatened species are animals or plants that are likely to become endangered in the foreseeable future. The USFWS determined, in December 2017, that the petition to list the tricolored bat presented substantial scientific information that federal listing may be warranted. Therefore, a status review was initiated and a determination will be made whether to propose listing tri-colored bats under the Endangered Species Act (USFWS 2016b).

Bat Capture and Processing

Fine mesh mist-nets (Avinet Inc., Dryden, NY, USA) were set up along forested roads that could act as travel corridors for bats. Each night, 2–8 mist-nets were set up within 200 m of a central processing location. Mist-nets were opened after sunset, and checked every 15 minutes for 2–5 hours, depending on capture rates and weather conditions. Captured bats were placed in cloth bags until processing.

We identified each captured bat to species by morphology, and determined sex, age and reproductive condition by physical examination. Each captured bat was weighed and measured, and the wings were inspected for damage as per Reichard and Kunz (2009). Each bat was then fitted with an individually-numbered lipped aluminum wing band (Porzana Ltd., Icklesham, United Kingdom).

Radio-transmitters (A2414 from Advanced Telemetry Systems Inc., Isanti, MN, USA) were attached to pregnant or lactating adult female northern long-eared bat (MYSE) or little brown myotis (MYLU) that did not have significant wing damage (wing score < 2). We trimmed a small section of hair in the center of the back and attached the transmitter to the skin using surgical adhesive (Perma-

Type, Permatype Company Inc., Plainville, CT, USA). Bats were released at the capture site after processing.

Radio-Tracking/Roost Tree Characterization

Bats with radio-transmitters were tracked to their roost each day until the transmitter failed or the transmitter fell off. Data recorded at each roost included roost type, tree species, and decay stage. At dusk, crews returned to the roosts to conduct emergence surveys. During an emergence survey, personnel watched the roost from 30 minutes before sunset to 1 hour after sunset. During the emergence survey we recorded the number of bats emerging in each 10-minute interval, the location of the exit point, and whether or not the bat with the transmitter left the roost.

Crews returned to each roost tree to conduct a more detailed characterization of the roost tree after bats left. This included measuring diameter at breast height (DBH), tree height, decay stage, canopy closure, slope, aspect and recording details about the vegetation surrounding the roost tree. All roost trees were marked with a numbered aluminum tree tag. Buildings used as roosts were not marked with a tag.

Study Area

Bats were captured for the large-scale study at 12 locations around the state of Minnesota in 2017, including Arden Hills Army Training Site (AHATS). AHATS covers 1,500 acres in the Twin Cities Metropolitan area and is comprised of forests, open fields and marsh/wetland. It is located within the city limits of Arden Hills (Ramsey County), and is surrounded by both residential and industrial areas (Figure 60).

Bat Capture Results

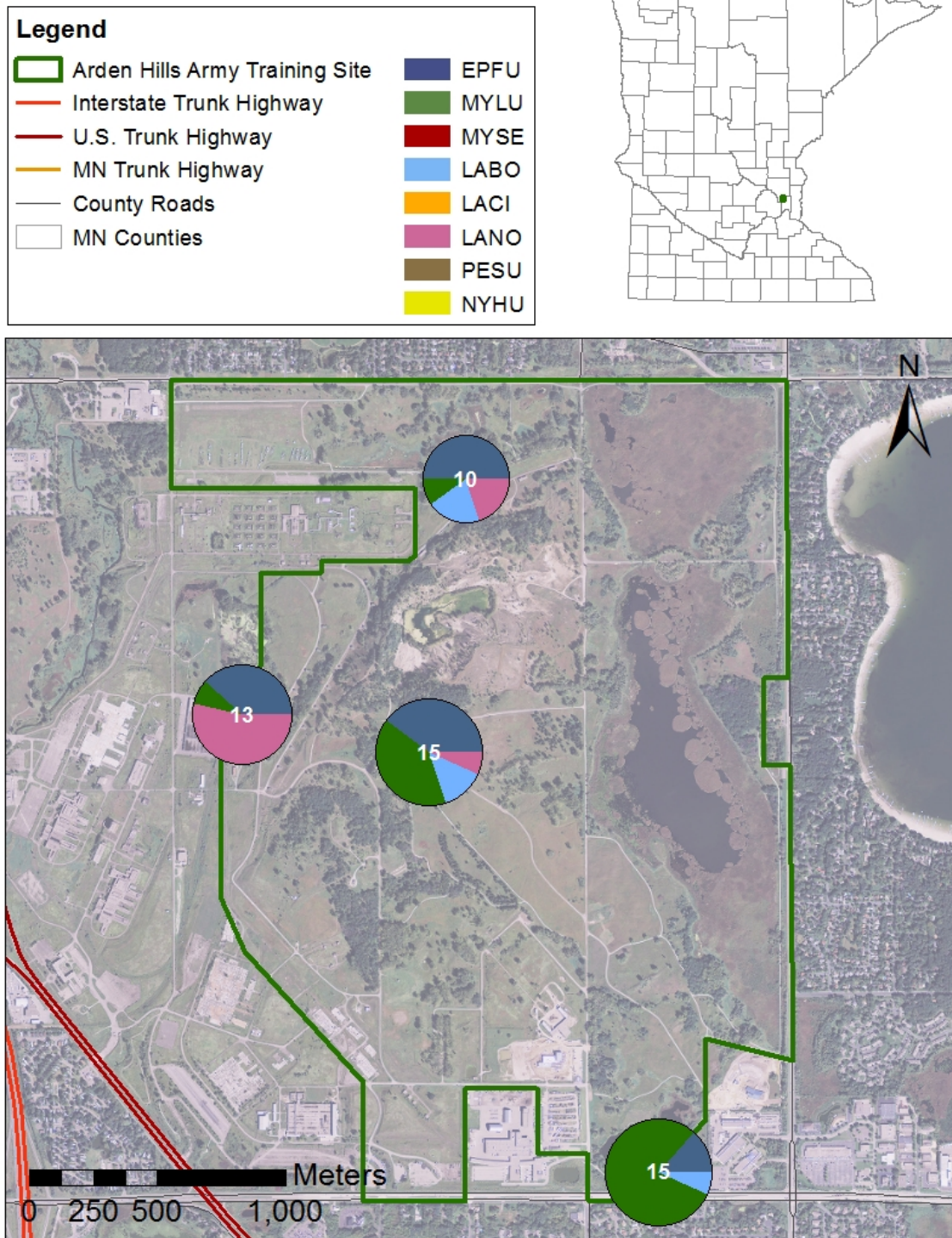
We mist-netted bats at four sites at Arden Hills Army Training Site on the nights of July 5 – 8, 2017 (Figure 60). We captured and processed 53 bats over 124.4 total net-hours. We captured bats of four species, but did not capture any northern long-eared bats (Table 41). Thirty-one of the bats captured were adults, and 22 were juveniles. Twenty-eight bats (53%) showed some wing damage consistent with that caused by WNS, but none had severe damage.

Table 41. Bats captured by species and sex, Arden Hills Army Training Site, July 5 – 8, 2017.

SPECIES and CODE									
Sex	Big Brown Bat (EPFU)	Red Bat (LABO)	Hoary Bat (LACI)	Silver-haired Bat (LANO)	Little Brown Myotis (MYLU)	Northern long-eared Bat (MYSE)	Tricolored Bat (PESU)	Evening Bat (NYHU)	Grand Total
Male	10	2	0	7	6	0	0	0	25
Female	8	3	0	3	14	0	0	0	28
Grand Total	18	5	0	10	20	0	0	0	53

Figure 60. Map of bat mist-netting sites at Arden Hills Army Training Site, July 5 – 8, 2017. The pie chart at each net site indicates the proportion of species captured at that site, and the size of the pie chart represents the total number of bats captured at that site relative to other sites.

Arden Hills Army Training Site- 2017 Bat Mist-Netting Sites



Radio-Telemetry/ Roost Characterization

We attached radio-transmitters to three female little brown bats: two of which were captured on the south side of AHATS on the night of July 6, and one of which was captured in Training Area 9 (Figure 60) in the northern part of AHATS on the night of July 8. All three female little brown bats given transmitters were lactating at the time of capture.

The three bats with radio-transmitters were tracked until the transmitter failed or fell off, which was after 5 – 7 days. We tracked the three bats with the radio-transmitters to two unique roosts, both of which were in buildings. Two of the bats with transmitters used the same roost building.

The average distance from the capture location to the first roost was 2,007 m (range: 1,624 – 2,199), and each bat used a single roost for the entire tracking period. Therefore, average time spent in each roost could not be calculated because the start and end dates of roosting were not known.

Field crews conducted three emergence counts on the two identified roosts. Bats were observed exiting the roost in all three of the emergence counts. Colony size (number of bats observed in an emergence count) ranged from 25 – 480 in those three emergence counts.

Discussion

The three little brown bats tracked at Arden Hills Army Training Site (AHATS) roosted in anthropogenic structures, a habit which has been commonly recorded across their range (Davis and Hitchcock 1965, Anthony et al. 1981, Henry et al. 2002, Bergeson et al. 2015). Little brown bat maternity colonies in buildings often number in the hundreds, with some studies reporting over 1,000 individuals roosting in one location (e.g., Davis and Hitchcock 1965). One of the buildings used in 2017 was also used by bats in 2016, and similar numbers of bats were observed at that building in each year. This may suggest that these bats are wintering in a hibernacula that has not yet experienced high levels of WNS mortality. However, our colony counts could have been inflated in 2017 by bats joining from a nearby maternity colony (a known nearby maternity colony was excluded from a building in 2017).

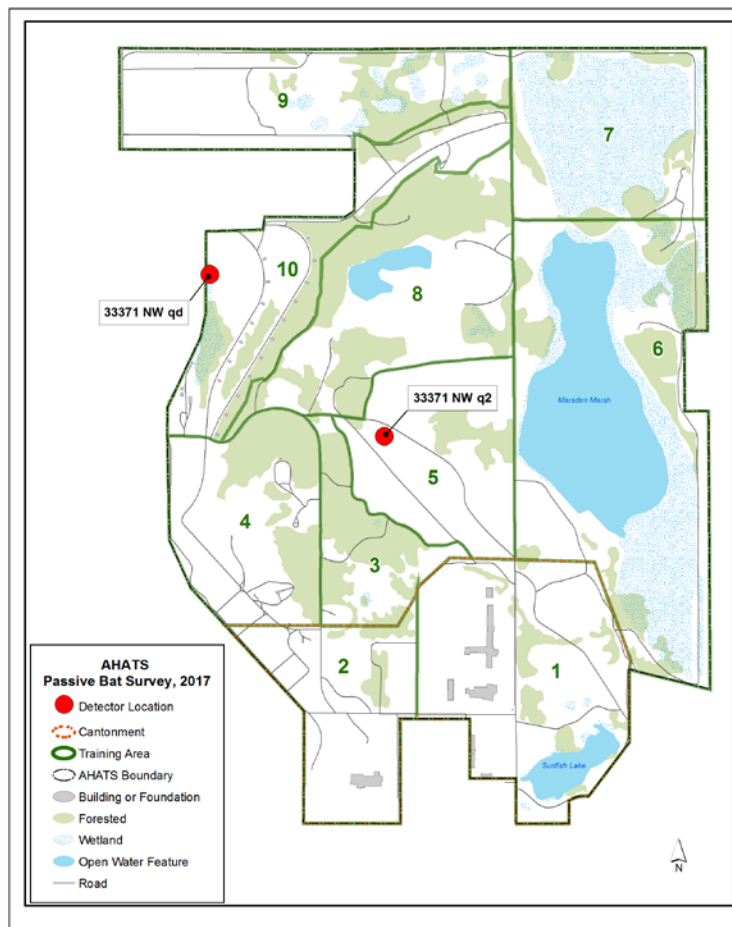
The number of bats captured at AHATS in 2017 was lower than in 2016, even with increased netting effort in 2017 (Dirks et al. 2016). Many factors may have influenced capture rates including net placement and weather. Zero northern long-eared bats were captured at AHATS in 2016 or 2017, although acoustic surveys have recorded northern long-eared bat calls (Minnesota Department of Natural Resources and Minnesota Army National Guard 2015). Northern long-eared bats may exist in smaller numbers in urban areas like that surrounding AHATS due to the lack of large continuous blocks of forest (Johnson et al. 2008).

The first verified evening bat (*Nycticeius humeralis*) recorded in Minnesota was captured at AHATS in July of 2016, however it was unknown if that record represented an incidental record or an established population. Although crews mist-netted at the same site in 2017, no evening bats were captured. This may indicate that the individual captured in 2016 was not part of an established population in the area. However, acoustic surveys of AHATS are ongoing in an effort to document further observations of this species (see Passive Acoustic Survey section below).

Passive Acoustic Bat Survey

Recording bat echolocation “calls” is the most efficient and least intrusive way of identifying different species of bats in a given area (USGS 2014). However, acoustic bat surveys have many variables that contribute to the quantity and quality of echolocation recordings. Bats can be characterized by the ‘volume’ of their echolocation calls, some bats are ‘shouting’ bats and others are ‘whispering’ bats. For example, big brown bats and little brown myotis are shouters, and emit sounds at 110 decibels (if we could hear them) similar to the loudness of a smoke alarm. However, northern long-eared bats produce sounds of 60 decibels, similar to the level of human conversation. Therefore, shouting bats can be heard by the detector at greater distances than whispering bats. Shouting bats can overpower the calls of the whispering bats, such as northern long-eared bat, when they are near the detector together. Northern long-eared bats therefore are more difficult to detect than other bats.

Figure 61. Passive bat acoustic survey, Pettersson D500X full spectrum detector, Arden Hills Army Training Site, Minnesota, 2017.



How sound attenuates in the atmosphere can also influence the quantity and quality of calls recorded and the zone of reception, the physical space where the bat can be detected. Weather conditions such as temperature, wind, humidity and air pressure affect bat activity and call quantity and quality. Also, structural clutter, such as vegetation, can block the path of the calls. In addition, calls recorded can be partial or parts of two species of bats, making bat identification difficult.

The objective for the 2017 passive acoustic bat survey was to place detectors in habitats suited for evening bats and to identify locations where they occur. The first evening bat capture in Minnesota was at AHATS in 2016 (MNDNR and MNARNG 2017). Passive acoustic bat surveys were conducted using Pettersson D500X full spectrum detectors from August 3 to 16, 2017 at two locations (Figure 61). Site

33371NWq2 (12 nights) recorded 16,541 call files and 33371NWqd (14 nights) had 19,000 call files. Calls were reviewed and analyzed by University of Minnesota-Duluth, Natural Resources Research Institute staff using Kaleidoscope Pro (version 4.0.4) and Sonobat (version 4.0.6) automated analysis software. Automated full spectrum software has not been approved by the USFWS for use in identifying presence of northern long-eared bats.

Northern long-eared bats, evening bats and tricolored bat calls were positively identified by Kaleidoscope Pro software at both sites; however, only tricolored bat calls were identified by Sonobat at both sites (Table 42). Presence of all the bat species from passive full spectrum acoustic surveys in 2017 have been confirmed either through captures or zero-crossing acoustic bat surveys (MNDNR and MNARNG 2017, 2016). Qualitative analysis of the evening bat call files are pending to confirm if they are regular visitors to AHATS.

Table 42. Acoustic bat survey results, Pettersson D500X full spectrum detector, Arden Hills Army Training Site, Minnesota, 2017.

AHATS Site Name	Big Brown Bat (EPFU)	Red Bat (LABO)	Hoary Bat (LACI)	Silver-haired Bat (LANO)	Little Brown Myotis (MYLU)	Northern long-eared Bat (MYSE)	Tricolored Bat (PESU)	Evening Bat (NYHU)	Not Identified	Noise, not bat	Grand Total
KALEIDOSCOPE PRO AUTOMATED ANALYSIS											
33371 NWq2	453	138	123	548	56	2	8	19	8,193	7,001	16,541
33371 NWqd	240	91	33	208	81	3	7	7	16,572	1,758	19,000
KPro Total	693	229	156	756	137	5	15	26	24,765	8,759	35,541
SONOBAT AUTOMATED ANALYSIS											
33371 NWq2	277	53	21	157	21	0	3	0	7,926	8,083	16,541
33371 NWqd	87	14	18	44	43	0	3	0	8,105	10,686	19,000
Sonobat Total	364	67	39	201	64	0	6	0	16,031	18,769	35,541

White-tailed Deer (*Odocoileus virginianus*) Aerial Survey

Historically, winter white-tailed deer populations at the AHATS and Twin Cities Army Ammunition Plant (TCAAP) properties have fluctuated from an estimated high of 400 in the late 1960s (Jordan et al. 1997) to 30 in 2001 and 2003. Overpopulation of deer may negatively impact vegetation and efforts to restore oak savannah, impact the vegetative structure required for military training and cause hazards due to vehicle collisions along perimeter roadways. Aerial deer surveys are conducted annually to track population changes. The number of deer counted during winter deer surveys had increased to a high of 124 in 2007, but has recently declined (Table 43). No aerial deer survey was conducted in 2017 because there was insufficient snow cover, a requirement for an accurate survey.

Table 43. Aerial surveys of white-tailed deer, Twin Cities Army Ammunition Plant and Arden Hills Army Training Site, 1999 – 2017.

Year	1999	2000	2001	2002 ^a	2003	2004	2005 ^a	2006	2007	2008	2009	2010	2011	2012 ^a	2013	2014	2015 ^a	2016	2017 ^a
Deer Counted	41	47	30	—	30	47	—	84	124	87	104	72	61	—	41	64	—	6	—

^a No count conducted

Although the properties are fenced, deer are not completely restricted from moving in and out of AHATS and TCAAP. Since control of the deer population at AHATS and the surrounding area occurs primarily on the training site, management of this population will rely primarily on archery hunting pressure. As the number of deer increased since 2003, the number of hunts and total number of deer harvested also increased to keep the deer herd from becoming too large (See Hunting Programs section in this document for hunt data summaries). The overall reduction in deer numbers is partially due to the harvest of deer in the fall of 2009, 2010, 2012, 2014, 2015, 2016 and 2017 when 66, 52, 53, 42, 25, 25 and 30 deer were harvested, respectively. These are the largest total number of deer harvested since hunts began in 2003. This indicates that hunting pressure has aided reduction in deer numbers and continues to be necessary to reduce and/or maintain the deer population.

Beaver (*Castor canadensis*)

Beaver are an important part of the natural ecosystems at AHATS. This species can have a large effect on the environment in which it lives. In a natural system, beavers create or enlarge wetland areas which trap nutrients and help to reduce flooding by holding and slowly releasing water. However, problems occur in localized areas when beavers plug road culverts, flooding and damaging roads. When this occurs, a cooperative effort between the Environmental Office, the DNR and AHATS Department of Public Works (DPW) is initiated to identify problem areas and implement solutions.

All problem areas are inspected by the Environmental Office and possible solutions are provided to AHATS's DPW. Some areas require the removal of beaver through trapping. AHATS beaver removal is conducted by a nuisance beaver trapper at the direction of the DNR/MNARNG staff. No beaver were removed from AHATS during 2016– 2017.

Many problem areas can be addressed through the use of damage control structures, such as Clemson levelers and beaver deceivers. These devices have been used successfully at AHATS in the past, when installed correctly. However, these devices do require maintenance and eventually fail and/or need to be replaced.

Beaver ponds and wetlands throughout AHATS provide habitat for Blanding's turtles and numerous reptiles and amphibians; as well as provide feeding areas for a variety of wildlife and habitat for waterfowl and other birds. Therefore, it is important that these wetlands not be permanently drawn down or drawn down in fall or winter in order to install these devices. Installation should occur after a temporary drawdown in spring or summer, or during natural low-water levels. Research in east-central Minnesota investigated the effects of a controlled drawdown on Blanding's turtle populations. The incidence of mortality was high after the drawdown due to predation, road mortality and winterkill (Dorff Hall and Cuthbert 2000).

Reptiles and Amphibians

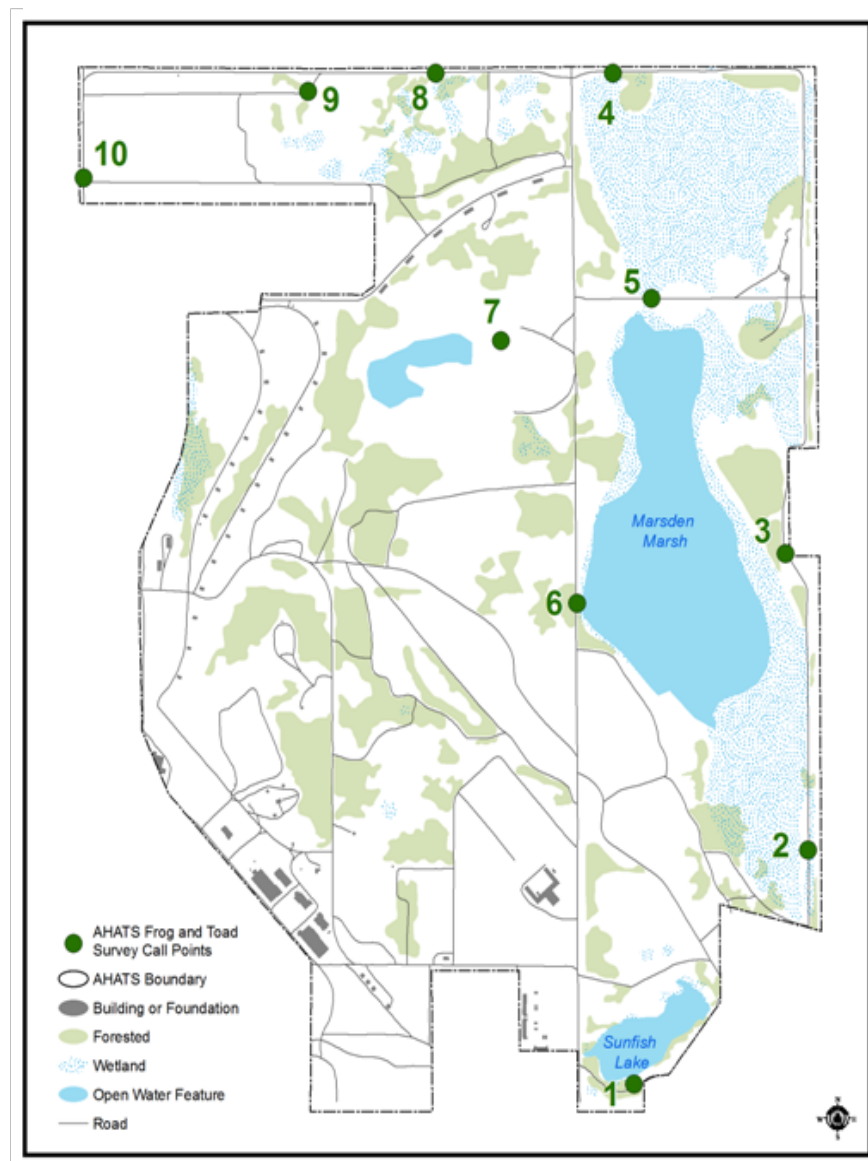
Blanding's Turtle (*Emys blandingii*)

The Blanding's turtle is listed as a state threatened species by the DNR. AHATS is part of a Blanding's turtle priority area as designated by the DNR (Figure 58 in MNDNR and MNARNG 2013). Priority areas are the most important areas in the state for management, protection and research of Minnesota's Blanding's turtle population. In July 2012, the USFWS was petitioned to include Blanding's turtles as threatened or endangered. The USFWS determined, in July 2015, that the petition presented substantial information that federal listing of Blanding's turtles may be warranted. Therefore, a status review was initiated and a determination will be made whether to propose listing Blanding's turtles under the Endangered Species Act (USFWS 2016d). This species depends upon a variety of wetland types and sizes, and uses sandy upland areas and roadways for nesting. Surveys of Blanding's turtles have occasionally occurred at AHATS. Because nest predation is extremely high, road surveys are conducted in known Blanding's habitats to find and protect nests. A Blanding's turtle road survey was not conducted in 2016–2017.

Anuran Surveys

Frog and toad calling surveys are conducted as part of a larger statewide survey, and have been conducted at AHATS since 1993. The statewide survey began due to growing

Figure 62. Anuran survey stops, Arden Hills Army Training Site, since 2003.



concern, for the past two decades, over declining amphibian populations worldwide. Frog and toad abundance estimates are documented by the index level of their chorus, following Minnesota Herpetological Society guidelines (Moriarty, unpublished). If individual songs can be counted and there is no overlap of calls, the species is assigned an index value of 1. If there is overlap in calls the index value is 2 and a full chorus is designated a 3. Anuran surveys are performed at ten stops. The routes are surveyed three times from April through July (Figure 62).

Surveys were conducted by Mary Lee, MNARNG, during two of the three survey time periods on April 4 and May 25, 2017. Site #7 was not surveyed during both time periods. Boreal chorus frogs (*Pseudacris maculata*) and wood frogs (*Lithobates sylvaticus*) were detected during the first time period (Figure 63). During the second time period, boreal chorus frogs and gray treefrogs (*Hyla versicolor*) were detected (Figure 64). Spring peepers (*Pseudacris crucifer*) were not detected during either time period but have been detected in four of the last six years. Population trends in 2009 indicated a detectable decrease in the proportion of statewide routes where spring peepers were heard. However, there were no detectable statewide trends for spring peepers in 2015. Interpretation of AHATS results can difficult be due to years when the anuran survey was not conducted, particularly during the third survey period.

Figure 63. Average anuran index value during the first survey period, Arden Hills Army Training Site, 2003, 2004, and 2008 – 2017. Surveys were not conducted from 2005 – 2007.

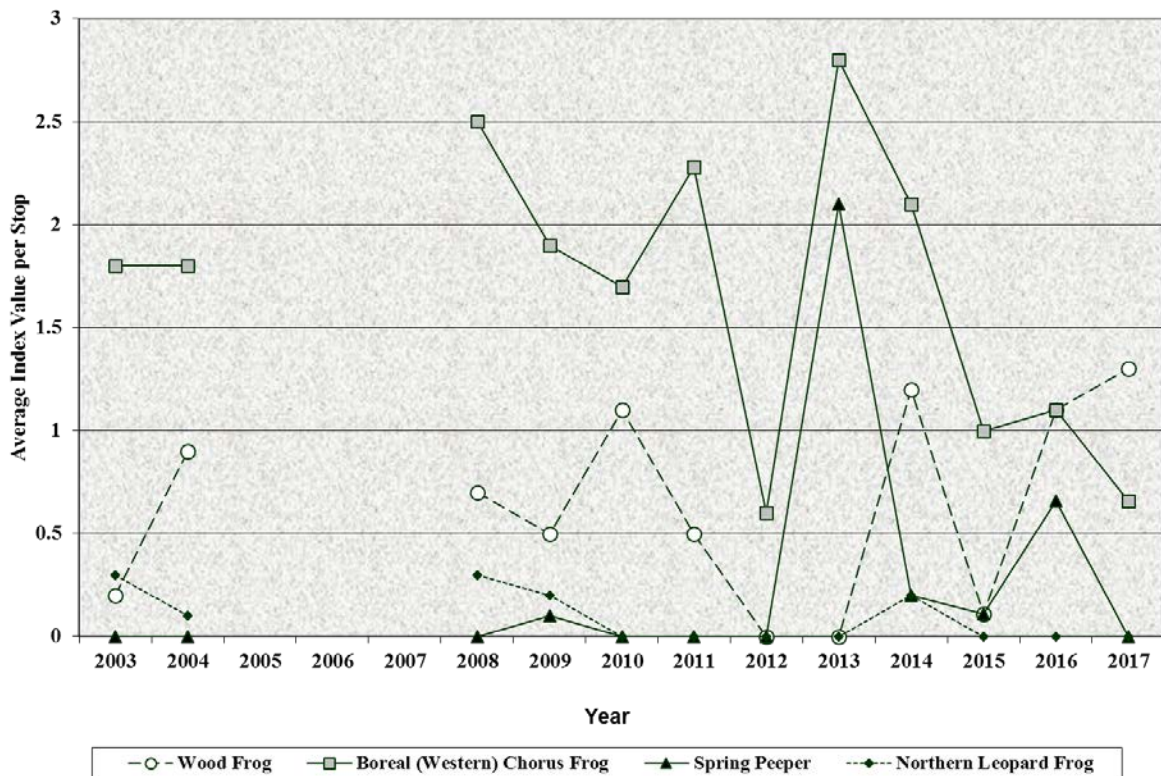
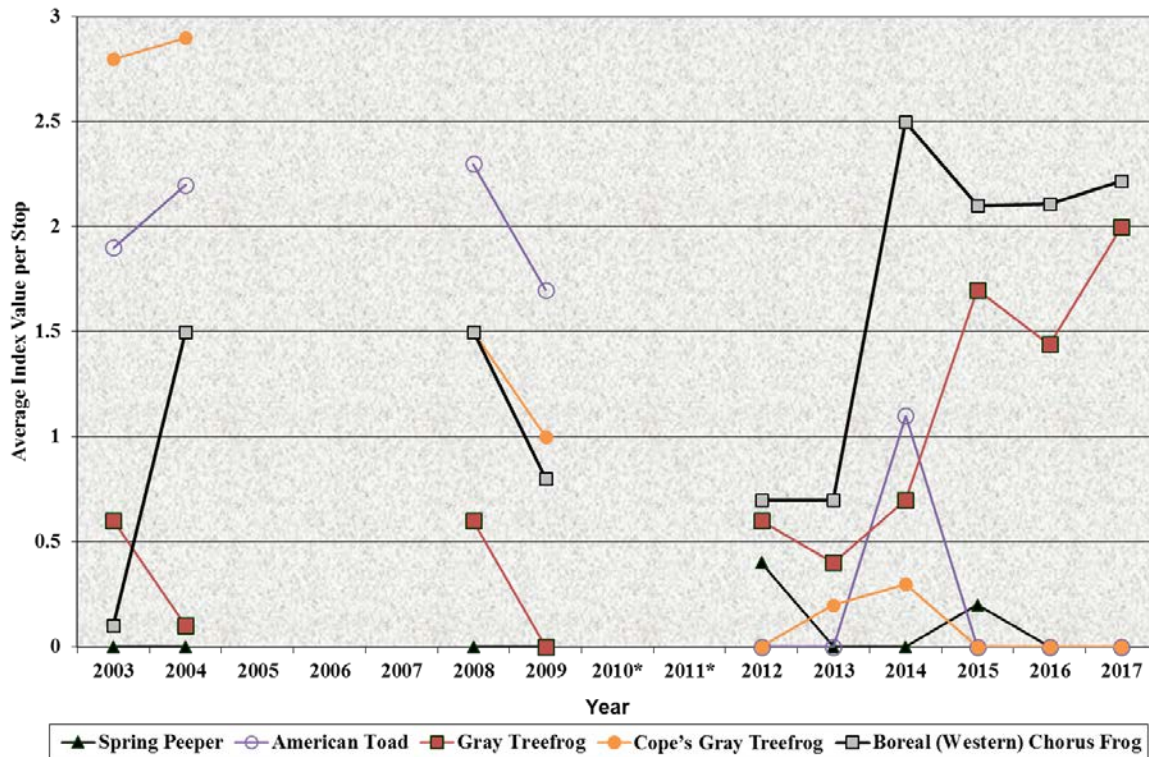


Figure 64. Average anuran index value during the first survey period, Arden Hills Army Training Site, 2003, 2004, 2008, 2009 and 2012 – 2017. Surveys were not conducted from 2005 – 2007, 2010 and 2011.



Insects

Butterfly Survey

The Saint Paul Audubon Society conducted their annual survey for butterflies at AHATS on July 8, 2017. Twelve species were recorded for a total of 30 individuals. In 2016 and 2017, the diversity of butterfly species decreased significantly from 2015 and 2016, as 2015 was one of the highest species diversities observed (Table 44). The number of individual butterflies observed was the lowest since 2001. Cabbage white (*Pieris rapae*) and common wood nymphs (*Cercyonis pegala*) (Figure 65) were the most common species observed in 2017. Common wood nymphs have been observed 15 of the 17 years but numbers have been low the past four years. Cabbage whites have been observed 10 of the past 17 years of the survey; however, in 2017 the largest number were observed (Table 44).

Figure 65. Common wood nymph, Arden Hills Army Training Site, July 8, 2017 (Photographer: Mary Lee).



Table 44. Number of butterflies, Arden Hills Army Training Site, Saint Paul Audubon Society, 2001 – 2017.

Common Name	Scientific Name	July 6, 2001	July 14, 2002	July 6, 2003	July 10, 2004	July 9, 2005	July 8, 2006	June 30, 2007	June 29, 2008	June 27, 2009	June 26, 2010	June 26, 2011	June 30, 2012	June 30, 2013	July 3, 2014	June 27, 2015	July 9, 2016	July 8, 2017
Black swallowtail	<i>Papilio polyxenes</i>	1				1	1	1										
Eastern tiger swallowtail	<i>Papilio glaucus</i>	4				2			2	1		1	2		1	2	2	
Swallowtail species	<i>species undetermined</i>	1		1								2						
Checkered white	<i>Pontia protodica</i>	3																
Cabbage white	<i>Pieris rapae</i>		5			1		5	5	2	2	5				9	2	10
"Whites"	<i>Pieris species</i>					1						1					1	
Clouded sulphur	<i>Colias philodice</i>	?	2	8		2	6	42			10		6			1	2	5
Orange sulphur	<i>Colias eurytheme</i>	100s	35	1	1	1		30			6		20	1	4	1	7	1
Dainty sulphur	<i>Nathalis iole</i>	1																
Sulphur species	<i>species undetermined</i>										15		3	2			5	
American copper	<i>Lycaena phlaeas</i>		3				2	2	2								1	
Gray copper	<i>Lycaena dione</i>	9	1	8														
Bronze copper	<i>Lycaena hyllus</i>																	
Edward's hairstreak	<i>Satyrrium edwardsii</i>			1														
Coral hairstreak	<i>Satyrrium titus</i>	2	1	1	1								1			1		
Banded hairstreak	<i>Satyrrium calanus</i>			1						1				2	2			
Striped hairstreak	<i>Satyrrium liparops</i>	1						1										
Hairstreak species	<i>species undetermined</i>			2						1				3	1	3		
Eastern tailed-blue	<i>Everes comyntas</i>	5	100's	4		6	32	34			2	1	5	11	1	2	5	14
Western tailed-blue	<i>Cupido amyntula</i>													1				
Blues species	<i>Species undetermined</i>															1	1	
Spring azure	<i>Celastrina ladon</i>									8	6					2	1	1
'Summer' spring azure	<i>Celastrina ladon neglecta</i>	4	1	3						8	1			1			1	
Variegated fritillary	<i>Euptoieta claudia</i>	1		1														
Great spangled fritillary	<i>Speyeria cybele</i>	12	11	40	9	16	5	13	2	4	17		15	2	2	8	1	4
Aphrodite fritillary	<i>Speyeria aphrodite</i>	4	4	dozens	19	10	14	2	2	4			5		2	10	1	
Regal fritillary	<i>Speyeria idalia</i>																	
Silver-bordered fritillary	<i>Boloria selene</i>																	
Fritillary species	<i>species undetermined</i>	32	10	14	14+		14	28		14	10		10			26	15	10
Silvery checkerspot	<i>Chlosyne nycteis</i>				1													
Pearl crescent	<i>Phyciodes tharos</i>	11			1													
Northern crescent	<i>Phyciodes selenis</i>			7	2		1			1					10	23	1	1
Northern pearl crescent	<i>Phyciodes selenis/tharos</i>					1	1	7	2									
Crescent species	<i>species undetermined</i>		2	4						6	1	16	2	1		7		
Baltimore checkerspot	<i>Euphydryas phaeton</i>	15		6	13	5	4	10	1	3	1							
Question mark	<i>Polygonia interrogationis</i>		1				2						1					
Silvery checkerspot	<i>Chlosyne nycteis</i>				1											3		2
Eastern comma	<i>Polygonia comma</i>			1			3		2		5		1					
Gray comma	<i>Polygonia progne</i>										2					1		

Table 44. Number of butterflies, Arden Hills Army Training Site, Saint Paul Audubon Society, 2001 – 2017.

Common Name	Scientific Name	July 6, 2001	July 14, 2002	July 6, 2003	July 10, 2004	July 9, 2005	July 8, 2006	June 30, 2007	June 29, 2008	June 27, 2009	June 26, 2010	June 26, 2011	June 30, 2012	June 30, 2013	July 3, 2014	June 27, 2015	July 9, 2016	July 8, 2017
Comma species	<i>species undetermined</i>																	
Mourning cloak	<i>Nymphalis antiopa</i>	2	2	5	2	5		3	2	1	2	2			3	1	3	1
American lady	<i>Vanessa virginiensis</i>	6	2	1		1		4										
Painted lady	<i>Vanessa cardui</i>	5									1							
Vanessa species	<i>species undetermined</i>		1															
Red admiral	<i>Vanessa atalanta</i>	12+		3			2	11			3		3	1		2	1	1
American lady	<i>Vanessa virginiensis</i>															1		1
Common buckeye	<i>Junonia coenia</i>	7	1			1		6						3				
White admiral	<i>Limenitis arthemis arthemis</i>								3							6		
Red-spotted purple	<i>(Limenitis a. astyanax)</i>								1	1						1		
Viceroy	<i>Limenitis archippus</i>	1	2	5		1			2			1		4			4	1
Hackberry emperor	<i>Asterocampa celtis</i>							2								6		
Northern pearly-eye	<i>Enodia anhedon</i>	2	4	7	1	5	9	5			2		1		2	1	3	
Eyed brown	<i>Satyrus eurydice</i>	46	15–20	22	3	5	32	26	1		4				1			9
Little wood satyr	<i>Megisto cymela</i>								2	7	2	7	1		3	10		
Common ringlet	<i>Coenonympha tullia</i>	4							6	11				6		3		
Common wood nymph	<i>Cercyonis pegala</i>	dozen	dozen	100–	100+	36	104	173		44	57	7	26		22	58	20	19
Monarch	<i>Danaus plexippus</i>	11	10	11	1	17	64	38	4	10	3	3	7	2	11	3	1	5
Silver-spotted skipper	<i>Epargyreus clarus</i>	2	2	1	1	1	2	2		2		1	8	7	7	6		5
Northern Cloudywing Skipper	<i>Thorybes pylades</i>									1								
Least skipperling	<i>Ancyloxypha numitor</i>									1			1					
European skipper	<i>Thymelicus lineola</i>	6		dozens	2	1		5	23	32	17	74	2	1	2	29	2	
Peck's skipper	<i>Polites peckius (=coras)</i>								2			1						
Northern cloudy skipper	<i>Thorybes pylades</i>																	
Tawny-edged skipper	<i>Polites themistocles</i>	4						1					1					
Long dash	<i>Polites mystic</i>							1										
Delaware skipper	<i>Atrytone logan</i>	4	7	11	1	4	7	2										3
Northern broken -dash	<i>Wallengrenia egeremet</i>	1		2			3	15					3					1
Mulberry wing	<i>Poanes massasoit</i>	1	1	1	3	1	6	1					1	1			2	3
Hobomok skipper	<i>Poanes hobomok</i>											1				1		
Dion skipper	<i>Euphyes dion</i>							1										
Black dash	<i>Euphyes conspurcua</i>							3										
Dun skipper	<i>Euphyes vestris</i>	1		3			8	4			2						3	7
Skipper species	<i>species undetermined</i>				1		4	2	2	1	3	2	2		1	3	5	
Grass skipper species	<i>species undetermined</i>														1			
Total Species*		35	26	32	17	23	20	32	18	22	23	13	20	17	15	31	20	20
Total Individuals**					176	124	329	480	66	156	173	125	127	49	76	232	90	104

*a species of butterfly and all its subspecies are counted as a single species

**total individuals may not be available due to estimates

Monarch Butterfly (*Danaus plexippus*)

Monarch butterflies are found throughout the United States. Eastern populations migrate vast distances of over 3,000 miles between U.S./Canada and central Mexico from breeding grounds to overwintering locations, across multiple generations each year. Adults in a summer generation live for two to six weeks while migratory generations live up to nine months. Monarchs from northern latitude breeding grounds that emerge after mid-August begin to migrate south towards overwintering grounds where they have never been before. When this migratory generation begins the northward journey into the southern U.S., this generation lays eggs and nectars as they breed and migrate north. The generation that re-populates the northern latitude breeding grounds the following spring is the second and third generation of the previous falls' generation (Monarch Joint Venture 2015).

Observations of monarchs have occurred annually since 2001 at AHATS (Figure 65); however, the number of individuals observed has declined since 2007 (Table 44). Populations of

Figure 65. Monarch (*Danaus plexippus*) caterpillar, Arden Hills Army Training Site, July 8, 2017 (compliments of Maurice Whalen, Saint Paul Audubon Society volunteer).



monarchs are declining in both the eastern and western portions of their North American range. Monarchs are now being considered for protection under the federal Endangered Species Act. The USFWS is currently conducting a species status assessment to describe the viability of monarch populations which will support ESA decisions. The USFWS anticipates an ESA listing decision by June 2019. The major population threats are breeding, migration and

overwintering habitat losses. Insecticides used to control insects are also harmful to monarchs. And, herbicides used to control weeds can affect milkweed populations, the only plant that female monarchs use to lay eggs and the only plant its' caterpillars eat (Monarch Joint Venture 2015).

Best management practices for monarch populations on AHATS should include avoiding mowing ditches when monarch larvae are present, late April to mid-August, particularly locations where common milkweed (*Asclepias syriaca*) is present. In addition, limiting insecticide and herbicide use would be beneficial.

Bumble Bees

By Nancy Dietz and Erica Hoaglund, DNR, Nongame Wildlife Program

Historically about 400 native bee species occurred in Minnesota. However, little is known about bees because the most recent state species list was published in 1919. Bumble bees are a group of insect pollinators. Pollinators are critical to the agricultural economy and natural habitats and ecosystems as 90% of the world's flowering plants rely on animal pollinators. "Pollination happens when wind, water and wildlife carry pollen from the anther (male part) to the stigma (female part) of plants" (MNDNR 2017c and Hatfield et al. 2012). Threats to bumble bee populations include habitat fragmentation, grazing, pesticide use, genetic diversity, pests and diseases, competition with honey bees and climate change (Hatfield et al. 2012). The economic value of pollination services provided by native insects (mostly bees) is estimated at \$3 billion dollars annually in the United States (USFWS 2017b).

Five bumble bees are listed as SGCN in Minnesota, they are: rusty patched bumble bee (*Bombus affinis*), Ashton cuckoo bumble bee (*Bombus bohemicus*), yellow-banded bumble bee (*Bombus terricola*) and golden northern bumble bee (yellow bumble bee; *Bombus fervidus*). Rusty patched bumble bee abundance and distribution has decline by 90% since the late 1990s. Recently the rusty patched bumble bee was listed as federally endangered under the Endangered Species Act on March 21, 2017. None of the single threats above are causing the rusty patched population decline, but the threats working in concert are likely causing the decline (USFWS 2017b).

Rusty patched bumble bee range includes AHATS. Rusty patched bumble bee observations occurred in 2016 and 2017 within 7.5 miles of AHATS (Bumble Bee Watch 2018). The cantonment area of AHATS is in a USFWS low potential zone (Figure 66). These zones are areas where maximum dispersal potential for known rusty patched bumble bee locations since 2007. These zones are used to determine where non-lethal survey methods and a scientific recovery permit for surveys are recommended. No lethal bumble bee surveys techniques have occurred on AHATS.

Department of Natural Resources central region nongame wildlife staff and volunteers conducted approximately 25 person hours of bumble bee net capture surveys on AHATS in summer 2017. Some of these surveys were associated with the annual butterfly survey (July 8, 2017) hosted at AHATS as well as incidental to bat surveys (July 6 and 7, 2017). All of these surveys targeted the federally endangered rusty patched bumble bee as well as the candidate species the yellow-banded bumblebee. Neither of these species were encountered on AHATS in summer 2017.

Although neither of the species of federal concern were encountered a total of seven other bumble bee species were encountered in varying abundances. Species encountered during 2017 surveys were: two-spotted bumble bee (*Bombus bimaculatus*), red-belted bumble bee (*Bombus rufocinctus*), common eastern bumble bee (*Bombus impatiens*), brown-belted bumble bee (*Bombus griseocollis*), black-and-gold bumble bee (*Bombus auricomus*), boreal bumble bee (*Bombus borealis*) and lemon cuckoo bumble bee (*Bombus citrinus*).

Rusty patched bumble bee potential zones include a significant number of MNARNG Readiness Centers across the state (Figure 66). Five Readiness Centers in the Minneapolis/St. Paul area are located within USFWS high potential zones where rusty patched bumble bee is likely to be present. And, ten Readiness Centers are found within low potential zones. No bumble bee surveys nor assessment of habitat availability have occurred at MNARNG Readiness Centers.

OUTREACH AND RECREATION

By Mary Lee, MNARNG

Hunting Programs

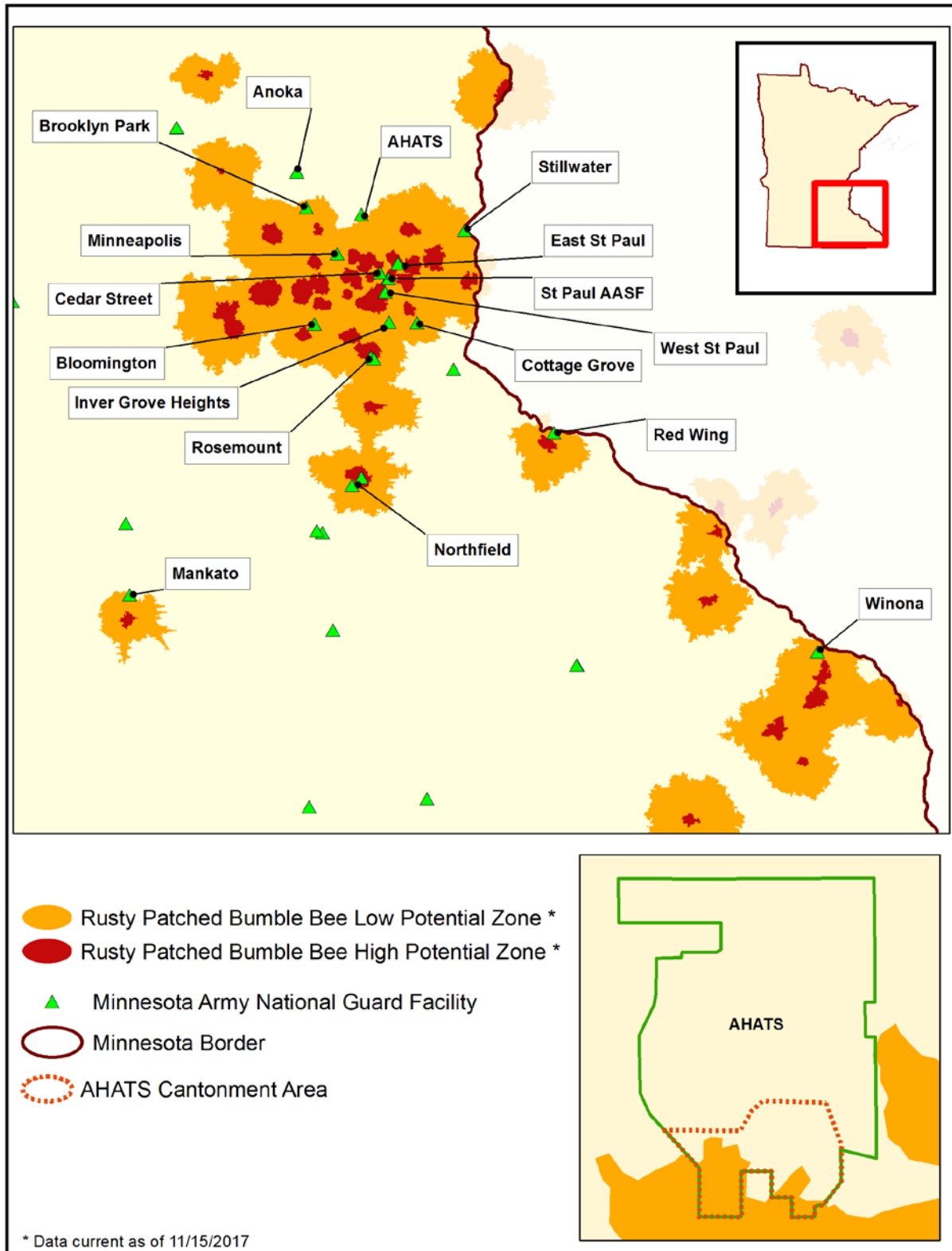
Soldiers Archery Wild Turkey Hunt

AHATS hosted its ninth annual soldier archery turkey hunt on May 10 – 12 and May 13 – 15, 2017. The hunt was organized and conducted by the Environmental staff. Sixteen hunters participated in two, three-day turkey hunts. One hunter was successful, for an overall 6.25% success rate (Table 45).

Table 45. Soldiers wild turkey hunt, Arden Hills Army Training Site, 2009 – 2017.

Year	Turkeys Harvested	Hunter Success	Permits Issued	Number of Hunters	Dates	Largest Turkey (lbs.)
2009	2	25%	8	8	April 15–17	20.9
2010	5	100%	10	5	April 14–16	Unknown
	2	33%	10	6	April 21–23	
2011	2	33%	10	6	April 15–17	22 lbs.
	1	25%	10	4	April 18–20	
2012	2	33%	10	6	April 21–22	23 lbs.
	3	50%	10	6	April 28–29	
2013	1	25%	20	4	April 20–21	Unknown
	4	40%	17	10	April 27–28	
2014	5	29%	20	17	May 8–10	Unknown
	1	33%	20	3	May 11–13	
2015	0	0	20	10	April 15–17	Unknown
	4	40%	20	10	April 25–27	
2016	3	25%	22	12	April 29–	23 lbs.
	0	0	9	4	May 1 May 9–11	
2017	1	10%	0	10	May 10–12	Unknown
	0	0	0	6	May 13–15	

Figure 66. Location of rusty patched bumble bee high and low potential zones and MNARNG Readiness Centers, Minnesota, 2017.



Soldiers Archery Deer Hunt

In 2017, the twelfth annual soldiers' archery deer hunt was held on October 16 – 18, October 27 – 29, November 8 – 10 and December 8 – 10. Forty permits for the first three hunts and ten permits for the last hunt were issued to current military members and Minnesota veterans (Table 46).

Table 46. Soldier archery white-tailed deer hunt, Arden Hills Army Training Site, 2006 – 2017.

Year	Deer Harvested	Bucks	Does	Fawns	Number of Hunters
2006	7	2	5	0	33
2007	13	4	5	4	55
2008	21	7	10	4	102
2009	30	8	6	16	104
2010	35	13	20	2	110
2011	24	8	12	4	79
2012	43	18	23	2	101
2013	19	10	8	1	70
2014	29	15	7	7	78
2015	22	8	10	4	81
2016	20	6	11	3	87
2017	22	9	11	1	74

Volunteer Archery Deer Hunt

Table 47. Volunteer archery white-tailed deer hunt, Arden Hills Army Training Site, 2003 – 2017.

Year	Deer Harvested	Bucks	Does	Fawns	Number of Hunters	Dates
2003	13	6	6	1	18	Nov. 28–30
2004	6	4	2	0	19	Nov. 26–28
2005	9	6	2	1	26	Nov. 25–27
2006	19	9	6	4	26	Nov. 24–26
2007	30	10	15	5	35	Nov. 23–25
2008	22	3	17	2	33	Nov. 28–30
2009	28	11	8	9	31	Nov. 27–29
2010	17	3	6	8	20	Nov. 26–28
2011	11	5	3	2	24	Dec. 2–4
2012	10	5	5	0	26	Nov. 30–Dec. 2
2013	8	5	3	0	33	Dec. 6–8
2014	13	6	5	2	31	Dec. 12–14
2015	3	2	1	0	38	Dec. 11–13
2016	5	1	2	1	26	Dec. 9–11
2017	8	4	3	1	28	Dec. 8–10

Volunteers that support the soldier hunts are allowed an opportunity to hunt at AHATS during the last soldiers hunt on December 8 – 10, 2017. Eight deer were harvested during the combined soldier/volunteer hunt (Table 47).

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Appendix A: Brief Descriptions of Endemic Vector-Borne Diseases in Minnesota.

Tick Borne

- Anaplasmosis – the second most common tick borne disease in Minnesota. It is a bacterial illness caused by *Anaplasma phagocytophilum* and transmitted by the bite of an infected blacklegged (deer) tick. It was formerly known as human granulocytic ehrlichiosis and was first recognized in Minnesota in the mid-1990s. Symptoms usually occur within 1-2 weeks of a tick bite and may include a sudden onset of fever, headache and muscle aches.
- Babesiosis – the third most common tick borne disease in Minnesota. It is caused by a blood parasite, *Babesia microti*, and transmitted by the bite of an infected blacklegged (deer) tick. Many people infected with babesiosis have no symptoms or only mild symptoms. Symptoms such as fever, headache, muscle aches and fatigue may appear within several weeks of a tick bite.
- Ehrlichiosis – a rarely reported form of ehrlichiosis (*Ehrlichia muris euclairensis*) has been found to be transmitted by the bite of infected blacklegged (deer) ticks in Minnesota and Wisconsin. It was first discovered in 2009 and is similar to anaplasmosis involving symptoms such as fever, headache and muscle/joint aches.
- Hard Tick Relapsing Fever – a recently identified illness caused by the bacteria, *Borrelia miyamotoi*. It was first identified as a cause of human illness in 2011 and is likely transmitted by the bite of an infected blacklegged (deer) tick. To date, low numbers of human disease have been reported from the Northeastern and Upper Midwestern regions of the United States. The most common symptoms have included fever, chills, headache, muscle/joint pain and fatigue.
- Lyme Disease – the most common tick borne disease in Minnesota and in the United States. It is a bacterial illness caused by *Borrelia burgdorferi* and transmitted by the bite of an infected blacklegged (deer) tick. It was discovered in Lyme, CT in 1975 and has since been found increasingly throughout several parts of the Northeastern and Upper Midwestern regions of the United States. Early symptoms typically appear within 30 days of a tick bite and may include rash, fever, headache, fatigue and muscle/joint pain. Other symptoms (e.g., multiple rashes, paralysis on one side of the face, or swelling in one or more joints) may occur weeks to months later if a person is not treated early in the course of illness. A closely related organism, *Borrelia mayonii*, was recently identified in 2013 to cause an illness similar to Lyme disease. To date, this organism has only rarely been found in patients with exposures to blacklegged (deer) ticks in Minnesota and Wisconsin.
- Rocky Mountain Spotted Fever – a very rare bacterial illness, caused by *Rickettsia rickettsii*, that is transmitted by the bite of an infected American dog (wood) tick. It is more commonly reported in south-central and southeastern states although rare cases have been reported in Minnesota. Symptoms may include an abrupt onset of fever, headache, muscle aches, nausea, vomiting and spotted rash. The illness can cause organ failure and death so prompt treatment is recommended in suspect cases
- Tularemia – a very rare bacterial illness caused by *Francisella tularensis* and transmitted by several different routes. For instance, bites from an infected deer fly or American dog (wood) tick may transmit the disease while contact with infected rabbits may also spread the disease. Symptoms vary depending on the route of exposure and may include fever, enlarged lymph

nodes, ulcerated skin wound, respiratory or gastrointestinal signs. The illness can cause serious complications and death so prompt treatment is recommended in suspect cases.

Mosquito Borne

- Eastern Equine Encephalitis (EEE) - a rare illness in humans that is maintained in nature through a transmission cycle involving *Culiseta melanura* and birds. Humans may become infected after a bite through an infected bridge vector such as *Coquillettidia perturbans*. Many people infected with EEE virus show no symptoms but some (primarily children) have severe illness. Symptoms may include a sudden onset of headache, fever and vomiting that may progress to disorientation, seizures, coma and death. Although cases have been reported in horses, no human cases have been identified in Minnesota.
- Jamestown Canyon Virus Disease – a rarely reported cause of illness in humans that may be transmitted by several different types of mosquitoes throughout Minnesota, particularly the snowmelt *Aedes* species. The virus is closely related to La Crosse virus although any age group may be affected and cases may occur anytime during the warmer months of the year, most commonly between May and September. Similar to other mosquito borne illnesses, symptoms may include fever, headache, meningitis or encephalitis (inflammation of the central nervous system, including the brain).
- La Crosse Encephalitis – this rare illness is caused by La Crosse virus and transmitted to humans primarily by *Aedes triseriatus* (tree hole mosquito) in Minnesota. Cases have been primarily reported from the southeastern region of Minnesota but the Minnesota Department of Health has had recent case reports from central Minnesota in Stearns County. Most people infected with this virus will have either no symptoms or a mild flu-like illness. Symptoms usually show up suddenly within 1 – 2 weeks of being bitten by an infected mosquito. A small percentage of people (especially children) may develop encephalitis (inflammation of the brain).
- West Nile Virus Disease - West Nile virus (WNV) is transmitted to people through the bite of an infected mosquito. In Minnesota, *Culex tarsalis*, a common mosquito in agricultural regions of western and central Minnesota, is the most important vector in transmitting the virus to humans. Most people infected with West Nile virus will have no symptoms or a mild illness with fever. A small percentage of people (<1%), especially elderly patients, may develop meningitis or encephalitis (inflammation of the central nervous system, including the brain). Approximately 10% of these encephalitis cases are fatal.



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