Bird Friendly Iowa

Application for Story County

PREAMBLE

As Board Chair of Story County, Iowa, I am applying for official recognition as a Bird Friendly County, having achieved the criteria set forth by the Bird Friendly Iowa organization.
Signed: Linda Murken Application Date: December 3, 2019

OFFICIAL CONTACTS

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- ❖ Bruce Ehresman, DNR Bird Biologist, retired, 810 Brookridge Avenue, Ames, 50010, 515-509-4165, behresman5@gmail.com

PARTNERS

- ➢ Outdoor Alliance of Story County, Diane Birt, dbirt.ames@gmail.com
- ➢ Big Bluestem Audubon Society, Bruce Ehresman, behresman5@gmail.com
- ➢ Story County Pheasants Forever, Joe Kooiker, jkooiker@storycountyiowa.gov

CRITERIA DOCUMENTED

Protect, restore & enhance bird habitat (3 of 11)

- ★ County has prepared a habitat assessment or management plan for one or more of its natural areas or parks, and is implementing the plan.
- ★ A list of bird species present has been completed for one or more designated areas in the County, and has been updated within the past three years.
- ★ A substantial portion of the county's land has legal protection through public ownership or conservation easement. These lands include managed native habitats that support at least 10 Greatest Conservation Need native bird species. The applicant needs to justify why it feels that this protection is "substantial".
- ★ County offers public information about controlling or removing invasive plant species.
- ★ One or more communities within the County have a storm water management program or other designation such as Tree City USA, Bird Friendly Iowa, etc.

Reduce threats to birds (2 of 10)

- ★ The County has ordinance language or other means for enforcing state law regarding time constraints for mowing roadsides.
- ★ The County supports bird-friendly construction and placement of communication towers.
- ★ The County has requirement(s) for non-toxic ammunition on public hunting areas.
- ★ The County has receptacles for used fishing line at one or more fishing areas.
- ★ Demonstrate, in narrative, some other important accomplishment in this category.

Educate & engage people in birding & conservation (3 of 13)

- ★ County staff and volunteers actively educate about birds, which includes providing information about identification, natural history, habitat needs, and/or environmental and human threats to bird populations.
- ★ The County encourages students and/or other community members to participate in citizen science bird monitoring or developing local bird species checklists. Areas within the County are represented in at least one bird monitoring program, such as the Great Backyard Bird Count, Audubon Christmas Bird Count, Project FeederWatch, or other actively coordinated citizen science project.
- ★ The County provides age-appropriate public programming on one or more bird information topics. This may include field trips, speaker series, displays, or other media.
- ★ The County has a program that involves schools, garden clubs or other organizations, habitat development or butterfly & bird conservation activities.

BIRD FRIENDLY COUNTY

Protect, restore, and enhance bird habitat

1) *County has prepared a habitat assessment or management plan for one or more of its natural areas or parks, and is implementing the plan*

Story County Conservation manages and protects Robison Wildlife Acres, which is a 78-acre park near Maxwell, Iowa. The wildlife refuge has a large variety of habitats including remnant prairie and savanna, upland forests, riparian forests, shrubland and a man-made pond.

The County was awarded Wildlife Diversity Grants in both 2011 and 2018 to conduct habitat assessments and implement habitat improvement. In 2011, Dr. Tom Rosburg was contracted out to do a baseline study for the area. For this study, he established four permanent plots from which plant and bird communities would be inventoried over time. He identified 135 plant species between the four sites. For these plant species, he provided statistical analysis of plant density and frequency along with basic ecological information to help guide future management. Thirty bird species were also observed at the study sites.

After seven years of management (2018), Dr. Rosburg returned to the four permanent plots to replicate his prior habitat assessment. He discovered an additional 39 plant species that were not present in 2011 which brings the total plant species for the area up to 174. Of the total plant species, 19 were of the non-native variety. With this new set of data, the land managers were able to see how the plant communities became healthier over time in three of the four sites – they increased in total native species richness and decreased in non-desirable plant stem density. One site didn't show significant improvement or decline. For this site, a new method of disturbance from the historic regime will be implemented.

All management that was conducted between 2010 and 2017 was recorded in Dr. Rosburg's final report. These management activities included mechanical woody clearing, goat grazing, and fall and spring controlled burns.

This habitat assessment has been an extraordinary resource to justify that staff time, money and resources applied to this area have been beneficial and that the County is on the right track to restoring the Robison Wildlife Acres area to its native state. The County has and will continue to manage the area using the proven beneficial management techniques as well as utilizing additional land management recommendations that were outlined in the habitat assessment. It should be a priority to conduct an additional bird survey at the park to see if the bird species abundance has increased due to the overall habitat improvement.

Dr. Tom Rosburg's final report is found in *Appendix A:* "*The Response of Vegetation to Seven Years of Ecological Practices at Robison Wildlife Acres, Story County, Iowa*" on page 11.

2) *A list of bird species present has been completed on one or more designated areas in the County, and has been updated within the past three years*

The Jennett Heritage Area (Jennett HA) is a 171-acre property in Story County that has been surveyed for birds in 2010 and 2019. See *Appendix B: "2010 Breeding Bird Survey for Jennett Heritage Area"* on page 80 and *Appendix C:* "*Breeding Bird Survey of Jennett Heritage Area: Final Report to Story County Conservation-2019"* on page 85. The Jennett HA holds diverse habitats and includes 25 acres of remnant prairie, oak savanna, woodlands, two streams, two ponds, and a shallow wetland. After a decade of habitat restoration work on the property, Story County Conservation was interested to learn what bird species are utilizing the area compared to before restoration work began. While 57 species were detected during the 2010 bird surveys (in ~22.5 hours of field time), 101 species were detected during 2019 (in ~13 hours of field time). More importantly, there were 15 SGCN (Species of Great Conservation Need) breeding birds documented in the 2010 survey, increasing to 28 SGCN breeding birds documented in the 2019 survey. During 2010, probable and confirmed evidence of breeding occurred for 20 species, and in 2019, probable and confirmed evidence of breeding occurred for 80 species. The results of these two surveys provide strong supportive evidence that habitat restoration work (by Story County Conservation) on Jennett HA is responsible for a dramatic increase in the number of species that nest on this property, and that the large scale of the restoration, particularly prairie, has increased the quality of the vegetation (as well as the space) that is needed for nesting by SGCN. For instance, several area-sensitive grassland birds, including state threatened Henslow's Sparrow, was found during 2019 surveys and not during the 2010 surveys. Jennett HA has become an area of critical importance to breeding SGCN grassland birds; particularly to Sedge Wren, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Dickcissel, Bobolink, and Eastern Meadowlark.

Ada Hayden Heritage Park is a 430-acre complex that includes two lakes, several wetlands, much grassland, and some wooded areas. Wolfgang (Wolf) Oesterreich, who lives beside the park, has kept a bird list for this area every year since 1997 (see bird lists documents in Appendix for Ada Hayden Park from 1997-2008 and 1997 to 2018). The area is owned by the City of Ames; Story County Conservation has helped with some management. From 1997 through 2018, Wolf has documented 274 bird species at the site. It seems safe to say that no other 430-acre area in this state has had as many species of birds documented. The water quality of the lakes is some of the highest in Iowa, and much effort has been made to manage and restore the entire area of the park to native vegetation.

The Ames Christmas Bird Count (CBC) in Story County has occurred every year since 1923. See *Appendix D: "2008 Ames CBC Results, 2010 Ames CBC Results, 2011 Ames CBC Results, 2018 Ames CBC Results"* on page 93. The CBC area surveyed includes a 7.5-mile radius circle that is centered in southeast Ames (approximately where Highway 30 intersects with I-35). Sponsored by Big Bluestem Audubon Society, each year as many as 43 participants contribute a total of up to 104.5 hours on the day of the event, counting every bird (up to approximately 27,000 individuals) seen while driving roads, walking (in fields, parks, and wildlife areas), or sitting while observing birds at feeders. The data collected by observers allow Audubon researchers, conservation biologists, wildlife agencies and other interested individuals

to study the long-term health and status of bird populations. This collected data provides a picture of how bird populations have changed in time and space over the past hundred years, it informs strategies to protect birds and their habitat, and it helps identify environmental issues with implications for people, as well.

3) *A substantial portion of the County's land has legal protection through public ownership or conservation easement. These lands include managed native habitats that support at least 10 Great Conservation Need native bird species. The applicant needs to justify why it feels that this protection is "substantial."*

Story County, Iowa, contains 367,127 acres of land area. In the unincorporated area, outside of city corporate limits, there are 344,775 acres. There are 4,780 acres of publicly owned and managed lands countywide for conservation purposes. See *Appendix E:* "*Story County Publicly Owned and Managed Lands"* on page 115. In addition to lands owned and/or managed by Story County Conservation, the 4,778 acres includes almost four acres owned by the City of Slater, one acre owned by the City of Cambridge, and 12 acres owned by the City of Maxwell that are part of the Heart of Iowa Nature Trail. It also includes areas owned by the Iowa Department of Natural Resources—the Bob Pyle Marsh, Hendrickson Marsh, and Interstate 35 Prairie—and parts of the Colo Ponds, Doolittle Prairie, and Skunk River Flats owned by the IDNR and Story County Conservation. And it includes several acres of land owned by the United States Army Corps of Engineers in the Skunk River Greenbelt for which Story County Conservation has a conservation easement. Not included are 494 acres of land owned by the Iowa Natural Heritage Foundation. In total, with the land owned by the Iowa Natural Heritage Foundation, there are 5,274 acres in public ownership or management. While this is 1.2% of the county's land area, it is almost as many acres as are owned by Iowa State University and the Board of Regents. The University and Board have ownership of approximately 5,912 acres in Story County for its campus, research park, and research farms. Based on this comparison, there are a substantial number of acres that are publicly owned or managed in Story County.

Beyond public management, natural resources in Story County have several different types of legal protections through the Story County Land Development Regulations (the County's adopted zoning code for the unincorporated area) and future land use plans. First, under Chapter 88.05 of the Story County Land Development Regulations, in areas designated as natural resources areas in the County's Cornerstone to Capstone Comprehensive Plan Future Land Use Map, no more than 15% of a natural resource may be removed without mitigation requirements. If an area is proposed to be subdivided, a 60-foot wide stream easement is required to be dedicated to Story County Conservation as part of the subdivision. The chapter also requires buffers for construction activities from natural resources ranging from 50 feet for streams and 100 feet from wetlands, lakes, and reservoirs. These standards would also apply to areas designated as Natural Areas in the Ames Urban Fringe Plan Land Use Framework Map, which serves as the future land use plan for areas within two miles of the City of Ames. Further, regarding restrictions on new development in these areas, a principle of the Ames Urban Fringe Plan is that new non-farm residential development is not supported. A principle of the C2C plan

is to “generally discourage development within these areas. In unique circumstances where appropriate development types may enhance the area, recognize and encourage such approaches.” Finally, the Story County Land Development Regulations Chapter 92 do not permit the rezoning of a parcel with 50% or more of its area designated as a natural resource area unless it is a rezoning to a more restrictive district, such as the Greenbelt Conservation District or Residential Conservation Design Overlay District, where the areas cannot be developed, or an easement protecting the areas is provided. See *Appendix F: “Areas Designated as Natural Resource Areas in the Ames Urban Fringe and C2C Plans”* on page 117. In total, the acres protected by these natural areas designations is 41,406—12% of the land area in unincorporated Story County.

Finally, Story County has a zoning district, the Greenbelt Conservation District, that provides further protections for the Skunk River Greenbelt north of Ames by restricting certain uses. The Statement of Intent for the district is:

> to provide special regulations for resource conservation of lands containing sensitive environmental conditions. These regulations permit reasonable economic use of property and at the same time protect the natural resources and recreational assets of the area. This District is designated to promote water quality and conservation, to protect aquifers, alluvial soils and slopes; and to protect areas which possess outstanding scenic, vegetation, wildlife habitat, and travel corridors, geological, historic or recreational values. Structures inconsistent with the permitted uses shall not be allowed in the Greenbelt-Conservation District.

Permitted uses of properties in the district include agriculture (no clear cutting permitted), truck gardening, nurseries, orchards, apiaries, tree farms, livestock grazing, but not including feedlots and poultry farms, sustained yield forestry, wildlife preserves, soil and water conservation activities, cultural and historic restoration, drainage and water retention, water measurement, and water control facilities, recreational uses such as canoeing access, boat launching ramps, swimming areas, primitive camping, hiking, horseback riding trails and similar open space uses. Parking and other accessory uses are also permitted in conjunction with permitted uses. Mineral extraction may be permitted through a conditional use permit approved by the Story County Board of Adjustment. There are 2,042 acres in this zoning district. See *Appendix G: “Greenbelt Conservation Zoning District”* on page 119.

There have been 327 species of birds documented to exist on the 4,780 acres of publicly owned and managed lands in Story County. Importantly, 147 of these species have nested in Story County, with at least 140 of these bird species nesting on public land. There have been 106 Species of Greatest Conservation Need documented in Story County, with 103 bird Species of Greatest Conservation Need documented on Story County public land, especially benefitting from the well-managed native (and restored to native) habitats that exist on these lands. Many area sensitive species and most of Iowa’s Endangered and Threatened bird species exist on these lands, as well. There are few (if any) other counties in Iowa that have documented this many bird species, this many nesting bird species, and this many bird Species of Greatest

Conservation Need on lands that have legal protection within the county. Much of the protected land in Story County exists in riparian corridors, where there is excellent habitat connectivity; and much protected land exists in substantially large landscapes of particular habitats that are now rare on privately owned land. These public land habitats include large blocks of forest, large blocks of wetlands, large blocks of grasslands, and some significant size blocks of savanna. It is the quality of these public land habitats, their size, and their connectivity that enables these habitats to support the lives of so many birds, including 103 Species of Greatest Conservation Need birds, and these are the main reasons why these public and legally protected lands of Story County are "substantial." See *Appendix H: "Bird List for Story County, Iowa (2019)"* on page 121 and *Appendix I:* "*GCN Bird List for Story County, Iowa (2019*)" on page 125.

4) *County offers public information about controlling or removing invasive plant species.*

Each year during National Invasive Species Awareness Week, Story County Conservation includes invasive species content in their social media posts. Many of these posts get engagement and facilitate conversations. For an example of one of these posts, see *Appendix J: "National Invasive Species Awareness Week Post"* on page 128.

Invasive species have also been a focus of several annual volunteer workdays. In 2019, Story County Conservation partnered with Weed Wrangle on a garlic mustard pulling event. This partnership brought more awareness and visibility to this growing problem. See *Appendix K: "Weed Wrangle Volunteer Event"* on page 130. Story County Conservation has also partnered with a local brewery on several "Mustard Pull and Pints" events where volunteers are rewarded with discounted pints after a garlic mustard pull. These informal events foster more conversations with staff and help broaden the target audience of our outreach efforts.

Christiansen Forest Preserve in Huxley, IA has a significant problem with invasive oriental bittersweet. Surrounding landowners were given a brochure detailing the issues surrounding oriental bittersweet so they can be monitoring for the plant on their properties as well. Story County Conservation is educating park visitors through an audio stop as part of the Dial and Discover Program https://storycounty.oncell.com/en/12-oriental-bittersweet-137724.html.

5) *One or more communities within the County have a stormwater management program or other designation such as Tree City USA, etc.*

Three communities in Story County are designated as a Tree City USA: Ames (for 35 years), Nevada (for 17 years), and Story City (for 23 years). These communities not only adhere to but exceed the four core standards of sound urban forestry management: maintaining a tree board or department, having a community tree ordinance, spending at least $2 per capita on urban forestry and celebrating Arbor Day.

Story County recently adopted a stormwater management program through its amended stormwater management and erosion and sediment control ordinances. The stormwater management ordinance requires development that disturbs one or more acres of land to submit a stormwater management plan. The plan must illustrate how criteria for stormwater management area met, including that a site:

- Is designed to manage the water quality volume of rainfall depth of 1.25 inches and to manage corresponding recharge volume through infiltration practices.
- To protect stream channels, is designed to provide 24-hours of extended detention of the channel protection volume determined for the 1 year, 24-hour storm.
- Is designed to limit the post development rate of runoff from the site area during the 5-year through the 100-year, 24-hour storm events to the lesser of the following values: runoff rates equivalent to those from a storm event of the same intensity and duration based on pre-development conditions or runoff rates equivalent to those from the 5 year storm event based on conditions which exist as of the date of the proposed improvement plans (row crop agriculture cover, contoured in good condition and surface soil types as identified from County Soil Maps; unless otherwise approved).

The stormwater management plan must include maintenance provisions for practices and must be prepared by a professional engineer.

The County's new erosion and sediment control ordinance includes requirements for development under one acre in size--the State of Iowa's National Pollutant Discharge Elimination System permit applies to sites over this threshold. Erosion control requirements include minimizing the disturbed area, having an appropriate concrete washout and stabilized construction entrance, and stabilization of exposed soils if work will not continue on an area for 14 days. Special requirements also apply to sites with natural areas including construction buffers and additional controls.

The City of Ames also has a Regulated Stormwater Program with a stormwater permit (MS4—Municipal Separate Storm Sewer System) from the Iowa Department of Natural Resources to discharge stormwater to the water of the State. As required by the permit, Ames has a Construction Site Erosion and Sediment Control Ordinance for runoff from construction activities that disturb one acre or more and a Post-Construction Stormwater Management Ordinance that applies to sites that disturb over one acre or create 10,000 square feet of impervious surface. The Construction Site Erosion and Sediment Control Ordinance includes a quarterly review of sites by the City to inspect practices. The Post-Construction Stormwater Management Ordinance encourages Low Impact Design and Green Infrastructure, requires rates of runoff from the site are equal to or less than the runoff prior to development of the site (pre-developed conditions), requires water quality measures to remove pollutants from runoff prior to leaving the developed sites, and requires a maintenance plan. As part of the permit, the City has a Good Housekeeping program for municipally-owned properties including spill prevention plans, the inspection of catch basins and City-owned stormwater management facilities, and staff training on fertilizers and pesticides. The City has an adopted Illicit Discharge Ordinance to prevent discharge of pollutants into the storm sewer system and has several public education, outreach,

and participation efforts, including rebates for homeowners who install stormwater management practices and education programs in schools and for contractors/builders.

Reduce threats to birds

1) *The County has ordinance language or other means for enforcing state law regarding time constraints for mowing roadsides.*

Story County has a well-developed and active Integrated Roadside Vegetation Management (IRVM) program. IRVM maintains a safe travel environment on the county rights-of-way with an emphasis on conservation – much of the staff time is spent planting and managing prairie, and educating Story County citizens about the importance of quality roadside habitat. Presence at community events, distribution of brochures, articles in the conservation department's newsletter, and press releases regarding the value of this habitat are some of the ways in which Story County's IRVM program spreads a conservation message. See *Appendix L: "IRVM Roadside Mowing Press Release"* on page 132.

2) *The County supports bird-friendly construction and placement of communication towers*.

Both commercial and noncommercial communication towers are required to meet standards in the Story County Land Development Regulations (the County's zoning ordinance), including lighting standards. Towers are not permitted to be lit, unless required by the FAA. The FAA requirements must be provided in writing from the FAA to allow lighting for commercial towers. The FAA typically requires lighting on structures 200 feet above ground level or if in a location may impair aviation safety.

Further, for commercial towers, the application is routed to County Departments, including Story County Conservation and the permitting process allows the recommendation of conditions on a tower if concerns are raised about environmental impacts. The Board of Adjustment must approve the permit and any conditions as well.

3) *The County has requirement(s) for non-toxic ammunition on public hunting areas*.

Traditional lead ammunition has been known for decades to pose significant threats to non-target birds and other animals. The Story County Conservation Board is cognizant of the unintentional effects of this ammunition on humans and wildlife. As a result of these effects, the conservation board required the use of non-toxic ammunition on all county-owned hunting areas. This rule took effect in 2018. An emphasis has been placed on education. Conservation staff worked with partner NGO's and 2 local firearms retailers to offer discounts on the purchase of non-toxic ammunition.

4) *The County has receptacles for used fishing line at one or more fishing areas.*

Fishing line recycling receptacles were built and installed by volunteer groups at our major fishing spots in 2018. The receptacles continue to be monitored by volunteers and the collected fishing line is dropped off at a local sporting goods store to be sent to Berkley's fishing line recycling program. See *Appendix M: "Fishing Line Recycling Receptacle"* on page 134 and *Appendix N: "Map of Existing Receptacles"* on page 136 (blue line indicates future location following the completion of a lake restoration).

5) *Demonstrate, in narrative, some other important accomplishment in this category.*

Both commercial and noncommercial Wind Energy Conversion Systems (wind turbines) are required to meet standards in the Story County Land Development Regulations (the County's zoning ordinance), including lighting standards. Noncommercial wind turbines are not permitted to be lit, unless required by the FAA. Commercial wind turbines are also not permitted to be lit "except to the extent required by the FAA or other applicable authority. Lighting, including lighting intensity and frequency of strobe, shall adhere to but not exceed requirements established by Federal Aviation Administration permits and regulations. Red strobe lights are preferred for night-time illumination to reduce impacts on migrating birds. Red pulsating incandescent lights should be avoided. Exceptions may be made for meteorological towers, where concerns exist relative to aerial spray applicators" (Story County Land Development Regulations 92.08).

Further, for commercial wind turbines, the application is routed to County Departments, including Story County Conservation and the permitting process allows the recommendation of conditions on a tower if concerns are raised about environmental impacts. The Board of Adjustment must approve the permit and any conditions as well.

<u>Education and engage people in birding and conservation</u>

1) *County staff and volunteers actively educate about birds, which includes providing information about identification, natural history, habitat needs, and/or environmental and human threats to bird populations.*

The Story County Conservation environmental education unit provides several classroom and outdoor experiences about bird identification, natural history, habitat need, and threats to bird populations. This year we have five 2.5hour *Birding Bonanza* scheduled for 225 1st and 2nd grade students. During this experience, students scour different habitats to learn about bird adaptations, practice using binoculars, and identify birds by sight and call. Twenty-eight 2.5-hour *Bird Nerds!* are scheduled for 700 students. First graders will discover how adult bird behaviors help young birds survive and thrive. Students will design a safe nest, protect and feed their "nestlings," and hike to meet the birds in their habitats. A one-hour *Birds of a Feather* classroom program where pre and kindergarten classes discover how birds use their special adaptations are scheduled for 25 class (570 students.) Story County Conservation also uses a resident raptor from a local rehabilitation clinic to conduct 13 raptor classroom visits for 560 students. Participants will learn about raptors and their special adaptations that allow them to

function and survive. In 2019, we will have conducted over 120 hours of bird related education and contacted over 2,000 students.

Story County Conservation works with Big Bluestem Audubon to provide Audubon Adventures Classroom kits free of charge. Ten grade levels in seven different schools will have received 55 classroom kits total this year. This partnership has been ongoing since 1998.

2) *The County encourages students and/or other community members to participate in citizen science bird monitoring or developing local bird species checklists. Areas within the County are represented in at least one bird monitoring program, such as the Great Backyard Bird Count, Audubon Christmas Bird Count, Project FeederWatch, or other actively coordinated citizen science project.*

The Christmas Bird Count is the first citizen Science Project of this continent and began in 1900. Ames Christmas Bird Count (Story County) has occurred annually since 1923, documenting 50 to 75 species of birds each year. Sponsored by Big Bluestem Audubon Society, as many as 43 participants contribute a total of up to 104.5 hours on the day of the event, counting every bird (up to approximately 27,000 individual birds) seen while driving roads, walking (in fields, parks, and wildlife areas), or sitting while observing birds at feeders. The data collected by observers allow Audubon researchers, conservation biologists, wildlife agencies and other interested individuals to study the long-term health and status of bird populations (both locally and across North America). When combined with other surveys such as the Breeding Bird Survey, this collected data provides a picture of how bird populations have changed in time and space over the past hundred years, it informs strategies to protect birds and their habitat, and it helps identify environmental issues with implications for people, as well. See *Appendix D: "2008 Ames CBC Results, 2010 Ames CBC Results, 2011 Ames CBC Results, 2018 Ames CBC Results"* on page 93.

In 2016, National Audubon Society's climate scientists piloted a new research project to see how climate change is affecting birds. Volunteer birders and community scientists from across the country run specific survey routes, twice a year (at the same time) to primarily count bluebirds and nuthatches. The goal is to see how both species are moving across the landscape to adjust to global warming. While bluebirds and nuthatches were selected as the focal birds, all birds observed at the predetermined survey sites on the route are recorded into the database. Starting in the May 15 – June 15, 2019 survey window, Climate Watch Survey volunteers were asked to also focus their search for goldfinches, towhees, and painted buntings. Currently, Story County has 2 established Climate Watch Survey routes that are being run twice each year, since 2016.

3) *The County provides age-appropriate public programming on one or more bird information topics. This may include field trips, speaker series, displays, or other media.*

Story County Conservation offers a handful of public programs related to birds each year. O.W.L.S. (Older Wiser Livelier Souls) programs are offered once each month (September -

May) at the conservation center. These one-hour free programs are followed with an optional lunch. Usually one of the presentations each year is about birds. Presenters have covered topics such as the raptors of Iowa and peregrine falcons.

Other public program offerings include an annual night hike designed for families. The experience includes information about owls and allows participants to try their hand at hooting. In June 2019 Story County Conservation held their first Get Outdoor Day celebration and Iowa Young Birders was present to teach youth and adults about bird identification and lead bird viewing walks.

4) *The County has a program that involves schools, garden clubs or other organizations, habitat development or butterfly & bird conservation activities.*

Story County Conservation environmental education staff helped three schools transform mowed grass into a flower-filled pollinator habitat. Students at Nevada Central Elementary, Collins-Maxwell and Roland-Story elementary schools grew native plants in classroom mini-greenhouses and planted them in their schoolyard. Throughout the school year, Story County Conservation naturalists and project partners taught students about the vital relationship between plants and their insect visitors. Story County Conservation received a Resource Enhancement and Protection Conservation Education Program grant to fund the projects.

Children have opportunities to investigate native plants from seed to flower along with the diversity of insects drawn to their habitat. Story County Conservation naturalists present educational programs to the schools. The pollinator program, developed for the schoolyard projects, introduces students to pollination and highlights their schoolyard's place in the "Monarch Highway," a federal effort to increase pollinator habitat along the I-35 corridor. Prairie Rivers of Iowa staff helped students design the habitat. Neal Smith National Wildlife Refuge provided students with seeds to grow in mini-greenhouses in their classrooms, and Story County Conservation coordinated planting the habitats. Story County Conservation shares lesson plans through www.teachersgoinggreen.com.

Beyond the schoolyard, the habitats also model how individuals, community organizations, and businesses can provide shelter and food to pollinators within towns. Collins-Maxwell Elementary has involved a variety of community members by expanding the project on their own. They created an outdoor classroom and vegetable garden alongside the pollinator habitat. Through donations of materials and labor, they built a seating area, outdoor whiteboard, and examples of shelter boxes for birds and bats.

Appendix A: The Response of Vegetation to Seven Years of Ecological Restoration Practices at Robison Wildlife Acres, Story County, Iowa

THE RESPONSE OF VEGETATION TO SEVEN YEARS OF ECOLOGICAL RESTORATION PRACTICES AT ROBISON WILDLIFE ACRES, STORY COUNTY, IOWA

Final Report to:
Story County Conservation
McFarland Park
56461 180th Street
Ames, Iowa 50050-9451

By:
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February 13, 2018

Introduction

Story County Conservation initiated an ecological restoration project during 2010 at Robison Wildlife Acres, a 78 acre park located about 3 miles northwest of Maxwell, Iowa (Figure 1). The natural area lies on the west side of West Indian Creek and supports a variety of habitats, including floodplain forest, upland forest and woodland, degraded savanna, shrubland, oldfield grassland and a pond (Figure 2). In early April 2010, a reconnaissance visit of the park was done with Story County Conservation personnel to identify four sites for future restoration work and the establishment of permanent plots (Figure 2). Baseline data on the plant and bird communities at each of the four sites were made during spring and summer in 2010. These data were presented in a progress report submitted in January of 2011 (Rosburg 2011). Recently it was determined that after seven years of restoration work and management, the time had come to repeat the measurements of the plant and bird communities at the four study sites to evaluate their progress. The plant communities were inventoried during the 2017 field season. Bird surveys were not done in 2017; those data will be collected in 2018. This document presents the results of the work completed in 2017, a comparison of those data with the baseline inventory of the plant communities, and an evaluation of the changes in the vegetation since 2010 as well as the quality of the restoration progress.

The overall goals of this research are to establish inventory methodology and conduct baseline and post-management field surveys to facilitate monitoring of the plant and bird communities over time and document their response to restoration work at Robison Wildlife Acres. More specifically the goals are:

a) Establish four permanent plots and methodology for measuring and monitoring plant and bird communities over time.

b) Identify and quantify the plant community composition and structure at four sites representing different habitats where tree and brush clearing has either recently occurred or where restoration management strategies were planned.

c) Describe the breeding bird community associated with the four habitats undergoing restoration work.

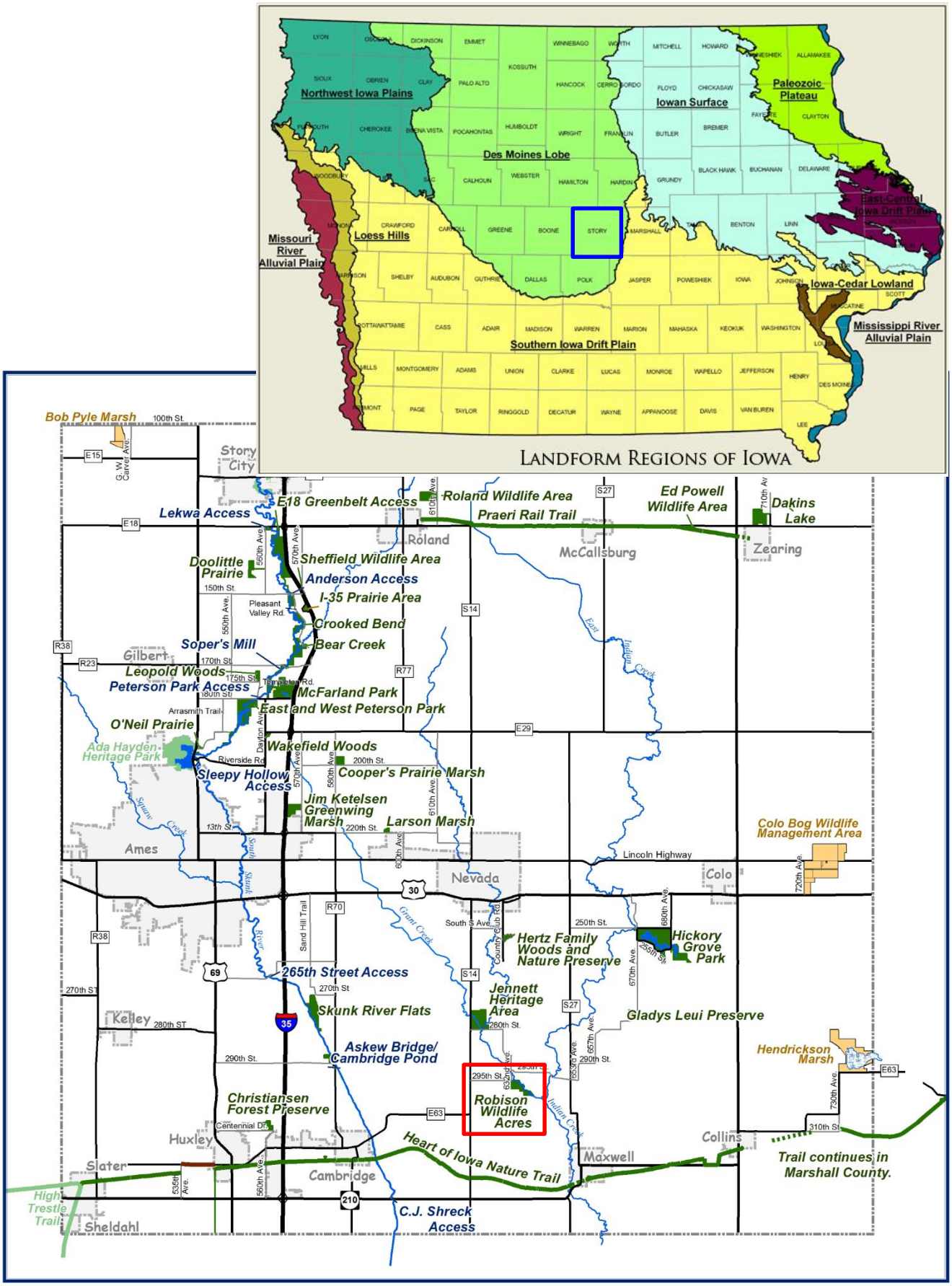

Figure 1. The location of Story County (blue) on a map of Iowa landform regions (above), and the location of Robison Wildlife Acres (red) within Story County (below).

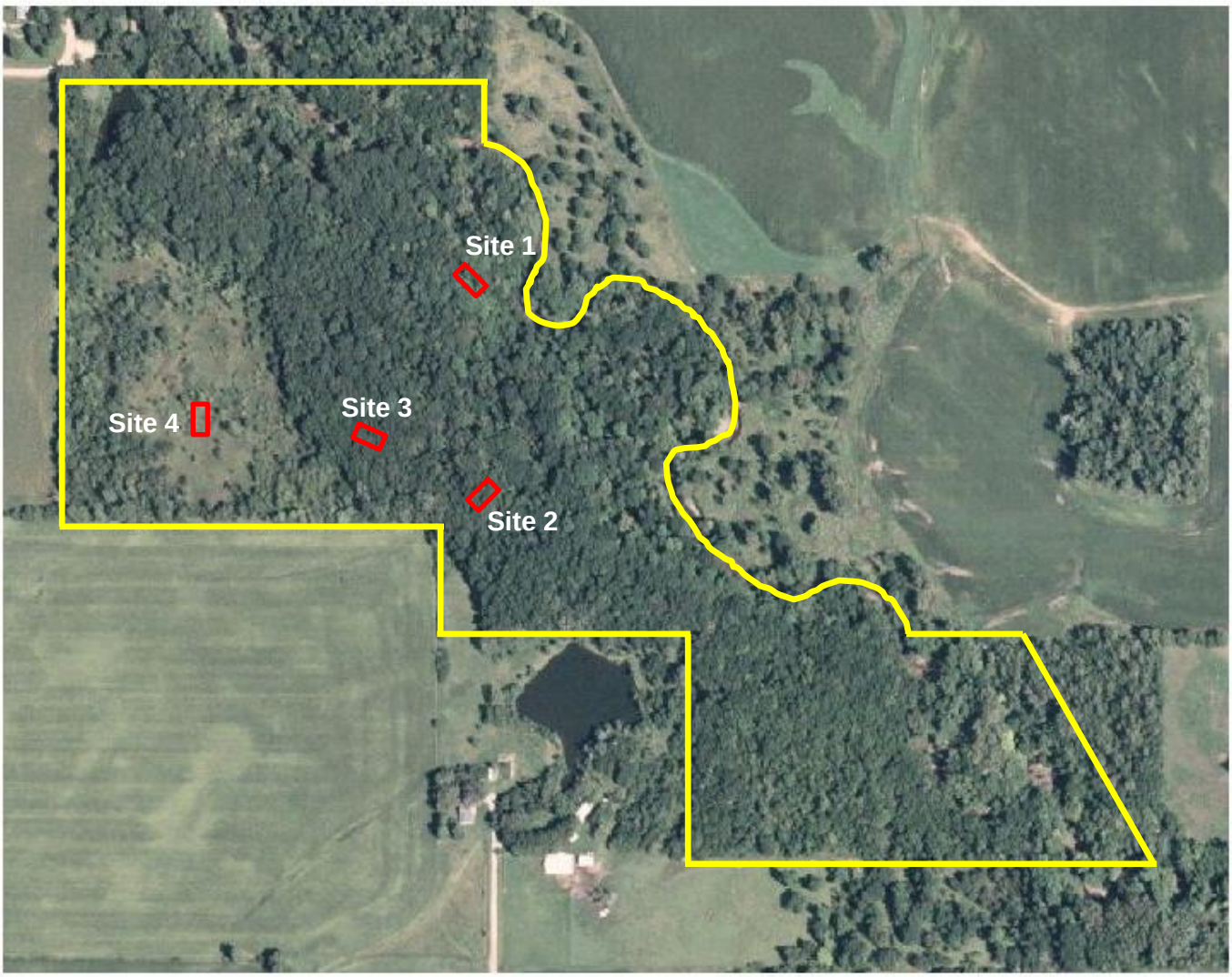

Figure 2. A 2009 aerial photograph showing Robison Wildlife Acres in south central Story County and the location of four study sites (red boxes). The approximate park boundary is delineated in yellow.

d) Conduct data analyses to ascertain the trends and patterns of vegetation response to land management tactics based on the changes in the plant and bird communities between the 2010 and 2017 .
e) Assess the natural quality of the vegetation and habitat observed at each study site.
f) Compile a bird list for all species observed at Robison Wildlife Acres during the breeding season.

Study Site

Robison Wildlife Acres was established in 1969 and 1970 with donations of 40 and 18 acres from Clay Robison, a former Story County Conservation Board member. In 1978 a purchase of 21.5 acres was added to the park and is known as the Whitaker Addition. The semi-natural area is located in the southern portion of the Des Moines Lobe, the most recently glaciated landform in Iowa. Upland soils occupy approximately 62 acres (about 80%) and all formed in glacial till, or alluvium derived from till. These soils include Lester (62%, well-drained, formed under savanna), Clarion (8%, well-drained, formed under mesic tallgrass prairie, Webster (6.5%, poorly-drained, formed under wet tallgrass prairie, and Nicollet (3.5%, somewhat poorly-drained, formed under wet-mesic tallgrass prairie). Floodplain soils occupy about 12 acres and range from poorly to moderately well drained. All of them formed in alluvium and likely experience annual flooding to some extent. These include Hanlon-Spillville (12%, moderately well to somewhat poorly drained, formed under wet-mesic tallgrass prairie), Spillville-Coland (3%, poorly to somewhat poorly drained, formed under wet tallgrass prairie), and Spillville (0.5%, moderately well to somewhat poorly drained, formed under wet-mesic tallgrass prairie).

No professional plant inventory has been done for the park. Dr. Michaeleen Gerkin Golay (Wartburg College) conducted research on nutrient sequestration in the herbaceous layer of central Iowa forest in 2005. She established two 20x20 m plots, one in disturbed forest and one in intact forest, which were inventoried and together produced a list of 41 herbaceous species. The list represents very common species typically observed in central Iowa forests, except for two species. *Goodyera pubescens* (rattlesnake plantain) and *Polygonatum pubescens* (downy Solomon's seal) were reported, but both are suspect and need documentation. Downy Solomon's seal is only known from three counties in extreme northeast Iowa and is considered

rare in those counties. It is very unlikely this is an accurate record. Rattlesnake plantain (an orchid) is considered rare and local in the eastern ¼ of Iowa. The nearest known population to Story county is a site in Iowa county.

Two plant species of special interest are known from Robison – *Malus ioensis* (Iowa prairie crabapple) observed by Jeff Carstens from the USDA Plant Introduction Station, and *Botrychium dissectum* (dissected grapefern) found by Amy Yoakum with Story County Conservation. Story county is on the western edge of the range of dissected grapefern, which encompasses the entire eastern half of the U.S.

There are no plant species monitored by the Iowa Natural Areas Inventory (INAI) database that are known to occur in or near the park (INAI tracks threatened, endangered, and special concern state-listed species, as well as some selected rare species). However, there are three bat species in the INAI database that have been observed in the northern portion of the park along or near West Indian Creek.

Site 1 is on a northeast-facing slope in Lester soil and represents a maple/basswood/red oak forest. Sites 2 and 3 are both on a gently sloping upland in Lester soil. Site 2 exemplifies an early to mid-successional bitternut hickory forest, although there are bur oak wolf trees in the area. Site 3 is occupied by a red oak forest. The native vegetation at sites 1, 2 and 3 was likely savanna or open woodland, as indicated by the Lester soil and the vegetation present in 1930 (Figure 3). Site 4 is on a level upland in an area with Webster and Clarion soil. Historic aerial photos indicate that it was agricultural land through the 1960s and undergoing old field succession by the 1970s. A shrubland/cool-season grass & forb plant association occurs on the site now; native vegetation was likely wet-mesic tallgrass prairie. The site apparently retains some remnant populations of prairie plant species.

Field Methods

Plant Survey

A standardized protocol for measurement of the plant species community composition and structure was implemented in both 2010 and 2017. A permanent 20x50 m plot (i.e., the

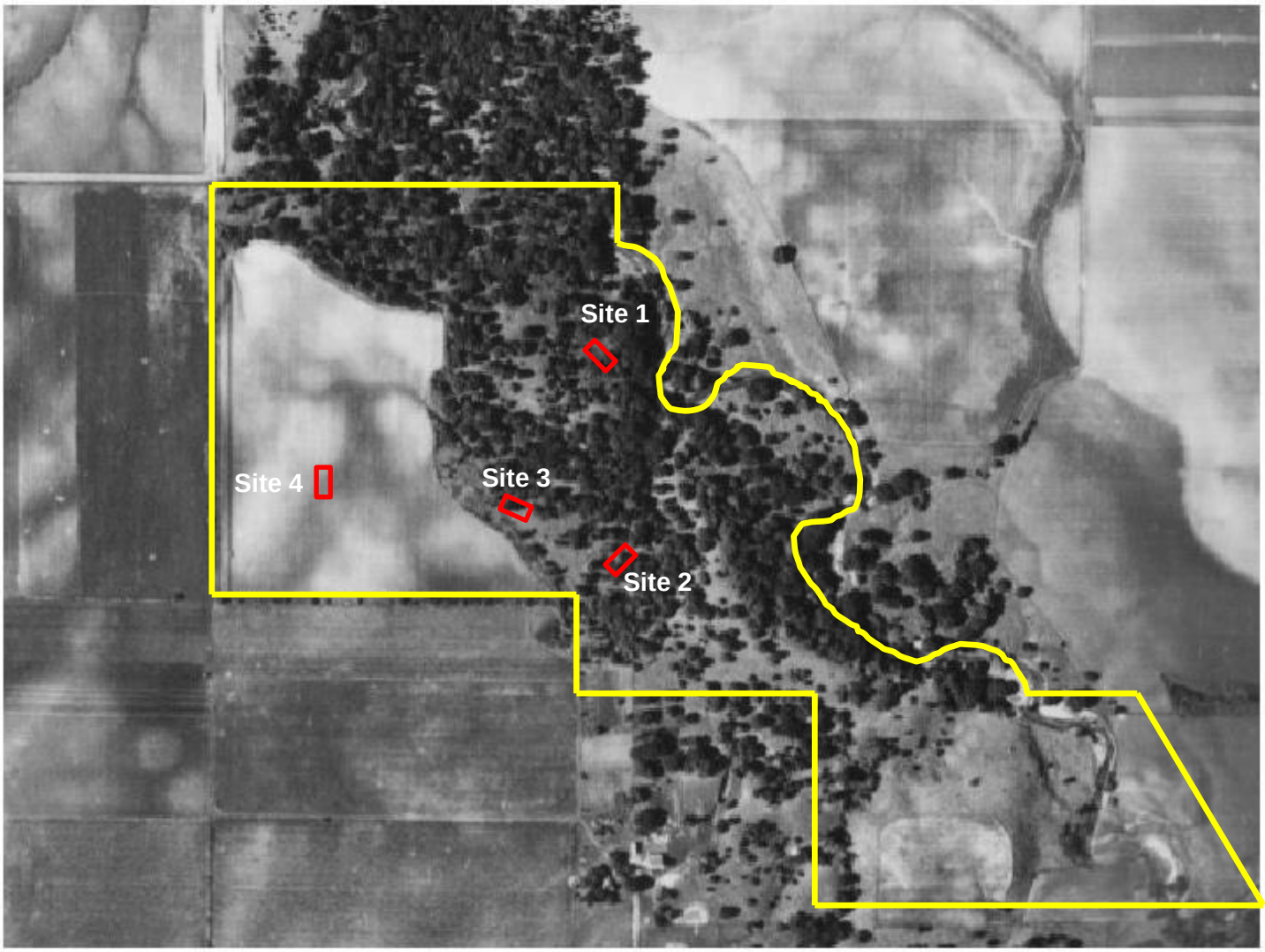

Figure 3. A 1930s aerial photograph showing Robison Wildlife Acres in south central Story County. The approximate park boundary is delineated in yellow.

community sample area) was established at each site (Figure 2). The corners of the plots were marked by driving a 6 foot steel post into the ground. Vegetation was measured in four structural layers: a) canopy/sub-canopy, b) saplings and understory, c) shrubs and d) herbaceous layer, which includes all herbaceous species and woody sprouts and seedlings. The community samples consist of a series of nested plots (Figure 4). The largest plot, which represents the boundary of the vegetation sample, is the 20x50 m plot. All woody stems within the 20x50 m plot that were 5 cm DBH (diameter at breast height) or greater and either alive or dead were identified and recorded. Their DBH was measured to derive a measurement of basal area (amount of cross-sectional area in the stems of trees). A nested 10x30 m subplot centered in the large plot was used to measure sapling density (woody stems less than 5 cm DBH and greater than 2 m tall) (Figure 4). All saplings either alive or dead and within the 10x30 subplot were identified and their stems counted. Three 2x30 m belt transects were established such that two of them coincided with the sides of the 10x30 m subplot and one coincided with the centerline of the 10x30 m subplot. All living shrubs (woody stems less than 2 m tall and greater than 50 cm tall) occurring in the belt transects were identified and their stems counted.

The species composition of the herbaceous layer was measured in 30 1x1 m quadrats that were systematically established within the three 2x30 m belt transects (10 on each of the 3 transects). The 30 m belt transect was divided into five sections each 6 m long. Two 1x1 m quadrats were located within each of the five 6-m sections such that one occurred on each side (left and right) of the centerline of the 2 m wide belt transect. The identity and presence of all herbaceous species and all woody stems less than 50 cm tall was recorded in the 1x1 m quadrats. A quantitative measurement of abundance for the species in the herbaceous layer was made by determining the density of ramets in four 25x25 cm subquadrats located in each of the corners of the 1x1 m quadrats (Figure 4). Ramets are individual stems, tillers or caudices that arise from the root system of an individual plant. Ramet density does not necessarily represent or conform to individual density, although individual density and ramet density can be positively correlated. Because many plant species are able to grow vegetatively, it is nearly impossible to recognize individuals. Thus ramet density represents the results of both sexual and asexual reproduction and is a good measure of a plant's overall success in a habitat. Frequency (presence or absence) was also measured in each 25x25 cm subquadrat. There were 120 25x25 cm subquadrats

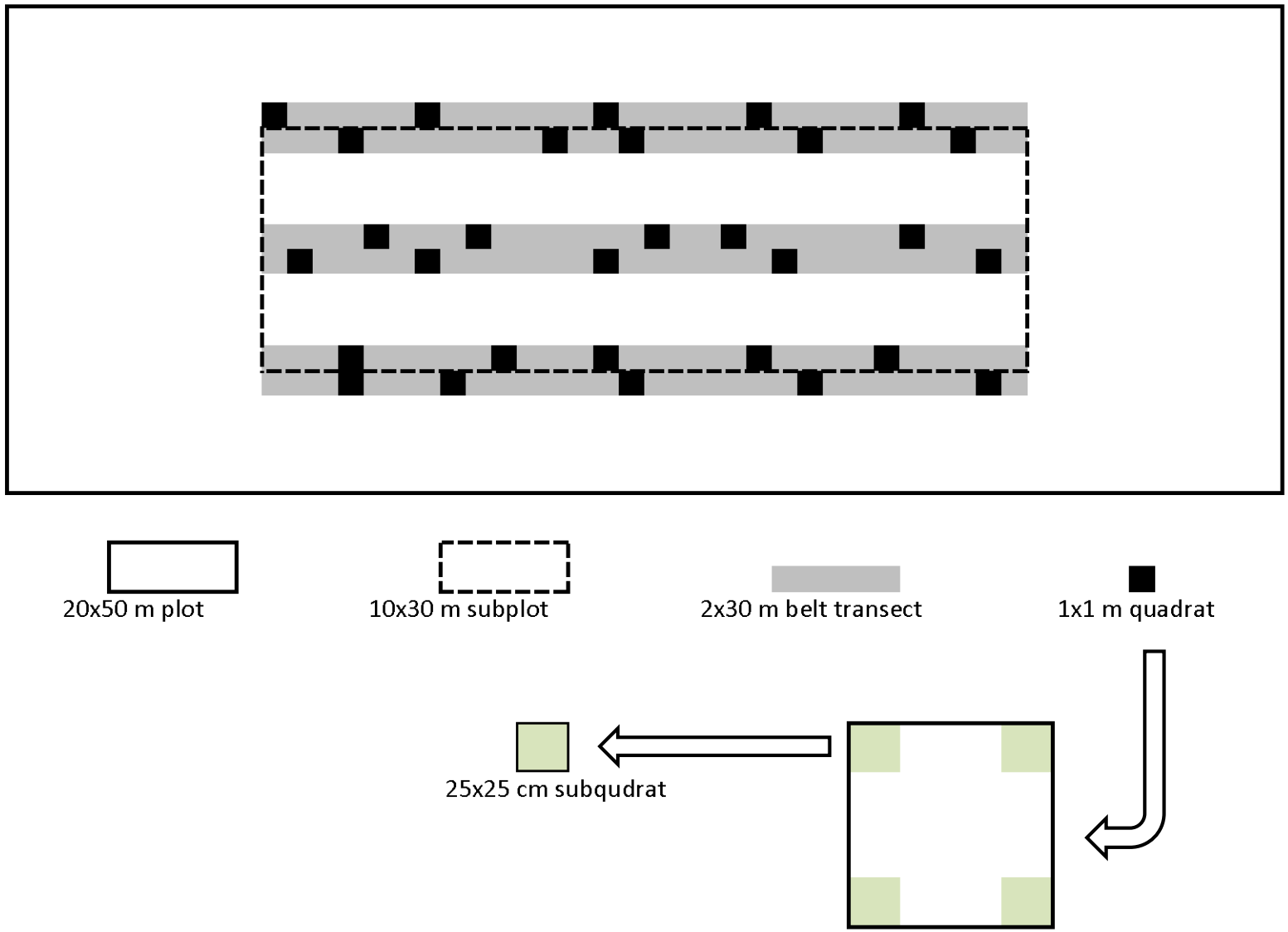

Figure 4. A diagram for the nested plots, transects and quadrats used in making a community sample of the vegetation. A community sample consists of 1 20x50 m plot, 1 20x30 m plot, 3 2x30 m belt transects, 30 1x1 m quadrats, and 120 25x25 cm subquadrats.

sampled in each community sample (20x50 m plot). Any herbaceous layer plant species that was not encountered in the quadrats and subquadrats, but was present and observed in the 10x30 m subplot, was also recorded. Thus the frequency (presence/absence) of species in the herbacous layer was measured at three scales – 10x30 m, 1x1m, and 25x25 cm.

The herbaceous layer of the forested plots (sites 1, 2 and 3) was sampled twice, the first survey completed early in the season (April 23 to May 8) to observe the spring ephemeral species. These are a suite of low stature forbs that utilize the higher light environment of mid-spring immediately prior to leaf out in the canopy. They produce above-ground growth, flower and disperse seed in a period of three weeks. Then they senesce (top growth dies) and go dormant until next spring. Typically all evidence of their presence (dead growth) is completely gone by early June. The focus of the spring survey was on the ephemerals, specifically trout lily, spring beauty, dutchmen's breeches, toothwort, and a few other species that are more conspicuous in the spring – cleavers bedstraw, bloodroot, yellow violet, and wild leek. A second survey was completed in mid-summer, between July 27 and August 12, to record all the remaining species. Plant nomenclature follows Eilers and Roosa (1994).

Methods of Data Compilation and Analysis

Plant Survey

Plant species abundance in the canopy/subcanopy (trees with DBH $\geq$ 5 cm) of each community is given in terms of density (number of stems per ha) and basal area (total cross sectional area at DBH in m^2 of all stems present in a ha). These data were combined to produce an Importance Value (IV) for each species in the community, which is the average of a species' relative density and its relative basal area. It is a relative measurement expressed as a percentage in this report. Because it integrates measurements of species abundance in space (i.e., density) and in time (i.e., basal area or size), it furnishes an integrated measure of abundance that reflects how "important" a species ranks. The IV is useful because it is an integrated measure of abundance, and because a relative measure of abundance is necessary to determine the Shannon Diversity Index (H') for the canopy/subcanopy species. The Shannon Diversity is a diversity index that integrates species richness (number of species) and the species' relative abundances (amount of each species) to measure the diversity of a community. It is calculated with this formula:

$$H' = \sum_{i=1}^{S} p_i (\ln p_i) \quad \text{where } p_i = \text{proportion for species } i$$

Values of H' fall within a narrow range of possibilities. For most samples, H' will likely be less than 5. A better understanding of the meaning of H' values is provided by Table 1.

Table 1. Values of H' given different values of species richness assuming perfect evenness (all species have the same relative abundance).

Richness	H'	Richness	H'
1,000	6.91	75	4.32
200	5.30	50	3.91
100	4.61	25	3.22

In addition to the use of IV in calculating the Shannon Diversity Index, they were also used to reflect species abundance in an ordination of plot data. In this application, Importance Values were critical for expressing species abundance in a form that was similar for plant species that were measured by different methods across multiple scales. This provided a more uniform and common scale of measurement for all plant species, from a small fern to a large canopy tree.

Plant species abundance in the sapling layer (woody ramets greater or equal to 2.0 m tall and less than 5 cm DBH) is given by stem density (number of ramets per are, or 100 m^2). Shrubs (woody ramets greater or equal to 50 cm tall and less than 2.0 m tall) were also measured with ramet density and conveyed as number of ramets per are. Only living stems of saplings and shrubs were reported. The Shannon Diversity Index was calculated for both saplings and shrubs using relative density.

In the herbaceous layer, both density of ramets and frequency of individuals in sampling frames (subplots, quadrats, and subquadrats) was observed. Absolute density (ramets/m^2) is reported for those species observed in the 25x25 cm subquadrats, but these species are among the most common species in the community. Density provides the more accurate measure of species abundance, and provides greater resolution, so it conveys the better measure of how species are responding to environmental factors. Frequency data was collected to increase the number of

species encountered and measured. Frequency has more resolution and provides more meaningful quantitative data when larger numbers of smaller sampling frames are used. Thus the frequency measured by the 120 25x25 cm subquadrats provides the best measure of abundance. However, since the 25x25 cm subquadrats do not sample as much total area as the 1x1 m quadrats, they result in fewer total species observed. The 1x1 m quadrats increase the number of species observed in a community sample, and still provide a measure, albeit more coarse, of species abundance. That is the purpose in supplementing the frequency measurements with data from the 1x1 m quadrats, and for the most uncommon species, in the single 10x30 m subplot.

While frequency was measured at three scales with three measurements, it is desirable to combine them into a single, meaningful measure for the purpose of reporting and comparing sites. This was done by calculating a weighted average of the three frequency measurements using this formula for the combined and weighted frequency (CWF):

$$\text{CWF} = \frac{(25\text{x}25\text{cm}\ F_{ij})(65) + (1\text{x}1\text{m}\ F_{ij})(34) + (10\text{x}30\text{m}\ F_{ij})(1)}{100}$$

$$\text{where } F_{ij} = \text{the absolute frequency of species } i \text{ at scale } j$$

All of the plant species observed in the community sample have 100% frequency in the 10x30 m subplot, thus its contribution was minimized with a very small weighting factor. It was also intended that for species only observed in the 10x30 m sublplot, the CWF would be equal to 1%, the lowest CWF possible. On the other end of the scale, the frequency derived from the 25x25 cm subquadrats was the most meaningful, so its weighting factor was the largest. A species that was observed in all 120 25x25 cm subquadrats has a CWF equal to 100%, the highest CWF possible. The frequency in the 1x1 m quadrat was assigned an intermediate weighting factor.

In order to calculate the Shannon Diversity Index (SDI), species abundance must be in a relativized form, i.e., a proportion. Since species in the herb layer were measured with two different measurements, density and frequency, they were combined to derive an IV in a way similar to the trees, where density and basal area were combined. The IV for species in the herb

layer, which again includes all herbaceous species and woody stems less than 50 cm tall, was obtained by combining density and CWF by averaging their relative density and relative CWF.

However, rather than use the observed ramet density to calculate the IV, an adjusted density (AjD) was calculated. The justification for this approach comes from the potential for some species to generate very high densities due to vigorous vegetative growth. Some of the graminoids and their capability to produce large numbers of tillers are good examples. Very large densities can greatly impact the IV and produce a strong bias in favor of these species. It is more desirable if density is determined mostly by the results of sexual reproduction (i.e., new individuals) rather than a large effect from asexual reproduction (i.e., cloning). Thus density was adjusted by decreasing it somewhat, and in a way that facilitates proportionately larger decreases for larger absolute densities. The following power function was used:

$$\text{AjD} = \left(\text{absolute density}\right)^{0.85}$$

The IV for the herbaceous layer species was calculated from the average of the species relative CWF and its relative AjD.

The Native Richness Index (NRI) was calculated to contrast the number of native species with the number of exotic species. It conveys the approximate number of native species that are present for every single exotic species present.

$$\text{NRI} = \frac{\text{Native Richness}}{\text{Nonnative Richness}}$$

Herbaceous layer species were separated into three growth forms to better assess community structure. These include forb/fern, graminoid (species in the grass, sedge and rush families), and woody species.

Variables and Statistical Analysis

The principal goal in this research is to ascertain the patterns of vegetation change between 2010 and 2017. Because the data are derived from the same plots collected at two different times, the study uses repeated measurements and the analyses should be done with a paired t-test. The four

plots established on the study sites are independent observational units and provide the replication for statistical analyses. Patterns that can be established and supported using the four sites as replicates have validity that is applicable to the entire park, and provide the best support for making extrapolation to other natural areas in Iowa. However, the fact that each site is a unique plant community with a certain set of environmental factors means that the responses of each plant community are likely to vary among the sites. It is worthwhile to explore the responses and look for patterns that are characteristic of individual sites, or in other words, conduct within site comparisons. Within site comparisons are meant to be meaningful to only the site under examination. They were done in this study by recognizing instances (anecdotal evidence) when species or species groups demonstrated relatively large changes. Statistical analyses were also done, but they required the use of pseudoreplicates (replication that is not independent). While pseudorepliction is not appropriate for making inferences to the entire park or beyond the park, it is suitable for the sole purpose of making inferences to a single site. Comparisons examining the vegetation change from 2010 to 2017 were done at two scales – 1) within site or fine scale, an intra analysis where the results are more site specific and representative of the site's environment, and 2) among sites or coarse scale, an inter analysis where the results are more broadly applicable to the park and to similarly managed areas beyond the park.

Many variables were utilized to evaluate community diversity, quality and structure and applied to all four structural layers – herb, shrub, sapling/understory, canopy/subcanopy. These variables are identified in Table 2 and were used in the inter analyses. Richness variables simply express the number of species observed. Density variables provide a highly quantitative measure of abundance. These data report ramet density rather than individual density, thus they are not equivalent to population size, although ramet density is likely positively correlated with population size for most plant species. density is always reported for a standardized area, either 1 m^2, are (100 m^2) or ha (10,000 m^2) in this study.

The Iowa Coefficients of Conservatism (ICC) were used to assess the natural quality of communities. The ICC reflect a species' affinity and requirement for native, pristine habitats in Iowa. The coefficients range from 0 to 10 and were initially assigned by a committee of Iowa

Table 2. Plant community variables used in this report for measuring vegetation.

Herbaceous Layer Variables	**Unit**	**Herbaceous Layer Variables**	**Unit**
Richness Native Forbs/Pteridophytes	species	Shannon Diversity Index Native Herbs	none
Richness Native Graminiods	species	Shannon Diversity Index Native Woody	none
Richness Native Woody	species	Shannon Diversity Index Exotic Species	none
Richness Exotic Species	species		
Richness High CC Herb Species	species		
Richness Total Native	species		
Native Richness Index	none		
		Shrub Layer Variables	
Density Native Forbs/Pteridophytes	ramets/m^2	Richness Native Shrubs	species
Density Native Graminiods	ramets/m^2	Richness Exotic Shrubs	species
Density Native Woody	ramets/m^2	Density Native Shrubs	ramets/are
Density Exotic Herbs	ramets/m^2	Density Exotic Shrubs	ramets/are
Density Exotic Woody	ramets/m^2	Density Total Shrub	ramets/are
		Shannon Diversity Index Shrubs	none
Density Spring Ephemerals (4 species*)	ramets/m^2		
Density High CC Native Herb Species ($CC \geq 6$)	ramets/m^2	**Sapling/Understory Layer Variables**	
Density Low CC Native Herb Species ($0 \leq CC \leq 2$)	ramets/m^2	Richness Native Saplings	species
Density Carex	ramets/m^2	Richness Exotic Saplings	species
Density Festuca, Elymus, Hystrix	ramets/m^2	Density Native Saplings	ramets/are
Density Aster, Solidago	ramets/m^2	Density Exotic Saplings	ramets/are
Density Sanicula, Circaea, Hackelia	ramets/m^2	Density Total Saplings	ramets/are
Density Polygonatum, Smilacina	ramets/m^2	Shannon Diversity Index Saplings	none
Density Native C3 grass	ramets/m^2		
Density Native C4 grass	ramets/m^2	**Canopy/Subcanopy Layer Variables**	
Density Desmodium, Monarda, Rudbeckia	ramets/m^2	Richness Native Trees	species
Density Non-native Bromus	ramets/m^2	Richness Exotic Trees	species
Density Non-native Poa	ramets/m^2	Density Native Trees	stems/ha
		Density Exotic Trees	stems/ha
Frequency Native Forbs/Pteridophytes	%	Density Total Trees	stems/ha
Frequency Native Graminiods	%	Basal Area Native Trees	m^2/ha
Frequency Native Woody	%	Basal Area Exotic Trees	m^2/ha
		Basal Area Total Trees	m^2/ha
Mean CC Native Forbs/Pteridophytes	none	Shannon Diversity Index Trees	none
Mean CC Native Graminiods	none		
Mean Weighted CC Native Herb	none	**Snag Variables**	
Mean Weighted CC All Species	none	Density Total	stems/ha
FQI Native Herb	none	Basal Area Total	m^2/ha
FQI All Species	none		
Weighted FQI Native Herbs	none		
Weighted FQI All Species	none		

* Dicentra cucularia, Erythronium albidum, Claytonia virginica, and Dentaria laciniata

botanists (Drobney et al. 2000). Higher coefficients correspond to higher conservatism, which reflects higher dependence on high quality natural areas. Thus the coefficients of conservatism provide a rough way to assess the floristic quality of an area. The ICC are currently under revision by the Flora of Iowa Working Group, a group of seven botanists. Their work is ongoing and needs comment from reviewers, so its not ready for use at this time. Nonetheless, one facet of their revision was incorporated into this research to improve the application of the ICC. In the original ICC, some ruderal native species were assigned a coefficient of 0. This is problematic because these species are not distinguished from non-native species, which are not assigned a coefficient and therefore by default have a coefficient equal to 0. This problem was corrected in this study by changing the ICC of native species that have a coefficient of 0 to a coefficient of 1. Another modification adopted for this study was to give non-native species a negative coefficient so that their negative impact on the natural quality of a community was better represented. A negative coefficient between -1 and -3 was assigned to all non-native species, a more negative value was assigned for the more aggressive species.

The ICC were applied to data in this study in several ways, but only to the herbaceous layer. The mean ICC was determined for groups of species, either native species (omitting non-native species) or all species (including non-native species). Another approach was to make these means more reflective of the impact of the species on the vegetation quality by weighting the mean with the species' abundance using CWF data. In this way, the coefficients of those species that are the most abundant have a larger effect in determining the mean. The ICC were also used to calculate the Floristic Quality Index (FQI). The FQI is essentially the mean conservatism weighted by the species richness:

$$\text{FQI} = (\text{mean conservatism})(\sqrt{\text{S}})$$

The FQI provides an adjustment to the mean conservatism that account for differences in the area sampled. It also incorporates the ecological principle embodied by the species area curve, which states that the larger the area sampled (or more time spent looking) the greater the number of species observed. For example consider this scenario. Site A is 2 ha and has a richness of 60 with a mean conservatism of 4.2. Site B is 10 ha and has a richness of 85 and a mean conservatism of 4.2. Based solely on the means, the two sites have equivalent quality. However,

the FQI for site A is 32.5, while the FQI for site B is 38.7 due to its greater richness. Larger sites have greater potential for higher quality simply due to their larger size.

Four values of FQI were calculated for the herbaceous layer – two utilized unweighted means of conservatism, one for only native herbaceous species and one for all the species, the other two utilized weighted means of conservatism for the same groups. What values of FQI represent high quality? More work is needed to be certain about this, but the current thinking is that an FQI over 30-35 is at the high end of quality, medium quality values range from 15 to 30, and values below 15 represent low quality. It is important to keep in mind that FQI is a product of both mean conservatism and species richness, thus when all of the species are utilized the FQI will be edged upward by the additional richness, but pushed downward by the negative conservatism of non-native species.

Statistical analyses were done with many of these variables using the four sites as replicates (inter analyses) to determine if there are patterns in how the vegetation has responded to either management or time. Data observed in 2010 were compared to the same data collected at the same site in 2017. It is important to recognize that since the study lacks controls, differences between the two years could be attributed to either management at the site or to the passage of time. The effects of those two factors cannot be separated.

Since this study uses a paired design (repeated measurements on the same observational units in time), paired t-tests are the appropriate analysis, and are desirable for their ability to control extraneous factors and increase statistical power. However, with only four replicates, the degrees of freedom (df) for a paired t-test is only 3, which reduces statistical power. Therefore analyses were done with paired t-tests and two sample t-tests. It is possible that since the two sample t-tests have df=6, they may provide higher statistical power than a paired t-test on the same data. The lowest p-value obtained between the two tests was reported. In some cases, the data did not meet the requirement for normality; in that case a non-parametric test, the Wilcoxon Signed Rank Test, was used and medians reported.

For a few variables, the data for both years were the null state, meaning that characteristic measured by the variable was not present. In these cases, the site does not contribute valid information to the analysis, so these sites were not included in the analysis. Analyses were not performed on all the variables because in some cases it could clearly be seen that the data supported the null hypothesis (no difference between the two years). Statistically significant resuts were claimed if the p-value ≤ 0.10. Trends in the data were described if the p-value was between 0.10 and 0.20.

Ordination Analysis

Detrended Correspondence Analysis (DECORANA) was used to produce two ordinations. An ordination is a technique to visualize the variation in multivariate data. Studies in community ecology often use ordinations to help see the patterns of similarity and dissimilarity among many community samples that are each characterized by numerous variables (occurrences of species). The results of an ordination are displayed in a scatter plot, where samples are ordinated in species space (samples in close proximity have similar species composition), or species are ordinated in sample space (species in close proximity are associated with each other).

Two ordinations were done for this study. One used all the species observed at the sites, in all four structural layers and across all spatial scales. Because management activities may affect the herbaceous layer differently from the woody structural layers (shrub, sapling and tree layers), the community composition for a plot at a site was ordinated as two samples – one representing the herb layer and one representing the woody species present in the shrub, sapling/understory, and canopy/subcanopy layers. The inclusion of species observed in disparate structural layers, as well as woody species observed in multiple structural layers and spatial scales, and species measured with different variables and different units, created a problem in uniformity. This was solved by using an IV to express the abundance of species. Importance Values provided a uniform scale measured in % and ranging from 0 to 100 for all species. However, the range of the IV data was extremely large, from as low as 0.05% to as large as 50%. The non-normality of these data, occurring across four magnitudes, was undesirable. Therefore the IV data were transformed to a new scale using this function:

$$\text{Transformed IV} = IV^{0.6} \times 10$$

The function compresses the range of values. For example data spanning four magnitudes – 0.05, 0.5, 5 and 50 – is transformed to data spanning three magnitudes – 1.7, 6.6, 26.3, and 104.6.

An additional problem is the woody species that occur in two or three structural layers. One approach is to include the species separately in each structural layer. This has the advantage of promoting the distinctive functions of woody individuals of differing sizes and the predominance of certain structural layers. However, the ordination analysis does not recognize structural species as the same taxonomic species. That is, red elm-shrub and red elm-sapling are treated as different species which inflates the number of actual species in the ordination and the species space. The other approach, and the one used in this study, avoids that problem by combining the abundances of a woody species that occur in more than one structural layer. In this study, this was done by calculating the IV for all species in each structural layer and averaging them across the three structural layers.

The ordination that included all of the plant species observed included 170 species and 16 samples. Each of the four sites was represented by a community sample obse4rved in 2010 and one observed in 2017. Each of these samples was divided into two subsamples – one reflecting the herb layer where species abundance was the transformed IV based on relative density and relative CWF, and one subsample representing the woody species over 50 cm tall, where species abundance was the transformed IV based on the relative density of shrubs and saplings, and the relative density and basal area of trees.

The second ordination was done with only the herb layer, which is really the main focus of this study. Only the more common species were included, determined by those that had a density measurement. Thus another important difference between this and the first ordination is that the first was based on relativized data, where a specie's abundance is based on how it compares to other species in the sample. The second ordination was based on absolute data, where a specie's abundance is completely independent from all the other species. There were 127 species and 8 samples in the second ordination.

Management

Ideally the baseline inventories are finished prior to any restoration work beginning; however that did not happen for sites 1 and 2. Some tree and sapling thinning occurred at site 1 in November 2009 before the 2010 baseline inventory. The cut material was removed and piled. The understory at site 2 was also thinned in November 2009 and the material scattered in place.

Management after the 2010 baseline inventory was focused on periodic prescribed burns, thinning and goat browsing. These are the management activities that occurred at each site.

Site 1: mechanical woody clearing in 2010; fall burn 2011; fall burn 2012; fall burn 2016
Site 2: mechanical woody clearing in 2012; fall burn 2012; fall burn 2016
Site 3: mechanical woody clearing in 2011; fall burn 2012; fall burn 2016
Site 4: goats - good access 2011, 2012, 2013 fall burn 2011; fall burn 2012; spring burn 2016
goats - marginal access 2014, 2015, 2016

Results and Discussion

There were 135 plant species observed in the community samples among the four sites in 2010. Another 39 species were added to the cumulative species list after the 2017 field season, for a total of 174 vascular plant species (Table 3). Three of the taxa in the table represent observations of two species – *Melilotus* (*alba* and *officinalis*), *Desmodium* (*paniculatum* and *illinoense*) and *Lonicera* (*maackii* and *tatarica*). Ten species could only be identified to the genera level, eight of them are clearly unique species while the other two – *Ranunculus* and *Carex* – are represented by additional identified species. It is possible these two generic taxa represent a species already listed, but there is reasonable expectation that they are new species. Two species were probable identifications – *Prunus americana*, and *Desmodium cuspidatum*. One *Carex* species was identified as either *C. rosea* or *C. convoluta*.

There are 19 non-native species among the 174, or 10.9% of the flora. On a positive note this is a very low percentage for natural areas in Iowa, which typically exhibit a non-native percentage of 15% to 20%. None of the species observed are conservation priority species (on the state list of endangered, threatened or special concern species). There were two upper tier ICC species (CC ≥ 8) – *Allium tricoccum* (wild leek) and *Desmodium cuspidatum* (large-bracted tick trefoil).

Table 3. Cumulative plant species list for study sites at Robison Wildlife Acres. Data are the sum of the transformed IV in four samples (2010 & 2017 herb layer and 2010 & 2017 woody layers). An IV is a relative measure of abundance that integrates density, frequency, and basal area. The use of "/" implies both species are likely present, the use of "-" means one or the other is present. Species preceded with an "x" are non-native.

			Sum of Transformed IV				Overall
	Scientific Name	Common Name	Site 1	Site 2	Site 3	Site 4	Mean
x	Abutilon theophrasti	velvet leaf	0	0	0	3.2	0.8
	Acalypha virginica	three-seeded mercury	0	0	0	21.8	5.4
	Acer negundo	box elder	2.8	0	0	64.9	16.9
	Acer nigrum	black maple	160.3	8.8	0	0	42.3
	Agrimonia gryposepala	tall agrimony	0	0	0	12.3	3.1
	Agrimonia pubescens	downy agrimony	0	12.8	4.3	0	4.3
x	Alliaria petiolata	garlic mustard	29.3	18.9	11.9	0	15.0
	Allium tricoccum	wild leek	8.4	9.4	26.5	0	11.1
	Ambrosia artemisiifolia	common ragweed	0	0	1.4	15.4	4.2
	Ambrosia trifida	giant ragweed	0	0	2.9	0	0.7
	Anemone virginiana	tall thimbleweed	0	3.0	0	0	0.7
	Apocynum sibiricum	dogbane	0	0	0	13.3	3.3
x	Arctium minus	burdock	4.7	0	0	0	1.2
	Arisaema triphyllum	Jack-in-the-pulpit	0	2.5	3.2	0	1.4
	Asclepias syriaca	common milkweed	2.2	0	0	9.5	2.9
	Aster ericoides	heath aster	0	0	0	6.0	1.5
	Aster ontarionis	Ontario aster	0	4.2	0	0	1.1
	Aster pilosus	hairy aster	0	0	0	14.9	3.7
	Aster sagittifolius	heart-leaf aster	2.9	10.4	2.9	0	4.0
	Bidens sp.	beggar tick species	2.8	0	0	0	0.7
	Botrychium virginianum	rattlesnake fern	0.0	14.7	1.8	3.2	4.9
x	Bromus inermis	smooth brome	0	0	0	92.2	23.0
	Calystegia sepium	bindweed	0	0	0	9.5	2.4
	Campanula americana	American bell flower	1.4	6.5	0	0	2.0
	Carex blanda	woodland sedge	1.4	0	0	1.6	0.8
	Carex cristatella	crested sedge	0	0	0	5.6	1.4
	Carex hirtifolia	hairy wood sedge	9.1	0	9.0	0	4.5
	Carex molesta	field oval sedge	0	0	0	1.6	0.4
	Carex rosea -- convoluta	rosy or star sedge	1.4	0	1.4	14.5	4.3
	Carex vulpinoidea	fox sedge	0	0	0	2.6	0.6
	Carex sp.	sedge species	47.0	73.9	49.9	112.8	70.9
	Carya cordiformis	bitternut hickory	48.0	148.0	61.4	0	64.4
	Carya ovata	shagbark hickory	16.0	20.2	41.6	0	19.4
	Celastrus scandens	bittersweet	0	4.8	2.9	3.2	2.7
	Celtis occidentalis	hackberry	166.1	24.0	49.3	3.9	60.8
	Chaerophyllum procumbrens	wild chervil	0	4.9	0	0	1.2
x	Chenopodium album	lamb's quarter	2.2	0	0	0	0.6
	Circaea lutetiana	enchanters nightshade	25.0	46.0	23.0	8.5	25.6
	Cirsium altissimum	tall thistle	0	0	2.3	10.5	3.2

			Sum of Transformed IV				Overall
	Scientific Name	Common Name	Site 1	Site 2	Site 3	Site 4	Mean
	Cirsium discolor	field thistle	0	0	0	10.0	2.5
	Claytonia virginica	spring beauty	83.4	5.7	4.9	0	23.5
	Conyza canadensis	horseweed	0	3.5	0	0	0.9
	Cornus foemina	gray dogwood	3.5	4.2	14.0	265.2	71.7
	Corylus americana	hazelnut	0	0	8.9	0	2.2
	Crataegus sp.	hawthorn species	0	3.0	0	0	0.7
	Cryptotaenia canadensis	honewort	19.5	51.8	33.8	5.7	27.7
	Cystopteris protrusa	southern fragile fern	33.0	0	0	0	8.3
x	Daucus carota	wild carrot	0	0	0	2.1	0.5
	Dentaria laciniata	toothwort	44.0	0	15.4	0	14.8
	Desmodium canadense	showy tick trefoil	0	0	0	3.4	0.8
	Desmodium cf. cuspidatum	large-bracted tick trefiol	1.4	0	0	0	0.3
	Desmodium paniculatum/illinoense	panicled/Illinois tick trefoil	0	0	0	18.3	4.6
	Diarrhena americana	beak grass	0	0	28.2	0	7.1
	Dicentra cucullaria	dutchman's breeches	70.5	0	62.8	0	33.3
	Dichanthelium acuminatum	common panic grass	0	0	0	25.7	6.4
	Dioscorea villosa	wild yam	0	0	23.9	0	6.0
x	Elaeagnus sp.	autumn olive	0	0	0	7.4	1.8
	Elymus canadensis	Canada wildrye	0	1.6	0	0	0.4
	Elymus villosus	silky wildrye	12.1	7.9	1.4	0	5.4
	Erigeron annuus	daisy fleabane	1.4	0	0	7.2	2.1
	Erythronium albidum	trout lily	64.3	0	107.0	0	42.8
	Euonymus atropurpureus	eastern wahoo	9.1	0	2.9	0	3.0
	Eupatorium rugosum	white snakeroot	13.2	18.1	16.7	2.6	12.6
	Festuca obtusa	woodland fescue	32.3	32.7	8.2	0	18.3
	Fragaria vesca	woodland strawberry	0	0	0	5.8	1.4
	Fragaria virginiana	wild strawberry	0	0	0	14.1	3.5
	Fraxinus pennsylvanica	green ash	12.7	11.0	0	49.7	18.4
	Galearis spectabilis	showy orchis	0	8.2	4.5	0	3.2
	Galium aparine	cleavers bedstraw	22.3	46.3	24.1	0	23.2
	Galium circaezans	forest bedstraw	6.6	0	0	0	1.7
	Galium concinuum	shining bedstraw	0	0	18.5	0	4.6
	Galium triflorum	sweet-scented bedstraw	25.2	20.2	28.9	30.5	26.2
	Gentiana alba	pale gentian	0	0	0	2.6	0.6
	Geranium maculatum	wild geranium	0	0	23.6	0	5.9
	Geum canadense	white avens	8.9	24.4	19.8	20.6	18.4
	Gleditsia triacanthos	honey locust	1.8	31.1	5.1	3.3	10.3
	Hackelia virginiana	stick seed	24.5	19.5	13.3	8.1	16.4
	Helianthus grosseserratus	saw-tooth sunflower	0	0	0	5.8	1.5
	Helianthus strumosus	woodland sunflower	0	0	8.0	0	2.0
	Helianthus tuberosus	Jerusalem artichoke	0	0	0	9.6	2.4
	Hydrophyllum virginianum	Virginia waterleaf	20.5	0	36.0	2.6	14.8
	Hypericum punctatum	dotted St. Johnswort	0	0	0	8.1	2.0
	Hystrix patula	bottlebrush grass	3.2	0	0	0	0.8

	Scientific Name	Common Name	Sum of Transformed IV				Overall Mean
			Site 1	Site 2	Site 3	Site 4	
	Impatiens pallida	pale jewelweed	21.3	0	0	0	5.3
	Isopyrum biternatum	false rue anemone	37.7	0	17	0	13.7
	Juglans nigra	black walnut	0	0	0	4	1.0
	Juncus dudleyi	Dudley's rush	0	0	0	19.9	5.0
	Juncus tenuis	path rush	0	0	0	10.7	2.7
	Lactuca canadensis	yellow wild lettuce	61	0	0	0	15.4
	Laportea canadensis	wood nettle	19.7	37.2	8.8	4.5	17.6
	Leersia virginica	white grass	21.7	27.2	1.8	45.1	24.0
x	Lonicera maackii/tatarica	amur/tatarian honeysuckle	12.4	206.0	3.6	27.2	62.3
x	Melilotus alba/officinalis	white/yellow sweet clover	0	0	0	7.6	1.9
	Menispermum canadense	moonseed	27.1	0	0	0	6.8
	Monarda fistulosa	wild bergamot	0	0	0	10.1	2.5
x	Morus alba	white mulberry	3.8	3.5	0	8.3	3.9
	Muhlenbergia frondosa	wire stem muhly	1.4	0	0	10.2	2.9
	Oenothera biennis	common evening primrose	1.8	0	0	2.6	1.1
	Osmorhiza longistylis	anise root	23.1	10.7	29.8	0	15.9
	Ostrya virginiana	ironwood	88.0	11.4	0	0	24.8
	Oxalis stricta	yellow wood sorrel	4.2	3.5	0	2.6	2.6
	Parietaria pensylvanica	Pennsylvania pellitory	0	4.8	0	0	1.2
	Parthenocissus vitacea	woodbine	42.0	43.1	67.9	28.6	45.4
x	Pastinaca sativa	wild parsnip	0	0	0	19.9	5.0
	Phlox divaricata	woodland phlox	32.5	34.0	14.0	0	20.1
	Phryma leptostachya	lopseed	15.9	28.8	23.5	5.6	18.5
	Physalis heterophylla	clammy ground cherry	6.7	0	0	0	1.7
	Pilea pumila	clear weed	5.6	7.3	3.2	0	4.0
	Plantago rugelli	Rugel's plantain	0	1.6	0	0	0.4
x	Poa pratensis	Kentucky bluegrass	0	0	0	126.9	31.7
	Podophyllum peltatum	mayapple	0	0	5.3	0	1.3
	Polygonatum biflorum	Soloman's seal	18.0	8.2	6.7	0	8.2
	Polygonum amphibium	water smartweed	0	0	0	17.3	4.3
	Polygonum punctatum	dotted smartweed	0	0	0	4.0	1.0
	Polygonum virginianum	jumpseed	11.6	42.6	10.0	3.2	16.9
	Potentilla norvegica	Norway cinquefoil	0	0	0	6.5	1.6
	Prunus cf. americana	American plum	0	0	0	3.9	1.0
	Prunus serotina	black cherry	23.2	25.3	54.0	6.3	27.2
	Prunus virginiana	chokecherry	0	3.9	139.6	0	35.9
	Quercus alba	white oak	0	0	2.3	0	0.6
	Quercus borealis	red oak	53.4	0	120.5	0	43.5
	Quercus macrocarpa	bur oak	0	38.3	25.5	0	16.0
	Ranunculus abortivus	kidney leaf buttercup	11.1	22.7	9.4	3.2	11.6
	Ranunculus septentrionalis	swamp buttercup	0	5.2	0	0	1.3
	Ranunculus sp.	buttercup species	2.2	0	0	0	0.6
	Ribes sp.	gooseberry species	62.3	74.4	52.5	0	47.3
x	Rosa multiflora	multiflora rose	33.3	150.5	15.2	16.9	54.0

	Scientific Name	Common Name	Sum of Transformed IV				Overall Mean
			Site 1	Site 2	Site 3	Site 4	
	Rubus allegheniensis	blackberry	0	0	3.9	0	1.0
	Rubus occidentalis	black raspberry	35.6	33.1	38.5	0	26.8
	Rudbeckia hirta	black-eyed susan	0	0	0	1.6	0.4
	Rudbeckia triloba	brown-eyed susan	0	1.6	0	0	0.4
	Rumex altissimus	pale sour dock	0	0	0	4.1	1.0
x	Rumex crispus	curly sour dock	0	0	0	3.7	0.9
	Sambucus canadensis	elderberry	3.3	0	0	1.0	1.1
	Sanguinaria canadensis	bloodroot	22.9	9.0	15.9	3.9	12.9
	Sanicula gregaria	black snakeroot	64.7	117.2	113.1	16.8	77.9
	Scutellaria sp.	skullcap species	0	0	0	3.3	0.8
x	Setaria faberi	giant foxtail	0	0	0	1.6	0.4
	Silene stellata	starry campion	0	0	3.5	0	0.9
	Silphium perfoliatum	cup plant	0	0	0	3.5	0.9
	Smilacina racemosa/stellata	false Solomon's seal	4.6	6.5	40.3	0	12.9
	Smilacina stellata	starry false Solomon's seal	0	0	7.0	0	1.7
	Smilax ecirrhata	short carrion flower	0	0	10.7	0	2.7
	Smilax herbacea	tall carrion flower	0	0	9.7	0	2.4
	Smilax hispida	green briar	49.2	39.6	66.4	10.3	41.4
	Solanum americanum	black nightshade	0	1.6	0	0	0.4
	Solanum carolinense	horse nettle	5.5	0	0	0	1.4
	Solidago alitissima	tall goldenrod	0.0	0	0	1.6	0.4
	Solidago canadensis	Canada goldenrod	1.4	0	0	9.3	2.7
	Solidago gigantea	giant goldenrod	0	0	0	31.3	7.8
	Solidago rigida	rigid goldenrod	0	0	0	4.1	1.0
	Solidago ulmifolia	elm-leaf goldenrod	4.5	0	4.3	0	2.2
x	Sonchus sp.	sow thistle species	1.8	0	0	2.1	1.0
	Sporobolus asper	tall dropseed	0	0	0	1.6	0.4
	Symphoricarpos sp.	buckbrush species	0	0	0	11.4	2.8
x	Taraxacum officinale	dandelion	7.6	7.8	2.9	5.3	5.9
	Teucrium canadense	American germander	0	12.3	0	3.2	3.9
	Thalictrum dasycarpum	purple meadow rue	0	0	1.4	0	0.4
	Tilia americana	basswood	47.9	0	52.7	0	25.1
	Toxicodendron radicans	poison ivy	20.8	42.7	33.9	93.0	47.6
x	Trifolium repens	white clover	0	0	0	7.3	1.8
	Ulmus americana	American elm	53.2	43.9	41.4	127.0	66.4
	Ulmus rubra	red elm	28.4	13.8	47.0	44.9	33.5
	Urtica dioica	stinging nettle	5.7	6.2	1.4	0	3.3
x	Verbascum thapsis	common mullein	1.8	0	0	0	0.5
	Verbena urticifolia	white vervain	0	0	0	14.6	3.7
	Veronicastrum virginicum	Culver's root	1.4	0	0	0	0.3
	Viola pubescens	yellow violet	17.7	42.7	34.7	0	23.8
	Viola sp.	violet species	52.6	55.1	46.5	18.1	43.1
	Vitis riparia	wild grape	22.5	7.2	0	36.8	16.6
	Zanthoxylum americanum	pricky ash	0	2.8	7.0	20.2	7.5

Table 4. The top 50 species observed at study sites at Robison Wildlife Acres based on transformed IV, a relativized measure of abundance.

Common Name	Overall Mean Transformed IV	Common Name	Overall Mean Transformed IV
black snakeroot	77.9	basswood	25.1
gray dogwood	71.7	ironwood	24.8
sedge species	70.9	white grass	24.0
American elm	66.4	yellow violet	23.8
bitternut hickory	64.4	spring beauty	23.5
amur honeysuckle	62.3	cleavers bedstraw	23.2
hackberry	60.8	smooth brome	23.0
multiflora rose	54.0	woodland phlox	20.1
poison ivy	47.6	shagbark hickory	19.4
gooseberry species	47.3	lopseed	18.5
woodbine	45.4	white avens	18.4
red oak	43.5	green ash	18.4
violet species	43.1	woodland fescue	18.3
trout lily	42.8	wood nettle	17.6
black maple	42.3	box elder	16.9
green briar	41.4	jumpseed	16.9
chokecherry	35.9	wild grape	16.6
red elm	33.5	stick seed	16.4
dutchman's breeches	33.3	bur oak	16.0
Kentucky bluegrass	31.7	anise root	15.9
honewort	27.7	false rue anemone	15.4
black cherry	27.2	garlic mustard	15.0
black raspberry	26.8	toothwort	14.8
sweet-scented bedstraw	26.2	Virginia waterleaf	14.8
enchanters nightshade	25.6	black walnut	13.7

The plant species composition of the plots at each site and its response to seven years of management is the principal focus in this study. These data are presented in two tables for each plot. One table presents the herbaceous layer species with density, CWF, and the IV for each species observed in 2010 and 2017. The second table reports the species composition of the shrub, sapling/understory, and canopy/subcanopy layers. The density of shrubs and saplings, and the density, basal area, and IV for trees, are given for both 2010 and 2017. The density and basal area of snags is also reported. These data can be found in Tables 5a and 5b for site 1, Tables 6a and 6b for site 2, Tables 7a and 7b for site 3, and Tables 8a and 8b for site 4.

Site-Level Intra Comparisons

In this section, the vegetation for each site is described and the trends and patterns that are apparent at individual sites are examined. Because IV integrates both the density and the frequency of species (and therefore combines two different measures of abundance to achieve a more balanced measurement), and because it is a relative measure of abundance that reflects a species "rank" in the community compared to the other species, it was used to make comparisons and establish patterns in species' responses within sites. Replication was achieved by constructing functional groups of species, that is species that are ecologically, morphologically, and physiologically similar, and using the species as replicates to examine patterns exhibited by the group.

Site 1 is a maple/basswood/red oak forest with a fairly open understory. Predominate species in the herb layer include four spring ephemerals (*Dicentra*, *Erythronium*, *Claytonia* and *Dentaria*), *Isopyrum biternatum*, *Sanicula gregaria*, *Viola* sp., and *Carex* sp. Species that exhibited a strong decreasing trend between 2010 and 2017, based on differences in IV, were *Claytonia virginica*, *Cystopteris protrusa*, *Dicentra cucullaria*, *Isopyrum biternatum* and *Dentaria laciniata*. Apparent increasers, using the change in IV as a measure, were *Alliaria petiolata*, *Viola* sp., *Sanicula gregaria*, *Laportea canadensis*, *Galium triflorum*, *Circaea lutetiana* and *Impatiens pallida*. *Carex* sp. and *Leersia virginica* also exhibited an increase, but to a lesser extent. The four spring ephemeral species form a functional group where the species can be used as pseudoreplicates for a statistical comparison. The mean IV for the spring ephemeral group in

2017 (5.52) was significantly lower than the mean IV in 2010 (9.59) (paired t-test, p-value=0.077, df=3). Graminoids form another functional group for comparison. The mean IV for the graminoids was 1.04 in 2010, which was not significantly different from the mean IV of 1.87 in 2017 (paired t-test, p-value=0.11, df=5). There were 21 woody species observed in the herb layer; most of them exhibited minor changes. Statistical comparison of woody species IV between 2010 and 2017 resulted in a significant decrease (paired t-test, p-value=0.024, df=20). Mean woody species IV decreased from 0.66 in 2010 to 0.29 in 2017.

There was a 5-fold increase in total shrub density from 2010 to 2017. Mechanical thinning was effective; total tree density deceased from 410 stems/ha to 190 stems/ha, mostly due to the removal of 89% of the *Ostrya virginiana*. Total basal area of trees remained about the same from 2010 to 2017.

Site 2 is an early to mid-successional bitternut hickory forest with a very dense understory and shrub layer. Predominate species in the herb layer include *Sanicula gregaria*, *Circaea lutetiana*, *Cryptotaenia canadensis*, *Galium aparine*, *Viola pubescens*, *Viola* sp., *Carex* sp. and *Parthenocissus vitacea*. Additional common species with lesser importance include *Rosa multiflora*, *Lonicera* sp., *Toxicodendron radicans*, *Phlox divaricata* and *Festuca obtusa*. Species that exhibited a strong decreasing trend between 2010 and 2017, based on differences in IV, were *Viola pubescens*, *Carex* sp., *Galium triflorum* and *Parthenocissus vitacea*. Those exhibiting the largest increases in IV included *Laportea canadensis*, *Polygonum virginianum*, *Sanicula gregaria*, and *Alliaria petiolata*. A group of five graminoids, similar to site 1, produced a statistical comparison that resulted in no difference between the mean IV in 2010 (3.13) and in 2017 (2.14) (paired t-test, p-value=0.37, df=4). There were 22 woody species observed in the herb layer that were used as pseudoreplicates to make a statistical comparison between 2010 and 2017. Mean woody species IV decreased significantly from 0.41 in 2010 to 0.18 in 2017 (Wilcoxon signed rank test, p-value=0.014, n=22).

Although the shrub was very dense, the data show that shrub density decreased by 184 stems/are. Some of that decrease may have been due to some of them growing into the sapling layer, as it increased by 16 stems/are. Tree density went done by 20%, mostly due to a decrease in the

Table 5a. Plant species composition of the herbaceous layer at site 1. ICC is the Iowa Coefficient of Conservatism. CW Frequency is the combined and weighted frequency. IV is the Importance Value. Species with an (*) have an ICC that was revised from 0 to 1.

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Forbs/Pteridophytes							
Allium tricoccum	9	0.3	0.1	3.8	3.8	0.30	0.17
Asclepias syriaca *	1	---	---	---	2.1	---	0.08
Aster sagittifolius	6	---	0.1	---	2.7	---	0.13
Bidens sp.	1	---	---	2.1	---	0.12	---
Campanula americana	4	---	---	---	1.0	---	0.04
Circaea lutetiana	5	1.2	10.7	4.9	39.8	0.59	2.60
Claytonia virginica	4	75.5	51.1	84.8	76.1	15.19	7.04
Cryptotaenia canadensis	4	1.6	2.7	9.4	17.1	0.93	0.98
Cystopteris protrusa	6	23.7	0.3	33.2	5.5	5.77	0.25
Dentaria laciniata	7	18.3	9.3	37.0	38.2	5.22	2.42
Desmodium cf. cuspidatum	8	---	---	---	1.0	---	0.04
Dicentra cucullaria	7	45.7	47.6	65.3	57.0	10.49	6.07
Erigeron annuus *	1	---	---	---	1.0	---	0.04
Erythronium albidum	6	24.3	48.3	61.4	68.5	7.46	6.55
Eupatorium rugosum	2	---	4.5	---	27.8	---	1.58
Galium aparine	1	0.5	8.1	10.6	22.1	0.76	1.71
Galium circaezans	6	---	2.7	---	4.4	---	0.50
Galium triflorum	7	0.3	10.3	7.2	46.5	0.50	2.82
Geum canadense	2	---	1.7	2.1	5.4	0.12	0.44
Hackelia virginiana *	1	0.3	7.6	10.0	40.5	0.66	2.35
Hydrophyllum virginianum	3	3.6	0.3	23.4	6.6	2.12	0.30
Impatiens pallida	5	0.1	9.2	2.7	41.5	0.20	2.54
Isopyrum biternatum	5	37.2	27.2	61.0	47.2	9.16	4.22
Laportea canadensis	3	---	13.6	2.1	27.6	0.12	2.39
Oenothera/Gaura sp.	2	---	---	1.0	---	0.06	---
Osmorhiza longistylis	5	1.7	0.8	24.0	18.4	1.79	0.82
Oxalis stricta *	1	---	0.4	---	4.4	---	0.23
Phlox divaricata	5	2.9	11.7	17.3	45.4	1.64	2.91
Phryma leptostachya	4	0.3	1.5	6.6	19.5	0.47	0.94
Physalis heterophylla	2	---	0.1	---	2.7	---	0.13
Physalis sp.	2	0.1	---	2.7	---	0.20	---
Pilea pumila	3	---	1.1	---	6.0	---	0.38
Polygonatum biflorum	4	1.2	1.9	6.6	20.0	0.69	1.01
Polygonum virginianum	5	---	4.5	---	19.9	---	1.28
Ranunculus abortivus *	1	0.1	0.5	4.9	8.8	0.33	0.42
Ranunculus sp.	3	---	---	---	2.1	---	0.08
Sanguinaria canadensis	7	1.6	2.4	23.4	13.9	1.73	0.83
Sanicula gregaria	5	16.9	64.5	54.9	81.5	6.06	8.16
Smilacina racemosa	4	0.4	---	2.7	---	0.27	---
Solanum americanum/carolinense *	1	---	0.3	1.0	3.8	0.06	0.19

Species & Group	ICC	Ramet Density (#/m2) 2010	Ramet Density (#/m2) 2017	CW Frequency Abs % 2010	CW Frequency Abs % 2017	IV % 2010	IV % 2017
Solidago canadensis *	1	---	---	---	1.0	---	0.04
Solidago ulmifolia	6	---	0.9	---	3.2	---	0.26
Urtica dioica *	1	---	0.1	2.1	2.7	0.12	0.13
Veronicastrum virginicum	5	---	---	---	1.0	---	0.04
Viola pubescens	5	0.8	1.9	7.7	19.5	0.66	0.99
Viola sp.	1	8.4	38.7	42.8	73.4	4.06	6.06
Forb seedling		0.7	18.0	7.2	50.4	0.60	3.62
Graminoids							
Carex cf. blanda	2	---	---	---	1.0	---	0.04
Carex hirtifolia	6	---	6.0	---	4.9	---	0.86
Carex rosea/convoluta	6.5	---	---	---	1.0	---	0.04
Carex sp.	3	9.7	32.8	27.9	55.2	3.41	4.94
Elymus villosus	5	---	6.0	1.0	9.9	0.06	1.05
Festuca obtusa	7	7.9	16.4	13.2	15.4	2.27	2.17
Hystrix patula	5	---	---	1.0	1.0	0.06	0.04
Leersia virginica	6	0.8	16.4	4.4	12.1	0.47	2.04
Muhlenbergia frondosa	3	---	---	---	1.0	---	0.04
Graminoid seedling/tiller		---	18.8	---	48.7	---	3.62
Woody Seedling/Sprouts							
Acer negundo *	1	---	---	2.1	---	0.12	---
Acer nigrum	5	0.5	7.7	17.9	36.6	1.18	2.22
Carya cordiformis	5	0.1	0.4	4.9	8.3	0.33	0.38
Carya ovata	5	0.4	0.3	9.4	6.6	0.66	0.30
Celtis occidentalis	2	2.1	2.0	28.4	17.2	2.13	0.91
Cornus sp.	2	---	0.1	---	3.8	---	0.17
Euonymus atropurpureus	7	0.3	0.4	4.4	3.8	0.34	0.21
Fraxinus pennsylvanica	3	0.3	---	6.6	---	0.47	---
Gleditsia triacanthos	1	---	---	1.0	---	0.06	---
Menispermum canadense	5	---	0.3	1.0	7.8	0.06	0.34
Ostrya virginiana	5	1.2	0.1	19.5	2.7	1.43	0.13
Parthenocissus cf. vitacea	1	3.9	4.4	10.5	22.2	1.43	1.36
Prunus serotina	3	0.3	0.4	2.7	6.0	0.24	0.29
Quercus borealis	6	---	---	---	3.3	---	0.12
Quercus sp.	4	0.5	---	8.3	---	0.63	---
Ribes sp.	3	---	---	3.3	2.1	0.19	0.08
Smilax hispida	4	0.4	0.5	12.8	7.8	0.86	0.38
Tilia americana	5	0.9	---	4.4	---	0.50	---
Toxicodendron radicans	1	0.3	0.5	5.5	8.8	0.40	0.42
Ulmus sp.	2	0.8	0.7	11.6	10.0	0.89	0.48
Vitis riparia	1	1.2	---	15.0	---	1.17	---
Woody seedling		0.9	---	9.4	---	0.79	---
Exotic							
Alliaria petiolata	-2	1.5	17.5	9.9	38.1	0.93	3.11
Arctium minus	-1	---	0.1	1.0	2.7	0.06	0.13
Chenopodium album	-1	---	---	---	2.1	---	0.08

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Sonchus sp.	-1	---	---	1.0	---	0.06	---
Taraxacum officinale	-1	---	0.7	2.1	4.9	0.12	0.29
Verbascum thapsis	-1	---	---	1.0	---	0.06	---
Morus alba	-3	0.1	---	2.7	---	0.20	---
Totals		301.9	537.2	869.6	1326.0		

Table 5b. Species composition for shrub, sapling/understory and canopy/subcanopy layers at site 1. Species with an (*) are non-native. BA is basal area.

					Trees						Snags			
	Shrubs (stem/are)		Saplings (stem/are)		Density (stem/ha)		BA (m^2/ha)		IV (%)		Density (stem/ha)		BA (m^2/ha)	
Species	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017
Acer nigrum	2.2	---	1.7	---	100	70	10.68	10.11	41.83	47.30	10	---	0.06	---
Carya cordiformis	0.6	1.1	---	---	20	20	0.89	1.13	4.92	8.49	---	---	---	---
Carya ovata	---	0.6	---	---	---	---	---	---			---	---	---	---
Celtis occidentalis	1.7	28.9	1.0	0.3	10	10	0.45	0.47	2.46	3.98	---	---	---	---
Fraxinus pennsylvanica	---	1.7	---	---	---	---	---	---			---	---	---	---
Juglans nigra	1.7	11.1	---	---	---	---	---	---			---	---	---	---
x Lonicera maackii	---	5.0	---	---	---	---	---	---			---	---	---	---
Menispermum canadense	---	11.1	---	---	---	---	---	---			---	---	---	---
Ostrya virginiana	---	---	1.0	---	190	20	1.51	0.37	27.37	6.33	40	---	1.17	---
Parthenocissus sp.	1.7	---	---	---	---	---	---	---			---	---	---	---
Prunus serotina	0.6	1.1	---	---	---	---	---	---			---	---	---	---
Quercus borealis	---	0.6	---	---	30	20	1.92	2.40	9.00	12.12	---	---	---	---
Ribes sp.	7.2	6.1	---	---	---	---	---	---			---	---	---	---
x Rosa multiflora	2.2	5.0	---	---	---	---	---	---			---	---	---	---
Rubus occidentalis	---	28.9	---	---	---	---	---	---			---	---	---	---
Sambucus canadensis	---	0.6	---	---	---	---	---	---			---	---	---	---
Smilax hispida	1.7	8.3	---	---	---	---	---	---			---	---	---	---
Tilia americana	0.6	---	---	---	20	20	1.55	1.95	6.73	10.84	---	---	---	---
Toxicodendron radicans	0.6	---	---	---	---	---	---	---			---	---	---	---
Ulmus americana	---	---	---	---	40	20	1.02	0.86	7.69	7.71	---	---	---	---
Ulmus rubra					---	10	---	0.21		3.23	---	---	---	---
Ulmus sp.	1.1	1.7	---	---	---	---	---	---			---	---	---	---
Vitis riparia	---	4.4	---	---	---	---	---	---			---	---	---	---
Totals	21.7	116.1	3.7	0.3	410	190	18.0	17.5	100	100	50	0	1.23	0.0

density of *Carya cordiformis* by 50 stems/ha, presumably by mechanical thinning. Tree basal area increased by 2.0 m^2/ha, or by 0.2 m^2 in the plot. That amount of growth is equivalent to a new tree with a DBH of 50 cm (20 inches).

Site 3 is a red oak forest with a fairly open understory. Predominate species in the herb layer include *Sanicula gregaria*, *Erythronium albidum*, *Dicentra cucullaria*, *Hydrophyllum virginianum*, *Viola pubescens*, *Viola* sp., *Carex* sp., and *Parthenocissus vitacea*. Species with secondary importance include *Smilacina racemosa*, *Osmorhiza longistylis*, *Cryptotaenia canadensis*, and *Diarrhena americana*. The species that experienced the largest decreases in relative abundance (decrease in IV) include *Parthenocissus vitacea*, *Erythronium albidum Sanicula gregaria*, *Viola pubescens*, *Hydrophyllum virginianum* and *Dicentra cucullaria*. The IV of both *Erythronium* and *Sanicula* decreased despite an increase in their density. This could have happened because their frequency did not change much, which would have a damping effect on their IV. If other species increased substantially, especially in frequency and this contributed to an increase in their IV, then their relative rank could have increased more than *Erythronium* and *Sanicula* (recall that frequency and density both contribute to IV). A specie's IV is determined by changes in other species just as much as it is by changes in its own abundance. Species whose IV increased substantially included *Smilacina racemosa*, *Galium triflorum*, *Geranium maculatum*, *Hackelia virginiana* and *Viola* sp. All four spring ephemerals are present and when analyzed as a group show no change in IV (paired t-test, p-value=0.23, df=3). The mean IV in 2010 was 6.8 and in 2017 was 5.2. The five graminoid species, analyzed as a group, exhibited a significant increase in their IV, increasing from a mean of 1.09 in 2010 to 1.63 in 2017 (paired t-test, p-value=0.098, df=4). Finally, there were 20 woody species in the herb layer that exhibited a significant decrease in median IV, dropping from 0.39 in 2010 to 0.13 in 2017 (Wilcoxon Signed Rank Test, p=0.002, n=20).

Shrub density increased slightly, about 15%, from 2010 to 2017. Five species dropped out, and five new species were observed. The effects of mechanical thinning were apparent; tree density decreased by 63%, from 880 stems/ha in 2010 to 330 stems/ha in 2017. Removal of *Carya ovata*, *Celtis occidentalis*, *Quercus borealis* contributed the most to this decrease; fewer trees of *Juglans nigra*, *Tilia americana* and *Ulmus americana* were also apparently removed. Basal area

Table 6a. Plant species composition of the herbaceous layer at site 2. ICC is the Iowa Coefficient of Conservatism. CW Frequency is the combined and weighted frequency. IV is the Importance Value. Species with an (*) have an ICC that was revised from 0 to 1.

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Forbs/Pteridophytes							
Agrimonia pubescens	4	0.7	0.0	11.1	4.4	0.72	0.27
Allium tricoccum	9	0.1	0.1	6.1	2.7	0.34	0.24
Anemone virginiana	4	---	---	---	2.1	---	0.13
Arisaema triphyllum	4	---	---	2.1	---	0.10	---
Aster ontarionis	3	---	0.1	---	2.7	---	0.24
Aster sagitifolius	6	0.5	0.1	6.0	2.7	0.45	0.24
Botrychium virginianum	6	0.7	0.3	12.2	4.9	0.78	0.43
Campanula americana	4	0.1	---	2.7	2.1	0.18	0.13
Chaerophyllum procumbrens	2	---	1.7	---	6.0	---	0.31
Circaea lutetiana	5	5.5	8.0	40.0	44.3	3.08	5.04
Claytonia virginica	4	---	0.5	---	2.7	---	0.40
Conyza canadensis *	1	0.1	---	2.7	---	0.18	---
Cryptotaenia canadensis	4	14.0	6.8	62.5	35.4	5.61	4.20
Eupatorium rugosum	2	1.5	0.5	14.5	6.6	1.08	0.64
Galearis spectabilis	4	---	0.1	3.3	3.8	0.15	0.31
Galium aparine	1	7.3	5.3	49.5	42.3	3.87	4.25
Galium triflorum	7	3.3	---	31.7	3.3	2.28	0.20
Geum canadense	2	2.0	0.8	25.0	12.8	1.69	1.11
Hackelia virginiana *	1	1.5	0.8	13.8	8.8	1.04	0.87
Laportea canadensis	3	2.8	5.7	15.5	46.2	1.41	4.59
Osmorhiza longistylis	5	0.5	---	7.7	3.3	0.53	0.20
Oxalis stricta *	1	0.1	---	2.7	---	0.18	---
Parietaria pensylvanica	3	0.3	---	4.4	---	0.30	---
Phlox divaricata	5	6.5	3.1	31.0	16.1	2.85	2.01
Phryma leptostachya	4	2.3	0.9	33.5	19.0	2.15	1.54
Pilea pumila	3	---	0.3	2.1	2.7	0.10	0.29
Plantago rugelli *	1	---	---	1.0	---	0.05	---
Polygonatum biflorum	4	0.1	---	6.1	2.1	0.34	0.13
Polygonum virginianum	5	1.3	13.3	17.3	52.5	1.18	6.81
Ranunculus abortivus *	1	1.6	0.9	16.7	14.5	1.21	1.26
Ranunculus septentrionalis	6	0.4	---	4.4	---	0.34	---
Rudbeckia triloba	5	---	---	1.0	---	0.05	---
Sanguinaria canadensis	7	0.1	0.3	2.7	3.8	0.18	0.36
Sanicula gregaria	5	94.3	73.1	95.7	82.0	17.93	20.20
Smilacina stellata/racemosa	4	---	0.1	1.0	3.8	0.05	0.31
Solanum americanum	1	---	---	1.0	---	0.05	---
Teucrium canadense	4	---	0.9	1.0	12.2	0.05	1.12
Urtica dioica *	1	---	0.4	---	4.4	---	0.45

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Viola pubescens	5	16.4	0.5	68.5	20.2	6.27	1.48
Viola sp.	1	12.9	6.7	66.9	52.1	5.64	5.20
Forb seedling		1.5	8.1	12.8	33.3	0.61	4.40
Graminoids							
Carex sp.	3	52.5	15.7	67.5	39.9	11.35	6.57
Elymus canadensis	5	---	---	1.0	---	0.05	---
Elymus villosus	5	0.4	---	3.8	2.1	0.31	0.13
Festuca obtusa	7	10.5	3.5	12.1	12.7	2.66	1.92
Leersia virginica	6	3.5	4.7	10.5	9.9	1.30	2.07
Graminoid seedlings		0.3	6.3	1.7	26.6	0.08	3.52
Woody Seedling/Sprouts							
Acer nigrum	5	---	0.1	3.3	4.9	0.15	0.38
Carya cordiformis	5	0.7	---	10.5	---	0.70	---
Carya ovata	5	0.1	---	2.7	---	0.18	---
Celastrus scandens	1	0.3	---	4.4	---	0.30	---
Celtis occidentalis	2	1.3	0.1	16.6	3.8	1.15	1.00
Cornus sp.	2	0.1	---	3.8	---	0.23	---
Crataegus sp.	3	---	---	---	2.1	---	0.13
Fraxinus pennsylvanica	3	0.7	---	7.2	---	0.54	---
Gleditsia triacanthos	1	---	0.1	---	2.7	---	0.24
Ostrya virginiana	5	0.4		6.0	---	0.41	---
Parthenocissus cf. vitacea	1	11.6	3.1	51.5	20.5	4.70	2.29
Prunus serotina	3	0.3	---	5.5	---	0.35	---
Ribes sp.	3	1.2	0.5	17.9	11.1	1.17	0.92
Rubus occidentalis	1	0.1	0.4	2.7	4.9	0.18	0.48
Smilax hispida	4	2.5	1.6	18.3	19.5	1.49	1.79
Toxicodendron radicans	1	3.3	2.4	31.7	26.7	2.29	2.48
Ulmus sp.	2	2.3	0.5	22.2	16.8	1.61	1.27
Vitis riparia	1	0.3	---	6.6	---	0.40	---
Woody seedling		0.1	0.0	1.7	2.1	0.08	0.13
Exotic							
Alliaria petiolata	-2	---	3.6	2.1	17.7	0.10	2.26
Taraxacum officinale	-1	0.1	0.1	2.7	2.7	0.18	0.24
Lonicera sp.	-3	4.3	1.5	31.7	10.0	2.47	1.16
Morus alba	-3	0.1	---	2.7	---	0.18	---
Rosa multiflora	-3	3.9	1.6	31.7	17.8	2.39	1.68
Totals		279.5	185.6	1055.7	810.1		

Table 6b. Species composition for shrub, sapling/understory and canopy/subcanopy layers at site 2. Species with an (*) are non-native. BA is basal area.

					Trees						Snags			
	Shrubs (stem/are)		Saplings (stem/are)		Density (stem/ha)		BA (m^2/ha)		IV (%)		Density (stem/ha)		BA (m^2/ha)	
	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017
Carya cordiformis	1.7	---	0.6	1.0	390	340	16.81	19.29	72.68	77.81	---	10	---	0.11
Carya ovata	---	---	---	---	30	10	0.20	0.13	3.17	1.41	---	---	---	---
Celtis occidentalis	2.2	---	---	---	---	---	---	---			---	---	---	---
Fraxinus pennsylvanica	3.3	---	---	---	---	---	---	---			---	---	---	---
Gleditsia triacanthos	---	---	---	---	30	20	1.34	0.95	5.68	4.21	20	---	0.39	---
x Lonicera maackii	132.2	92.2	44.1	46.3	---	---	---	---			---	---	---	---
Ostrya virginiana	---	---	---	---	10	---	0.09	---	1.11		---	---	---	---
Parthenocissus sp.	0.6	---	---	---	---	---	---	---			---	---	---	---
Prunus serotina	1.1	2.2	0.4	---	30	10	0.13	0.11	3.02	1.35	30	10	0.21	0.04
Prunus virginiana	1.1	0.6	---	---	---	---	---	---			---	---	---	---
Quercus macrocarpa	---	---	---	---	10	10	3.64	3.73	8.97	8.71	---	---	---	---
Ribes sp.	61.7	60.6	---	---	---	---	---	---			---	---	---	---
x Rosa multiflora	256.1	143.3	---	13.7	---	---	---	---			---	---	---	---
Rubus occidentalis	24.4	8.9	---	---	---	---	---	---			---	---	---	---
Smilax hispida	8.9	3.3	---	---	---	---	---	---			---	---	---	---
Ulmus americana	---	---	---	---	50	50	0.37	0.41	5.37	6.51	---	---	---	---
Ulmus sp.	---	1.1	---	---	---	---	---	---			---	---	---	---
Toxicodendron radicans	4.4	0.6	---	0.3	---	---	---	---			---	---	---	---
Vitis riparia	0.6		---	---	---	---	---	---			---	---	---	---
Zanthoxylum americanum	---	1.1	---	---	---	---	---	---			---	---	---	---
Unknown sp.	---	---	---	---	---	---	---	---			---	20	---	0.60
Totals	498.3	313.9	45.0	61.3	550	440	22.6	24.6	100	100	50	40	0.60	0.75

dropped 2.2 m^2/ha, from 33.6 m^2/ha to 31.4 m^2/ha, primarily due to removal of *Carya*, *Celtis* and *Juglans*. The basal area of *Quercus borealis* actually increased, so the larger red oaks that were not removed got larger.

Site 4 is a shrubland/cool-season grass and forb old field. Predominate species in the herb layer include *Poa pratensis*, *Bromus inermis*, *Carex* sp., *Leersia virginica*, *Toxicodendron radicans*, *Cornus foemina*, *Parthenocissus vitacea*, *Solidago gigantea* and *Galium triflorum*. Based on changes in their IV, the species that exhibited the largest decreases are *Bromus inermis*, *Toxicodendron radicans*, *Poa pratensis*, *Parthenocissus vitacea* and *Acalypha virginica*. The decrease in the IV of *Poa* occurred despite an increase it is density by 125%, from 198 ramets/m^2 to 448 ramets/m^2. However the frequency of *Poa* decreased, thus the occurrence of *Poa* within the plot decreased, but increased tillering made localized patches more dense. Since the IV weights frequency somewhat higher than density, the IV of *Poa*, which may have also been impacted by other species increasing more, was reduced. The species that responded favorably and increased the most in their IV include *Carex* sp., *Apocynum sibiricum*, *Viola* sp. and *Leersia virginica*. There were 58 species whose IV increased, and 36 species that decreased, thus many more were favorably impacted than were negatively affected. When the seven native graminoid species were analyzed as a group, their mean IV in 2010 (3.2) was not significantly different from the mean in 2017 (3.9) (paired t-test, p-value=0.18, df=6). The two non-native C3 grasses were grouped for an analysis and exhibited a large decrease in their mean IV, from 21.0 in 2010 to 14 in 2017. But with only two replicates, statistical significance of this decrease was not established (paired t-test, p-value=0.27, df=1). A group of 17 woody species present in the herb layer collectively exhibited no change from 2010 (median IV=0.15) to 2017 (median IV=0.20) (Wilcoxon Signed Rank Test, p=0.89, n=17).

The shrub layer decreased dramatically, from 895 stem/are in 2010 to 398 stem/are in 2017, a decrease of 56%. Some of this decrease, particularly for *Cornus foemina*, may have occurred as individuals grew from the shrub to sapling layer. Saplings of *Cornus foemina* increased from 29 stems/are to 75 stems/are. The density and basal area of trees remained the same.

Table 5a. Plant species composition of the herbaceous layer at site 1. ICC is the Iowa Coefficient of Conservatism. CW Frequency is the combined and weighted frequency. IV is the Importance Value. Species with an (*) have an ICC that was revised from 0 to 1.

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Forbs/Pteridophytes							
Allium tricoccum	9	0.3	0.1	3.8	3.8	0.30	0.17
Asclepias syriaca *	1	---	---	---	2.1	---	0.08
Aster sagittifolius	6	---	0.1	---	2.7	---	0.13
Bidens sp.	1	---	---	2.1	---	0.12	---
Campanula americana	4	---	---	---	1.0	---	0.04
Circaea lutetiana	5	1.2	10.7	4.9	39.8	0.59	2.60
Claytonia virginica	4	75.5	51.1	84.8	76.1	15.19	7.04
Cryptotaenia canadensis	4	1.6	2.7	9.4	17.1	0.93	0.98
Cystopteris protrusa	6	23.7	0.3	33.2	5.5	5.77	0.25
Dentaria laciniata	7	18.3	9.3	37.0	38.2	5.22	2.42
Desmodium cf. cuspidatum	8	---	---	---	1.0	---	0.04
Dicentra cucullaria	7	45.7	47.6	65.3	57.0	10.49	6.07
Erigeron annuus *	1	---	---	---	1.0	---	0.04
Erythronium albidum	6	24.3	48.3	61.4	68.5	7.46	6.55
Eupatorium rugosum	2	---	4.5	---	27.8	---	1.58
Galium aparine	1	0.5	8.1	10.6	22.1	0.76	1.71
Galium circaezans	6	---	2.7	---	4.4	---	0.50
Galium triflorum	7	0.3	10.3	7.2	46.5	0.50	2.82
Geum canadense	2	---	1.7	2.1	5.4	0.12	0.44
Hackelia virginiana *	1	0.3	7.6	10.0	40.5	0.66	2.35
Hydrophyllum virginianum	3	3.6	0.3	23.4	6.6	2.12	0.30
Impatiens pallida	5	0.1	9.2	2.7	41.5	0.20	2.54
Isopyrum biternatum	5	37.2	27.2	61.0	47.2	9.16	4.22
Laportea canadensis	3	---	13.6	2.1	27.6	0.12	2.39
Oenothera/Gaura sp.	2	---	---	1.0	---	0.06	---
Osmorhiza longistylis	5	1.7	0.8	24.0	18.4	1.79	0.82
Oxalis stricta *	1	---	0.4	---	4.4	---	0.23
Phlox divaricata	5	2.9	11.7	17.3	45.4	1.64	2.91
Phryma leptostachya	4	0.3	1.5	6.6	19.5	0.47	0.94
Physalis heterophylla	2	---	0.1	---	2.7	---	0.13
Physalis sp.	2	0.1	---	2.7	---	0.20	---
Pilea pumila	3	---	1.1	---	6.0	---	0.38
Polygonatum biflorum	4	1.2	1.9	6.6	20.0	0.69	1.01
Polygonum virginianum	5	---	4.5	---	19.9	---	1.28
Ranunculus abortivus *	1	0.1	0.5	4.9	8.8	0.33	0.42
Ranunculus sp.	3	---	---	---	2.1	---	0.08
Sanguinaria canadensis	7	1.6	2.4	23.4	13.9	1.73	0.83
Sanicula gregaria	5	16.9	64.5	54.9	81.5	6.06	8.16
Smilacina racemosa	4	0.4	---	2.7	---	0.27	---
Solanum americanum/carolinense *	1	---	0.3	1.0	3.8	0.06	0.19

Species & Group	ICC	Ramet Density (#/m2) 2010	Ramet Density (#/m2) 2017	CW Frequency Abs % 2010	CW Frequency Abs % 2017	IV % 2010	IV % 2017
Solidago canadensis *	1	---	---	---	1.0	---	0.04
Solidago ulmifolia	6	---	0.9	---	3.2	---	0.26
Urtica dioica *	1	---	0.1	2.1	2.7	0.12	0.13
Veronicastrum virginicum	5	---	---	---	1.0	---	0.04
Viola pubescens	5	0.8	1.9	7.7	19.5	0.66	0.99
Viola sp.	1	8.4	38.7	42.8	73.4	4.06	6.06
Forb seedling		0.7	18.0	7.2	50.4	0.60	3.62
Graminoids							
Carex cf. blanda	2	---	---	---	1.0	---	0.04
Carex hirtifolia	6	---	6.0	---	4.9	---	0.86
Carex rosea/convoluta	6.5	---	---	---	1.0	---	0.04
Carex sp.	3	9.7	32.8	27.9	55.2	3.41	4.94
Elymus villosus	5	---	6.0	1.0	9.9	0.06	1.05
Festuca obtusa	7	7.9	16.4	13.2	15.4	2.27	2.17
Hystrix patula	5	---	---	1.0	1.0	0.06	0.04
Leersia virginica	6	0.8	16.4	4.4	12.1	0.47	2.04
Muhlenbergia frondosa	3	---	---	---	1.0	---	0.04
Graminoid seedling/tiller		---	18.8	---	48.7	---	3.62
Woody Seedling/Sprouts							
Acer negundo *	1	---	---	2.1	---	0.12	---
Acer nigrum	5	0.5	7.7	17.9	36.6	1.18	2.22
Carya cordiformis	5	0.1	0.4	4.9	8.3	0.33	0.38
Carya ovata	5	0.4	0.3	9.4	6.6	0.66	0.30
Celtis occidentalis	2	2.1	2.0	28.4	17.2	2.13	0.91
Cornus sp.	2	---	0.1	---	3.8	---	0.17
Euonymus atropurpureus	7	0.3	0.4	4.4	3.8	0.34	0.21
Fraxinus pennsylvanica	3	0.3	---	6.6	---	0.47	---
Gleditsia triacanthos	1	---	---	1.0	---	0.06	---
Menispermum canadense	5	---	0.3	1.0	7.8	0.06	0.34
Ostrya virginiana	5	1.2	0.1	19.5	2.7	1.43	0.13
Parthenocissus cf. vitacea	1	3.9	4.4	10.5	22.2	1.43	1.36
Prunus serotina	3	0.3	0.4	2.7	6.0	0.24	0.29
Quercus borealis	6	---	---	---	3.3	---	0.12
Quercus sp.	4	0.5	---	8.3	---	0.63	---
Ribes sp.	3	---	---	3.3	2.1	0.19	0.08
Smilax hispida	4	0.4	0.5	12.8	7.8	0.86	0.38
Tilia americana	5	0.9	---	4.4	---	0.50	---
Toxicodendron radicans	1	0.3	0.5	5.5	8.8	0.40	0.42
Ulmus sp.	2	0.8	0.7	11.6	10.0	0.89	0.48
Vitis riparia	1	1.2	---	15.0	---	1.17	---
Woody seedling		0.9	---	9.4	---	0.79	---
Exotic							
Alliaria petiolata	-2	1.5	17.5	9.9	38.1	0.93	3.11
Arctium minus	-1	---	0.1	1.0	2.7	0.06	0.13
Chenopodium album	-1	---	---	---	2.1	---	0.08

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Sonchus sp.	-1	---	---	1.0	---	0.06	---
Taraxacum officinale	-1	---	0.7	2.1	4.9	0.12	0.29
Verbascum thapsis	-1	---	---	1.0	---	0.06	---
Morus alba	-3	0.1	---	2.7	---	0.20	---
Totals		301.9	537.2	869.6	1326.0		

Table 7b. Species composition for shrub, sapling/understory and canopy/subcanopy layers at site 3. Species with an (*) are non-native. BA is basal area.

					Trees						Snags			
	Shrubs (stem/are)		Saplings (stem/are)		Density (stem/ha)		BA (m^2/ha)		IV (%)		Density (stem/ha)		BA (m^2/ha)	
	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017
Carya cordiformis	5.6	13.9	---	---	10	10	1.42	1.63	2.68	4.11	---	---	---	---
Carya ovata	---	---	---	---	170	20	2.36	1.26	13.17	5.03	10	---	0.05	---
Celtis occidentalis	1.1	0.6	---	---	170	10	1.64	0.17	12.10	1.78	---	---	---	---
Cornus drummondii	2.8	---	---	---	---	---	---	---			---	---	---	---
Corylus americana	1.1	P	---	---	---	---	---	---			---	---	---	---
Juglans nigra	0.6	0.6	---	---	30	---	1.70	---	4.23		---	---	---	---
x Lonicera maackii	---	0.6	---	---	---	---	---	---			---	---	---	---
Parthenocissus sp.	10.6	---	---	---	---	---	---	---			---	---	---	---
Prunus serotina	3.9	18.3	---	---	---	---	---	---			10	---	0.31	---
Prunus virginiana	15.0	28.9	0.33	---	---	---	---	---			10	---	0.06	---
Quercus borealis	---	8.3	---	---	260	160	18.21	20.38	41.85	56.71	---	30	---	0.55
Quercus macrocarpa	---	---	---	---	30	20	1.71	1.10	4.25	4.78	20	10	0.41	0.06
Ribes sp.	23.3	0.6	---	---	---	---	---	---			---	---	---	---
x Rosa multiflora	1.1	0.6	---	---	---	---	---	---			---	---	---	---
Rubus allegheniensis	0.6	---	---	---	---	---	---	---			---	---	---	---
Rubus occidentalis	6.1	9.4	---	---	---	---	---	---			---	---	---	---
Smilax hispida	11.1	16.7	---	---	---	---	---	---			---	---	---	---
Tilia americana	0.6	---	---	---	90	60	2.44	2.61	8.74	13.25	20	20	0.12	0.06
Toxicodendron radicans	5.0	---	---	---	---	---	---	---			---	---	---	---
Ulmus americana	---	---	---	---	90	20	1.37	0.95	7.16	4.55	70	---	1.83	---
Ulmus rubra	---	---	---	---	30	30	2.76	3.29	5.82	9.79	10	---	0.19	---
Ulmus sp.	---	0.6	---	---	---	---	---	---			---	---	---	---
Zanthoxylum americanum	---	1.7	---	---	---	---	---	---			---	---	---	---
Unknown	---	0.6	---	---	---	---	---	---			10	---	0.05	---
Totals	88.3	101.1	0.3	0.0	880	330	33.6	31.4	100	100	160	60	3.03	0.67

Table 8a. Plant species composition of the herbaceous layer at site 4. ICC is the Iowa Coefficient of Conservatism. CW Frequency is the combined and weighted frequency. IV is the Importance Value. Species with an (*) have an ICC that was revised from 0 to 1.

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Forbs/Pteridophytes							
Acalypha virginica *	1	2.1	2.0	20.0	10.5	1.80	0.63
Agrimonia gryposepala	3	0.4	---	6.0	7.2	0.52	0.37
Ambrosia artimiisifolia *	1	0.4	---	9.4	9.4	0.77	0.53
Apocynum sibiricum	1	---	2.8	1.0	21.7	0.07	1.22
Asclepias syriaca *	1	0.1	---	4.9	3.8	0.39	0.21
Aster ericoides	3	0.8	---	3.8	---	0.43	---
Aster pilosus *	1	0.7	1.2	10.0	7.2	0.85	0.41
Botrychium virginianum	6	---	---	---	2.7	---	0.15
Calystegia sepium *	1	0.1	---	4.9	3.8	0.39	0.21
Circaea lutetiana	5	---	11.6	---	8.8	---	0.77
Cirsium altissimum	4	---	---	5.5	2.7	0.40	0.15
Cirsium altissimum/discolor	2.5	---	0.4	---	4.9	---	0.29
Cirsium discolor	1	---	---	3.3	4.4	0.24	0.25
Cryptotaenia canadensis	4	0.1	---	2.7	1.0	0.23	0.05
Desmodium canadense	6	---	---	---	2.7	---	0.16
Desmodium paniculatum/illinoense	6.5	1.2	0.8	15.6	7.8	1.34	0.48
Erigeron annuus *	1	---	3.6	---	9.3	---	0.58
Eupatorium rugosum	2	---	---	---	2.1	---	0.10
Fragaria vesca	7	---	0.4	---	7.2	---	0.40
Fragaria virginiana	3	1.3	---	4.9	8.8	0.59	0.53
Galium triflorum	7	2.9	5.6	21.7	30.0	2.03	2.01
Gentiana alba	4	---	---	---	2.1	---	0.10
Geum canadense	2	1.2	7.2	9.4	19.4	0.89	1.22
Hackelia virginiana *	1	---	2.8	---	12.2	---	0.71
Helianthus grosseserratus	4	---	---	2.1	2.1	0.15	0.10
Helianthus tuberosus *	1	---	---	2.1	7.7	0.15	0.47
Hydrophyllum virginianum	3	---	---	---	2.1	---	0.10
Hypericum punctatum	5	0.3	---	4.4	2.1	0.37	0.10
Lactuca canadensis	1	0.1	---	2.7	8.8	0.23	0.51
Laportea canadensis	3	---	---	---	4.9	---	0.26
Monarda fistulosa	2	0.1	---	4.9	4.9	0.39	0.26
Oenothera biennis *	1	---	---	---	2.1	---	0.10
Oxalis stricta *	1	---	---	---	2.1	---	0.10
Phryma leptostachya	4	---	---	1.0	2.7	0.07	0.18
Polygonum amphibium	3	0.8	0.8	14.5	7.7	1.20	0.45
Polygonum punctatum	4	---	1.6	---	3.2	---	0.22
Polygonum virginianum	5	---	---	---	2.7	---	0.15
Potentilla norvegica	2	---	6.4	---	6.0	---	0.49
Ranunculus abortivus *	1	---	0.4	---	2.7	---	0.15

Species & Group	ICC	Ramet Density (#/m2) 2010	Ramet Density (#/m2) 2017	CW Frequency Abs % 2010	CW Frequency Abs % 2017	IV % 2010	IV % 2017
Rudbeckia hirta	2	---	---	---	1.0	---	0.05
Rumex altissimus *	1	0.1	---	2.7	---	0.23	---
Sanicula canadensis	6	---	0.4	---	3.8	---	0.21
Sanicula gregaria	5	0.3	1.6	5.5	18.9	0.46	1.09
Scutellaria sp.	6	---	---	2.1	---	0.15	---
Silphium perfoliatum	1	---	1.2	---	2.7	---	0.18
Solidago alitissima *	1	---	---	---	1.0	---	0.05
Solidago canadensis *	1	---	0.8	1.0	10.5	0.07	0.59
Solidago gigantea	3	3.3	3.6	24.4	28.8	2.28	1.95
Solidago rigida	4	0.1	---	2.7	---	0.23	---
Teucrium canadense	4	---	0.4	---	2.7	---	0.15
Verbena urticifolia	2	0.1	2.0	2.7	18.9	0.23	1.09
Viola sp.	1	0.1	6.8	2.7	28.2	0.23	1.75
Forb seedling		1.7	27.6	9.4	55.8	0.98	4.19
Graminoids							
Carex blanda	2	---	---	---	1.0	---	0.05
Carex cristatella	5	---	4.4	---	4.9	---	0.38
Carex molesta	2	---	---	---	1.0	---	0.05
Carex rosea/convoluta	6.5	---	78.4	---	4.9	---	1.86
Carex vulpinoidea	3	---	---	---	2.1	---	0.10
Carex sp.	3	121.6	364.8	74.0	93.5	16.45	19.35
Dichanthelium acuminatum	3	2.3	13.6	15.5	19.9	1.50	1.55
Juncus dudleyi	2	---	2.8	---	2.7	---	0.23
Juncus tenuis *	1	3.3	26.0	2.7	8.2	0.72	1.30
Muhlenbergia frondosa	3	2.1	---	3.8	2.1	0.63	0.10
Leersia virginica	6	16.1	33.6	17.7	49.1	3.27	4.54
Sporobolus asper	3	---	---	---	1.0	---	0.05
Graminoid seedling		---	12.8	---	32.1	---	2.58
Woody Seedling/Sprouts							
Celastrus scandens	1	---	0.4	---	2.7	---	0.15
Celtis occidentalis	2	---	---	---	3.8	---	0.21
Cornus foemina	1	2.3	11.2	25.0	41.6	2.18	2.69
Fraxinus pennsylvanica	3	---	---	---	2.7	---	0.15
Gleditsia triacanthos	1	---	---	2.1	---	0.15	---
Parthenocissus sp.	1	2.4	1.6	28.9	22.3	2.48	1.23
Prunus cf. americana	2	---	0.4	---	3.8	---	0.21
Prunus serotina	3	---	0.4	---	8.3	---	0.47
Smilax hispida	4	0.1	0.4	3.8	3.8	0.31	0.21
Symphoricarpos sp. *	1	---	---	2.1	2.7	0.15	0.19
Toxicodendron radicans	1	23.6	6.0	69.6	43.7	7.77	3.35
Ulmus sp.	2	0.7	0.8	11.6	10.6	0.97	0.58
Vitis riparia	1	0.8	0.8	11.6	12.2	0.99	0.66
Zanthoxylum americanum	3	0.3	0.8	4.4	4.4	0.37	0.25

		Ramet Density (#/m2)		CW Frequency Abs %		IV %	
Species & Group	ICC	2010	2017	2010	2017	2010	2017
Exotic							
Abutilon theophrasti	-1	---	---	---	2.7	---	0.15
Bromus inermis	-3	124.4	84.8	96.8	77.6	18.30	8.05
Daucus carota	-3	---	---	1.0	---	0.07	---
Melilotus sp.	-3	---	---	---	9.3	---	0.63
Pastinaca sativa	-3	0.7	2.4	12.2	16.1	1.01	0.96
Poa pratensis	-2	197.9	448.0	95.7	79.8	23.71	19.87
Rumex crispus	-2	---	---	1.0	1.0	0.07	0.05
Setaria faberi	-2	---	---	---	1.0	---	0.05
Sonchus sp.	-1	---	---	1.0	---	0.07	---
Taraxacum officinale	-1	---	0.8	---	6.0	---	0.34
Trifolium repens	-3	---	---	1.0	4.4	0.07	0.34
Elaeagnus sp.	-3	---	1.6	---	4.9	---	0.31
Morus alba	-3	0.3	0.4	2.7	3.8	0.25	0.21
Rosa multiflora	-3	---	---	2.1	2.1	0.15	0.10
Totals		517.5	1189.2	694.2	1017.4		

Table 8b. Species composition for shrub, sapling/understory and canopy/subcanopy layers at site 4. Species with an (*) are non-native. BA is basal area.

					Trees						Snags			
	Shrubs (stem/are)		Saplings (stem/are)		Density (stem/ha)		BA (m^2/ha)		IV (%)		Density (stem/ha)		BA (m^2/ha)	
	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017
Acer negundo	2.2	---	---	---	60	40	0.54	0.41	25.2	17.5	---	---	---	---
Cornus foemina	640.0	371.7	29.0	74.7	---	---	---	---			---	---	---	---
x Elaeagnus sp.	---	1.1	---	---	---	---	---	---			---	---	---	---
Fraxinus pennsylvanica	3.9	3.9	---	---	10	10	1.30	0.02	23.3	3.1	---	---	---	---
x Lonicera maackii/tatarica	8.9	0.6	2.3	1.7	---	---	---	---			---	---	---	---
x Rosa multiflora	7.8	5.6	---	---	---	---	---	---			---	---	---	---
Sambucus canadensis	0.6	---	---	---	---	---	---	---			---	---	---	---
Smilax hispida	1.1	---	---	---	---	---	---	---			---	---	---	---
Symphoricarpos sp.	3.3	0.6	---	---	---	---	---	---			---	---	---	---
Toxicodendron radicans	177.2	6.7	---	---	---	---	---	---			---	---	---	---
Ulmus americana	---	---	---	---	100	110	1.19	2.47	46.5	68.7	10	10	0.02	0.12
Ulmus rubra	---	---	---	---	10	20	0.14	0.34	5.0	10.7	10	---	0.04	---
Ulmus sp.	2.8	---	---	---	---	---	---	---			---	---	---	---
Vitis riparia	38.3	6.1	---	---	---	---	---	---			---	---	---	---
Zanthoxylum americanum	8.9	2.2	---	0.3	---	---	---	---			---	---	---	---
Unknown	---	---	---	---	---	---	---	---			---	10	---	0.03
Totals	895.0	398.3	31.3	76.7	180	180	3.17	3.24	100	100	20	20	0.06	0.15

Macro Scale Inter Comparisons

The results of statistical analyses on the variables identified in Table 2 are presented in Table 9. Because there is more variability among sites in the types of vegetation and environmental factors present, and also because there is generally less replication, these analyses are expected to produce less significant outcomes than did the within site inter analysis. However, the significant results that are found carry a greater level of validity and applicability. The majority of variables examined characterize the herbaceous layer.

There was a weak trend for herbaceous layer richness to generally increase between 2010 and 2017; four of six richness measurements were higher in 2017 (Table 9). However only the richness for native forbs and pteridophytes exhibited a significant increase. The native richness index did not change, the mean for 2010 was 19.5, and the mean for 2017 was 16.6. Both of these are relatively high when compared to values that are typically encountered in Iowa.

No significant differences were found for the total density of species in the herbaceous layer classified by growth form and nativity (Table 9). It is worth noting that there was a strong trend for an increase in the density of native forbs and pteridophytes, an increase in the density of exotic herbs, and a decrease in the density of native woody species. Three of the four sites exhibited large increases in both the density of native forbs/pertidophytes and the density of native graminoids. It is likely that if the single plot that was incongruous, the plot at site 2, was omitted from the analysis there would have been significant increases in the means of both variables.

Comparisons were made for 13 variables that enumerated total density for 11 taxonomic groups and two ecological groups (Table 9, third group). Five of these variables were only measured on site 4, so these variables lack replication for analysis. There was one significant outcome among the others – the density of low conservatism native herbaceous species (low conservatism defined as species with an ICC ≤ 2) increased from 13.4 ramets/m^2 in 2010 to 48.7 ramets/m^2 in 2017. Although not significant, there was a strong trend for an increase in the density of high conservatism native herbaceous species (high conservatism defined as species with an ICC ≥ 6). For both of these variables, there was a clear increase exhibited at sites 1, 3 and 4, while the

Table 9. Plant community variables for measuring vegetation changes between 2010 and 2017. Data that are shaded were inlcuded in the calculation of means and statistical analysis. P-values from two sample statistical tests that are bolded and blue are significant; those without an (*) result from a paired t-test, those with an (*) result from a two-sample t-test. Medians are reported for Wilcoxon Signed Rank Tests.

	Site 1		Site 2		Site 3		Site 4		Mean (Median)		
Herbaceous Layer Variables	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	p-value
Richness Native Forbs/Pteridophytes	31	42	35	32	35	43	29	47	32.5	41.0	**0.052 ***
Richness Native Graminiods	5	9	5	4	3	6	5	12	4.5	7.8	0.14
Richness Native Woody	19	15	16	10	15	15	9	13	14.8	13.3	0.55
Richness Exotic Species	6	4	5	4	1	2	9	12	5.3	5.5	0.83
Richness High CC Herb Species	9	15	8	7	14	14	4	8	8.8	11.0	0.27
Richness Total Native	55	66	56	46	53	64	43	72	51.8	62.0	---
Native Richness Index	9.2	16.5	11.2	11.5	53.0	32.0	4.8	6.0	19.5	16.5	0.66
Density Native Forbs/Pteridophytes (ramets/m^2)	267.7	404.7	178.5	139.7	366.8	560.3	18.7	92.0	207.9	299.2	0.16
Density Native Graminiods (ramets/m^2)	18.4	96.4	67.2	30.1	20.0	69.7	145.5	536.4	62.8	183.2	0.29
Density Native Woody (ramets/m^2)	14.1	17.9	25.3	8.9	27.2	14.3	30.1	22.8	24.2	16.0	0.12 *
Density Exotic Herbs (ramets/m^2)	1.5	18.3	0.1	3.7	0.0	8.9	322.9	536.0	(0.8)	(13.6)	0.13
Density Exotic Woody (ramets/m^2)	0.1	0.0	8.3	3.1	0.3	0.0	0.3	2.0	2.2	1.3	---
Density Spring Ephemerals (4 species) (ramets/m^2)	163.7	156.3	0.0	0.5	163.3	212.3	0.0	0.0	163.5	184.3	0.60
Density High CC Nat Herb Species (CC ≥ 6) (ramets/m^2)	34.5	55.6	19.2	8.9	13.1	55.3	20.3	119.2	21.8	59.8	0.15 *
Density Low CC Nat Herb Species (0 ≤ CC ≤ 2) (ramets/m^2)	9.5	62.1	27.1	17.2	8.3	49.3	8.7	66.0	13.4	48.7	**0.025 ***
Density *Carex* (ramets/m^2)	9.7	38.8	52.5	15.7	14.1	36.7	121.6	447.6	49.5	134.7	0.37
Density *Festuca* , *Elymus* , *Hystrix* (ramets/m^2)	7.9	22.4	10.9	3.5	0.0	3.5	0.0	0.0	6.3	9.8	---
Density *Aster* , *Solidago* (ramets/m^2)	0.0	1.1	0.5	0.3	0.0	0.0	4.9	5.6	1.8	2.3	---
Density *Sanicula* , *Circaea* , *Hackelia* (ramets/m^2)	18.4	82.8	101.2	81.9	155.7	184.9	0.3	16.4	68.9	91.5	0.28
Density *Polygonatum* , *Smilacina* (ramets/m^2)	1.6	1.9	0.1	0.1	1.6	26.9	0.0	0.0	1.1	9.6	---
Density Native C3 grass (ramets/m^2)							18.4	47.2			---
Density Native C4 grass (ramets/m^2)							2.1	0.0			---
Density *Desmodium* , *Monarda* , *Rudbeckia* (ramets/m^2)							1.3	0.8			---
Density Non-native *Bromus* (ramets/m^2)							124.4	84.8			---
Density Non-native *Poa* (ramets/m^2)							197.9	448.0			---

	Site 1		Site 2		Site 3		Site 4		Mean (Median)		
Herbaceous Layer Variables	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	p-value
Frequency Native Forbs/Pteridophytes (%)	625.8	981.1	675.7	555.6	640.6	996.7	207.8	423.7	537.5	739.3	0.17
Frequency Native Graminiods (%)	47.5	150.2	96.6	91.2	44.2	134.5	113.7	222.6	75.5	149.6	**0.062 ***
Frequency Native Woody (%)	178.6	146.9	212.5	115.2	172.3	122.2	159.3	162.4	180.7	136.7	**0.031 ***
Mean CC Native Forbs/Pteridophytes	4.0	4.0	3.8	3.9	4.7	4.2	2.8	2.9	3.84	3.76	0.88 *
Mean CC Native Graminiods	5.2	4.8	5.2	5.3	5.0	5.6	3.2	3.3	4.65	4.74	0.68
Mean Weighted CC Native Herb	4.8	4.4	3.8	3.7	4.9	4.5	3.3	3.2	4.20	3.94	**0.045**
Mean Weighted CC All Species	4.4	4.0	3.0	3.1	4.4	4.2	1.0	1.6	3.19	3.22	---
FQI Native Herb	24.8	29.6	25.1	24.3	29.4	30.8	16.9	23.0	24.1	26.9	0.17
FQI All Species	26.0	31.4	24.5	22.6	30.6	31.9	12.6	18.8	23.4	26.2	0.23
Weighted FQI Native Herbs	28.9	31.4	24.2	22.2	30.1	31.7	19.0	24.2	25.6	27.4	---
Weighted FQI All Species	34.1	33.8	23.7	21.6	32.0	34.1	7.0	14.4	24.2	26.0	0.45
Shannon Diversity Index Native Herbs	2.46	2.80	1.93	1.92	2.34	2.69	1.36	1.82	2.02	2.31	**0.064**
Shannon Diversity Index Native Woody	0.61	0.38	0.65	0.46	0.58	0.32	0.52	0.44	0.59	0.40	**0.004 ***
Shannon Diversity Index Exotic Species	0.08	0.14	0.21	0.22	0.02	0.07	0.74	0.69	0.26	0.28	0.55
Shrub Layer Variables											
Richness Native Shrubs	11	14	11	8	14	13	10	6	11.5	10.3	0.48
Richness Exotic Shrubs	1	2	2	2	1	2	2	3	1.5	2.3	---
Density Native Shrubs (ramets/are)	19.5	106.1	110.0	78.3	87.2	100.0	878.3	391.1	273.8	168.9	0.48
Density Exotic Shrubs (ramets/are)	2.2	10.0	388.3	235.6	1.1	1.1	16.7	7.2	(9.5)	(8.6)	0.50
Density Total Shrub (ramets/are)	21.7	116.1	498.3	313.9	88.3	101.1	895.0	398.3	375.8	232.4	---
Shannon Diversity Index Shrubs	2.15	2.17	1.33	1.28	2.20	1.93	0.92	0.37	1.65	1.44	---
Sapling/Understory Layer Variables											
Richness Native Saplings	3	1	2	2	1	0	1	2	1.8	1.3	---
Richness Exotic Saplings	0	0	1	2	0	0	1	1	1.0	1.5	---
Density Native Saplings (ramets/are)	3.7	0.3	0.9	1.3	0.33	0	29.0	75.0	8.5	19.2	---
Density Exotic Saplings (ramets/are)	0	0	44.1	60.0	0	0	2.3	1.7	23.2	30.9	---
Density Total Saplings (ramets/are)	3.7	0.3	45.0	61.3	0.33	0	31.3	76.7	26.7	46.1	---
Shannon Diversity Index Saplings	1.07	0.00	0.11	0.64	0.00	None	0.27	0.13	0.48	0.26	---

	Site 1		Site 2		Site 3		Site 4		Mean (Median)		
Canopy/Subcanopy Layer Variables	2010	2017	2010	2017	2010	2017	2010	2017	2010	2017	p-value
Richness Native Trees	7	8	7	6	9	8	4	4	6.8	6.5	---
Richness Exotic Trees	0	0	0	0	0	0	0	0			
Density Native Trees (stems/ha)	410	190	550	440	880	330	180	180	505.0	285.0	0.16
Density Exotic Trees (stems/ha)	0	0	0	0	0	0	0	0			
Density Total Trees (stems/ha)	410	190	550	440	880	330	180	180	505.0	285.0	---
Basal Area Native Trees (m^2/ha)	18.0	17.5	22.6	24.6	33.6	31.4	3.17	3.24	19.3	19.2	0.87
Basal Area Exotic Trees (m^2/ha)	0	0	0	0	0	0	0	0			
Basal Area Total Trees (m^2/ha)	18.0	17.5	22.6	24.6	33.6	31.4	3.17	3.24	19.3	19.2	---
Shannon Diversity Index Trees	1.55	1.67	1.03	0.84	1.82	1.46	1.19	0.91	1.40	1.22	0.18
Snag Variables											
Density Total (stems/ha)	50	0.0	50	40	160	60	20	20	70.0	30.0	---
Basal Area Total (m^2/ha)	1.23	0.00	0.60	0.75	3.03	0.67	0.06	0.15	1.2	0.4	---

opposite was observed at plot 2. There is evidence that vegetation responses at site 2 were often opposite of the responses at the other three sites.

Unlike the measurements of total species abundance using density (of native forbs, native graminoids, and native woody) which did not change significantly, the use of total frequency did result in significant patters (Table 9). The mean total frequency of native graminoids increased significantly from 75.5% in 2010 to 149.6% in 2017. Native woody species in the herb layer exhibited a significant decrease in mean total frequency, from 180.7% to 136.7%. Although the mean total frequency for forbs/pteridophytes did not change significantly, there was a strong trend indicating an increase from 538% in 2010 to 739% in 2017.

Statistical analyses were completed for six of the eight variables that characterize vegetation quality using the ICC and FQI (Table 9). Only one of those six variables exhibited a significant pattern – the mean weighted conservatism of native herbaceous species decreased from 4.20 in 2010 to 3.94 in 2017. Although not significant, a strong trend was observed for the mean FQI for native herbaceous, which increased from 24.1 to 26.9.

The last of the herbaceous layer variables is the Shannon diversity index. Shannon diversity indices for both native herbaceous species and native woody species exhibited highly significant changes (Table 9). The mean diversity index for native herbaceous species increased from 2.02 to 2.31, while the mean diversity index for native woody species decreased from 0.59 to 0.40. There was no change in the mean diversity index for exotic species.

Among the six shrub layer variables examined, three of them were analyzed statistically, but none resulted in a significant finding (Table 9). There is a substantial amount of variation among the sites. At site 1, all of the shrub variables showed an increasing pattern, but at sites 2 and 4 nearly all of them exhibited a decreasing pattern. Site 3 shrub variables were mixed, two were decreasing, three were increasing, and one was constant.

None of the six sapling variables were analyzed statistically (Table 9). The richness variables were low and presented little change from 2010 to 2017. Only sites 2 and 4 had a substantial

density of saplings. The site 2 sapling layer was dominated by exotic species, while the sapling layer at site 4 was dominated by native species. Because sapling layer richness ranged from 0 to 4, the mean Shannon diversity indices were very low for all sites.

There were nine variables that characterized the canopy/subcanopy layer and examined the trees on the site (Table 9). Because there were no exotic tree species present at any of the sites, the three variables focused on exotic species (richness, density and basal area) were unimportant. Three of the remaining six variables were analyzed statistically, but none of them resulted in significant results. However two of them produced a strong trend. Due to substantial reduction of trees on sites 1, 2 and 3, there was a decreasing trend in mean tree density. Mean basal area did not change from 2010 to 2017. The second trend was a decrease in the Shannon diversity index. This was most likely due to a slight decrease in richness at three of the four sites, or an increase in unevenness as thinning occurred and some species were reduced in abundance but not eliminated.

Ordination Results

DECORANA ordination produces a graph with three dimensions that correspond to the three most important gradients in species composition (DCA1, DCA2, and DCA3), those that explain the most variation in species composition among the samples. The ordination figures presented in this document show DCA1 and DCA2, as they are the two most important. The distance between two samples in ordination spaces represents the amount of dissimilarity there is between the species composition of the two samples. The ordination figures presented pair the samples collected in 2010 and 2017 on the same site, so that the distance between them represents the amount of change in species composition. These distances are the Euclidean distance between two coordinates. They were calculated and presented for both 2 dimensional space with DCA1 and DCA2 (as shown in the figures) and for 3 dimensional space with DCA1, DCA2 and DCA3 (not shown in the figures).

The ordination using all of the species and their IV for a measure of abundance, with each community sample for each site and year combination separated into an herbaceous layer sample and a woody layer sample (representing woody stems ≥ 50 cm in height), is displayed in Figure

5. It clearly shows, as is expected, that the samples separate into two groups, the herbaceous layer samples on the left (low values on DCA1) and woody layer samples on the right (high values on DCA1). The most important source of variation in these samples is the difference in species due to growth form. Woody species characterize the portion of the graph with DCA1 coordinates above 200, herbaceous species are aligned with the portion of the graph with DCA1 coordinates below 150. The second most important source of variation is aligned with DCA2 and appears to be differences that exist between sites 1 and 3. This is interesting because to the casual eye, these two sites appear to be somewhat similar. Site 1 is a maple/basswood/red oak forest, and site 2 is a red oak forest. Both sites have populations of all four spring ephemerals, and share other common forest species like *Circaea lutetiana*, *Cryptotaenia canadensis*, *Galium aparine*, *Galium triflorum*, *Hydrophyllum virginianum* and *Osmorhiza longistylis*.

However, indicator species for each community were identified by studying the ordination of the species in sample space. These plant species were either only observed at one site or the other, or were much more abundant at one site or the other. For site 1, these include the following herbaceous layer species: *Cystopteris protrusa*, *Claytonia virginica*, *Isopyron biternatum*, *Dentaria laciniata*, *Quercus borealis*, *Tilia americana*, and *Ostrya virginiana*. Indicator woody species in the shrub/sapling/canopy layers include *Menispermum canadense*, *Acer nigrum*, and *Ostrya virginiana*. Indicator species for site 3, or species that distinguish it from the other sites, include *Corylus americana*, *Diarrhena americana*, *Geranium maculatum*, *Smilax herbacea*, *Smilax ecirrhata*, *Prunus virginiana*, and *Galium concinnum* in the herbaceous layer, and *Prunus virginiana*, *Rubus allegheniensis*, and *Quercus borealis* in the shrub/sapling/canopy layers.

The direction and distance the plots move from 2010 to 2017 characterize the change in species composition. The total distances among all four sites for the herb layer are 93 (for two axes) and 200 (for three axes), while the same measurements for the shrub/sapling/canopy layer are 71 (for two axes) and 118 (for three axes). Thus there is more change in species composition indicated for the herb layer than for the shrub/sapling/canopy layer. This might be expected due the greater number of species in the herb layer. The direction of species change between the herb and shrub/sapling/canopy layers within each site is uniformly different and nearly opposite.

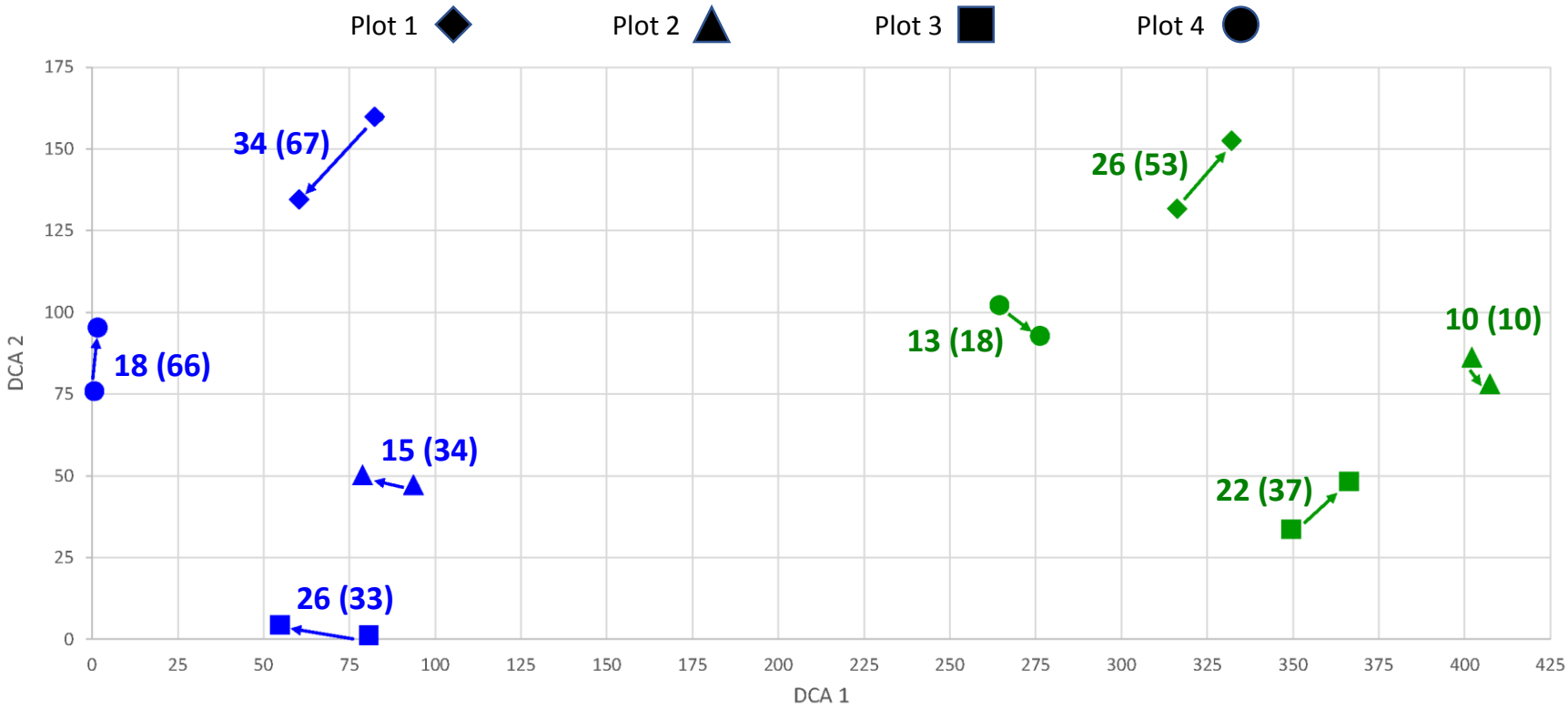

Figure 5. DECORANA ordination of the plant communities in 2010 and 2017 based on the adjusted importance values for all 170 plant species that were observed (see the text for more information on adjusted importance values). The vegetation for each site by year sample was ordinated with two samples – the herbaceous layer in blue and the shrub/sapling/tree layers in green. The arrows begin at the 2010 sample and point towards the 2017 sample. The numbers correspond to the Euclidean distance between 2010 and 2017 points. The first number is the distance in 2 dimensional space, as shown on the figure with DCA 1 and DCA 2. The second number in ( ) is the distance in 3 dimensional space with the addition of DCA 3, which is not shown.

Within the herb layer, the three forest sites (sites 1, 2 and 3) are moving in a uniform direction towards site 4. Thus there is a slight shift of all the forest herb layers in the direction of the herb layer in the shrubland/C3 grass and forb old field. It is also clear that the herb layers at sites 1 and 4 became more similar to each other.

The shift in the shrub/sapling/canopy layers from 2010 to 2017 for all four sites is to the right, which is towards the forest end of DCA1. Sites 1 and 3, the forests with a fairly open understory are moving uniformly to the right and up, while sites 2 and 4, the sites with highest densities of shrubs and saplings, are moving uniformly to the right and down. A characteristic sites 2 and 4 share with respect to their change is that shrub density decreased and sapling density increased. A feature that sites 1 and 3 shared in terms of their change was that shrub density increased and tree density decreased. It is also evident that sites 1 and 3 experienced the most change in species composition, and sites 2 and 4 exhibited the least amount of change in species composition.

It is helpful to look more closely at the herb layer, since that is where much of the action is concerning vegetation dynamics. The ordination presented in Figure 6 illustrates changes in species composition of just the herbaceous layer (thus a smaller volume of species space). It also differs from Figure 5 in that abundance in Figure 6 was measured by density. This lowers the number of species even more, to the most common species in the herb layer. It also increases the resolution in the measurement of abundance by increasing the range of possible values. Density measurements range from 0.13 to 450, while the measurements of IV used in Figure 5 ranged from 1.4 to 120. Thus the ordination in Figure 5 is the result of a measurement scale that is more compressed and lessens the impact of very common and very sparse species. The measurement scale used in constructing Figure 6 is less compressed and gives very common and very sparse species more influence in the species composition and ordination.

The most apparent pattern in Figure 6 is the separation of the forest communities (sites 1, 2 and 3 on the low end of DCA1) from the shrubland/C3 grass and forb old field (site 4 on the high end of DCA1). It is also evident that if both two dimensional and three dimensional space are

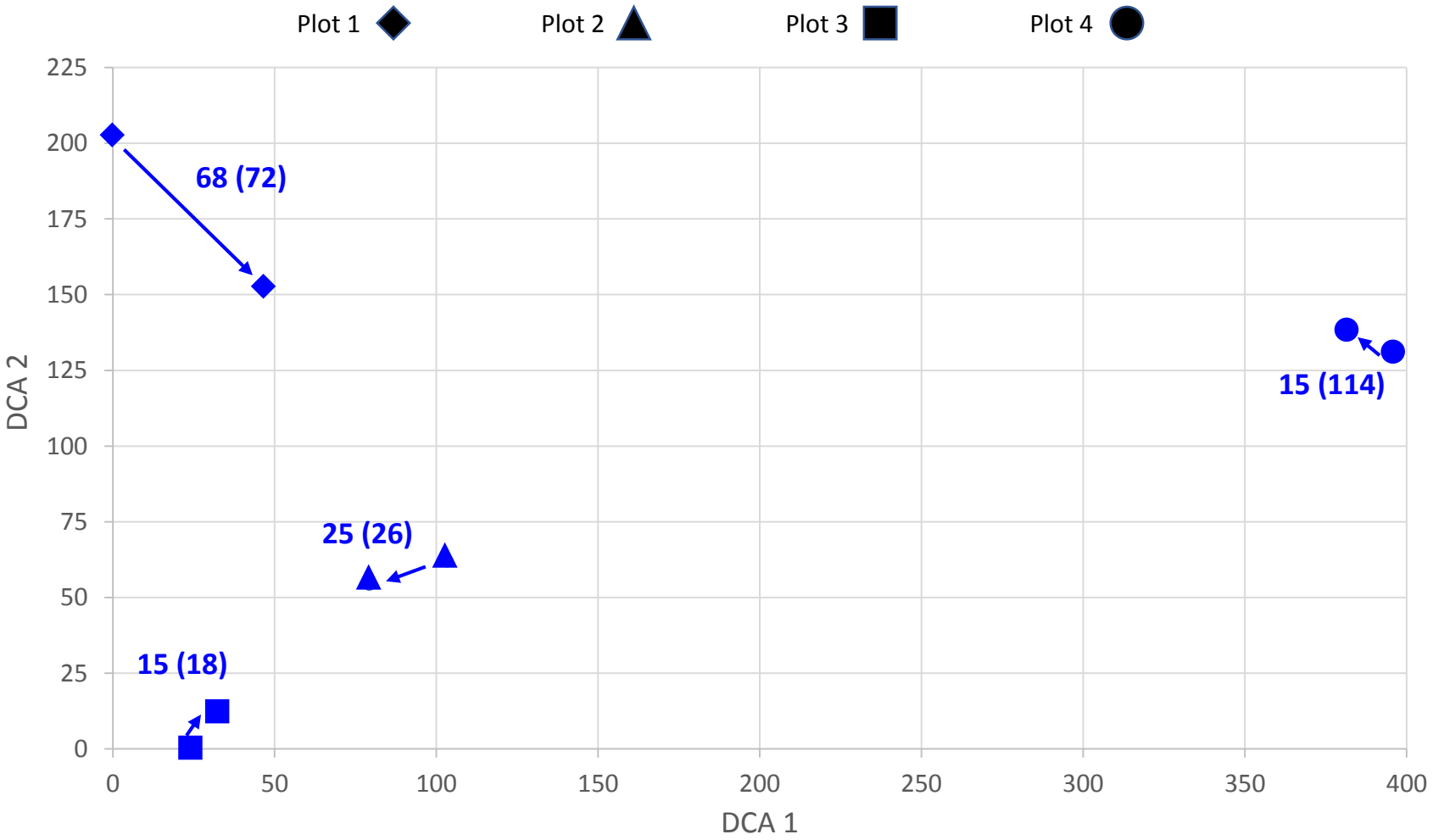

Figure 6. DECORANA ordination of the plant communities in 2010 and 2017 based on the ramet density of the plant species observed in the herbaceous layer. There were 127 plant species represented by a density measurement (observed in the 25x25 cm subquadrats). The arrows begin at the 2010 sample and point towards the 2017 sample. The numbers correspond to the Euclidean distance between 2010 and 2017 points. The first number is the distance in 2 dimensional space, as shown on the figure with DCA 1 and DCA 2. The second number in ( ) is the distance in 3 dimensional space with the addition of DCA 3, which is not shown.

considered, that sites 1 and 4 changed the most and sites 2 and 3 changed the least (site 3 was the most stable). Site 4 changed the most in species composition when all three axes are included. This makes sense due to the large number of new species observed there in 2017. There were 19 new species at site 4, while site 1 exhibited 14 new species, the second highest number.

Another pattern in Figure 6 is sites 1 and 4 shifted towards each other, although they are of coarse still very different. At the same time, sites 2 and 3 shifted towards each other and became slightly more similar. In fact all three forest sites exhibited a small shift towards convergence. The area inscribed by the three 2017 points is noticeably smaller than the area inscribed by the three 2010 points.

Vegetation Discussion

The data support the following conclusions:

1) Site 1, on an northeast-facing, supports a maple/basswood/red oak forest. Historically it was likely an oak woodland. Site 3 occupies a fairly level upland that is currently a red oak forest. It was likely an open oak woodland or savanna historically. Both have apparently experienced encroachment of oak and shade-tolerant tree species as a consequence of more than a century of fire suppression. Still, they support extant communities that are decidedly natural and exhibit the highest quality vegetation among the four study sites studied. Sites 1 and 3 have impressive native richness indices of 17 and 32, a weighted FQI for all species of 33.8 and 34.1, and a Shannon diversity index for native herbs of 2.80 and 2.69.

Management has had many impacts on the herb layer at both sites that can be viewed as positive. Most of these are trends in the data and not statistically significant outcomes. Those that are statistically significant are in boldface:

a) native richness for forbs/pteridophytes increased

b) native richness of graminoids increased

c) native richness of native woody species decreased (site 1) or remained the same (site 3)

d) richness of high conservatism herbaceous species increased or (site 1) or remained the same (site 3)

e) richness of exotic species decreased (site 1) or increased by only 1 (site 3)

f) density of native forbs/pteridophytes increased

g) density of native graminoids increased

h) density of native woody species increased only slightly (site 1) or decreased (site 3)

i) density of spring ephemeral species remained about the same (site 1) or increased (site 3)

j) density of high conservatism native herbaceous species increased

k) density of sedges increased

l) density of woodland and savanna grasses increased

m) density of Solomon's seal and false Solomon's seal increased

n) frequency of native forbs/pteridophytes increased

o) frequency of native graminoids increased

p) frequency of native woody species decreased

q) FQI for native herbs and all species increased

r) weighted FQI for native herbs and all species increased in three out of four instances

s) Shannon diversity index for herbs increased

t) Shannon diversity index of native woody species decreased

u) total density of saplings decreased

v) total density of trees decreased

w) total basal area of trees remained stable

Increases in *Carex* sp. and *Leersia virginica* at site 1, both graminoids that functionally increase the fine fuel loads and support surface fire, are a positive. Increases in *Smilacina racemosa*, *Geranium maculatum* and *Viola* species at site 3 are also arguably beneficial from the stand point of diversity in structural, phenological and morphological habitat. The plant community at site 1 experienced the greatest amount of change in species composition. Species composition of the herb layer at sites 1 and 3 shifted in a direction that made them slightly more similar.

Management also had some impacts at both sites that were possibly detrimental to the herb layer. Again these are mostly trends; those that are statistically significant are in boldface:

a) density of exotic herbs increased

b) density of low conservatism native herbs increased

c) density of ectozoochory species (dispersal by animal fur) increased

d) richness of all shrubs increased slightly (site 1) or remained the same (site 3)
e) mean conservatism of native forbs/pteridophytes and native graminoids decreased
f) mean weighted conservatism of native herbs decreased
g) mean weighted conservatism of all species decreased

Some site specific changes in species abundance are also unfavorable. At site 1, decreases in *Claytonia virginica*, *Cystopteris protrusa*, *Dicentra cucullaria*, *Isopyrum biternatum* and *Dentaria laciniata*, while plant species increasing were *Alliaria petiolata*, *Sanicula gregaria*, *Laportea canadensis*, *Galium triflorum*, *Circaea lutetiana*.

2) A couple of large "wolf" bur oak trees at Site 2 indicate a savanna or open woodland was historically present. Succession has since created a mid-successional open forest that is highly dominated by bitternut hickory in the canopy and sub-canopy. There is no oak regeneration present. The shrub layer is very dense, the highest of the three wooded communities, and primarily composed of exotic species (honeysuckle and multiflora rose). While it was difficult to sample the plot in 2010 due to dense shrubs and saplings, it was possible to see through most of the plot and to collect data reasonably unimpeded. However, in 2017 the shrubs and saplings formed a nearly impenetrable wall. Help was needed to cut lanes around and through the plot in order to get the plots and transects set up. Site 2 has medium vegetation quality among the four sites. Its native richness is 11.5, its weighted FQI for all species is 21.6, and its Shannon diversity index for native herbs is 1.92.

Management has been less effective here. Trends in the herbaceous layer that are positive are fewer and less definite than at sites 1 and 3. Those that are statistically significant are in boldface:
a) richness of native woody species decreased
b) native richness index increased slightly
c) density of native and exotic woody species decreased
d) density of low conservatism native herbs decreased
e) density of ectozoochory species (dispersal by animal fur) decreased
f) frequency of native woody species decreased

g) Shannon diversity index of native woody species decreased

h) richness of native shrubs decreased

i) density of native and exotic shrubs decreased

j) Shannon diversity index of shrubs decreased

k) total density of trees decreased

l) Shannon diversity index of trees decreased

A decrease in *Parthenocissus vitacea* was observed and is also a positive change.

Some detrimental outcomes at Site 2 include:

a) native richness for forbs/pteridophytes decreased

b) density of native forbs/pteridophytes and native graminoids decreased

c) density of high conservatism native herbaceous species decreased

d) density of sedges decreased

e) density of woodland and savanna grasses decreased

f) frequency of native forbs/pteridophytes decreased

g) frequency of native graminoids decreased

h) FQI for native herbs and all species decreased

i) weighted FQI for native herbs and all species decreased

j) density of native and exotic saplings increased

k) Shannon diversity index of saplings increased

Changes in species abundance that are site-specific and negative are decreases in *Viola pubescens* and *Carex* sp., and increases in *Laportea canadensis*, *Polygonum virginianum*, *Sanicula gregaria*, and *Alliaria petiolata*.

The change in the distribution of trees (woody stems > 5 cm DBH) from 2010 to 2017 provide insight into the dynamics of the woody vegetation (Figure 7). Three *Ostrya virginiana* (5-10 cm DBH) were removed by tree cutting. There was no change in *Ulmus americana*. Among three *Prunus serotina* in the 5-10 cm DBH class, two were removed and one advanced into the 10-15 cm DBH class. There were three *Carya ovata* present in 2010, two in the 5-10 cm DBH class and one in the 10-15 cm DBH class. The two smaller ones were removed, and the larger one

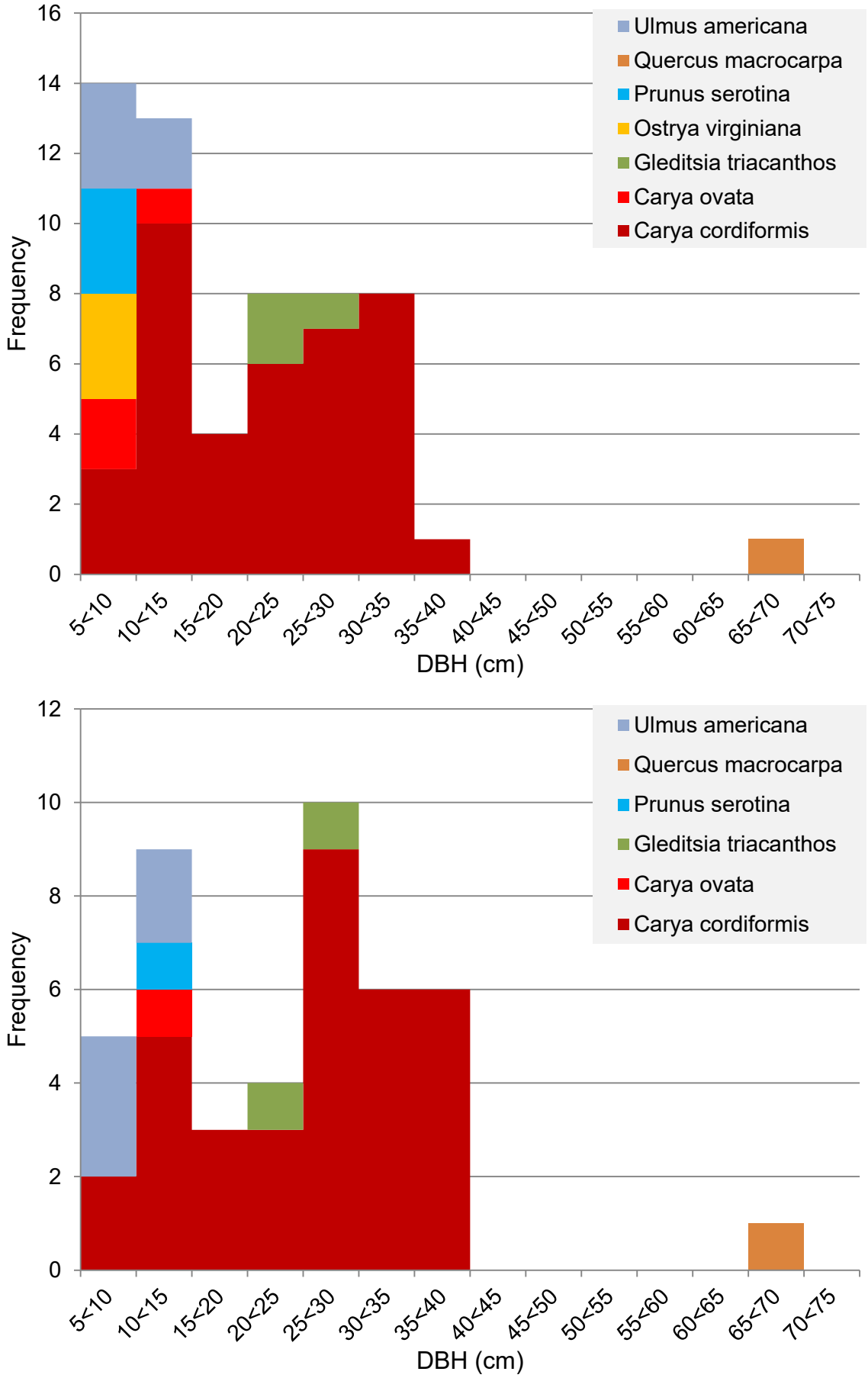

Figure 7. Distribution of understory, sub-canopy and canopy trees at site 2 in 2010 (top) and in 2017 (bottom).

saved. There were three *Gleditsia triacanthos* present in 2010, two in the 20-25 cm DBH class and one in the 25-30 cm DBH class. It appears that one of the smaller trees was removed, but it cannot be determined for certain. Alternatively the large one could have been removed and one of the smaller ones advanced into the next size class. One large *Quercus macrocarpa* in the 65-70 cm DBH class was present in 2010 and was protected. Finally the dominant species, *Carya cordiformis*, was represented by 39 trees ranging in size from size class 5-10 cm DBH to 35-40 cm DBH in 2010. They were reduced to 34 trees spanning the same size range. But there is an obvious shift of individuals into the larger size classes. Other than one species being completely removed, the structural form of the forest did not change appreciably.

3) Site 4 is furthest away from West Indian Creek on a relatively level upland, and in the portion of the park that was historically used the most for agriculture. Based on its soils and drainage, the native vegetation was likely wet-mesic tallgrass prairie. Secondary succession has produced a shrubland/C3 grass and forb old field with a few remnant populations of native prairie plants. It has the lowest quality among the four sites, with a native richness of 6.0, a weighted FQI for all species at 14.4, and a Shannon diversity index for native herbs equal to 1.82.

Management at this site, which includes prescribed fire and variable goat herbivory, has had many positive effects. These are primarily trends in the difference between 2010 and 2017. Those that are statistically significant are in boldface:

a) richness of native forbs/pteridophytes increased

b) richness of native graminoids increased

c) richness of high conservatism herbaceous species increased

d) native richness index increased

[Note – site 4 had the lowest native forb and native total richness in 2010, and the highest native forb and native total richness in 2017. It also had the highest native graminoid richness in 2017].

e) density of native forbs/pteridophytes increased

f) density of native graminoids increased dramatically

g) density of native woody species decreased

h) density of high conservatism native herbaceous species increased

i) density of sedges increased

j) density of native C3 grass increased

k) density of smooth brome decreased

l) frequency of native forbs/pteridophytes increased

m) frequency of native graminoids increased

n) mean weighted conservatism of all species increased

o) FQI for native herbs and all species increased

p) weighted FQI for native herbs and all species increased

q) Shannon diversity index for herbs increased

r) Shannon diversity index of native woody species decreased

s) Shannon diversity index of exotic species decreased

t) richness of native shrubs decreased

u) density of native and exotic shrubs decreased

v) Shannon diversity index of shrubs decreased

Changes in single species abundance at site 4 that are positive for restoration include decreases by *Bromus inermis*, *Toxicodendron radicans*, *Poa pratensis* and *Parthenocissus vitacea*. Likewise, increases in *Carex* sp., *Viola* sp. and *Leersia virginica* are also beneficial. There were not any species changes that were clearly negative. But there were some negative trends and results at site 4 among the community variables measured:

a) richness of native woody species increased

b) richness of exotic species increased

c) density of exotic herbs increased a great deal

d) density of exotic woody species increased

e) density of low conservatism native herbs increased

f) density of ectozoochory species (dispersal by animal fur) increased

g) density of native C4 grass decreased slightly

h) density of Kentucky bluegrass increased

i) frequency of native woody species increased

j) density of total saplings increased

Again, keep in mind that only the boldfaced patterns are statistically significant. The others are trends in the data that do not carry statistical verification. However, trends were only claimed when there was an appreciable amount of difference between the data points. Another cautionary point to keep in mind is that the distinction between what are positive and negative outcomes can subjective. The sum total of these patterns suggests that management at Robison Wildlife Acres over the last seven years has produced more potentially helpful outcomes than adverse ones at sites 1, 3 and 4. The number of helpful and adverse outcomes at site 2 was about the same, so there appears to be less positive news for it. Such a conclusion is not a surprise given the severity of *Lonicera maackii* and *Rosa multiflora* growth.

4) Some of the more notable plants observed during the study in the forest communities include these species: *Dentaria laciniata*, *Dicentra cucullaria*, *Erythronium albidum*, *Claytonia virginica*, *Sanguinaria canadensis*, *Allium tricoccum*, *Aster sagittifolius*, *Desmodium* cf. *cuspidatum*, *Galium circaezans*, *Solidago ulmifolia*, *Carex hirtifolia, Botrychium virginianum*, *Galearis spectabilis*, *Galium concinuum*, *Smilacina stellata*, *Geranium maculatum*, *Thalictrum dasycarpum*, *Hystrix patula*, *Diarrhena americana* and *Euonymus atropurpureus*.

Notable species in the shrubland/C3 grass and forb community at site 4 were: *Botrychium virginianum*, *Desmodium paniculatum*, *Desmodium illinoense*, *Desmodium canadense*, *Sanicula canadensis*, *Fragaria vesca*, *Solidago rigida*, *Sporobolus asper*, *Juncus dudleyi* and *Carex cristatella*. The last two provide testament to the wetness on the site.

Future Work and Management

A major concern at site 1 is the possible decline of spring ephemerals (Figure 8). A statistical decrease in IV was found for the group, but each of the four species responded differently. *Claytonia virginica* seems to be the most threatened, as it decreased in both density and frequency. The density of *Dentaria laciniata* decreased by half, but its frequency was bumped up a little bit. *Dicentra cucullaria* exhibited a slight increase in density, but a decrease in frequency. *Erythronium albidum* nearly doubled in density and also increased in frequency. It's not clear what factors could be contributing to any of the changes observed. Observational studies are limited in their ability to identify causal factors. Most likely it's a biotic factor at site

1 that is a problem. Perhaps the increases in *Laportea canadensis*, *Sanicula gregaria*, *Hackelia virginiana* and *Circaea lutetiana* are an issue. An argument against these herbaceous species is that they shouldn't be very competitive at the same time the spring ephemerals are active. Another concern is the increase in shrub density, from 22 stems/are to 116 stems/are, an over 5-fold increase. The biggest threats are *Rubus occidentalis*, *Celtis occidentalis*, *Juglans nigra*, *Menispermum canadense* and *Smilax hispida.* Increased effort on shrub suppression is probably warranted.

The invasive problem at site 2 is an extremely difficult one (Figure 9). The area surrounding site 2 on the south side of the ravine between sites 2 and 3, and near a dogleg in the park boundary, appears to be heavily infested (Figure 2). The only realistic approach in this area, which does have nice bur oak trees, is probably a forestry mower followed with judicious foliar application of triclopyr to the leafy resprouts. An assessment of the area to determine the full scope of the problem and what might be gained by declaring an all out war against the invasives would help in making a decision on what to do. The herbaceous layer on the study plot indicates there is a fairly diverse and interesting community underneath all the invasive growth.

Site 3 appears to be doing pretty well. It has the highest native richness index, highest mean native conservatism, highest weighted mean conservatism, highest FQI, and lowest exotic richness. There is a population of *Alliaria petiolata* that should removed before it gains more momentum. Site 3 has the highest densities of the an ectozoochory group of species – *Circaea lutetiana*, *Hackelia virginiana* and *Sanicula gregaria* – which seem to be increasing and becoming more ubiquitous throughout Iowa's forests. Their success likely comes at the expense of other species. Any community that has even a few native species that become overly successful and competitive suffers a loss of evenness that can depress species diversity. Depending on the management plan for Robison and the goal for this area, there could be more tree thinning done to achieve a physiognomy that is more on line with an open woodland or savanna.

Site 4 has elements of a degraded prairie. Three *Desmodium* species, *Sporobolus asper*, *Aster ericoides*, *Gentiana alba*, *Helianthus grosseserratus*, *Rudbeckia hirta* and *Solidago rigida* were

all observed and contribute to a prairie persona. However there are serious impediments to a prairie recovery. There is a substantial amount of negative resilience in the form of *Cornus* and other woody species, non-native cool-season grasses, specifically *Bromus inermis* and *Poa pratensis*, and a suite of non-native herbaceous species with invasiveness potential, for example *Daucus carota*, *Pastinaca sativa*, *Trifolium repens* and *Melilotus* sp. Site 4 has the highest exotic richness, highest exotic herb density, lowest mean conservatism of forbs and graminoids and the lowest FQI scores. It will require a substantial and extensive "push" to overcome the negative resilience and achieve a higher quality prairie.

The woody standing biomass has to go, or at least most of it, which is a job that a forestry mower could easily achieve. Goats could be used to control the resprouts and woody seedlings. Herbicide could also be used. The area is compatible with mowing, at least when the ground is not saturated. Repeated mowing, along with fire, could also contribute to a woody suppression strategy. But before that strategy can be initiated, the current standing biomass has to be removed. Mowing, or more specifically haying, is a management practice that has saved many of Iowa's best remnant prairies. Haying mimics fire in many ways, and most importantly, it has historically (and currently) been done the same time of the year that natural fire occurred during the millenia that prairie organisms evolved strategies to survive fire.

An interesting study or demonstration project that could be done at Robison is to establish three large plots where three different treatments are applied. The plot on one end would be mown or hayed, the plot in the middle would be mown/hayed and burned, and the plot on the other end would be burned. But before that can begin, the woody standing biomass on all three plots must be removed.

Literature Cited

Drobney. P., D. Lewis, D. Horton, D. Roosa, D. Smith, J. Pearson, M. Leoschke, and G. Wilhelm. 2000. Floristic quality technique: Iowa database; draft version. Unpublished data. http://www.public.iastate.edu/~herbarium/coeffici.html

Eilers, L., and D. Roosa. 1994. The vascular plants of Iowa: an annotated checklist and natural history. University of Iowa Press, Iowa City, IA.

Rosburg, T.R. 2011. Monitoring plant and bird response to ecological restoration practices at Robison Wildlife Area. Progress Report to Story County Conservation. 36 pages.

Figure 8. Species inventory at Site 1, May 2017. The centerline transect is visible in the center of the photo.

Figure 9. Species inventory at Site 2, May 2017. A transect on the boundary of the 10x30 m subplot is visible in the photo.

Figure 10. Species inventory at Site 3, May 2017. The centerline transect is visible in the center of the photo.

Appendix B: A Breeding Bird Survey of the Birds of Jennett Heritage Area

A Breeding Bird Survey of the Birds of Jennett Heritage Area
Hank Zaletel

Breeding bird populations were surveyed at the Jennett Heritage Area, Story County, Iowa (http://www.storycounty.com/index.aspx?=7172.706,15,6,1,Documents) during May and June of 2010. Nine site visits were made with an average of 2.5 hours spent per visit.

The area was surveyed using the methodology of the Iowa Breeding Bird Atlas II with observations of species present, abundance and breeding level.

A total of 57 species were observed with 6 species confirmed as breeders, 14 species as probable, 8 species as possible and 29 species observed. Species of note include Wild Turkey, Bald Eagle, Yellow-billed Cuckoo, Sedge Wren, Lark Sparrow and Orchard Oriole.

The main objective of this survey was to determine what bird species utilize Jennett Heritage Area for breeding. The information gathered for one summer has several uses. It provides a baseline inventory of the breeding birds of Jennett Heritage Area, and it can be used to develop a breeding bird checklist for the area.

BREEDING EVIDENCE CODES

Observed – Species (male or female) observed in area during breeding season, but no evidence of breeding observed

Possible – (A) Species (male or female) observed in suitable nesting habitat during it breeding season. **(B)** Less than 7 singing males present in suitable nesting habitat during the breeding season.

Probable – **(A)** Pair observed in suitable nesting habitat during its breeding season. **(B)** 7 or more males singing in suitable nesting habitat during the breeding season.

Confirmed – **(A)** Nest building by all species except wrens and woodpeckers. **(B)** Recently fledged young. **(C)** Occupied nest. **(D)** Attending young. **(E)** Nest with eggs. **(F)** Nest with young.

SPECIES	OBSERVED	POSSIBLE	PROBABLE	CONFIRMED
Canada Goose				X
Wood Duck			X	
Ring-necked Pheasant		X		
Wild Turkey	X			
Great Blue Heron	X			
Turkey Vulture		X		
Bald Eagle	X			
Red-tailed Hawk			X	
Killdeer	X			
Rock Pigeon		X		

SPECIES	OBSERVED	POSSIBLE	PROBABLE	CONFIRMED
Mourning Dove	X			
Yellow-billed Cuckoo	X			
Barred Owl	X			
Common Nighthawk	X			
Belted Kingfisher	X			
Red-headed Woodpecker	X			
Downey Woodpecker		X		
Northern Flicker	X			
Eastern Wood Pewee	X			
Least Flycatcher	X			
Eastern Phoebe	X			
Great-crested Flycatcher		X		
Eastern Kingbird			X	
Yellow-throated Vireo	X			
Warbling Vireo			X	
Red-eyed Vireo	X			
Blue Jay			X	
American Crow	X			
Bank Swallow			X	
Barn Swallow	X			
Black-capped Chickadee	X			
White-breasted Nuthatch	X			
House Wren			X	
Sedge Wren	X			
Eastern Bluebird	X			
American Robin			X	
Gray Catbird		X		
Brown Thrasher				X
European Starling	X			
Cedar Waxwing				X
American Redstart	X			
Common Yellowthroat			X	
Chipping Sparrow		X		
Field Sparrow	X			
Lark Sparrow			X	
Song Sparrow			X	
Northern Cardinal			X	
Rose-breasted Grosbeak			X	
Indigo Bunting			X	
Dickcissel		X		
Red-winged Blackbird				X
Eastern Meadowlark	X			
Common Grackle				X
Orchard Oriole	X			
Baltimore Oriole				X

American Goldfinch	X
House Sparrow	X

NUMBER OF DAYS SPECIES SEEN

Canada Goose	1
Wood Duck	2
Ring-necked Pheasant	2
Wild Turkey	1
Great Blue Heron	1
Turkey Vulture	3
Bald Eagle	1
Red-tailed Hawk	1
Killdeer	2
Rock Pigeon	1
Mourning Dove	2
Yellow-billed Cuckoo	2
Barred Owl	3
Common Nighthawk	1
Belted Kingfisher	3
Red-headed Woodpecker	1
Downey Woodpecker	6
Northern Flicker	2
Eastern Wood Pewee	1
Least Flycatcher	1
Eastern Phoebe	2
Great-crested Flycatcher	4
Eastern Kingbird	5
Yellow-throated Vireo	1
Warbling Vireo	4
Red-eyed Vireo	3
Blue Jay	4
American Crow	1
Bank Swallow	1
Barn Swallow	1
Black-capped Chickadee	1
White-breasted Nuthatch	1
House Wren	6
Sedge Wren	1
Eastern Bluebird	1
American Robin	6
Gray Catbird	4
Brown Thrasher	5
European Starling	1

Cedar Waxwing	2
American Redstart	1
Common Yellowthroat	8
Chipping Sparrow	3
Field Sparrow	4
Lark Sparrow	3
Song Sparrow	7
Northern Cardinal	7
Rose-breasted Grosbeak	3
Indigo Bunting	6
Dickcissel	4
Red-winged Blackbird	2
Eastern Meadowlark	4
Common Grackle	1
Orchard Oriole	1
Baltimore Oriole	3
American Goldfinch	5
House Sparrow	1

Appendix C: Breeding Bird Survey of Jennett Heritage Area

Final Report to Story County Conservation

Breeding Bird Survey of Jennett Heritage Area
Final Report to Story County Conservation

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20 July 2019

Introduction

The Jennett Heritage Area (Jennett HA) is a 171-acre property located approximately three and one-half miles south of Nevada, Iowa in T83N R22W, Section 31, Story County. Jennett holds diverse habitats and includes 25 acres of remnant prairie, oak savanna, woodlands, two streams, two ponds, and a shallow wetland. The area was acquired by Story County Conservation in 2010, and since then prairie habitat restoration has been a major focus. The area is bordered by row-crop agriculture to the north and northeast and primarily woodland to the west, south and southeast. The area is a public fishing and hunting area, with no lead ammunition allowed.

In order to inform the restoration and management process, Story County Conservation is interested to learn what bird species are utilizing the area after nearly a decade of restoration work. Since European settlement, Iowa lost more than 99% of its native grassland and wetland habitat (Samson and Knopf 1994). This extreme loss and alteration of habitat indicates how important remaining high quality habitat areas are. This property contains critical habitat and supports diverse grassland and woodland wildlife communities. This includes at least 29 avian Species of Greatest Conservation Need (SGCN), listed in Iowa's Comprehensive Wildlife Action Plan (Reeder and Clymer 2015), as well as many SGCN of other taxonomic groups.

The objective of this project was to 1) document breeding bird species at Jennett Heritage Area to compare with a baseline bird list gathered in 2010, 2) provide a list of breeding birds for future comparisons of the bird community, and 3) help inform habitat restoration and management activities for birds, based on presence of bird Species of Greatest Conservation Need and game birds. This report presents results from point count surveys run this year and compares results to those of an Atlas type survey run in 2010 (Zaletel 2010).

Survey methods

Seven survey points were established to represent most habitats at Jennett Heritage Area (Figure 1). Points were placed greater than 200 meters apart to ensure independence among points and avoid double counting birds. Points were placed using Google Earth imagery. All seven points were surveyed on a single visit, and the order of points surveyed was randomized during each visit. Unlimited distance, 10-minute point counts were conducted for breeding birds at all points three times from 23 May – 15 July 2019 (Blondel et al. 1981). Counts were started no earlier than 15 minutes before sunrise and finished no later than 4 hours after sunrise. All individual birds heard or seen at each point were recorded, the linear distance to each bird was estimated, and the bird record was placed in one of five distance bins: 0-25 m, 25-50 m, 50-75 m, 75-100 m, and >100 m. Each individual bird was recorded when it was originally detected at each point. If the bird was detected again at the same point or at a subsequent point, it was not recorded again. Incidental birds detected were recorded between points, if they were not previously recorded at a survey point. Prior to starting a survey at each point, temperature (℉), cloud cover (%), and wind speed (mph) were measured. Surveys were not conducted if wind speeds were greater than 12 mph. For the purpose of developing

a more comprehensive species list for the area, incidental observations from one visit to the area, before the above-mentioned survey period, also were included. While a few migrant species were recorded, more visits in late summer and early-to-late fall will substantially add to the number of species currently documented.

Results

In 2019, a total of 101 bird species were detected at Jennett Heritage Area, 28 of which are SGCN breeding birds and 1 that is a SGCN migratory bird (Appendix 1). The SGCN breeding birds include: Blue-winged Teal (*Anas discors*), Northern Bobwhite (*Colinus virginianus*), Bald Eagle (*Haliaeetus leucocephalus*), Broad-winged Hawk (*Buteo platypterus*), Forster's Tern (*Sterna forsteri*), Yellow-billed Cuckoo (*Coccyzus americanus*), Black-billed Cuckoo (*Coccyzus erythrophtalmus*), Chimney Swift (*Chaetura pelagica*), Belted Kingfisher (*Ceryle alcyon*), Red-headed Woodpecker (*Melanerpes erythrocephalus*), Northern Flicker (*Colaptes auratus*), Eastern Wood-Pewee (*Contopus virens*), Acadian Flycatcher (*Empidonax virescens*), Eastern Kingbird (*Tyrannus tyrannus*), Bell's Vireo (*Vireo belli*), Bank Swallow (R*iparia riparia*), (Sedge Wren (*Cistothorus platensis*), Wood Thrush (*Hylocichia mustelina*), Brown Thrasher (*Toxostoma rufum*), Common Yellowthroat (*Geothlypis trichas*), Field Sparrow (*Spizella pusilla*), Grasshopper Sparrow (*Ammodramus savannarum*), Henslow's Sparrow (*Ammodramus henslowii*), Dickcissel (*Spiza americana*), Bobolink (*Dolichonyx oryzivorus*), Eastern Meadowlark (*Sturnella magna*), Western Meadowlark (*Sturnella neglecta*) and Baltimore Oriole (*Icterus galbula*). The only SGCN migratory bird present was Le Conte's Sparrow (*Ammodramus leconteii*).

Using the highest number counted during a survey, the most numerous species were Red-winged Blackbird (*Agelaius phoeniceus*; 50 observations), Dickcissel (39 observations), Common Yellowthroat (34 observations), Sedge Wren (30 observations), and Eastern Meadowlark (19 observations). The most unexpected species found was a territorial male Alder Flycatcher (*Empidonax alnorum*), documented on the last two surveys conducted in June (at survey site #2). There currently only is one Iowa nesting record for Alder Flycatcher, and that occurred in 2009 in Dallas County. Although 3 singing Henslow's Sparrows was the most documented from survey points, 7 different territorial males were heard singing during one visit. A Le Conte's Sparrow was seen during the first visit on 22 April 2019. Another happy surprise is the presence of Northern Bobwhite, although only 1 territorial male was documented.

Conclusions

The only species found during the 2010 Atlas type survey (Zaletel 2010) that was not found this year is Common Nighthawk (*Chordeiles minor*), which is a breeding Species of Greatest Conservation Need. While 57 species were detected during the 2010 bird surveys (in approximately 22.5 hours of field time in nine site visits), 101 species were detected during 2019 (in approximately 13 hours of field time during four site visits). The presence of both Henslow's and LeConte's sparrows indicates that a particular habitat now exists that did not in 2010. For instance, Henslow's Sparrow is an area-sensitive grassland-obligate breeding species and a SGCN that requires deep, dense ground litter and tall, dense vegetation for breeding habitat (Herkert et al. 2002). Henslow's Sparrow is considered a threatened species in Iowa (Reeder and Clymer 2015) and also is listed as a species of conservation concern by the U.S. Fish and Wildlife Service and North American Bird Conservation Initiative in both Bird Conservation Region 22 (Eastern Tallgrass Prairie) and Bird Conservation Region 23 (Prairie Hardwood Transition Region), both of which include parts of Iowa (USFWS 2008, NABCI 2016). Le Conte's Sparrow is a migratory SGCN in Iowa and requires wet grassland and marshes during the breeding season and is often found in similar habitats during migration (Lowther 2005). Despite suffering severe declines throughout their respective ranges, historically, due largely to habitat loss, both species are increasing in the above-mentioned Bird Conservation Regions in recent years (Sauer et al. 2014). The need still exists, however, to restore and manage grassland

habitats that benefit both of these species and help maintain increasing population trends (Herkert et al. 2002, Lowther 2005).

While the methodology for bird data collection differs between 2010 and 2019, there are some useful observations to be made from the two data-sets. For instance, using the current SGCN bird list (Reeder and Clymer 2015), there were 15 SGCN breeding birds documented in the 2010 survey (Zaletel 2010) and 28 SGCN breeding birds documented in the 2019 survey. While there were 57 species documented in the 2010 survey, there were 101 species documented in 2019 (in 9 ½ fewer hours of field time). The data for the breeding status is comparable, because both studies used the same Breeding Bird Atlas Evidence of Nesting codes. During 2010, probable evidence of breeding occurred for 14 species, and confirmed evidence of breeding occurred for 6 species. In 2019, probable evidence of breeding occurred for 55 species, and confirmed evidence of breeding occurred for 25 species.

It appears that habitat restoration work on Jennett HA is responsible for a dramatic increase in the number of species that nest on this property. More importantly, the large scale of the restoration, particularly prairie, has increased the quality of the vegetation (as well as the space) that is needed for nesting by SGCN. Of particular note is the fact that most of Iowa's grassland SGCN birds appear to nest on this property. This is an incredible achievement, since it has been accomplished in less than a decade. It also is a very good example of how grassland birds can pioneer into new areas when appropriate vegetation exists. Jennett HA has become an area of critical importance to breeding grassland birds; particularly to Sedge Wren, Field Sparrow, Grasshopper Sparrow, Henslow's Sparrow, Dickcissel, Bobolink, and Eastern Meadowlark. Apparent newcomers to this area include Northern Bobwhite and Bell's Vireo. It will continue to be critical habitat as long suitable habitat conditions are maintained.

Recommended Management

A native shrub component should be maintained in the grasslands (or at its edge) on this property, if it is desired to continue to have nesting SGCN, like Northern Bobwhite and Bell's Vireo. Native dogwoods and Wild Plum work well for this purpose. Ideally, 20-30% of the entire property will be burned each year (Herkert et al. 2002). This rotation will help control unwanted woody vegetation and provide a variety of habitat that suits the needs of most, if not all, of the grassland bird species that currently nest here. To maintain nesting habitat for Henslow's Sparrow, the primary keys to management are to provide large areas (at least 50 ha (125 acres) in size) with suitable habitat (tall, dense, herbaceous vegetation with well-developed ground litter), avoid breeding habitat disturbances during the nesting season, and control succession using management tools (Herkert 2003).

Continuing savanna restoration work will allow keystone savanna SGCN, like Red-headed Woodpecker and Northern Flicker, to prosper and multiply. It is especially important to leave dead trees/snags standing. Woodpeckers will create cavities in snags, in which at least 20 other bird species will nest. The presence of Pileated Woodpeckers is a bonus, since they create large cavities that are utilized by many other wildlife species, including Chimney Swifts.

Important management considerations for the Red-headed Woodpecker include improving habitats by 1) encouraging the existence of a diverse size selection of dead limbs and snags, preferably in groups because birds require multiple snags for nesting, roosting, and foraging (Sedgewick and Knopf 1990); 2) creating and maintaining open savanna-like areas with low density ground cover for aerial and ground foraging (Conner and Adkisson 1977); and 3) increasing mast production by improved management for mast producing plants, since there appears to be a correlation of wintering Red-headed Woodpecker numbers with mast crop abundance (Smith et al. 2000).

Please do not overlook the value of native shrubs for woodland/savanna SGCN, like Yellow-billed Cuckoo and Black-billed Cuckoo. These are shrubland specialists. Black-billed Cuckoo has become even rarer in this state than Henslow's Sparrow, according to Breeding Bird Atlas data collected from 2008-2012 (unpublished). The fact that this rare species appears to be breeding on the Jennett HA is quite notable. Dogwoods, willows, and Wild Plum (6-10 feet tall), provide habitat for many nesting shrub-loving birds. Wood Thrush is another shrub-loving woodland SGCN that nests on Jennett HA, specifically there were three territorial males in the oak woodland in the southeastern corner.

Literature Cited

Blondel, J., C. Ferry, and B. Frochot. 1981. Points counts with unlimited distance. Studies in Avian Biology 6:414-420.

Conner, R. N., C. S. Adkisson. 1977. Principal component analysis of woodpecker nesting habitat. Wilson Bull. 89: 122–129.

Herkert, J. R. 2003. Effects of management practices on grassland birds: Henslow's Sparrow. Northern Prairie Wildlife Research Center, Jamestown, ND. Northern Prairie Wildlife Research Center Online. http://www.npwrc.usgs.gov/resource/literatr/grasbird/hesp/hesp.htm (Version 12DEC2003).

Herkert, J.R., P.D. Vickery, and D.E. Kroodsma. 2002. Henslow's Sparrow (*Ammodramus henslowii*), The Birds of North America Online (P.G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from The Birds of North America: https://birdsna.org/Species-Account/bna/species/henspa DOI: 10.2173/bna.672

Lowther, P.E. 2005. Le Conte's Sparrow (*Ammodramus leconteii*), The Birds of North America Online (P.G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from The Birds of North America: https://birdsna.org/Species-Account/bna/species/lecspa DOI: 10.2173/bna.224

North American Bird Conservation Initiative (NABCI). 2016. State of North America's Birds 2016. Washington D.C. Accessed: <http://www.stateofthebirds.org/2016/>.

Reeder, K.F., and J.A. Clymer. 2015. Iowa's Wildlife Action Plan: Securing a future for fish and wildlife. Iowa Department of Natural Resources, Des Moines, Iowa.

Sauer, J. R., J. E. Hines, J. E. Fallon, K. L. Pardieck, D. J. Ziolkowski, Jr., and W. A. Link. 2014. The North American Breeding Bird Survey, Results and Analysis 1966 - 2013. Version 01.30.2015 USGS Patuxent Wildlife Research Center, Laurel, Maryland.

Sedgwick, J. A., F. L. Knopf. 1990. Habitat relationships and nest site characteristics of cavity-nesting birds in cottonwood floodplains. J. Wildl. Manage. 54: 112–124.

Smith, K. G., J. H. Withgott, and P. G. Rodewald. 2000. Red-headed Woodpecker (*Melanerpes erythrocephalus*). *In* The Birds of North America, No. 518 (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA.

U.S. Fish and Wildlife Service (USFWS). 2008. Birds of Conservation Concern 2008. Division of Migratory Bird Management, Arlington, Virginia.

Zaletel, H. 2010. A breeding bird survey of the birds of Jennett Heritage Area. Report for Story County Conservation.

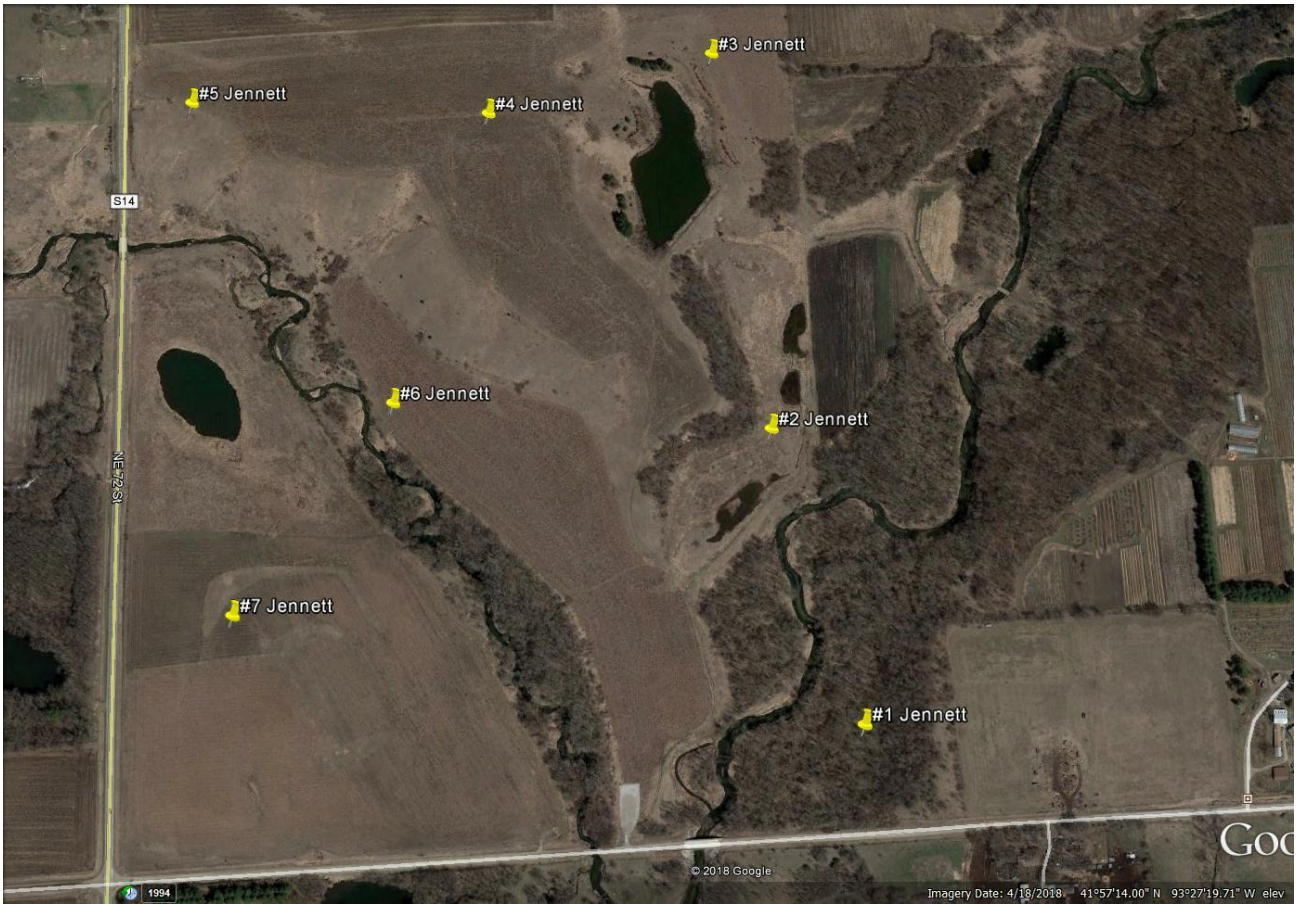


Figure 1: Map of survey points on Jennett Heritage Area, Story County, Iowa, 2019.

Appendix 1: List of bird species and total number observed at Jennett Heritage Area, Story County, Iowa, 2019. "*" denotes Species of Greatest Conservation Need (SGCN). "↟" denotes confirmed or probable breeding on Jennett Heritage Area.

Common Name	**Scientific Name**	**2010 observations – Yes or No**	**2019 observations – most per survey day. "#" = incidental record**
Canada Goose ↟	*Branta canadensis*	Yes	15
Wood Duck ↟	*Aix sponsa*	Yes	1
Mallard ↟	*Anas platyrhynchos*	No	2
Blue-winged Teal * ↟	*Anas discors*	No	2
Ring-necked Pheasant↟	*Phasianus colchicus*	Yes	14
Wild Turkey ↟	*Meleagris gallopavo*	Yes	2
Northern Bobwhite *↟	*Colinus virginianus*	No	1
Great Blue Heron	*Ardea herodias*	Yes	1
Turkey Vulture	*Cathartes aura*	Yes	2
Bald Eagle *	*Haliaeetus leucocephalus*	Yes	1
Broad-winged Hawk *	*Buteo platypterus*	No	1
Red-tailed Hawk ↟	*Buteo jamaicensis*	Yes	1
Killdeer↟	*Charadrius vociferus*	Yes	2
Forster's Tern*	*Sterna forsteri*	No	2#
Rock Pigeon ↟	*Columba livia*	Yes	2
Mourning Dove ↟	*Zenaida macroura*	Yes	2
Yellow-billed Cuckoo *↟	*Coccyzus americanus*	Yes	2

Appendix 1 (cont.): List of bird species and total number observed at Jennett Heritage Area, Story County, Iowa, 2019. "*" denotes Species of Greatest Conservation Need (SGCN). "↟" denotes confirmed or probable breeding on Jennett Heritage Area.

Common Name	**Scientific Name**	**2010 observations – Yes or No**	**2019 observations – most per survey day. "#" = incidental record**
Black-billed Cuckoo *↟	*Coccyzus erythropthalmus*	No	1
Great Horned Owl ↟	*Bubo virginianus*	No	2
Barred Owl ↟	*Strix varia*	Yes	1
Chimney Swift*↟	*Chaetura pelagica*	No	2
Ruby-throated Hummingbird ↟	*Archilochus colubris*	No	1
Belted Kingfisher *↟	*Ceryle alcyon*	Yes	1
Red-headed Woodpecker*↟	*Melanerpes erythrocephalus*	Yes	3
Red-bellied Woodpecker↟	*Melanerpes carolinus*	No	3
Downy Woodpecker↟	*Picoides pubescens*	Yes	1
Hairy Woodpecker↟	*Picoides villosus*	No	1#
Northern Flicker *↟	*Colaptes auratus*	Yes	1
Pileated Woodpecker	*Dryocopus pileatus*	No	1
Eastern Wood-Pewee*↟	*Contopus virens*	Yes	1
Yellow-bellied Flycatcher	*Empidonax flaviventris*	No	1#
Acadian Flycatcher *↟	*Empidonax virescens*	No	1#
Willow Flycatcher*↟	*Empidonax trailii*	No	2
Alder Flycatcher ↟	*Empidonax alnorum*	No	1
Least Flycatcher	*Empidonax minimus*	Yes	1#
Eastern Phoebe ↟	*Sayornis phoebe*	Yes	1
Great Crested Flycatcher ↟	*Myiarchus crinitus*	Yes	2
Eastern Kingbird*↟	*Tyrannus tyrannus*	Yes	1
Bell's Vireo *↟	*Vireo bellii*	No	1
Yellow-throated Vireo ↟	*Vireo flavifrons*	Yes	1
Warbling vireo ↟	*Vireo gilvus*	Yes	6
Philadelphia Vireo	*Vireo philadelphicus*	No	1#
Red-eyed Vireo ↟	*Vireo olivaceus*	Yes	1
Blue Jay ↟	*Cyanocitta cristata*	Yes	5
American Crow ↟	*Corvus brachyrhynchos*	Yes	2
Tree Swallow ↟	*Tachycineta bicolor*	No	5
Northern Rough-winged Swallow ↟	*Steigidopteryx serripensis*	No	2
Bank Swallow *↟	*Riparia riparia*	Yes	2#
Cliff Swallow ↟	*Petrochelidon pyrrhonota*	No	1
Barn Swallow ↟	*Hirundo rustica*	Yes	2
Black-capped Chickadee ↟	*Parus atricapillus*	Yes	4
White-breasted Nuthatch ↟	*Sitta carolinensis*	Yes	2
House Wren ↟	*Troglodytes aedon*	Yes	8
Sedge Wren*↟	*Cistothorus platensis*	Yes	30
Marsh Wren↟	*Cistothorus palustris*	No	1
Eastern Bluebird ↟	*Sialia sialis*	Yes	1
Wood Thrush *↟	*Hylocichla mustelina*	No	3
American Robin↟	*Turdus migratorius*	Yes	8
Gray Catbird ↟	Dumetella carolinensis	Yes	10

Appendix 1 (cont.): List of bird species and total number observed at Jennett Heritage Area, Story County, Iowa, 2019. "*" denotes Species of Greatest Conservation Need (SGCN). "↟" denotes confirmed or probable breeding on Jennett Heritage Area.

Common Name	**Scientific Name**	**2010 observations – Yes or No**	**2019 observations – most per survey day. "#" = incidental record**
Brown Thrasher*↟	*Toxostoma rufum*	Yes	4
European Starling ↟	*Sturnus vulgaris*	Yes	4
Cedar Waxwing	*Bombycilla cedrorum*	Yes	1
Tennessee Warbler	*Vermivora peregrina*	No	1
Nashville Warbler	*Vermivora ruficapilla*	No	2#
Mourning Warbler	*Oporornis philadelphia*	No	1#
Northern Parula ↟	*Parula americana*	No	1#
Yellow Warbler↟	*Dendroica petechia*	No	5
Chestnut-sided Warbler	*Dendroica pensylvanica*	No	1
Magnolia Warbler	*Dendroica magnolia*	No	1#
Yellow-rumped Warbler	*Dendroica coronata*	No	1#
Palm Warbler	*Dendroica palmarum*	No	1#
American Redstart ↟	*Setophaga ruticilla*	Yes	2
Ovenbird ↟	*Seirus motacilla*	No	1
Common Yellowthroat*↟	*Geothlypis trichas*	Yes	34
Eastern Towhee ↟	*Pipilo erythrophthalmus*	No	3
Chipping Sparrow ↟	*Spizella passerina*	Yes	1
Field Sparrow *↟	*Spizella pusilla*	Yes	6
Vesper Sparrow ↟	*Pooecetes gramineus*	No	3
Lark Sparrow ↟	*Chondestes grammacus*	Yes	2
Savannah Sparrow ↟	*Passerculus sandwichensis*	No	1
Grasshopper Sparrow*↟	*Ammodramus savannarum*	No	6
Henslow's Sparrow*↟	*Ammodramus henslowii*	No	3
Le Conte's Sparrow*	*Ammodramus leconteii*	No	1#
Lincoln's Sparrow	*Melospiza lincolnii*	No	1#
Song Sparrow↟	*Melospiza melodia*	Yes	17
Swamp Sparrow↟	*Melospiza georgiana*	No	1
Dark-eyed Junco	*Junco hyemalis*	No	1#
Northern Cardinal ↟	*Cardinalis cardinalis*	Yes	13
Rose-breasted Grosbeak ↟	*Pheucticus ludovicianus*	Yes	12
Indigo Bunting ↟	*Passerina cyanea*	Yes	4
Dickcissel*↟	*Spiza americana*	Yes	39
Bobolink*↟	*Dolichonyx oryzivorus*	No	5
Red-winged Blackbird↟	*Agelaius phoeniceus*	Yes	50
Eastern Meadowlark*↟	*Sturnella magna*	Yes	19
Western Meadowlark*	*Sturnella neglecta*	Yes	1
Common Grackle↟	*Quiscalus quiscula*	Yes	6
Brown-headed Cowbird↟	*Molothrus ater*	No	8
Orchard Oriole ↟	*Icterus spurius*	Yes	2
Baltimore Oriole *↟	*Icterus galbula*	Yes	11
American Goldfinch ↟	*Spinus tristis*	Yes	9
House Sparrow ↟	*Passer domesticus*	Yes	2#

Appendix D: 2008 Ames CBC Results, 2010 Ames CBC Results, 2011 Ames CBC Results, 2018 Ames CBC Results

Subject: **Bohemian Waxwings - Ames**
From: Shane Patterson <shane7896@yahoo.com>
Date: Mon, 22 Dec 2008 10:43:56 -0800 (PST)
X-Message-Number: 3

On the Ames CBC, I observed a flock of eight Bohemian Waxwings fly in and perch atop a big tree at the YMCA woodland in west Ames. They surveyed their surroundings for a while before heading north - probably to seek out the next round of suburban fruit trees. The Northridge subdivision, located just NE of this woodland, has dozens of crabapple trees, nearly all of which are loaded with fruit right now.

Although there were no Cedar Waxwings in this small group, we had very good numbers of them in general for the CBC. In fact, we had respectable counts for many of the frugivorous winter species, which were taking advantage of the abundant hackberry fruit and
crabapples around Ames.

(I'll post full results from the CBC later on today.)

Shane Patterson
Ames, Story County

Subject: **2008 Ames CBC results: annotated list**
From: Shane Patterson <shane7896@yahoo.com>
Date: Mon, 22 Dec 2008 20:58:51 -0800 (PST)
X-Message-Number: 4

Thirty-three field counters and at least ten feeder-watchers participated in the Ames Christmas Bird Count on Saturday. Many of us will remember this CBC for the picturesque winter morning that was interrupted by a vicious prairie blizzard.

Despite deteriorating conditions in the afternoon, we still managed to find enough rare/uncommon birds to push the day's species list (59) above the 18-year mean (57). Among the notables were Gray Partridge, Pied-billed Grebe, Northern Harrier, Merlin, Short-eared Owl, Yellow-bellied Sapsucker, Carolina Wren, Winter Wren, Hermit Thrush, Bohemian Waxwing, Swamp Sparrow, Lapland Longspur, and Snow Bunting.

Below is an annotated list of all species recorded; this includes most of our feeder-watcher data. As in past years, I added comments in regard to the highest counts for the last 18 years (i.e., "record-highest" is in reference to data from 1991-2008).

The list:
*Canada Goose - 83; a rather low total, as expected, with the extensive ice coverage

*Mallard - 28; well below average, but, again, a reasonable number considering the weather

*Gray Partridge - 27; third-highest, following the record high of 34 from last year

*Ring-necked Pheasant - 165; well above average

*Pied-billed Grebe - 1; second occurrence on the Ames CBC (other was in 1999 - a much warmer year); this bird in particular has been patrolling what looks to be a 5x3 ft. hole in the ice at Ada Hayden Park

*Bald Eagle - 8; similar to most totals from recent years

*Northern Harrier - 1; an adult male hunting at dusk over the restored prairie at Ada Hayden Park was one of the last additions to the day's list

*Sharp-shinned Hawk - 3; right at the average for recent years

*Cooper's Hawk - 4; down from the previous three CBCs, but in the expected range for the last decade

*Red-tailed Hawk - 45; included at least two western dark-morph adults

*Rough-legged Hawk - 2; both were light-morph adults; a dark-morph adult was observed earlier in the week

*American Kestrel - 7; lowest since 2000, but probably a good tally under the blustery conditions

*Merlin - 2; fourth occurrence (2004, 2006, 2007, 2008); one of this year's individuals was a prairie female (F.c. richardsonii) that attacked a Barred Owl at River Valley Park

*Rock Pigeon - 243; low visibility probably contributed to this somewhat low count

*Eurasian Collared-Dove - 4; of annual occurrence

*Mourning Dove - 244; second-highest, on the heels of the record 309 last year; a sizeable portion of this year's total came from feeder-watchers

*Eastern Screech-Owl - 1; in the last decade, it has been typical to find just one or two screech-owls during our pre-dawn efforts

*Great Horned Owl - 9; second-highest, which is just a few notches above the median

*Barred Owl - 5; about average, although we did put in more owling time this year than usual

*Short-eared Owl - 1; the first SEOW recorded on our CBC in 13 years; seen by Pat Schlarbaum at dawn in the eastern quarter of the circle

*Belted Kingfisher - 4; apparently the Skunk River and its tributaries still had enough open water for a respectable number of kingfishers

*Red-bellied Woodpecker - 140; second-highest, after the 142 found last year; mean count from 1991 to 2000 = 57; mean count from 2001 to 2008 = 114

*Yellow-bellied Sapsucker - 8; record-highest, which actually doubles the previous high from 2007; this species has now occurred on five consective Ames CBCs after a five-year absence

*Downy Woodpecker - 189; 2nd-highest, following the high of 205 from last year; perhaps an increased emphasis on feeder-watching has boosted this and other
species' count totals in the last few years

*Hairy Woodpecker - 52; third-highest; the past three years have all exceeded 50

*Northern Flicker - 61; record-highest; top-five counts for flicker since 1991 are 61, 46, 19, 16, 12, with single-digits occurring more often

*Blue Jay - 199; above average, as in most recent years

*American Crow - 11,900; a bit lower than in most recent CBCs, but still w/in the expected range

*Horned Lark - 455; record-highest, eclipsing the previous high of 364 from the 2000 CBC; double-digit numbers are more typical for this species, although I presume many individuals get overlooked in snow-free years

*Black-capped Chickadee - 301; lowest since 1991, but still not extremely far below the mean and median

*Tufted Titmouse - 4; the third-lowest count of the last 18 years

*White-breasted Nuthatch - 150; down from the rather high numbers of the previous six years, but still pretty close to average

*Brown Creeper - 41; second-highest, after the 47 found in 2002; at least a dozen were feeding in mixed-species flocks at Brookside Park

*Carolina Wren - 6; second-highest; counts since 2003 have gone 1-1-2-10-3-6

*Winter Wren - 2; 8th year in a row for this species, which seems to find plenty of suitable habitat in the sheltered streamside ravines throughout Ames

*Eastern Bluebird - 17; record-highest; this species is often difficult to find in our count circle in winter, despite being regular in many CBCs to the south and east

*Hermit Thrush - 1; observed about every other year

*American Robin - 217; third-highest, continuing the theme of widespread fruit-eating birds

*European Starling - 2247; total is within the expect range for the CBC

*Bohemian Waxwing - 8; first ever for the Ames CBC; see previous listserv post

*Cedar Waxwing - 157; third-highest, as another member of the frugivore party this year

*American Tree Sparrow - 276; after 400+ during the two previous CBCs, this year's result returned to about average

*Song Sparrow - 5; lowest since 1998, but not particularly surprising with the deep snow cover

*Swamp Sparrow - 1; recorded about once out of every three years

*White-throated Sparrow - 44; second-highest and well above the median of seven; Larry Dau found 22 of them around shrubs (and feeders) along various buildings on the ISU campus

*Harris's Sparrow - 1; scarce again; there has only been one double-digit count from 2003-2008

*Dark-eyed Junco - 930; down from 2007's record tally (1,556), but still well above average

*Lapland Longspur - 138; record-highest by far; even though flocks of longspurs are often observed around Story County in Jan-Feb, this CBC count is actually greater than all other post-1990 CBC totals combined

*Snow Bunting - 63; second-highest after last year's 204; the heavy snow helped to concentrate many open-country species along rural roads and farm entrances

*Northern Cardinal - 364; record-highest...just above last year's 363; both counts bolstered in part by feeder-watcher contributions and perhaps the heavy snow coverage (making birds more obvious up above the dense ground cover)

*Red-winged Blackbird - 4; this characteristic single-digit result pales in comparison to the 204 found in the unusual spring-like flocks of 2006 (a very warm CBC season)

*Meadowlark species - 5; about average; unlike last year, none of these meadowlarks vocalized while we listened

*Common Grackle - 2; definitely no flocks this time

*Brown-headed Cowbird - 70; record-highest, and only the third double-digit total since 1991

*Purple Finch - 38; second-highest (39 in '03), after three consecutive single-digit years

*House Finch - 200; well above the historic average, but in the expected zone for recent CBCs

*Pine Siskin - 48; ties fourth-highest, following a second-best 61 from '07; many of these siskins were at feeders, as expected

*American Goldfinch - 195; fourth-highest, with many talkative flyovers in the mix

*House Sparrow - 953; a little below average, as we often tally over a thousand

Total = 59 species (plus count week Cackling Goose, Northern Shrike, and Common Redpoll)

And a sincere thank-you goes out again to the many who participated, especially the various section leaders, including Jon and Joyce Bahrenfus; Mary Doud and Jeff Nichols; Sherry Dragula and Mark Widrlechner; David and Jeanne Edwards; Bruce and Marlene Ehresman; Mike Meetz; and Hank Zaletel. (Wolf Oesterreich and Kevin Healy typically lead sections and would have this year as well, if not for scheduling conflicts.) Sherry and Mark also coordinated another excellent post-count potluck for the group.

Shane Patterson
Ames, Story County

Subject: Ames CBC results - annotated list
From: shane_patterson@usa.com
Date: Wed, 29 Dec 2010 16:44:49 -0500
X-Message-Number: 1

--**Ames Christmas Bird Count (held Saturday, Dec.18th**)-- During what turned out to be an agreeable day weather-wise (coldethan average, but without excessively high winds), 35 field participants and 9 feeder watchers completed the 2010 Ames CBC.

The species total (65) - bolstered by a diverse gathering of waterfowl was well above the 20-year mean (57), while encompassing both less-than-exptected and higher-than-usual numbers throughout the list. But for many species, the returns were within the established count-total range for our CBC.
Birds of note (either in terms of Ames-CBC rareness or general interest to wintertime birders) included Greater White-fronted Goose, Cackling Goose,Trumpeter Swan, Northern Pintail, Common Goldeneye, Hooded Merganser, GrayPartridge, Rough-legged Hawk, Long-eared Owl, Red-headed Woodpecker, NorthernShrike, Carolina Wren, Winter Wren, Hermit Thrush, Harris's Sparrow, LaplandLongspur, Snow Bunting, Rusty Blackbird, and White-winged Crossbill. Conspicuous in their absence were Northern Harrier, Merlin, Swamp Sparrow,Red-winged Blackbird, and Common Grackle.

The list:

-Greater White-fronted Goose = 5 at Ada Hayden HeritagePark (AHHP); third occurrence in Ames CBC history (2 found in 1999 and 2006)

-Cackling Goose = 82; first count-day appearance since '06; alongside thousands of Canada Geese

-Canada Goose = 3,962; just below record-highest count (3,981 on a warm day in 2006); numbers in the hundreds are more typical

-Trumpeter Swan = 6; third CBC occurrence ever; others were in '94(1) and'98(3)

-Mallard =235; 2nd-highest total (447 in '02); count-day numbers during the2000s have generally been greater than those of the 1990s

-Northern Pintail = 1; male at AHHP; fourth occurrence overall for our CBC

-Common Goldeneye =1; second count-day instance in this century (7 found in'06) and sixth overall on count days

-Hooded Merganser = 1 female at AHHP; first for the 2000s and third of all time

-Gray Partridge = 17 of this ever-popular species were seen SE of Ames;= a separate covey of 21 was observed in preceding days NE of Ames

-Ring-necked Pheasant = 99; within the anticipated range - and just one less than last year

-Wild Turkey =15; has now been recorded on 8 of our last 20 CBCs

-Great Blue Heron = 1; especially scarce in cold Decembers; this wader had not been encountered since 2006, and it was found more reliably in the late 1990s and early 2000s

-Bald Eagle = 11; same number as last year, thereby keeping with the recent trend of double-digit returns (11 or more noted on five of previous six counts)

-Sharp-shinned Hawk = 4; consistency reigns supreme here; totals from 2004 to 2010: 4-4-3-2-3-4-4

-Cooper's Hawk = 7; outnumbered in all but one year by the previous species during the 1990s (10 to 33 in that span), totals for this medium-sized Accipiter have grown to exceed that of its smaller counterpart by a wide margin 2000-2010 (72 to 28)=20 -Red-tailed Hawk = 89; well above the historic mean, but similar to recent years in which 80+ totals have become prevalent; we noted one each of western dark morph and rufous morph this year

-Rough-legged Hawk = 1, modest returns, especially of just 1 or 2, are= typical

-American Kestrel = 4; a very low number; only four other single-digit= results since 1991; counts in the middle teens are more commonplace

-Rock Pigeon = 384; about average for recent years

-Eurasian Collared-Dove = 72; very close to last year's record-obliterating total (70); mere single digits (2-5-9-4) werenoted 2005-2008, with no occurrences prior to that; ECDO apparently only trails House Sparrow as the most numerous bird in the tiny town of Kelley =20 -Mourning Dove = 71; more in line with tallies from the 1990s than the much higher numbers of most recent years (from 2003-2009: 175-227-201-74-309-245-173)

-Eastern Screech-Owl = 1; a daytime addition near Walnut Creek; none were heard by our dedicated owlers before sunrise or after sunset =20 -Great Horned Owl = 5; near the 20-year mean (110 recorded 1991-2010)

-Barred Owl = 13; a very high total for our CBC (20-year mean = 5)

-Long-eared Owl = 1; at the ISU horticulture farm north of Ames; always= a great find, as this wary owl had been noted in just 5 out of the previous 19 counts

-Belted Kingfisher = 3; probably a good number considering the icy conditions; this follows last year's unusual count-day absence

-Red-headed Woodpecker = 3; actually ties the second-highest total of the last20 years (3 also in '94 and '03); 8 were noted in 1991

-Red-bellied Woodpecker = 125; definitely more numerous in the last ten years than in prior decades -Yellow-bellied Sapsucker = 1;seventh year in a row for this previously "unexpected" visitor

-Downy Woodpecker = 190; well above the mean and median, but generally in line with results from the last five

-Hairy Woodpecker = 43; similar to last year's (41), and, like DOWO, easily surpassed the mean and median counts

-Northern Flicker = 40; third-highest in the last 20 years (61 in '08 an= d 46 in'01); one red-shafted individual joined the list this year

-Northern Shrike = 1; including this year, noted on 17 of last 20 CBCs,= with exactly 1 found during 60% of those counts

-Blue Jay = 157; down from the record highs of the preceding five years, but still close to the 20-year median (164)

-American Crow = 7,700; one of the smaller assemblages observed at the ISU campus roost, but certainly large enough to draw the ire of non-birders (and probably some birders, too)

-Horned Lark = 222; third-highest total since '91; flocks of various sizes were easy to spot along snowy rural roads in much of the circle

-Black-capped Chickadee = 582; record-highest; nearly every field group commented on the prevalence of this friendly backyard bird

-Tufted Titmouse = 2; although never abundant in/around Ames, this species has seemingly become more scarce in the last three years

-Red-breasted Nuthatch = 5; note the fluctuating results from 2000-2010:= 1-15-1-6-39-7-6-46-0-12-5

-White-breasted Nuthatch = 221; continuing with its theme of higher totals following the turn of the century

-Brown Creeper = 29; down from the 40+ found in '07 and '08, but about= average for the last decade and close to 2009's tally (31)

-Carolina Wren = 2; eighth year in a row, but lowest total since '05; several observers speculated that the previous harsh winter may have taken a toll on this resident

-Winter Wren = 6; tenth year in a row and 2nd-highest number of all time= (7 in'04); it would be interesting to see how many of these little birdlets remain through the winter -Eastern Bluebird =3D 24; highest count the last 20 years (17 in '08, 16 in= '01, 13 in '05)

-Hermit Thrush = 1; recorded about every other year, as many prime ravines and creekside habitats are thoroughly searched

-American Robin = 252; flocks encountered throughout the circle; counts totaling fewer than 60 have been more customary in recent years

-European Starling = 2,597; fourth-highest since 1991

-Cedar Waxwing = 193; triple-digit totals occur on about 1/3 of our CBCs

-American Tree Sparrow = 578; second-highest total of the last 20 years,= and rivaling this year's record chickadee numbers

-Song Sparrow = 10; within the established numeric range; individuals were distributed over much of the territory

-White-throated Sparrow = 29; fourth-highest, including many found away from feeders

-Harris's Sparrow = 2; much like unimpressive results from the previous= four years (2-1-1-2)

-Dark-eyed Junco = 1,288; 2nd-greatest total; two male Oregon Juncos wer= e noted

-Lapland Longspur = 27; found every year 2006-2010, after going undetected during all but three counts 1991-2005

-Snow Bunting = 33; noted in mixed flocks an as singles by four field parties; sixth count-day appearance in last 20 years, but seen 3 out of last
5 years

-Northern Cardinal = 304; in keeping with contemporary counts: 2002-2009= :306-261-297-312-289-363-369-313

-Meadowlark species = 2; no vocalizations heard - just like the previous two CBCs

-Rusty Blackbird =1; absent in '08 and '09, but found on 8 of last 20; several likely go unnoticed each year in difficult-to-reach riparian areas

-Brown-headed Cowbird = 1; a loner, after back-to-back years of flocks= (70individuals in '08, 30 in '09)

-Purple Finch = 2; obviously a low count, and greater numbers have been hard to find over the last few winters around Ames

-House Finch =169; similar to other results from the last decade

-White-winged Crossbill 1 female found on private land; only the fourth appearance on our CBC's 40-year history

-Pine Siskin = 105; a very high count for our CBC circle; perhaps as an indication of this species' erratic nature, numbers 2000-2010 registered
As 0-19-0-1-15-5-1-61-69-2-105

-American Goldfinch = 121; below average, and the fewest since 1999;outnumbered by siskins at several locations =20 -House Sparrow =3D 802; beginning with the year 2000, all but three Ames CBCs have produced sub-1000 counts for this species, compared to the annual quadruple-digit numbers in decades prior to that =20 --Total species =3D 65 (plus count week Green-winged Teal, Redhead, Ruddy Duck, and American Coot; the teal was a new addition to our all-time list) -- Total individuals =3D 20,962 =20

Once again, I thank those who helped out with this CBC, especially our field-group leaders: Jon Bahrenfus, Joyce Bahrenfus, Dave Edwards, Jeannie Edwards, Bruce Ehresman, Mike Meetz, Jeff Nichols, Wolf Oesterreich, Matt= Wetrich, Mark Widrlechner, and Hank Zaletel. Continuing with Sherry Dragula's tradition, John Pohlman put together another impressive potluck for the compilation.

-Shane Patterson
Ames CBC coordinator and compiler
Story County

Ames Christmas Bird Count
Dec. 17, 2011

The annual Ames Christmas Bird Count took place on a relatively mild December day (Saturday the 17th, 2011) that lacked snow cover.

The total-species result (63) was reminiscent of the previous year's (65), with each list receiving boosts from diverse assemblages of waterfowl. And while the overall numbers of individuals (26,597 in ’11 vs. 20,962 in ’10) might seem to differ greatly at first glance, they compare more favorably when considering that the disparity was largely generated by a unusually high tally for one species (Canada Goose, as discussed below).

Notable birds this time (due to either Ames-CBC rareness or general interest to wintertime observers) included Greater White-fronted Goose, Snow Goose, Cackling Goose, Gadwall, Greater Scaup, Bufflehead, Gray Partridge, Rough-legged Hawk, American Coot, Northern Shrike, Carolina Wren, Winter Wren, Lapland Longspur, Yellow-rumped Warbler, Fox Sparrow, Harris's Sparrow, White-crowned Sparrow, and Rusty Blackbird. Among the disappointing and/or unexpected absences were Merlin, Eastern Screech-Owl, Long-eared Owl, Horned Lark, Hermit Thrush, Snow Bunting, Swamp Sparrow, Western Meadowlark, Common Grackle and Brown-headed Cowbird.

Although an oft-discussed Snowy Owl did venture into the CBC circle during count week, it apparently never accomplished that feat in the presence of human spectators on the official day of the count.

Species, numbers, and comments:

-Greater White-fronted Goose = 4; second year in a row, following the five found in 2010; fourth occurrence ever, with none recorded before ‘99

-Snow Goose = 3; after hanging around for five CBCs from ’96 to ’02, this migrant was gone by count day '03 to '10

-Cackling Goose = 311; second-largest Ames CBC total since this small goose became an officially recognized species, yet not a surprising result considering the extent of ice-free water and the large flocks of CAGO in multiple locations

-Canada Goose = 8,776; more than doubles each of next two greatest (3,981 in ‘06 and 3,962 in ‘10); openings on deep reservoirs set the stage for these gatherings

-Gadwall = 2; fourth count-day occurrence; last noted during count week in ’04 and on count day in ‘00

-Mallard = 247; a respectable total, much like last year’s 235; found primarily alongside Canada Geese

-Greater Scaup = 1; first ever on the official day of our CBC (recorded previously during count week); photographed at Ada Hayden Heritage Park

-Lesser Scaup = 1; typically not present in large numbers throughout winter in Ames, but seen on almost half of our CBCs after 1990

-Bufflehead = 1; third count-day appearance (also in ’06 and ’07); merely a count-week rarity prior to that

-Common Goldeneye = 2; second year in a row and 7th overall for count day

-Gray Partridge = 5; diligent searches of dependable open-country areas NE of Ames yielded this lone covey,

whereas trips through similarly reliable spots SE of Ames came up empty; lack of snow cover makes this sought-after species more difficult to detect in these agricultural landscapes

-Ring-necked Pheasant = 45; fewest since the 40 in ’06 and well below the numbers detected from ’07 to ’11 (177, 165, 100, 99)

-Wild Turkey = 20; nowhere near the record-highest count (83 in ’94), yet still a respectable result for our CBC circle; this game bird is likely less common here than in many portions of the state

-Bald Eagle = 17; comparable to results of the last few years; the top seven tallies have all taken place in the current seven-year stretch, with sequential totals of 13, 14, 12, 8, 11, 11 and 17

-Northern Harrier = 3; although this fascinating raptor often shows up on our CBC (14 out of the previous 20, for example), it has never been found in abundance

-Sharp-shinned Hawk = 2; in keeping with the numbers from recent outings (2 to 4 seen every time from 2004 to present)

-Cooper's Hawk = 8; as has come to be expected in this century, this Accipiter was encountered much more widely than its smaller relative

-Red-tailed Hawk = 129; soaring above the previous all-time high (98 in ’07, followed by 96 in ’09); 10 of the top-11 greatest tallies for this conspicuous Buteo have occurred since the year 2000

-Rough-legged Hawk = 4; a bit more than usual, as 0-2 were noted on 17 of the preceding 20 CBCs

-American Kestrel = 10; close to both the current mean (12) and median (12 also) for this century

-American Coot = 12; fourth count-day appearance, with all from recent years (2 in ‘99, 8 in ‘06, and 2 in ‘07)

-Rock Pigeon = 261; a fairly low number, although still within the established count range

-Eurasian Collared-Dove = 40; not quite up to the respective highs of 72 and 70 on the last two CBCs, but far above the single digits found prior to 2009; this year's numbers were split nearly evenly between the towns of Nevada and Kelley; Ames itself seems to have very few ECDOs, for now

-Mourning Dove = 116; above last year’s result (71), down from the three prior to that (309-245-173), and right within historic parameters

-Great Horned Owl = 7; a typical result - just slightly beyond both the mean and median

-Barred Owl = 9; although apparently more prevalent now than 20+ years ago, this talkative owl has also produced pretty steady CBC numbers in recent years

-Belted Kingfisher = 8; an above-average find and the most since ‘04 (9), with four or fewer recorded in each intervening year

-Red-bellied Woodpecker = 216; record-highest, more than doubling the historic mean and even jumping well above the consistently rich totals of ’07-’10 (142, 140, 141, 125)

-Yellow-bellied Sapsucker = 1; eighth consecutive occurrence; this individual was found at one of the more reliable winter/migration sites (the State Forest Nursery) for this species in Ames

-Downy Woodpecker = 237; not far below the record high of 251 set just two years ago; totals in the high 100s and low/mid 200s have now become commonplace

-Hairy Woodpecker = 51; right within the range (41 - 59) noted during my first five years (’06 – ’10) as Ames CBC compiler

-Northern Flicker = 19; a top-five outcome for the last 20 CBCs; median for that span = 9

-Northern Shrike = 5; second-greatest after the 7 found in ‘07; we typically observe only one throughout the circle

-Blue Jay = 161; strikingly similar to last year’s amount (157) and also very close the median (164) from the past 20

-American Crow = 9,000; the notorious ISU-campus roost totaled a bit more than the previous crow census (7,700) while just barely outdoing this year’s record showing for Canada Goose (8,776)

-Black-capped Chickadee = 608; surpasses the all-time high (582) set in '10; as always, one of our most effective means of finding some less-numerous species was to first seek out the vociferous chickadees

-Tufted Titmouse = 5; single-digit results have clearly become the norm, although many of us maintain that this sociable bird is more prevalent in the Ames area than our CBCs indicate

-Red-breasted Nuthatch = 1; in some years (e.g., in ’07 with 46 birds and ’04 with 39) almost every observer has nuthatch stories to tell, whereas in others, like this one, we wait in suspense during the compilation

-White-breasted Nuthatch = 282; continues the theme of strong recent results; each of the top-seven totals have taken place since '00

-Brown Creeper = 54; another record (previous = 47 in ‘02); from flocks in mature woodlands to individuals at isolated farm groves, this entertaining spiral-feeder was enjoyed by many

-Carolina Wren = 1; beginning with the year 2000, counts have gone as follows: 1-0-0-1-1-2-10-3-6-7-2-1; will the numbers bounce back up any time soon?

-Winter Wren = 1; truly an expected member of the annual list (11th year in a row) after going unrecorded on many CBCs in the 1970s and 1980s

-Eastern Bluebird = 24; often absent, but has been discovered more frequently on our 21st-century efforts

-American Robin = 12; bigger totals like last year’s (252) are often flanked by more limited outcomes, contributing to a roller-coaster effect (e.g., 505-51-13-165-17-104-17-44-51-3-217-12-252-12 from ‘98 onward)

-European Starling = 2,116; not far from the mean and median, like many results from the past decade

-Cedar Waxwing = 45; the numbers of this erratic, nomadic frugivore follow a fluctuating pattern that seems to mirror American Robin’s, at least on recent counts

-Lapland Longspur = 32; fifth CBC in a row (27 counted in ‘10); unlike last year, these small flocks were observed without either of their usual open-country associates (Horned Lark and Snow Bunting)

-Yellow-rumped Warbler = 6; first occurrence since ‘06; found along the conifer-rich habitats of the State Forest Nursery; there are likely some that elude detection in most years on (unsearched) private lands, particularly in areas with clumps of Eastern Red-cedar

-American Tree Sparrow = 593; very close to the rather large number (578) from '10

-Fox Sparrow = 2; not quite an expected species; noted on nearly half of our CBCs after 1990

-Song Sparrow = 4; one of the lowest totals ever, and the fewest recorded since ’98 (3)

-White-throated Sparrow = 7; falling short of both the mean and median, with no reports from feeders on count day

-Harris's Sparrow = 7; outnumbering the combined totals of the previous four outings, yet still scarce compared to the 1990s and early 2000s

-White-crowned Sparrow = 1; sixth count-day appearance, with four of those instances occurring from '99 to '04

-Dark-eyed Junco = 1,001; in line with the 900+ registered on each post-2005 CBC

-Northern Cardinal = 410; an all-time best, following closely after several other plentiful years (previous records were set consecutively in ’07 and ’08, with ’09 and ’10 totals not far behind)

-Red-winged Blackbird = 46; first flocks encountered since a very warm day five Decembers ago

-Rusty Blackbird = 1; no results of greater than one have happened after ‘06

-Purple Finch = 30; another songbird that continues to produce variable CBC totals (2000-2011: 7-2-0-39-20-7-3-4-38-7-2-30)

-House Finch = 242; third-highest; other sizable accumulations include 259 in ’05, 248 in ’08, 238 in ’04, 206 in ’02, and 179 in ‘98

-Pine Siskin = 2; almost went unnoticed this time after hitting triple digits (105) on the ’10 count

-American Goldfinch = 307; set a modern high mark (previous = 286 in ’09) by exceeding last year’s sparse report (121) by more than 2.5x

-House Sparrow = 1,022; back into more realistic quadruple digits after several counts that averaged well under a thousand; likely underrepresented as usual (but, of course, I really don't blame anyone for spending comparatively little time in classic HOSP habitat)

--Total species = 63 (plus a count week Snowy Owl that represented the first such occurrence on the Ames CBC since 2001 and the third overall in our count's history)
--Total individuals = 26,597

-->As always, I thank the many volunteers (36) who assisted with this endeavor, especially our field-group leaders: Jon Bahrenfus, Joyce Bahrenfus, Mary Doud, Dave Edwards, Jeannie Edwards, Bruce Ehresman, Mike Meetz, Jeff Nichols, Wolf Oesterreich, Mark Widrlechner, and Hank Zaletel. And to conclude the event, John Pohlman organized and hosted another excellent potluck dinner for our compilation.

Shane Patterson

Historical Results By Count

Printout Date: 11/15/2019

Count Name:	Ames	Count Code:	IAAM
Latitude/Longitude:	42.0076910000/-93.5711390000		

Weather

Year	Low Temp.	High Temp.	AM Clouds	PM Clouds	AM Rain	PM Rain	AM Snow	PM Snow
119	19.0 Fahrenheit	51.0 Fahrenheit	Clear	Clear	None	None	None	None

Effort

Year	Count Date	Num. Participants	Num. Hours	Num. Species Reported
119	12/15/2018	32	104.50	72

Sponsoring Organization

Year	Sponsoring Organization
119	Big Bluestem Audubon Society, Iowa Audubon

Checklist

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Greater White-fronted Goose [Anser albifrons]	Number:	28
	Num/Party Hrs.:	0.2679
	Flags:	HC,
Snow Goose [Chen caerulescens]	Number:	cw
	Num/Party Hrs.:	0.0000
	Flags:	
Ross's Goose [Chen rossii]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Cackling Goose [Branta hutchinsii]	Number:	151
	Num/Party Hrs.:	1.4450
	Flags:	
Canada Goose [Branta canadensis]	Number:	12135
	Num/Party Hrs.:	116.1244
	Flags:	HC,

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Trumpeter Swan [Cygnus buccinator]	Number:	69
	Num/Party Hrs.:	0.6603
	Flags:	HC,
Gadwall [Anas strepera]	Number:	2
	Num/Party Hrs.:	0.0191
	Flags:	
Mallard [Anas platyrhynchos]	Number:	784
	Num/Party Hrs.:	7.5024
	Flags:	
Lesser Scaup [Aythya affinis]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Common Goldeneye [Bucephala clangula]	Number:	2
	Num/Party Hrs.:	0.0191
	Flags:	
Ring-necked Pheasant [Phasianus colchicus]	Number:	110
	Num/Party Hrs.:	1.0526
	Flags:	
Gray Partridge [Perdix perdix]	Number:	3
	Num/Party Hrs.:	0.0287
	Flags:	
Wild Turkey [Meleagris gallopavo]	Number:	15
	Num/Party Hrs.:	0.1435
	Flags:	
Great Blue Heron (Blue form) [Ardea herodias [herodias Group]]	Number:	4
	Num/Party Hrs.:	0.0383
	Flags:	HC,
Northern Harrier [Circus cyaneus]	Number:	5
	Num/Party Hrs.:	0.0478
	Flags:	HC,
Sharp-shinned Hawk [Accipiter striatus]	Number:	3
	Num/Party Hrs.:	0.0287
	Flags:	

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Cooper's Hawk [Accipiter cooperii]	Number:	11
	Num/Party Hrs.:	0.1053
	Flags:	HC,
Accipiter sp. [Accipiter sp.]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Bald Eagle [Haliaeetus leucocephalus]	Number:	24
	Num/Party Hrs.:	0.2297
	Flags:	HC,
Red-tailed Hawk [Buteo jamaicensis]	Number:	99
	Num/Party Hrs.:	0.9474
	Flags:	
Rough-legged Hawk [Buteo lagopus]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Rock Pigeon (Feral Pigeon) [Columba livia (Feral Pigeon)]	Number:	388
	Num/Party Hrs.:	3.7129
	Flags:	
Eurasian Collared-Dove [Streptopelia decaocto]	Number:	13
	Num/Party Hrs.:	0.1244
	Flags:	
Mourning Dove [Zenaida macroura]	Number:	111
	Num/Party Hrs.:	1.0622
	Flags:	
Eastern Screech-Owl [Megascops asio]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Great Horned Owl [Bubo virginianus]	Number:	9
	Num/Party Hrs.:	0.0861
	Flags:	
Barred Owl [Strix varia]	Number:	14
	Num/Party Hrs.:	0.1340
	Flags:	HC,

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Long-eared Owl [Asio otus]	Number:	7
	Num/Party Hrs.:	0.0670
	Flags:	HC,
Belted Kingfisher [Megaceryle alcyon]	Number:	4
	Num/Party Hrs.:	0.0383
	Flags:	
Red-headed Woodpecker [Melanerpes erythrocephalus]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Red-bellied Woodpecker [Melanerpes carolinus]	Number:	148
	Num/Party Hrs.:	1.4163
	Flags:	
Yellow-bellied Sapsucker [Sphyrapicus varius]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Downy Woodpecker [Picoides pubescens]	Number:	185
	Num/Party Hrs.:	1.7703
	Flags:	
Hairy Woodpecker [Picoides villosus]	Number:	57
	Num/Party Hrs.:	0.5455
	Flags:	
Northern Flicker (Yellow-shafted) [Colaptes auratus auratus/luteus]	Number:	6
	Num/Party Hrs.:	0.0574
	Flags:	LC,
Pileated Woodpecker [Dryocopus pileatus]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
American Kestrel [Falco sparverius]	Number:	9
	Num/Party Hrs.:	0.0861
	Flags:	
Merlin [Falco columbarius]	Number:	2
	Num/Party Hrs.:	0.0191
	Flags:	

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Prairie Falcon [Falco mexicanus]	Number:	cw
	Num/Party Hrs.:	0.0000
	Flags:	US,
falcon sp. [Falco sp.]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Northern Shrike [Lanius excubitor]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Blue Jay [Cyanocitta cristata]	Number:	206
	Num/Party Hrs.:	1.9713
	Flags:	
American Crow [Corvus brachyrhynchos]	Number:	7100
	Num/Party Hrs.:	67.9426
	Flags:	
Horned Lark [Eremophila alpestris]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	LC,
Black-capped Chickadee [Poecile atricapillus]	Number:	278
	Num/Party Hrs.:	2.6603
	Flags:	
Red-breasted Nuthatch [Sitta canadensis]	Number:	19
	Num/Party Hrs.:	0.1818
	Flags:	
White-breasted Nuthatch [Sitta carolinensis]	Number:	197
	Num/Party Hrs.:	1.8852
	Flags:	
Brown Creeper [Certhia americana]	Number:	20
	Num/Party Hrs.:	0.1914
	Flags:	LC,
Winter Wren [Troglodytes hiemalis]	Number:	2
	Num/Party Hrs.:	0.0191
	Flags:	

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Carolina Wren [Thryothorus ludovicianus]	Number:	5
	Num/Party Hrs.:	0.0478
	Flags:	
Golden-crowned Kinglet [Regulus satrapa]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
Eastern Bluebird [Sialia sialis]	Number:	75
	Num/Party Hrs.:	0.7177
	Flags:	HC,
Hermit Thrush [Catharus guttatus]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
American Robin [Turdus migratorius]	Number:	23
	Num/Party Hrs.:	0.2201
	Flags:	
Gray Catbird [Dumetella carolinensis]	Number:	cw
	Num/Party Hrs.:	0.0000
	Flags:	US,
European Starling [Sturnus vulgaris]	Number:	3462
	Num/Party Hrs.:	33.1292
	Flags:	
Cedar Waxwing [Bombycilla cedrorum]	Number:	127
	Num/Party Hrs.:	1.2153
	Flags:	
Lapland Longspur [Calcarius lapponicus]	Number:	35
	Num/Party Hrs.:	0.3349
	Flags:	
American Tree Sparrow [Spizelloides arborea]	Number:	359
	Num/Party Hrs.:	3.4354
	Flags:	
Fox Sparrow [Passerella iliaca]	Number:	2
	Num/Party Hrs.:	0.0191
	Flags:	

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Dark-eyed Junco (Slate-colored) [Junco hyemalis hyemalis/carolinensis]	Number:	766
	Num/Party Hrs.:	7.3301
	Flags:	
White-crowned Sparrow [Zonotrichia leucophrys]	Number:	3
	Num/Party Hrs.:	0.0287
	Flags:	
Harris's Sparrow [Zonotrichia querula]	Number:	3
	Num/Party Hrs.:	0.0287
	Flags:	LC,
White-throated Sparrow [Zonotrichia albicollis]	Number:	117
	Num/Party Hrs.:	1.1196
	Flags:	HC,
Song Sparrow [Melospiza melodia]	Number:	42
	Num/Party Hrs.:	0.4019
	Flags:	
Swamp Sparrow [Melospiza georgiana]	Number:	5
	Num/Party Hrs.:	0.0478
	Flags:	
Northern Cardinal [Cardinalis cardinalis]	Number:	272
	Num/Party Hrs.:	2.6029
	Flags:	
Red-winged Blackbird [Agelaius phoeniceus]	Number:	319
	Num/Party Hrs.:	3.0526
	Flags:	HC,
Western Meadowlark [Sturnella neglecta]	Number:	4
	Num/Party Hrs.:	0.0383
	Flags:	
Western/Eastern Meadowlark [Sturnella neglecta/magna]	Number:	6
	Num/Party Hrs.:	0.0574
	Flags:	
Rusty Blackbird [Euphagus carolinus]	Number:	31
	Num/Party Hrs.:	0.2967
	Flags:	HC,

Species	Year	2018 [119] Count Date: 12/15/2018 # Participants: 32 # Species Reported: 72 Total Hrs.: 104.50
Common Grackle [Quiscalus quiscula]	Number:	6
	Num/Party Hrs.:	0.0574
	Flags:	
Brown-headed Cowbird [Molothrus ater]	Number:	1
	Num/Party Hrs.:	0.0096
	Flags:	
House Finch [Haemorhous mexicanus]	Number:	164
	Num/Party Hrs.:	1.5694
	Flags:	
Purple Finch [Haemorhous purpureus]	Number:	4
	Num/Party Hrs.:	0.0383
	Flags:	
Pine Siskin [Spinus pinus]	Number:	28
	Num/Party Hrs.:	0.2679
	Flags:	
American Goldfinch [Spinus tristis]	Number:	129
	Num/Party Hrs.:	1.2344
	Flags:	
House Sparrow [Passer domesticus]	Number:	779
	Num/Party Hrs.:	7.4545
	Flags:	

Compiler(s)

Year	First Name	Last Name	Email	Is Primary Compiler
119	Shane	Patterson	shanepatterson@alumni.iastate.edu	Yes

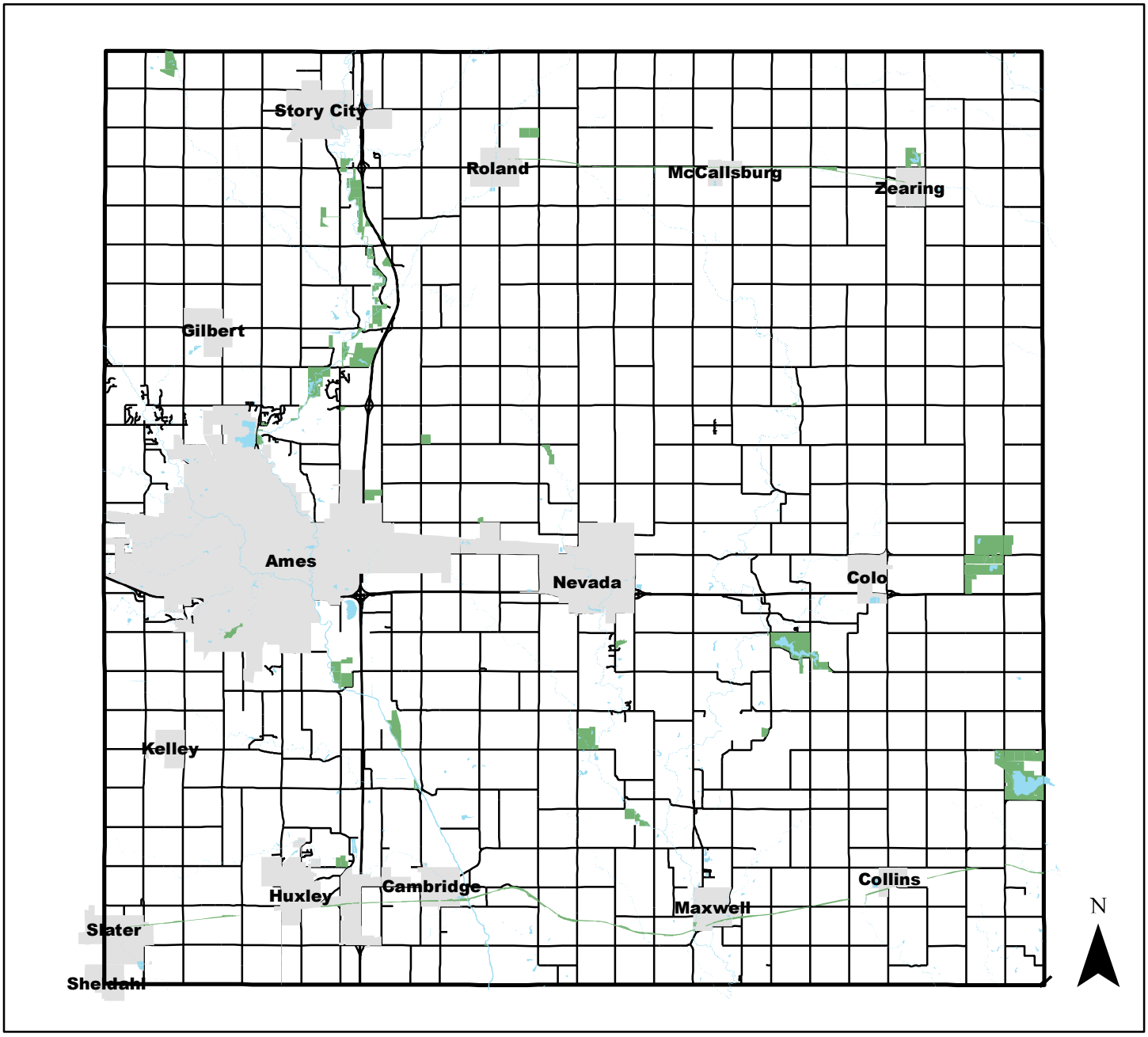
Participants(s)

Year	First Name	Last Name
119	Jon	Bahrenfus
119	Joyce	Bahrenfus
119	Dean	Check
119	Stan	Crull
119	Larry	Dau
119	Stephen	Dinsmore

119	Paul	Domoto
119	Mary	Doud
119	Dave	Edwards
119	Jeanne	Edwards
119	Bruce	Ehresman
119	Karl	Grotheer
119	Tim	Grotheer
119	Doug	Harr
119	Al	Johnson
119	Erv	Klaas
119	Steve	Lekwa
119	Judy	Levings
119	Randall	Levings
119	Grace	Meetz
119	Linda	Meetz
119	Michael	Meetz
119	Floramay	Miller
119	Jeff	Nichols
119	Wolf	Oesterreich
119	Eric	Ollie
119	Shane	Patterson
119	Pat	Schlarbaum
119	Tim	Stewart
119	Matt	Wetrich
119	Stephen	Willson
119	Hank	Zaletel

Appendix E: Story County Publicly Owned and Managed Lands

Story County Publicly Owned and Managed Lands



Legend

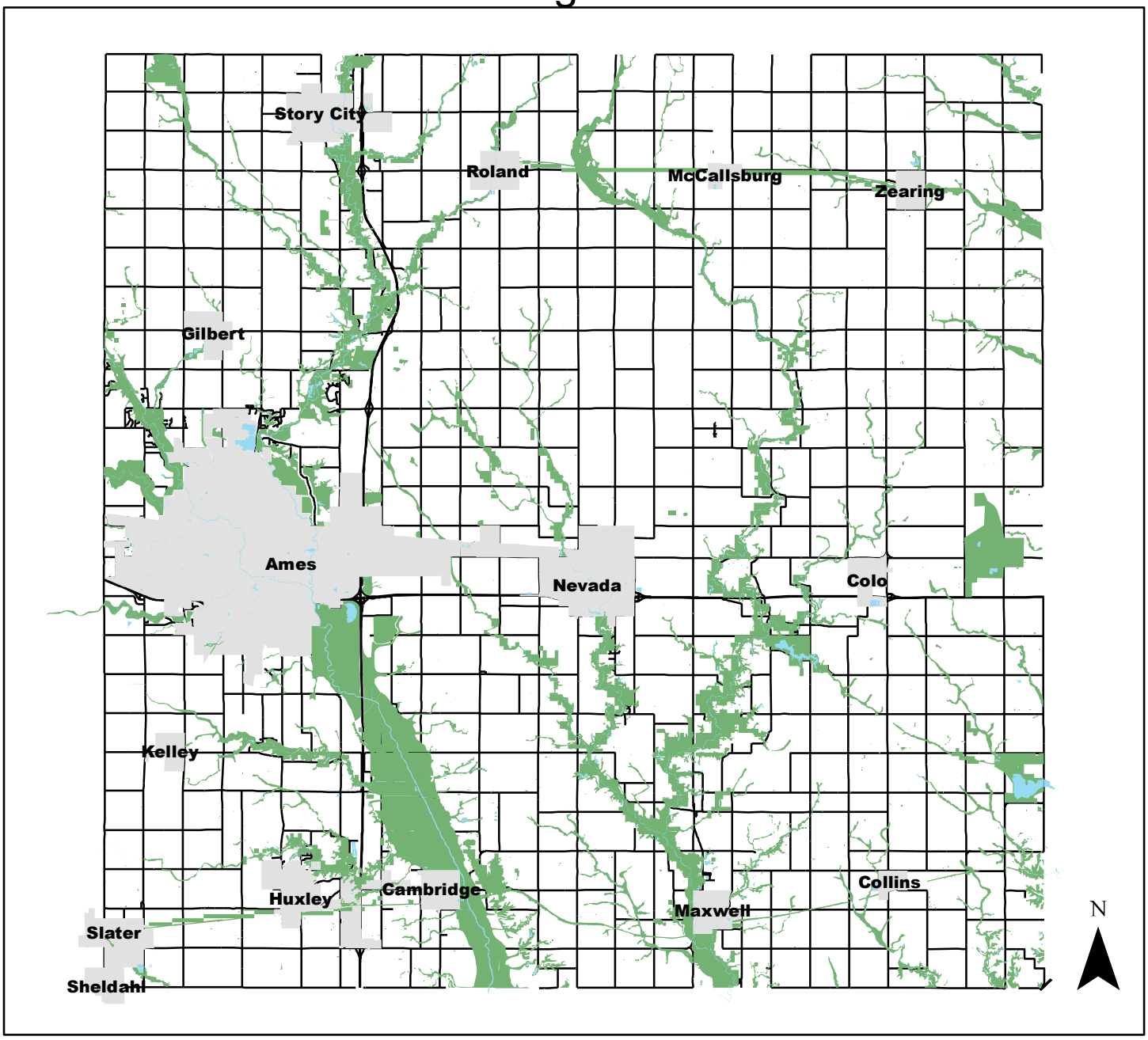
- Publicly Owned and Managed Lands
- Hydrography
- Story County Boundary
- City Limits
- Roads

Map created on 11/20/2019
by the Story County
Planning and Development Department.

DISCLAIMER:
Story County's digital cadastral data is a representation of recorded plats and surveys for use within the Geograpical Information System for the purpose of data access and analysis. These and other digital data do not replace or modify land surveys, deeds, and/or other legal instruments defining land ownership or use.

Appendix F: Areas Designated as Natural Resource Areas in the Ames Urban Fringe and C2C Plans

Areas Designated as Natural Resource Areas in the Ames Urban Fringe and C2C Plans



Legend

- Hydrography
- City Limits
- Roads
- Natural Areas

Map created on 11/19/2019
by the Story County
Planning and Development Department.

DISCLAIMER:
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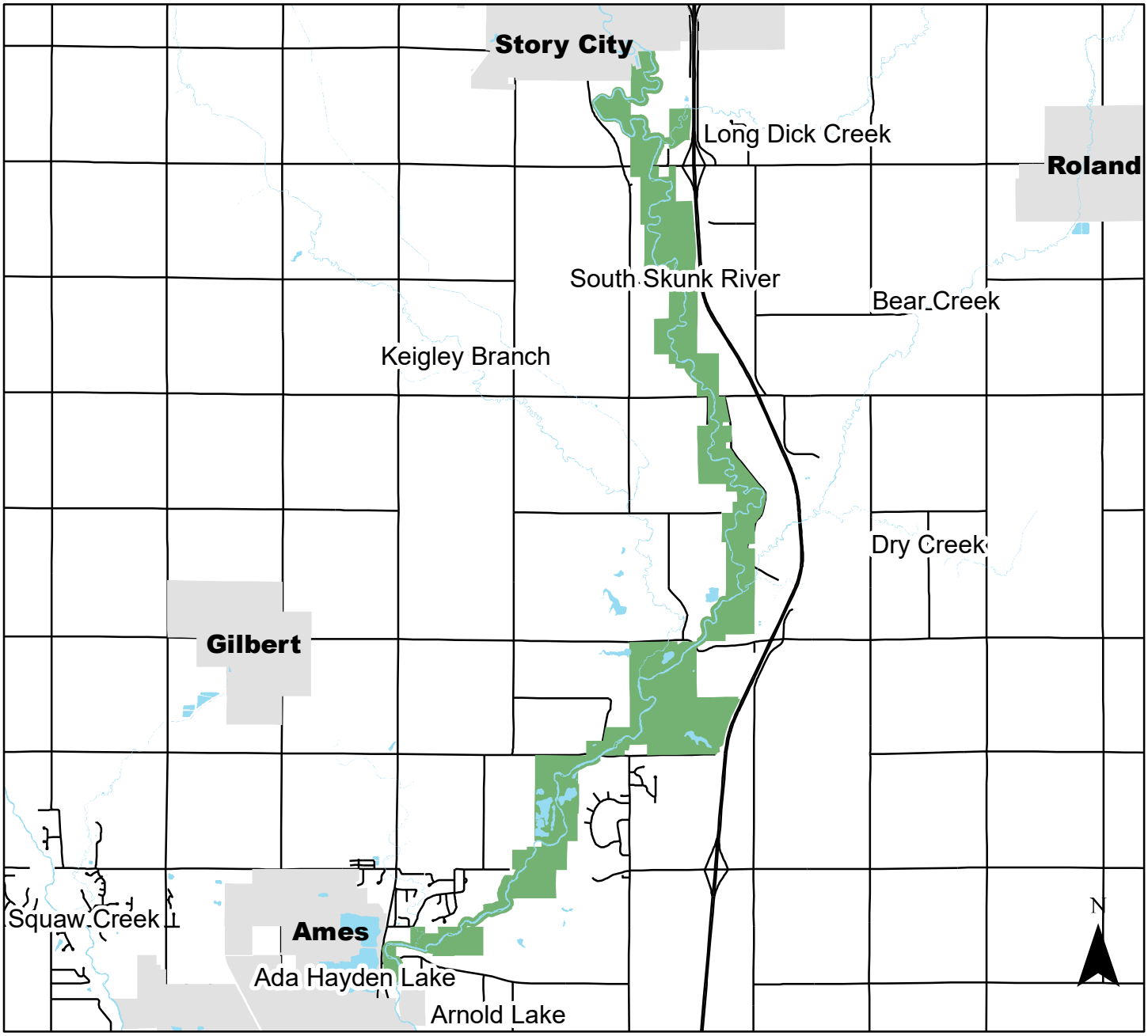
Appendix G: Greenbelt Conservation Zoning District

Greenbelt Conservation Zoning Distrct



Legend

- Hydrography
- Greenbelt Conservation District
- City Limits
- Roads

Map created on 11/19/2019
by the Story County
Planning and Development Department.

DISCLAIMER:
Story County's digital cadastral data is a representation of recorded plats and surveys for use within the Geograpical Information System for the purpose of data access and analysis. These and other digital data do not replace or modify land surveys, deeds, and/or other legal instruments defining land ownership or use.

Appendix H: Bird List for Story County, Iowa (2019)

Bird List for Story County, Iowa (2019) 327 species
* = confirmed or likely breeder in county (some historical records) = **146**
31 Iowa Wildlife Action Plan Migratory Species of Greatest Conservation Need
75 Iowa Wildlife Action Plan Nesting Species of Greatest Conservation Need

___Snow Goose
___Ross's Goose
___Greater White-fronted Goose
___Cackling Goose
___Canada Goose*
___Mute Swan
___**Trumpeter Swan**
___Tundra Swan
___Wood Duck*
___**Blue-winged Teal***
___Cinnamon Teal
___Northern Shoveler*
___Gadwall*
___**American Wigeon**
___Mallard*
___American Black Duck
___**Northern Pintail***
___Green-winged Teal*
___**Canvasback**
___**Redhead***
___**Ring-necked Duck***
___**Greater Scaup**
___**Lesser Scaup***
___Surf Scoter
___White-winged Scoter
___Black Scoter
___Long-tailed Duck
___Bufflehead
___Common Goldeneye
___Hooded Merganser*
___Common Merganser
___Red-breasted Merganser
___Ruddy Duck*

___**Northern Bobwhite***
___Gray Partridge*
___Ring-necked Pheasant*
___**Greater Prairie-Chicken*** **(Historical)**
___Wild Turkey*

___Pied-billed Grebe*
___Horned Grebe
___**Red-necked Grebe**
___**Eared Grebe**
___Western Grebe
___Clark's Grebe

___Rock Pigeon*
___Eurasian Collared-Dove*
___White-winged Dove
___Mourning Dove*

___**Yellow-billed Cuckoo***
___**Black-billed Cuckoo***

___**Common Nighthawk***
___**Chuck-will's Widow**
___**Eastern Whip-poor-will**
___**Chimney Swift***
___Ruby-throated Hummingbird*
___Rufous Hummingbird

___**Yellow Rail**
___**Black Rail**
___**King Rail***
___Virginia Rail*
___Sora*
___Purple Gallinule
___**Common Gallinule***
___American Coot*
___Sandhill Crane*
___Black-necked Stilt
___American Avocet
___**Black-bellied Plover**
___**American Golden Plover**
___Semipalmated Plover
___**Piping Plover**
___Killdeer*
___**Upland Sandpiper***
___**Whimbrel**
___**Hudsonian Godwit**
___**Marbled Godwit**
___**Ruddy Turnstone**
___**Red Knot**
___Ruff
___**Stilt Sandpiper**
___**Sanderling**
___Dunlin
___Baird's Sandpiper
___Least Sandpiper
___**White-rumped Sandpiper**
___**Buff-breasted Sandpiper**
___**Pectoral Sandpiper**
___**Semipalmated Sandpiper**
___Western Sandpiper
___**Short-billed Dowitcher**
___**Long-billed Dowitcher**
___**American Woodcock***
___**Wilson's Snipe***
___Spotted Sandpiper*
___Solitary Sandpiper
___**Lesser Yellowlegs**
___Willet
___Greater Yellowlegs
___**Wilson's Phalarope**
___Red-necked Phalarope

___Bonaparte's Gull
___**Franklin's Gull**
___Ring-billed Gull
___Herring Gull
___Glaucous Gull
___**Least Tern**
___**Caspian Tern**
___**Black Tern***
___Common Tern

___**Forster's Tern***

___Red-throated Loon
___Pacific Loon
___**Common Loon**
___Yellow-billed Loon

___Double-crested Cormorant
___**American White Pelican**

___**American Bittern***
___Least Bittern*
___Great Blue Heron*
___Great Egret
___Snowy Egret
___**Little Blue Heron**
___Cattle Egret
___Green Heron*
___**Black-crowned Night-Heron***
___Yellow-crowned Night-Heron

___**White-faced Ibis**

___Turkey Vulture*
___Black Vulture
___Osprey
___Golden Eagle
___**Northern Harrier***
___Sharp-shinned Hawk
___Cooper's Hawk*
___Northern Goshawk
___**Bald Eagle***
___Mississippi Kite
___**Red-shouldered Hawk***
___**Broad-winged Hawk***
___**Swainson's Hawk***
___Red-tailed Hawk*
___Rough-legged Hawk
___Ferruginous Hawk

___**Barn Owl***
___**Eastern Screech-Owl***
___Great Horned Owl*
___Snowy Owl
___**Burrowing Owl**
___Barred Owl*
___**Long-eared Owl***
___**Short-eared Owl**
___Northern Saw-Whet Owl

___**Belted Kingfisher***

___**Red-headed Woodpecker***
___Acorn Woodpecker (2005) SP
___Red-bellied Woodpecker*
___Yellow-bellied Sapsucker
___Downy Woodpecker*
___Hairy Woodpecker*
___**Northern Flicker***
___Pileated Woodpecker*

___**American Kestrel***
___Merlin
___**Peregrine Falcon**
___Prairie Falcon

___Great Crested Flycatcher*
___Western Kingbird
___**Eastern Kingbird***
___Scissor-tailed Flycatcher*
___**Olive-sided Flycatcher**
___**Eastern Wood-Pewee***
___Yellow-bellied Flycatcher
___**Acadian Flycatcher***
___Alder Flycatcher*
___Willow Flycatcher*
___Least Flycatcher
___Eastern Phoebe*
___**Say's Phoebe**

___**Loggerhead Shrike***
___Northern Shrike

___White-eyed vireo**
___**Bell's vireo***
___Yellow-throated Vireo*
___Blue-headed Vireo
___Philadelphia Vireo
___Warbling Vireo*
___Red-eyed Vireo*

___Blue Jay*
___Black-billed Magpie
___American Crow*
___Common Raven
___**Horned Lark***
___**Bank Swallow***
___Tree Swallow*
___Northern Rough-winged Swallow*
___**Purple Martin***
___Barn Swallow*
___Cliff Swallow*

___Black-capped Chickadee*
___Tufted Titmouse*
___Red-breasted Nuthatch*
___White-breasted Nuthatch*
___Brown Creeper*
___House Wren*
___Winter Wren
___Pacific Wren (2003) SP
___**Sedge Wren***
___Marsh Wren*
___Carolina Wren*
___Blue-gray Gnatcatcher*

___Golden-crowned Kinglet
___Ruby-crowned Kinglet

___Eastern Bluebird*
___Mountain Bluebird
___Townsend's Solitaire
___**Veery***

___Gray-cheeked Thrush
___Swainson's Thrush
___Hermit Thrush
___**Wood Thrush***
___American Robin*
___Varied Thrush

___Gray Catbird*
___**Brown Thrasher***
___Northern Mockingbird*
___European Starling*

___**Bohemian Waxwing**
___Cedar Waxwing*
___House Sparrow*
___Eurasian Tree Sparrow

___American Pipit

___Evening Grosbeak
___Pine Grosbeak
___House Finch*
___Purple Finch
___Common Redpoll
___Hoary Redpoll
___Red Crossbill
___**White-winged Crossbill**
___Pine Siskin*
___American Goldfinch*

___Lapland Longspur
___Chestnut-collared Longspur
___**Smith's Longspur**
___Snow Bunting

___**Grasshopper Sparrow***
___Lark Sparrow*
___Chipping Sparrow*
___Clay-colored Sparrow
___**Field Sparrow***
___Fox Sparrow
___**American Tree Sparrow**
___Dark-eyed Junco
___White-crowned Sparrow
___**Harris's Sparrow**
___White-throated Sparrow
___Vesper Sparrow*
___**Le Conte's Sparrow**
___Nelson's Sparrow
___**Henslow's Sparrow***
___Savannah Sparrow*
___Song Sparrow*
___Lincoln's Sparrow
___Swamp Sparrow*
___Spotted Towhee
___Eastern Towhee*

___Yellow-breasted Chat

___Yellow-headed Blackbird*
___**Bobolink***
___**Eastern Meadowlark***
___**Western Meadowlark***
___Orchard Oriole*
___Bullock's Oriole
___**Baltimore Oriole***
___Red-winged Blackbird*
___Brown-headed Cowbird*
___Rusty Blackbird
___Brewer's Blackbird
___Common Grackle*
___Great-tailed Grackle*

___Ovenbird*
___**Worm-eating Warbler**
___Louisiana Waterthrush*
___Northern Waterthrush
___**Golden-winged Warbler**
___Blue-winged Warbler
___Black-and-white Warbler
___**Prothonotary Warbler***
___Tennessee Warbler
___Orange-crowned Warbler
___Nashville Warbler
___Connecticut Warbler
___Mourning Warbler
___**Kentucky Warbler***
___**Common Yellowthroat***
___Hooded Warbler
___American Redstart*
___Cape May Warbler
___**Cerulean Warbler**
___Northern Parula*
___Magnolia Warbler
___**Bay-breasted Warbler**
___Blackburnian Warbler
___Yellow Warbler*
___Chestnut-sided Warbler
___Blackpoll Warbler
___Black-throated Blue Warbler
___Palm Warbler
___Pine Warbler
___Yellow-rumped Warbler
___Yellow-throated Warbler*
___Prairie Warbler
___Black-throated Green Warbler
___**Canada Warbler**
___Wilson's Warbler

___Summer Tanager*
___Scarlet Tanager*
___Western Tanager
___Northern Cardinal*
___Rose-breasted Grosbeak*
___Black-headed Grosbeak
___Blue Grosbeak
___Lazuli Bunting
___Indigo Bunting*
___Painted Bunting
___**Dickcissel***

Records from Iowa Breeding Bird Atlas, *The Birds of Story county, Iowa,* Ames Christmas Bird Count, and bird surveys conducted on public land.

Appendix I: GCN Bird List for Story County, Iowa (2019)

GCN Bird List for Story County, Iowa (2019)
106 species total out of 112 SGCN possible
* = confirmed or likely breeder in county (some historical records)
31 Iowa Wildlife Action Plan Migratory Species of Greatest Conservation Need
75 Iowa Wildlife Action Plan Nesting Species of Greatest Conservation Need

___Trumpeter Swan
___Blue-winged Teal*
___American Wigeon
___Northern Pintail*
___Canvasback
___Redhead*
___Ring-necked Duck*
___Greater Scaup
___Lesser Scaup*

___Northern Bobwhite*
___Greater Prairie-Chicken* (Historical)

___Red-necked Grebe
___Eared Grebe

___Yellow-billed Cuckoo*
___Black-billed Cuckoo*

___Common Nighthawk*
___Chuck-will's Widow
___Eastern Whip-poor-will
___Chimney Swift*

___Yellow Rail
___Black Rail
___King Rail*
___Common Gallinule*
___Black-bellied Plover
___American Golden Plover
___Piping Plover
___Upland Sandpiper*
___Whimbrel
___Hudsonian Godwit
___Marbled Godwit
___Ruddy Turnstone
___Red Knot
___Stilt Sandpiper
___Sanderling
___White-rumped Sandpiper
___Buff-breasted Sandpiper
___Pectoral Sandpiper
___Semipalmated Sandpiper
___Short-billed Dowitcher
___Long-billed Dowitcher
___American Woodcock*
___Wilson's Snipe*
___Lesser Yellowlegs
___Wilson's Phalarope

___Franklin's Gull
___Least Tern
___Caspian Tern
___Black Tern*
___Forster's Tern*

___Common Loon

___American White Pelican

___American Bittern*
___Little Blue Heron
___Black-crowned Night-Heron*

___White-faced Ibis

___Northern Harrier*
___Bald Eagle*
___Red-shouldered Hawk*
___Broad-winged Hawk*
___Swainson's Hawk*

___Barn Owl*
___Eastern Screech-Owl*
___Burrowing Owl
___Long-eared Owl*
___Short-eared Owl

___Belted Kingfisher*

___Red-headed Woodpecker*
___Northern Flicker*

___American Kestrel*
___Peregrine Falcon

___Eastern Kingbird*
___Olive-sided Flycatcher
___Eastern Wood-Pewee*
___Acadian Flycatcher*
___Say's Phoebe

___Loggerhead Shrike*

___Bell's vireo*

___Horned Lark*
___Bank Swallow*
___Purple Martin*

___Sedge Wren*

___Veery*
___Wood Thrush*

___Brown Thrasher*

___Bohemian Waxwing
___White-winged Crossbill
___Smith's Longspur

___Grasshopper Sparrow*
___Field Sparrow*
___American Tree Sparrow
___Harris's Sparrow

___Le Conte’s Sparrow
___Henslow’s Sparrow*

___Bobolink*
___Eastern Meadowlark*
___Western Meadowlark*
___Baltimore Oriole*

___Worm-eating Warbler
___Golden-winged Warbler
___Prothonotary Warbler*
___Kentucky Warbler*
___Common Yellowthroat*
___Cerulean Warbler
___Bay-breasted Warbler
___Canada Warbler

___Dickcissel*

Appendix J: National Invasive Species Awareness Week Post

Story County Conservation
February 26 ·

A new invasive species discovery was made in Iowa last fall: Mile-A-Minute Weed. Until then, this species had only been present in the mid-Atlantic states and Oregon. A landowner in Marion County contacted ISU Extension and Outreach for help in identifying a plant he had been battling for three years. Since this is the only known population in Iowa, the seeds likely came in with nursery plants that were grown in a state that already had this species. What to look for: Triangle shaped leaves and small spikes on the vine. #NationalInvasiveSpeciesAwarenessWeek

Story County Conservation
Government Organization

Send Message

2,187	300	Boost Post
People Reached	Engagements	

17 3 Comments 12 Shares

Performance for Your Post

2,187 People Reached

43 Reactions, Comments & Shares

8 Like	7 On Post	1 On Shares
1 Haha	0 On Post	1 On Shares
2 Wow	1 On Post	1 On Shares
10 Sad	9 On Post	1 On Shares
10 Comments	8 On Post	2 On Shares
12 Shares	12 On Post	0 On Shares

257 Post Clicks

84 Photo Views	0 Link Clicks	173 Other Clicks

NEGATIVE FEEDBACK

0 Hide Post	0 Hide All Posts
0 Report as Spam	0 Unlike Page

Reported stats may be delayed from what appears on posts

Appendix K: Weed Wrangle Volunteer Event

Event Description:

Help us wrangle the garlic mustard!!

Garlic mustard is a rapidly spreading invasive species in Iowa's woodlands. Introduced from Europe in the mid-1800s, this plant forms dense blankets on the forest floor which crowds out native vegetation like wildflowers, tree seedlings, etc.

The good news is that the control method is pretty simple - just pull it! We need lots of hands to wrangle these weeds at East Peterson Park. After a quick orientation we'll spread out and work for about an hour, meeting back at the parking lot for light refreshments.

Volunteers should wear long pants, long sleeves, and sturdy, closed-toe shoes. Bring a pair of work gloves if you have them and a full water bottle (we will have a water jug for refills). This volunteer event is intended for adults but children can attend if accompanied by a guardian.

Event Date/Time: Thu, May 16, 2019 - 5:30 PM to 7:00 PM

Volunteers Needed: Registration Closed

Event Meeting Location: East Peterson Park 55756 180th Street Ames, IA 50010

Event Organizer: Erica Place
eplace@storycountyiowa.gov
515-598-4761

Event Category: Invasive Species

Appendix L: IRVM Roadside Mowing Press Release

FOR IMMEDIATE RELEASE: (6/14/2019)

For more information contact:

Name: Joseph Kooiker
Title: Vegetation Management Biologist
Office: 837 N. Avenue Nevada, IA
Email: Jkooiker@storycountyiowa.gov
Phone number: 515-382-7367

Iowa mowing law designed to protect roadside habitats

Story County Conservation reminds Iowans to protect roadside habitat for nesting game birds and song birds this spring and early summer.

According to Iowa Code 314.17, mowing roadside ditches is restricted until July 15, to protect young pheasants and other ground-nesting birds until they are ready to fledge. The law, which applies to county secondary roads as well as state primary and interstate highways, also protects habitat for pollinators and other beneficial insects, including crop-pest predators.

Exceptions for visibility and weed control are built into the law, but non-essential mowing – including cutting for hay – is prohibited.

Iowa Code 314.17 states: Mowing roadside vegetation on the rights-of-way or medians on any primary highway, interstate highway, or secondary road prior to July 15 is prohibited, except as follows:

-Within 200 yards of an inhabited dwelling
-On right-of-way within one mile of the corporate limits of a city
-To promote native species of vegetation or other long-lived and adaptable vegetation
-To establish control of damaging insect populations, noxious weeds and invasive plant species
-For visibility and safety reasons
-Within rest areas, weigh stations and wayside parks
-Within 50 feet of a drainage tile or tile intake
-For access to mailbox or for other accessibility purposes
-On right-of-way adjacent agricultural demonstration or research plots

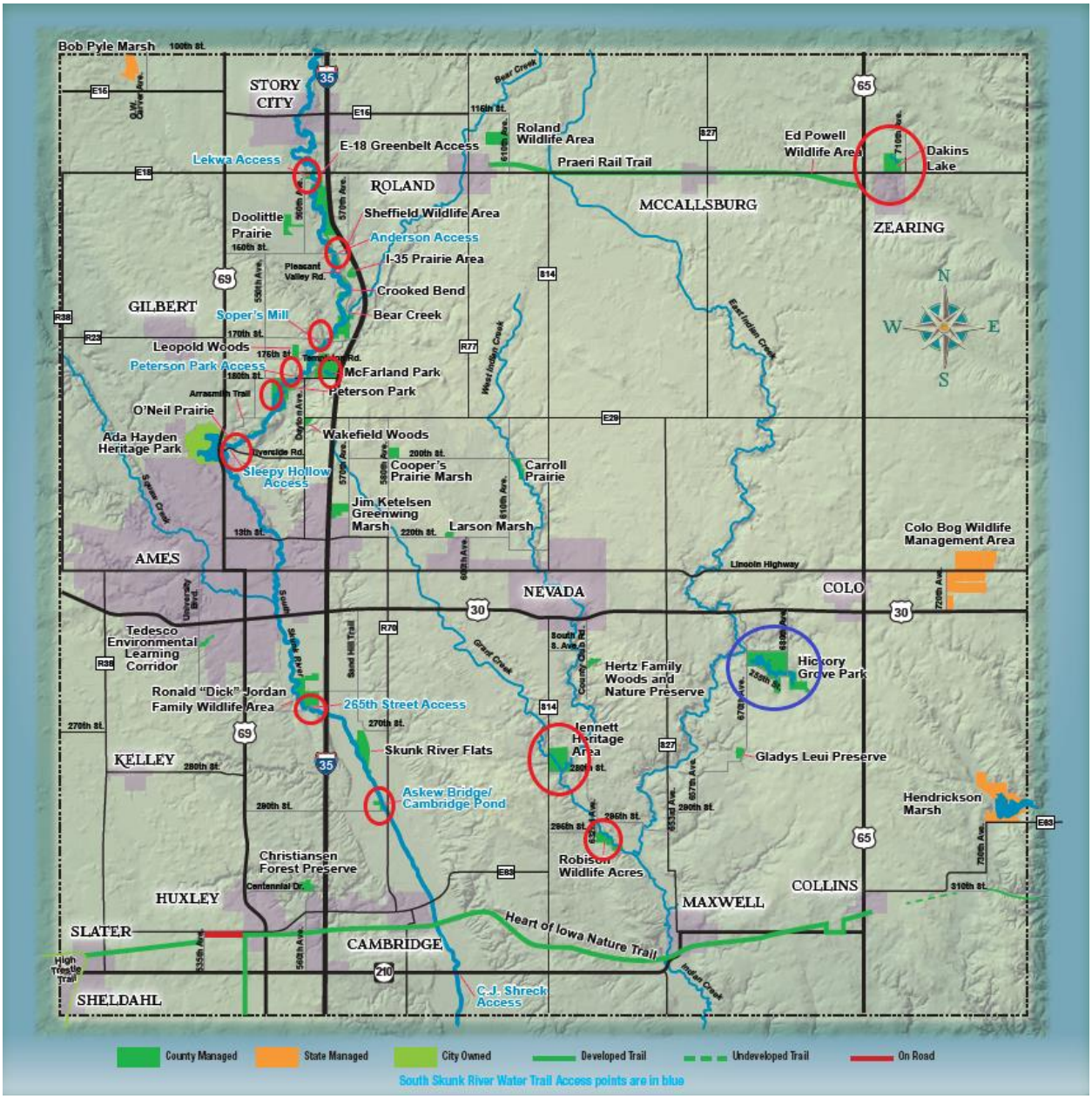
Iowa's roadsides provide a valuable refuge for wildlife. The mowing law serves as a reminder to only mow shoulders during the critical nesting season and leave the rest of the roadside for the birds. For more information, see a brochure called Iowa's Mowing Law for Roadsides, available at: www.tallgrassprairiecenter.org/irvm-brochures.

- END -

Appendix M: Fishing Line Recycling Receptacle


SED FISHING
LINE
de pesca usada
WARNING
BOTTLES OR TRASH
Story County Conservation
and
Ames Anglers

Appendix N: Map of Existing Receptacles



Blue line indicates future location following the completion of a lake restoration