2023 Ecological Activities Report



Round-headed bush clover in late summer, growing amongst little bluestem, in unit DP-1.

Pine Bend Bluffs Property

Prepared for:

Flint Hills Resources

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Winter 2024

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PROJECT SUMMARY

This report describes the ecological activities completed by Friends of the Mississippi River and Great River Greening at the Flint Hills Resources Pine Bend Bluffs natural area in 2023. This restoration work has been on-going for 24 years and there is a lot to show for it. Nearly 200 acres of forest, prairie and savanna have been restored, and the associated wildlife have rebounded, including an endangered bumblebee and 14 species of greatest conservation need (SGCN). The long-term goal is to restore all the accessible, non-aquatic areas of the FHR bluffland, about 400 acres.

A summary of the 2023 ecological tasks is shown below.

Acres	Habitat	Activity
42	Oak forest	Follow-up invasive woody & forb control
46	Oak savanna	Management (spot spray invasive forbs, cut/treat woody, Rx burn)
10	Native sand-gravel prairie	Management (spot mow, spot spray)

98 Total Acres Managed in 2023

Volunteer events: FHR employee participation in 2023 included 38 participants in the spring kick-off, and 39 volunteers at 6 field events. In addition, 93 community and employee volunteers attended the fall community event. There was a total of 170 volunteers for the year, representing over 510 hours.



Figure 1. Map of Flint Hills Resources Pine Bend Bluffs Ecological Work 2023

FOREST RESTORATION - ON-GOING ENHANCEMENT, 28 AC

Unit DD2a, 4 acres

Management of this unit began in 2019 with removal of a very dense shrub layer of mature buckthorn. The unit was later seeded with seven native grass species and in 2021 the ground layer was dominated by dense grasses, especially wild rye. The tree canopy is still dominated by boxelder, with some black cherry, and green ash. Eventually, it could be converted to oak savanna by removing the boxelder and planting bur oak and hazelnut shrubs, among other species.

In 2023, small populations of garlic mustard were spot-sprayed in April. Consistent spotspraying in combination with dense native grass cover helps keep garlic mustard populations low.

Unit DD1e, 3 acres

This unit was the site of the 2019 fall community volunteer event and was later seeded with native grasses. In the 2022 evaluation, small buckthorn and honeysuckle were noted. In 2023, the unit was forestry mowed in late June and early July to reduce buckthorn and honeysuckle regrowth. Areas that were inaccessible with equipment were cut using brush saws. Follow-up foliar herbicide could be considered for resprouts in 2024, as well as spot-seeding areas with limited native grass cover.



Figure 2. Image of Unit DD1e in late summer after forestry mowing. Some bare patches of soil are present, but grass cover in the background is a sign of successful seeding.

Unit DD1f, 2 acres

Buckthorn, Siberian elm saplings, honeysuckle were treated in this unit 2023. Some areas were cut and stump treated in January. The majority of the acreage was managed in November. Woody material was stacked in burn piles located away from trees on the top of the slope to give space away from the pipeline running through adjacent unit G-2. Buckthorn was thick, and most areas do not have sufficient groundcover. Piles will be burned in 2024. A foliar herbicide treatment should be considered for resprouts in 2024, with follow-up seeding to establish cover and prevent erosion.



This unit has potential to transition to savanna habitat over time. The canopy is largely green ash, Siberian elm, quaking aspen growing amongst open-grown oak trees. With continued management and reestablishment of prescribed fire, this unit could extend the savanna habitat established in DD-1a, DD1-g, and DD-1e.

Figure 3. Image of Unit DD1f in fall after cutting and piling Buckthorn.

Unit DD1g, 2.5 acres

This unit was the location of the 2021 volunteer brush removal work, followed by seeding. In 2022 the unit was mowed in June and August to reduce the buckthorn regrowth. Hazelnut seeds were planted to try to improve the native shrub cover. In 2023, the unit was mowed again in late June / early July to reduce buckthorn and honeysuckle regrowth. Additional spot-seeding could be planned for 2024 to increase native plant cover in the understory.

Unit DD4, 2.5 acres

Garlic mustard was spot-sprayed in this unit in April, when most other plants are still dormant.

Unit OF2, 23 acres, split into east (15 acres) and west (8 acres)

Work in this unit in 2023 was confined to follow-up work on 15 acres in the east side of the unit. Areas with carpets of garlic mustard were spot-sprayed for the 2nd year in a row in April. In 2022, buckthorn regrowth was abundant in much of the unit with some shrubs tall and ready to be cut or basal-bark treated. A subset of 2 acres were treated in the fall. In 2023, large buckthorn, honeysuckle, and Siberian elm plants (greater than 6' tall) were cut and stump treated with herbicide in April. In June, accessible areas were forestry mowed to reduce abundance of small buckthorn and honeysuckle. Additional woody control will be needed annually to address the regrowth in the east side and manage larger material in the west side.



Figure 4. Image of Unit OF2 after forestry mowing was completed. The green area on the left side of the image illustrates what this area looked like before being forestry mowed.

Unit SS, 8 acres

This was the location of the fall volunteer brush haul event in 2022 and 2023. A follow-up foliar application of herbicide to small buckthorn and honeysuckle plants in the footprint of the 2022 brush haul was completed in October, prior to the 2023 event (Approximately 2.5 acres). For the 2023 event, buckthorn, honeysuckle, and black locust on about 3 acres were cut and stump treated. Volunteers hauled some material off the unit and created large stacks that were later removed by FHR contractors. Volunteers also piled material within the unit that will be burned in 2024. Native woodland seed was broadcast in the 2022 woody removal area.



Figure 5 (left). Image of large cottonwood trees on border of Unit SS and wetland. The area to the right of the cottonwood trees was cleared in the 2022 community brush haul. The area to the left of the trees is mature buckthorn that was cut and stump treated by Great River Greening prior to the 2023 community brush haul. Figure 6 (right). Image of volunteers at the 2023 community brush haul event hauling buckthorn next to the same cottonwoods, illustrating the openness of habitat after buckthorn was removed.

PRAIRIE/SAVANNA RESTORATION, 35 AC

PRAIRIE/SAVANNA RECONSTRUCTION

Unit DD1a, 4 ac

Prior to 2017, this unit was a densely wooded area, almost entirely composed of non-native invasive shrubs (mature common buckthorn) and trees (large Siberian elm). It was clearcut in early 2017 then forestry mowed, followed by spraying weeds and seeding in fall 2018. The unit was burned in 2021 and invasive weeds were spot-treated in 2022. Invasive weed management continued in 2023. It was isolated to spot-treating small pockets (less than 20 square feet) of invasive plants including non-native thistles, birdsfoot trefoil, spotted knapweed, wild parsnip, sweet clover, St. John's wort, buckthorn and honeysuckle. Seed reduction strategies, including weed whipping before seed formation, were targeted. Continued annual maintenance is recommended to keep populations of invasive weeds low and protect the quality of restoration.

Vegetation surveys over the years since seeding have recorded 32 of the 44 species that were seeded (72%). This number continues to rise as the savanna ages. In any restoration, it is expected that some species will not establish for a variety of reasons. However, the seed mix included a large number of species so that even if some didn't establish, there would still be a good variety. In addition to the seeded species, several other native species have established,

so the total number of native flowers and grasses is 43, which is considered a good assemblage. The landscape change to this area from before and after restoration is dramatic.

However, many of the species that did not establish are those that bloom earlier in the season. It is important to have good floral resources throughout the entire growing season, to support pollinators and other wildlife. Some prairie plants are very slow to establish and it is very likely that additional species will appear over time. However, they are not likely to be present in large numbers. Therefore, to increase the early-season species, it would be good to do supplemental seeding or planting. This may require creating planting patches, by spraying areas that have a lot of weeds to provide a planting bed. Some early species to add would be lupine, columbine, penstemon and onion. Common milkweed could also be increased and anise hyssop should also be added.

Canada goldenrod had become overly abundant in some areas and was mowed in past years in mid-August when flowering started. This was an effective tool at reducing it and allowing other species to co-exist more equitably. The plan was to re-mow it again in 2023 to further reduce the population, but a beneficial insect stepped in to help out. This insect is a species of leaf beetle, and it voraciously eats the leaves of goldenrod plants. It was observed in this area in past years, but in 2023 the population grew enough to make a large impact on Canada goldenrod, reducing the cover and allowing the re-allocation of funds originally slated for mowing. This is a good sign that this unit is supporting habitat for beneficial insects.

PRAIRIE RECONSTRUCTION

Unit G1a, 4 ac

This unit began as grassland that was primarily smooth brome, with an abundance of honeysuckle and small Siberian elm trees. Unit G1a was restored to prepped and seeded to native prairie in fall 2015. It was first burned in 2018.

Native plant diversity started out very good for a few years, but invasive grasses (switchgrass and reed canary grass) became too abundant, especially in the dredge spoils mound. The grasses have been mowed, grazed, and sprayed to reduce their cover. The grasses were sprayed again in May 2022 and mowed in August. The area was monitored in 2023 to assess the efficacy of treatments in 2022. It continues to be a monoculture of invasive grasses. Prescribed fire to clear out the duff layer, followed by herbicide treatment and re-seeding, could be considered for 2024.

Unit G1b, 3 ac

Like G1a, Unit G1b started out as a brome dominated grassland with invasive woody plants. It was prepped in 2017 and seeded in fall 2018, along with DD1a with a similar seed mix. Both units have since been managed annually by spot-spraying or mowing invasive weeds. They were also burned at the same time in 2021, followed by overseeding the goldenrod dominated area.

Unit G1b has established better than DD1a, with a greater abundance of native species (90% or more). Thirty of the 37 seeded species have been detected so far (77%), and the cover of invasive species is low. Compass plant and rattlesnake master, which are both fairly conservative species, were found in small numbers. Compass plant is especially desirable because its tall stalks provide good perches for birds.

Some of the dense goldenrod stands were mowed in 2021 to help reduce it and black locust saplings were also cut. Invasive weed control (knapweed, Queen Anne's lace, thistles) was performed in 2022 and continued in 2023. Continuing invasive weed management annually is recommended to preserve investment and continue to keep populations of invasive species low.

Like DD1a, supplemental seeding or planting of early-season blooms is needed.

Figure 7. Image of a great spangled fritillary (Speyeria cybele) visiting a native field thistle in mid-August. Native thistles provide important nectar resources for pollinators such as butterflies.

Unit G2, 5.4 ac

Invasive woody species including buckthorn, honeysuckle, and Siberian elm saplings were cut and stump treated with herbicide in October and November 2023. Most work occurred in a 3 acre subset of the unit along the boundary of G2 and DD1f. All woody material was stacked in unit DD1f, away from the pipeline running through the unit. The soil in unit G2 is extremely dry and sandy, and small pockets of remnant prairie exist on south-facing knolls. Efforts should be made to preserve and expand these pockets in the future through continued woody removal.

Unit MP2, 3 ac

This unit was seeded in 2013. It has taken some years to get good establishment of native prairie species. It has improved a lot over the years and was dominated by native species, with about 30 of the 39 seeded species found. However, just a few species dominated, and most were present in very low numbers. Invasive grasses were oversprayed in 2022 to reduce cover.

This unit was burned in May 2023, alongside the west side of unit SV1. The burn carried well, in large part due to the cool-season grass thatch (Photo XXX). Follow up spot-spraying of invasive forbs including leafy spurge, garlic mustard, birdsfoot trefoil, crown vetch, and Canada thistle occurred 1 week after the burn. A native seed mix was drilled to increase diversity, and additional seed was hand-broadcast.



Figure 8. Image of a fire technician lighting the prescribed fire in Unit MP2.

Native grasses dominated the unit in the summer and fall, invigorated by the spring burn. The pipeline corridor through the middle of the unit was mowed in August for equipment accessibility needs. Efforts were made to avoid mowing a large patch of native field thistle, as this was one of the only flowering plants in the unit at that time. Continued monitoring should occur in 2024 to assess the efficacy of the burn and seeding.

SAVANNA RECONSTRUCTION

Unit SV1-w, 4 ac.

This unit was burned and drill seeded along with MP2 in May 2023.



Figure 9. Image of prescribed fire burning unit SV1-w. Prior to burning, the crew mowed a fire break around the oak tree in the background to protect it from the fire. Although bur oak trees are adapted to fire, this effort was made to prevent the leaves in the canopy from catching fire.

All SV units, 28 ac.

Invasive woody removal (honeysuckle, buckthorn, black locust) was completed all SV units in June 2023. Invasive weed management also occurred across all SV units and consisted of managing leafy spurge, Canada thistle, and birdsfoot trefoil.

Similar to DD1-a, the Canada goldenrod in unit SV2 has historically been managed through mowing. In 2023, this was not needed because leaf beetles defoliated the plants, reducing their overall cover.

Overall, the cover of invasive woody and herbaceous species is low, which is a result of diligent management over time. Native shrubs are beginning to dominate the understory in the eastern SV units (SV2, SV3, SV1c, SV4a). These units would greatly benefit from a higher frequency, low severity fire regime to maintain an open understory. Effort to bring fire to these units will be made in 2024.



Figure 10. Image of bur oak tree extending its lower limbs over 20 feet toward the once-open bluff prairie to the south in Unit SV4a.

NATIVE PRAIRIE – ON-GOING MANAGEMENT

UNITS SGP A, B, C, D, E, F, FF, G, H, I, K, M, N, O, P; DP-1 12 ac

INVASIVE PLANT CONTROL

Invasive weeds, including trefoil, thistles, crown vetch and knapweed, were spot-treated or pulled throughout the summer in all SGP units. *Galium mollugo* was spot-sprayed for the second year in a row in SGP-M and N. In August, invasive woody plants were removed from prairie edges to 20 feet into the woods at all the SGP A-I units.

Work has been done to remove invasive woody plants from the wooded edges of units SGP-M,N,O in 2022. Seed collected from Spring Lake Park was sown in 2022 to encourage the spread of the prairie. In 2023, further invasive woody removal was done in OF-2e, the forest unit surrounding these three prairies. This will likely set woody encroachment back even further, allowing more time for native plants to establish and expand in these units.



Figure 11. Image of Unit SGP-O taken in July 2023. Removal of invasive woody plants along the perimeter of this unit ensures small bluff prairies such as this are protected and can continue to provide critical habitat resources for plants and animals.

Unit SGP-E was cleared in 2019 and seeded in 2020 but was still in rough shape in 2021 with an abundance of non-native plants. Most, however, were simply weedy and not invasive. We want to avoid using a lot of herbicide at this unit if possible, to allow the native seedbank to germinate. Monitoring in 2022 and 2023 was poor due to the droughts, but on a glance this prairie has not appeared to have rebounded after initial clearing in 2019. Monitoring will continue in 2024, and additional actions such as burning or seeding may be needed.



Unit SGP-FF was largely overrun with invasive woody encroachment. All woody species aside from oaks were cut, stump treated, and stacked in the woods to allow sunlight to reach the soil surface. This unit will be monitored for native seed bank reestablishment in 2024. If non occurs. supplemental seeding and follow-up invasive management will likely be needed.

Figure 12. Image of Unit SGP-FF after invasive woody brush was cleared in spring 2024. This unit is at the beginning of its restoration trajectory, with continued woody management and likely reseeding necessary to bring the native plant community back to this bluff.

PRAIRIE VEGETATION SURVEY

Most of the native prairies have not been surveyed in many years, so we began to do that in 2019 to help evaluate changes to these areas over time. The established 1-meter plots at all of the SGP units A-I were surveyed in 2019 and 2021, along with a meander survey of the entire unit. The vegetation survey was not completed in 2022 and 2023 because the drought caused the plants to go dormant and the vegetation was dry and brown. These units will be surveyed in 2024 to gain a more complete picture of change over time.



Figure 13. Image of silky purple prairie clover (purple, foreground), whorled milkweed (white, right), and lead plant (silver-purple, background) growing amongst other native grasses and forbs in Unit SGP-F.

Discoveries from the Vegetation Survey:

An exciting discovery in 2021 was a single individual of the prairie turnip plant (*Pediomelum esculentum*) (Photo 7). This is a relict prairie species, and very seldom found any more in the local region. Though not rare, it is unusual. It was a very important food source for Native Americans. We collected 10 seeds off of it in 2021 to try to increase the population.

The seeds were grown in 2022 by our partners at Dakota County Parks (DCP) and seven plants survived. The plants were too small to plant in 2022 and 2023, and will be planted in 2024. The prairie turnip we found in 2021 was mowed by deer in 2022 and did not flower. This was a good reminder that plants we install at the site need to have fencing to protect them. The prairie turnip was present in July 2023 it appeared to have produced seeds. Monitoring in 2024 will confirm whether this population is growing.

DCP also grew a couple dozen ground plum (*Astragalus crassicarpus*) plants, from seed that we collected at SGP-I in 2021. These plants were grown in a greenhouse for two growing seasons, 2022 and 2023, and then planted by FMR staff in early-October 2023. To protect against herbivory and promote population establishment, the plugs were planted in the following configuration: 5 individual plugs were planted in a circular array with a footprint of approximately 5 square feet. 3 foot tall galvanized fencing was installed as a cage around each array to protect from deer. 5 arrays were planted in SGP-A and 4 were planted in SGP-D. In total, 47 plugs were planted (two arrays had 6 plants instead of 5). All were watered during initial planting, and then received approximately 1 inch of rain the following week. The plantings were inspected in December 2023 and 8 of the 9 cages remained intact. Populations will be monitored throughout the growing season in 2024 to assess establishment.



Figure 14 (left). Image of five ground plum plugs planted in a circle surrounded by galvanized metal cage, supported with garden stakes. Figure 15 (right). Image of two cage locations in SGP-A. Cages were placed across a diversity of microhabitats (steep slope, shallow slope, shaded edge, exposed center, etc.) to ensure some survival because specific preferred microhabitat is unknown.

Cheatgrass Management Results:

The vegetation survey allows us to comprehensively assess the current state of cheatgrass and native species after roughly a decade of management. Previous surveys indicated overall native plant species richness (number of species) was lower in plots that had higher cheatgrass density. However, we were concerned about the impacts of management to native species and have withheld cheatgrass management for several years now.

The SGP-M, N, and O units generally seemed to have better native species diversity than the A-I units, and also much less cheatgrass. At Unit M, we recorded abundant cheatgrass in 2008, but none was present in 2022.

Overall, we still recommend holding off on cheatgrass management at the remnant prairies until more information is known about native species presence and abundance in these remnants, and to determine whether or not native plants are being lost due to management or can recover in areas where cheatgrass has been managed.

RARE PLANT SURVEY

The annual survey for the state endangered **James's polanisia** (JP) was completed at the sand-gravel prairie units on July 18 and July 31. The populations at all previous locations were surveyed using the same methods as previous years. After three years with among the lowest total number of plants (35, 29, and 59), there was a 370 percent increase in 2023 with 277 plants recorded. This is the fifth highest count since annual recording began in 2006. Although it is nowhere near the highest count of 843 plants in 2014, this rebound is promising after a period of significantly low counts. For the past 3 years, (2021, 2022, and 2023) plants were only found in two locations. It is likely that five of the seven historical locations may no longer harbor any plants.

The far east end of Unit I has been a stronghold for the plant, in part due to the steep sandy slopes that tend to have a lot of bare soil. James's polanisia is an annual species that requires some soil disturbance to create bare soil openings where it can grow. Weedy species such as cheatgrass and mullein, however, also readily occupy such bare soils and seem to be a primary competitor at the Unit I location. We began cutting the weeds in early spring in that area over the past couple years, to help facilitate space for the polanisia, and that method seems to be helping. At other units, like Unit D, there are ample bare soil patches, but the polanisia is no longer there. We will continue to monitor and the plant may recur there.

How long the seeds remain viable in the soil is not known, but it is thought that a plant that grows in such dry conditions as this one is likely to have long seed viability, which will hopefully help the population to recover at some of the other units. It is also apparent that this species has significant year to year fluctuations so it will be important to continue annual monitoring.

	2003	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Survey Dates		7/25	6/28, 7/7	8/14, 21	7/29, 8/5	7/29, 8/12, 9/16	8/4, 8/16, 9/1	8/8	9/4	8/14, 8/28	8/5	8/8	8/14	8/15	7/31	8/25	7/8	8/10	7/18, 7/31
SGP-A	Present	-	-	-	2	2	0	1		0	0	0	0	0	0				
SGP-D_east	Present	15+	Present	35 +	23	26	282	99		154	0	0	0	0	18	6	0	0	0
SGP-F	-	-	-	-	-	-	-	49	207	292	9	0	3	3	5	1	16	20	203
SGP-H_east	-	-	-	-	50	0	15	0		0	0	0	0	0	0		0	0	0
SGP-I_east	Present	27	-	Dozens	55	47	134	509	0	397	86	8	44	63	448	28	13	39	74
SGP-I_mid	-	3	-	Dozens	-	1	0	67	0	0	0	0	0	0	0		0	0	0
SGP-I_west	Present	-	5	Unkno wn	3	9	12	71	0	0	0	0	3	0	0		0	0	0
		45		88	133	85	443	796	207	843	95	8	50	66	471	35	29	59	277
% change from previous yr					51%	-36%	421%	80%	-74%	307%	-89%	-92%	525%	32%	614%	-93%	-17%	103%	369%

Table 1. Data table describing population counts of James's polanisia in specific bluff prairies located at FHR. Surveys normally occur in July and August. In 2023, there is a boom of individuals in SGP-F, with the 3rd highest population number recorded in this bluff prairie.



Figure 15. Graph visualizing population fluctuations of James's polanisia at all FHR bluff prairies over time. Time in years is on the X axis, and total number of individuals is on the Y axis.

VOLUNTEER EVENTS

POLLINATOR SURVEY

Three employees participated in the pollinator monitoring in 2023. The season started with a 2-hour training on June 15, where employees learned the Xerces Society survey protocols. Volunteers returned to complete three surveys over the summer (approx. 15 volunteer hours). As in the previous year, volunteers in 2023 learned to identify the 10 common groups of bees and to differentiate bees from other similar-looking pollinators like flies and wasps. Volunteers recorded multiple groups at the site, including some to genus level (*Bombus*). Surveys provide documentation of the pollinator use of these restorations, supplementing the professional pollinator surveys.

PRAIRIE MAINTENANCE EVENT

On July 20, three employee volunteers participated in a prairie tending event (4.5 hours). They pulled spotted knapweed and hoary alyssum from the DP-1 unit.

SEED COLLECTION

On October 5, 13 FHR employees collected prairie seed from units G1-a, G1-b, and DD1-a (26 volunteer hours). Species collected included yellow coneflower, rattlesnake master, field thistle, hoary vervain, monarda, stiff goldenrod, common milkweed, little bluestem, side oats grama, and Canada wild rye. Volunteers collected just over 30 oz of seed (1.9 lbs), which is quite a lot given there can be thousands of prairie seeds per ounce. The seed will be broadcast in the DD1-g and DD1-e units where invasive woody removal has occurred.

MONARCH MONITORING

Six employees, plus the FMR intern, participated in the sixth year of the monarch monitoring program. The season started with a 2-hour training on June 8. Volunteers surveyed 6 plots between them. Volunteers returned weekly through August, ten to thirteen visits, and recorded eggs and larvae at their designated plots, following established protocols of the Monarch Joint Venture's Monarch Larva Monitoring Protocol (MLMP). Each volunteer surveyed about 50 plants each week and total volunteer hours was about 60.

Results over four years show there was steady increase in numbers of eggs and larvae detected almost every year for the first four years, with a sharp decline in 2022. Numbers increased again in 2023 (Figure 16), with more 3rd, 4th, and 5th instars observed than in previous years. The results were submitted to the Monarch Joint Venture database and are combined with other data from the region.

2023 MLMP Monarch Density for Flint Hill Resources



Total avg. sample size = 101 plants/week

of sites monitored = 1

Monarch Larva Monitoring Project

Figure 16. Graph visualizing monarch egg and larval densities at FHR in 2023. Survey dates are on the X axis, and the number of monarchs per surveyed milkweed plant is on the Y axis.

The overwintering population of monarchs in Mexico has declined dramatically (90 percent) over the past 35 years, but the population has been fairly stable in the past 8 years.

The FHR monitoring demonstrates the importance of the bluffland habitat and the vital resources it provides to monarchs, among many other animals. Plans are to continue monarch monitoring in 2024.

WILDLIFE MONITORING

Five employees participated in the pilot year of wildlife camera monitoring at FHR. The season started with a 2-hour training on July 13. Volunteers monitored 4 wildlife cameras, downloading and processing images, between July and November 2023. Cameras captured images of wildlife using the FHR bluff lands for habitat and included observations of whitetail deer (Figure 17), squirrels, turkeys, coyotes (Figure 18), raccoons, red-tailed hawks, possums, and more.





Figure 18. A coyote was captured on a wildlife camera at night in November 2023.

COMMUNITY VOLUNTEER EVENT

Ninety-three community volunteers participated in the annual community volunteer event on October 28, 2023, hauling invasive woody shrubs from the lowland forest by the spring lake marsh for three hours (279 volunteer hours, Figure 19). The event expanded on invasive woody removal that has taken place in this area in previous years. Half of the brush was stacked in the mowed grassy area outside of the forest and piles were later removed and chipped. The remaining half of the brush was stacked in burn piles in the interior of the unit (Figure 20). These piles will be burned in early 2024. A follow up volunteer event could include stacking the remaining brush, raking out ash in burn piles, and seeding burn pile areas. The transformation in this unit has been remarkable and would not have been possible without volunteer support.





Figure 19 (top). Image of the group of volunteers smiling after hauling brush for several hours. Figure 20 (left). Image of a volunteer at the brush haul event stacking brush on a pile more than twice his height. Large brush piles were created within the unit to be burned rather than dragging brush several hundred feet out of the unit.

BREEDING BIRD SURVEYS

FMR has been conducting annual breeding bird surveys every year for fourteen of the past fifteen years (with the exception of 2020, due to Covid). We also typically host a bird hike during spring migration each year; it was held on May 16 in 2023, with 9 employees in attendance. The total of 258 birds and 49 species were observed in 2023 (Appendix C).

The 2023 annual breeding bird survey was completed on June 7 and 21, at the same points and using the same point count methods that have been used for 13 years (5 min, 50 m radius). All species seen or heard are recorded. One new species, the Common Grackle, was recorded in 2023. The total number of species recorded during the breeding season is 82, and the average number of species in any given year is about 47. Of the 82 species recorded, a few of them (e.g. herons, egrets, cormorants) would not be breeding at the site, so the total species likely to use the property for breeding is 79.

The number of species recorded in the 2023 breeding bird survey was average at 48 and the number of birds (247) was somewhat higher than average (215).

The most abundant species in 2023 was the American redstart. American goldfinch was the next most abundant species, followed by American robin and yellow warbler. The top ten species fluctuate somewhat from year to year, but the other most common species are pretty consistent: cedar waxwing, common yellowthroat, gray catbird, house wren, red-winged blackbird, and song sparrow (Appendix C). All are habitat generalist species, common in forest edges as well as suburban housing areas, and very common throughout their range. The abundance of cowbirds is an unfortunate byproduct of the habitat fragmentation that has occurred with human development of the landscape. These brood parasites are much more abundant than they were historically, and have very negative impacts on the breeding success of many other bird species, especially the neotropical migrants.

The number of species of greatest conservation need (SGCN) in 2023 was 6, slightly above the annual average of 5 (Table 3).

	Species	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022	2023	Avg /yr
1	American Kestrel	2		1									1			1.3
2	Black-billed cuckoo												1			1.0
3	Brown thrasher			1				1	5	1	1					1.8
4	Chimney swift				5	3	1	1	2	2	1				4	2.1
5	Dickcissel								2	4			1			2.3
6	Eastern meadowlark	2				2		1					1		1	1.5
7	Eastern Towhee	3	3	3	7	5	4	4	6	3	6	4	7	6	7	4.9
8	Field Sparrow	7	4	7	10	4	7	10	7	5	7	3	7	7	7	6.6
9	Northern Rough-winged Swallow	1	1	1		2	1		1	6		2	23	2	4	4.0
10	Sedge wren		1													1.0
11	Wood thrush	1			1								4	1		1.8
12	Yellow-billed cuckoo			1					3	1						1.7
13	Yellow-headed blackbird												1	2	2	1.5
	No. birds	16	9	14	23	16	13	17	26	22	15	9	46	18	25	18.8
	No. species	6	4	6	4	5	4	5	7	7	4	3	9	5	6	5.3

Table 1. Thirteen-Year summary of Species of Greatest Conservation Need recorded during the breeding season. Orange highlights indicate the first year a species was recorded.

The chimney swift house built by FHR employee volunteer Jack Seibenaler, and installed in fall 2012, was used for the first time in 2017, and again in 2018. In 2019 it was used for roosting but no nest was visible. In 2020 and 2021 it did not appear to have been used at all. However, in 2022 there were two nests in the chimney. This is unusual as the research indicates chimneys are generally only used by one pair. Four chimney swifts were observed during 2023 breeding bird surveys, which may be an indication of 2022 breeding success at the site.

POLLINATOR SURVEYS

For the fifth year, pollinator surveys were conducted at both the native bluff prairies and the restored savanna and prairie units. These surveys provide valuable information on how wildlife is responding to the restoration changes over time. The full document is attached to this report (**Appendix D**).

Four surveys were conducted on June 15, July 11, August 18, and September 14, 2023. Timed meander surveys were completed in five plots. Twenty-one species or species groups of native bees and wasps (221 individuals), including 9 bumble bee species, were recorded, as well as 14 butterfly species (86 individuals), pollinating beetles (222 individuals), and syrphid flies (33 individuals). Pollinators were observed on 29 different plant species, with the highest number of observations on field thistle, followed by Canada goldenrod and whorled milkweed.

The federally endangered rusty-patched bumble bee was recorded at the restored savanna (unit SV1) in 2019 and 2020, but was not noted in 2021, 2022, or 2023.

APPENDIX A. SEEDING IN 2023

Seed mix for species drill-seeded in MP-2 after spring burn (3 acres)

	Scientific Name	Common Name	% of Mix	Totl Lb	Cost/ Ib	Tot	al cost	Origin
	Graminoids							
	Bouteloua curtipendula	side-oats grama	21.6	3.63	\$17.00	\$	61.71	Pope Co. MN
	Schizachyrium scoparium	little bluestem	18.2	3.05	\$18.00	\$	54.89	Dakota Co. MN
	Total grams		39.8	6.68		\$	116.60	
	FORBS							
1	Agastache foeniculum	blue giant hyssop	0.5	0.09	\$216.00	\$	18.82	Benton Co. MN
2	Allium stellatum	Prairie Wild Onion	4.7	0.78	\$240.00	\$	188.16	McLeod Co. MN
3	Amorpha canescens	lead plant	3.7	0.62	\$72.00	\$	44.96	Dakota/Rice Co. MN
4	Aquilegia canadensis	columbine	1.7	0.29	\$720.00	\$	206.34	Kandiyohi Co. MN
5	Asclepias syriaca	common milkweed	9.7	1.63	\$102.00	\$	166.62	Rice Co. MN
6	Asclepias tuberosa	butterfly milkweed	1.8	0.30	\$510.00	\$	154.99	Benton/McLeod Co. MN
7	Baptisia alba	white wild indigo	1.9	0.32	\$240.00	\$	76.87	St. Croix Co. WI
8	Chamaecrista fasciculata	partridge pea	10.8	1.82	\$11.00	\$	19.97	Houston Co. MN/Allamakee Co. IA
9	Dalea candida	white prairie clover	2.7	0.46	\$30.00	\$	13.76	Stearns Co. MN
10	Dalea purpurea	purple prairie clover	3.0	0.51	\$22.00	\$	11.18	Dakota/Rice Co. MN
11	Desmodium canadense	Canada tick trefoil	2.8	0.48	\$60.00	\$	28.51	McLeod Co. MN
12	Eryngium yuccifolium	rattlesnake master	2.2	0.36	\$168.00	\$	60.98	Dakota Co. MN
13	Monarda fistulosa	wild bergamot	0.3	0.06	\$210.00	\$	11.76	Rice Co. MN
		large-flowered beard						
14	Penstemon grandiflorus	tongue	3.2	0.54	\$330.00	\$	179.69	Pope Co. MN
15	Pycnanthemum virginianum	mint	0.2	0.03	\$420.00	\$	12.47	McLeod Co. MN
16	Rudbeckia hirta	black-eyed susan	0.7	0.12	\$60.00	\$	7.10	Martin Co. MN
17	Silphium laciniatum	compass plant	3.9	0.66	\$300.00	\$	198.00	Dakota/Rice Co. MN
18	Symphyotrichum oolentangiens	skyblue aster	1.3	0.22	\$240.00	\$	52.27	Otter Tail Co. MN
19	angliae	New England aster	1.0	0.16	\$240.00	\$	38.60	McLeod Co. MN
20	Tradescantia ohiensis	Ohio spiderwort	2.0	0.34	\$360.00	\$	122.51	Dakota Co. MN
21	Verbena stricta	hoary vervain	1.3	0.21	\$120.00	\$	25.29	Redwood Co. MN
22	Veronicastrum virginicum	Culver's root	0.7	0.12	\$900.00	\$	105.36	McLeod Co. MN
	Total forbs		60.2	10.1		\$	1,744.21	
	-	I						
	Total		100.0	17	0	\$	1,860.81	

Seed mix for species broadcast seeded in SS north, following fall foliar treatment of 2022 buckthorn removal & community brush haul event (2 acres)

			PLS Lb/	Totl PLS				
	Scientific Name	Common Name	acre	Lb	Cost/ Ib	% of Mix	Seeds/SF	Origin
	Graminoids							
1	Elymus canadensis	Canada Wild Rye	0.80	1.68	\$18.00	9.7	1.5	Crawford Co. WI / Allamakee Co. IA
2	Elymus hystrix	Bottlebrush Grass	2.1	4.41	\$120.00	25.4	5.9	Benton/Wrignt Co. MN
3	Elymus villosus	Silky Wild Rye	2.00	4.20	\$52.00	24.2	4.0	Morrison Co. MN
4	Elymus virginicus	Virginia Wild Rye	2.60	5.46	\$10.00	31.4	4.0	Rice Co. MN
5	Carex blanda	Sedge	0.08	0.16	\$514.00	0.9	0.3	Rice Co. MN
6	Carex molesta	Troublesome Sedge	0.20	0.42	\$300.00	2.4	1.8	Rice Co. MN
7	Carex sprengelii	Long-beaked Sedge	0.13	0.26	\$343.00	1.5	0.5	Morrison Co. MN
	Total graminoids		7.91	16.59		95.5	18.1	
	Forbs							
		Fragrant Giant						
8	Agastache foeniculum	Hyssop	0.12	0.25	\$257.00	1.4	4.0	Benton Co. MN
9	Aquilegia canadensis	Columbine	0.10	0.21	\$514.00	1.2	1.4	Kandiyohi Co. MN
10	Rudbeckia laciniata	Wild Golden Glow	0.10	0.21	\$300.00	1.2	0.5	Fillmore Co. mN
11	Solidago flexicaulis	Zigzag Goldenrod	0.03	0.06	\$1,199.00	0.3	0.9	Mille lacs Co. MN
12	Symphyotrichum lateriflorum	Calico Aster	0.03	0.06	\$600.00	0.3	2.8	Benton Co. MN
	Total forbs		0.4	0.8		4.5	9.6	
1		I						l
	Total		8.29	17.38		100.0	27.6	

APPENDIX B. VEGETATION SURVEYS

Disturbed Deciduous Woodland DD1-a Vegetation Survey

Forestry mowed 2017. Sprayed June 2018. Seeded fall 2018. Spot-sprayed weeds 2020. Rx burn and supplemental seeding 2021. Invasive weed control 2022, 2023.

43	Total Species 2023
7	Native grasses
22	Native forbs
12	Nonnative species
19	No. seeded species recorded
43%	% of seeded

FHR Unit DD1a. Prairie Restoration. Vegetation Survey

Seeded Nov 2018

4 ac

			Surveyor:	KS	KS	KS
			Method:	Cover	Cover	Cover
Non- native	Seeded	Scientific Name	Common Name	9/4/20	7/8 & 8/19/21	7/13/22
		Graminoids		3	3	3
1	x	Andropogon gerardii	big bluestem			0.5
2	x	Bouteloua curtipendula	side-oats grama	1	0.5	0.5
x		Bromus inermis	Smooth brome			
3		Carex blanda	common woodland sedge		0.5	
4		Carex cristatella	crested sedge			0.5
5	x	Elymus canadensis	Canada wild rye	2	1	1
6	x	Elymus hystrix	bottlebrush grass			
6	x	Elymus trachycaulus	slender wheatgrass		1	
7 x		Eriochloa villosa	hairy cupgrass	1		
8		Hordeum jubatum	foxtail barley		0.5	
9		Panicum virgatum	switchgrass			1
x		Phalaris arundinacea	Reed canary grass			
х		Phleum pratense	Timothy			
10 x		Poa pretensis	Kentucky bluegrass		0.5	0.5
11	x	Schizachyrium scoparium	little bluestem	1	1	1
12 x		Setaria pumilla	yellow foxtail	2	2	1
14	x	Sorghastrum nutans	Indian grass			
15	х	Sporobolis heterolepis	prairie dropseed			
			Total	5.0	8.0	8.0

_			Forbs		3	4	4	14
1			Achillea millefolium	yarrow	1	1		1
2		x	Agastache foeniculum	blue giant hyssop	0.5			
3			Ageratina altissima	white snakeroot	0.5			0.5
4		x	Allium stellatum	prairie wild onion				
4			Ambrosia artemisiifolia	common ragweed		1		
6		x	Amorpha canescens	lead plant				
7		x	Aquilegia canadensis	columbine				
5	х		Arctium minus	common burdock	0.5	1		0.5
6			Artemisia absinthium	absinthe wormwood			0.5	0.5
7		x	Artemisia ludoviciana	prairie sage	0.5	0.5		0.5
8		x	Asclepias syriaca	common milkweed		0.5	0.5	0.5
9		x	Asclepias tuberosa	butterflyweed		0.5		
13		x	Asclepias verticillata	whorled milkweed				
10			Aster pilosus	frost aster	1			0.5
11[x	Astragalus canadensis	Canada milk vetch		1		
16		x	Baptisia alba	white wild indigo				
12	х		Berteroa incana	hoary alyssum	0.5	0.5	1	0.5
13	х		Cannabis sativa	hemp		0.5		
14	х		Carduus nutans	musk thistle		0.5	0.5	
15	х		Centaurea stoebe	spotted knapweed		1		0.5
16		x	Chamaecrista fasciculata	partridge pea	0.5	0.5		
17	х		Cirsium arvense	Canada thistle		2	1	0.5
18			Cirsium discolor	field thistle	2	0.5		0.5
19	х		Cirsium vulgare	bull thistle	1			
20			Conyza canadensis	horseweed	1			
21		x	Dalea candida	white prairie clover		0.5	1	0.5
22		x	Dalea purpurea	purple prairie clover		0.5		
23	х		Daucus carota	Queen Anne's lace	0.5		0.5	0.5
29		x	Desmodium canadense	Canada tick trefoil				0.5
24			Erigeron sp	fleabane	1	0.5		
31		x	Eryngium yuccifolium	rattlesnake master				
25		x	Galium boreale	northern bedstraw		0.5		
26			Hackelia virginiana	Virginia stickseed	2			
27[x	Helianthus maximiliani	Maximilian's sunflower	1	1	1	1
28		x	Heliopsis helianthoides	ox-eye	1	0.5	1	
29	х		Hypericum perforatum	common St. Johnswort		0.5	0.5	
30		x	Lespedeza capitata	round-headed bush clover		1		0.5
31	х		Leucanthemum vulgare	shasta daisy		0.5		
39		x	Liatris ligulistylis	northern plains blazing star				0.5
32		x	Liatris pycnostachya	prairie blazing star		0.5		
33	х		Lotus corniculatus	birds-foot trefoil		1	0.5	
34	х		Melilotus alba	white sweet clover	0.5			
ſ	х		Melilotus officinalis	Yellow sweet clover				0.5
35		x	Monarda fistulosa	wild bergamot	1	1	1	1
36	х		Pastinaca sativa	wild parsnip		0.5	0.5	

45		х	Penstemon grandiflorus	large-flowered beard tongue				
37	x		Potentilla recta	sulfur cinquefoil			0.5	
38		х	Pycnanthemum virginianum	Virginia mountain mint			0.5	
39		х	Ratibida pinnata	gray-headed coneflower	2	2	2	2
40		х	Rudbeckia hirta	black-eyed susan	2	1	1	
41	х		Rumex crispus	curly dock		0.5	0.5	
42		х	Scrophularia lanceolata	lance-leaved figwort		0.5	1	0.5
43	х		Silene latifolia	white campion		0.5		
ſ			Silphium inntegrifolium	Rosinweed				0.5
44		х	Silphium laciniatum	compass plant		0.5		0.5
45			Solidago canadensis	Canada goldenrod	3	3	2	2
46			Solidago gigantea	late goldenrod		1		
47		х	Solidago rigida	stiff goldenrod	1	1		1
57		х	Solidago speciosa	showy goldenrod				
[Symphyotrichum ericoides	White heath aster				0.5
48		х	Symphyotrichum laeve	smooth aster	1			
59		х	Symphyotrichum novae-angliae	New England aster				0.5
60		х	Tradescantia ohiensis	Ohio spiderwort				
49			Urtica dioica	stinging nettle		0.5		
50	х		Verbascum thapsus	common mullein	1	0.5	0.5	0.5
51		х	Verbena stricta	hoary vervain	1	1	1	1
52			Verbena urticifolia	white vervain	1	0.5		
65		х	Veronicastrum virginicum	Culver's root				
53			Viola sp	violet	0.5			
54		х	Zizia aurea	golden alexanders	1	1	1	
		44		Total	28	41	23	29
				non-native	6	13	11	11
			Woody	•		-		
1	х		Rhamnus cathartica	common buckthorn		0.5		0.5
2			Rubus ideaus	red raspberry			0.5	1
ļ			Quercus bicolor	swamp white oak (regen)				0.5
3	х		Ulmus pumila	Siberian elm		0.5		
	26			non-native	0	2	1	2

* Cover Classes: 0.5 (0-1%), 1 (1-5%), 2 (5-25%), 3 (25-50%), 4 (50-75%), 5 (75-100%).

Lowland Hardwood Forest (SS-north) Vegetation Survey

Buckthorn cut and stump treated in 2021, 2022, brush hauled to burn piles. Follow up foliar spraying completed in 2022, 2023. BT replacement mix was seeded in 2022.

26	Total Species 2023
1	Native grasses
10	Native forbs
3	Native shrubs
6	Native canopy trees
6	Nonnative species

FHR Unit SS1-north, Lowland hardwood forest 2 ac

	-		Surveyor	KS	LW
			Method:	Cover	Cover
-			includu.		
NoN Nati	Family	Scientific name	Common Name	9/15/20	9/9/23
Grou	undlayer - forbs, fe	erms, woody		3	4
	Asteraceae	Ageratina altissima	white snakeroot	2	5
х	Brassicaceae	Alliaria petiolata	Garlic mustard		1
	Fabaceae	Amphicarpaea bracteata	hog peanut	2	1
х	Asteraceae	Arctium minus Campanulastrum	common burdock	1	1
	Campanulaceae	americanum	tall bellflower	0.5	
	Cannabaceae	Cannabis sativa	Hemp		0.5
	Onagraceae	Circaea lutetiana	sweet cicely	1	0.5
	Apiaceae	Cryptoaenia candensis	honewort	1	
	Boraginaceae	Hackelia virginiana	Virginia stickseed		2
	Urticaceae	Laportea canadensis	wood nettle	1	
х	Lamiaceae	Leonurus cardiaca	motherwort	1	0.5
	Menispermaceae	Menispermum canadense	Canada moonseed		0.5
	Urticaceae	Pilea pumila	clearweed	0.5	0.5
	Asteraceae	Rudbeckia laciniata	goldenglow	0.5	1
	Boraginaceae	Scrophularia lanceolata	lance-leaved figwort	1	0.5
	Lamiaceae	Teucrium canadense	American germande	1	
	Urticaceae	Urtica dioica	stinging nettle	0.5	0.5
	Vitaceae	Vitis riparia	Riverbank grape		2
Grou	undlayer - gramino	ids		0	1
			American slough gra	SS	0.5
Grou	undlayer - woody			3	1
	Juglandaceae	Carya cordiformes	bitternut hickory	0.5	
	Cannabaceae	Celtis occidentalis	hackberry	1	1
	Vitaceae	Parthenocissus inserta	Virginia creeper	2	2
	Roseaceae	Prunus serotina	black cherry	0.5	
x	Rhamnaceae	Rhamnus alnifolia	glossy buckthorn	0.5	
х	Rhamnaceae	Rhamnus cathartica	common buckthorn	2	1
	Roseaceae	Ribes sp	gooseberry	0.5	1
			Honeysuckle		1
Shru	ıb layer			0	
Can	opy/Subcanopy			5	4
	Sapindaceae	Acer negundo	boxelder	4	2
	Sapindaceae	Acer saccharinum	Silver maple		1
	Juglandaceae	Juglans nigra	Black walnut		1
	Juglandaceae	Carya cordiformes	bitternut hickory	1	2
	Salicaceae	Populus deltoides	Cottonwood		2
	Ulmaceae	Ulmus americana	American elm	2	2

Cover Classes: 0.5=0-1%, 1=1-5%, 2=5-25%, 3=25-50%, 4=50-75%, 5=75-100%

* D=dominant, A=abundant, C=Common, P=present, R=rare

APPENDIX C. BIRD SURVEY DATA

BIRD SPECIES RECORDED AT FLINT HILLS RESOURCES BLUFF PROPERTY, 2009 - 2023

Species of Greatest Conservation Need (Minnesota Department of Natural Resources) are red font. New species found each year are highlighted orange. Species that have no data shown, were noted at the spring bird hike. Breeding bird surveys - Maximum of 2 visits in June, 12 point counts, 8 minutes. 50m radius, 250m apart.

Common name	Code	May Bird hikes	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022	2023	Annual Avg	Likely breedin g spp
1 Alder flycatcher			0	0	0	0	1	0	0	0	0	0	0	0	0	0	0.1	х
2 American Crow	AMCR	х	2	6	4	2	2	1	3	1	2	4	5	5	4	3	3.1	х
3 American Goldfinch	AMGO	х	19	9	8	13	5	11	4	8	10	9	17	14	16	16	11.4	х
4 American Kestrel	AMKE		2	0	1	0	0	0	0	0	0	0	0	1	0	0	0.3	x
5 American Redstart	AMRE	х	12	5	8	11	13	13	14	19	12	13	14	21	14	20	13.5	x
6 American Robin	AMRO	х	7	6	10	7	6	4	5	12	8	3	6	3	7	15	7.1	x
7 American white pelican	AMPE	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
8 Bald Eagle	BAEA	х	0	0	0	0	0	0	0	0	0	2	0	1	0	1	0.3	x
9 Baltimore Oriole	BAOR	х	5	7	8	4	3	1	2	3	4	7	6	6	1	2	4.2	x
10 Barn swallow	BASW	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
11 Barred owl	BAOW		0	0	1	0	0	0	0	0	0	0	0	0	0	0	0.1	х
12 Bay breasted warbler	BBWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
14 Black tern	BLTE	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
13 Black-and-white warbler	BAWW	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
15 Black-billed cuckoo	BBCU	X	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0.1	X
16 Black-capped Chickadee	BCCH	х	2	8	4	7	12	1	4	6	8	2	1	2	2	5	4.6	х
17 Black-throated Green Warbler	BTNW	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
18 Blackburnian Warbler	BLWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
19 Blackpoll warbler	BPWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
20 Blue grosbeak	BLGR	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
21 Blue Jay	BLJA	х	4	4	7	5	6	2	1	3	3	5	2	8	3	7	4.3	x
22 Blue-gray Gnatcatcher	BGGN	х	5	5	1	5	6	1	3	6	4	2	2	4	3	4	3.6	x
23 Blue-headed vireo	BHVI	x	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0.1	х
24 Blue-winged warbler	BWWA		0	0	0	0	0	0	1	1	0	0	0	0	0	0	0.1	х
25 Bobolink	BOBO	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
26 Broad-winged hawk	BWHA	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	x

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Common name	Code		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022	2023	Annual Avg	Likely breedin g spp
28 Brown thrasher	BRTH	X	0	0	1	0	0	0	1	5	1	1	0	0	0	0	0.6	X
27 Brown-headed Cowbird	BHCO	х	29	10	11	6	11	11	8	14	14	13	7	17	18	0	12.1	х
29 Canada goose	CAGO	х	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0.1	х
30 Cape May warbler	CMWA	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
31 Carolina wren	CAWR	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
32 Cedar Waxwing	CEWA	х	4	13	19	10	5	15	10	6	7	7	12	13	3	3	9.1	х
33 Chestnut-sided Warbler	CSWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
34 Chimney swift	CHSW	X	0	0	0	5	3	1	1	2	2	1	0	0	0	4	1.4	X
35 Chipping Sparrow	CHSP	х	7	2	2	4	5	5	5	1	2	5	1	2	2	1	3.1	x
36 Clay-colored Sparrow	CCSP	х	4	5	2	3	7	5	6	4	6	3	2	2	5	4	4.1	х
37 Cliff swallow	CLSW		0	0	0	3	0	0	0	0	0	0	0	0	0	0	0.2	х
38 Common Grackle	COGR		0	0	0	0	0	0	0	0	0	0	0	0	0	3	0.2	х
39 Common Yellowthroat	COYE	х	1	9	13	10	9	9	10	9	9	11	1	10	7	7	8.2	х
40 Cooper's hawk	COHA	х	0	0	0	1	0	0	0	0	2	0	0	0	0	1	0.3	х
41 Dark-eyed junco	DEJU	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
42 Dickcissel	DICK		0	0	0	0	0	0	0	2	4	0	0	1	0	0	0.5	X
43 Double-crested cormorant	DCCO	х	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0.1	
44 Downy Woodpecker	DOWO	х	1	1	3	1	0	2	1	3	0	0	0	2	2	3	1.4	х
45 Eastern bluebird	EABL	х	4	1	4	4	2	3	3	3	1	1	0	1	1	0	2.0	х
46 Eastern Kingbird	EAKI	х	1	2	2	2	1	0	0	1	2	1	0	2	0	2	1.1	х
47 Eastern meadowlark	EAME	x	2	0	0	0	2	0	1	0	0	0	0	1	0	1	0.5	x
48 Eastern Phoebe	EAPH	х	6	1	2	1	0	0	1	1	1	0	0	0	0	0	0.9	х
49 Eastern Towhee	EATO	x	3	3	3	7	5	4	4	6	3	6	4	7	6	7	4.9	X
50 Eastern wood pewee	EAWP	х	6	4	3	9	5	4	4	4	5	5	4	8	4	8	5.2	х
51 European Starling	EUST	х	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0.1	х
52 Field Sparrow	FISP	x	7	4	7	10	4	7	10	7	5	7	3	7	7	7	6.6	x
53 Golden-winged warbler	GWWA	x	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
54 Grasshopper sparrrow	GRSP	x	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
55 Gray Catbird	GRCA	х	7	8	4	10	7	6	6	8	12	13	1	11	9	10	8.0	х
56 Great Blue Heron	GBHE	х	0	4	0	1	0	0	1	0	0	0	0	0	0	0	0.4	
57 Great Egret	GREG	х	1	20	0	0	0	0	2	0	4	0	0	0	0	0	1.9	
58 Great-crested Flycatcher	GCFL	х	6	3	6	5	6	2	0	2	2	0	1	4	2	6	3.2	x
59 Hairy woodpecker	HAWO	х	1	1	0	1	0	1	1	1	1	3	1	0	3	2	1.1	х

Common name	Code		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022	2023	Annual Avg	Likely breedin g spp
60 Harris sparrow		Х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
61 House Finch	HOFI	х	2	0	0	0	0	0	0	1	1	0	1	0	1	3	0.6	x
62 House Wren	HOWR	х	14	12	8	14	15	6	13	15	12	13	13	12	12	13	12.3	x
63 Indigo Bunting	INBU	х	7	6	8	7	5	7	6	7	5	7	5	5	5	8	6.3	x
64 Killdeer	KILL	х	0	0	0	0	1	0	1	0	1	2	0	0	1	1	0.5	x
65 Lark Sparrow	LASP	x	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
66 Least Flycatcher	LEFL	х	0	0	0	0	0	0	2	0	1	0	0	0	0	0	0.2	x
67 Magnolia warbler	MAWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
68 Mallard	MALL	х	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.1	x
69 Marsh wren	MAWR		0	4	5	0	2	0	0	0	2	2	0	0	2	2	1.4	x
70 Mourning Dove	MODO	х	1	0	3	1	1	0	1	1	1	1	0	1	1	0	0.9	x
71 Mourning Warbler	MOWA	х	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.1	x
72 Nashville Warbler	NAWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
73 Northern cardinal	NOCA	х	7	7	4	6	3	2	3	11	4	4	3	5	5	7	5.1	x
74 Northern Flicker	YSFL	х	1	1	2	2	0	1	1	2	1	1	0	0	0	0	0.9	x
75 Northern harrier	NOHA		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
76 Northern parula	NOPA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
77 Northern Rough-winged Swallow	NRWS	X	1	1	1	0	2	1	0	1	6	0	2	23	2	4	3.1	x
78 Olive-sided flycatcher	OSFL	x	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
79 Orange-crowned warbler	OCWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
80 Orchard oriole	OROR	х	0	1	2	1	3	0	0	3	0	1	0	0	0	1	0.9	x
81 Osprey	OSPR	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
82 Ovenbird	OVEN	х	5	1	4	2	3	0	1	1	0	2	0	0	1	2	1.6	x
83 Palm Warbler	PAWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
84 Pileated Woodpecker	PIWO	х	1	0	0	1	0	1	0	0	0	0	1	1	1	0	0.4	x
85 Red-bellied woodpecker	RBWO	х	0	0	3	1	1	1	1	0	0	3	2	3	1	3	1.4	x
86 Red-eyed Vireo	REVI	х	3	3	3	6	4	2	3	4	3	2	0	2	5	1	2.9	x
87 Red-headed woodpecker	RHWO	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
88 Red-tailed Hawk	RTHA	х	0	0	1	2	0	0	0	1	1	0	0	1	0	0	0.4	x
89 Red-winged Blackbird	RWBL	х	3	3	7	4	3	7	13	2	6	2	1	18	8	9	6.1	х
90 Ring-billed Gull	RBGU	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
91 Ring-necked pheasant	RNPH	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
92 Rose-breasted Grosbeak	RBGR	Х	8	6	3	1	5	4	3	5	5	3	4	5	4	5	4.4	х

	Common name	Code		2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2021	2022	2023	Annual Avg	Likely breedin g spp
93	Ruby-crowned kinglet	RCKI	Х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
94	Ruby-throated Hummingbird	RTHU	х	2	0	0	0	2	0	1	1	1	0	0	3	0	1	0.8	х
95	Sandhill crane	SACR	х	0	0	0	0	0	0	0	0	0	2	0	0	2	0	0.3	х
96	Savannah Sparrow	SAVS	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
97	Scarlet tanager	SCTA	х	0	1	0	1	1	1	1	0	0	0	0	1	1	0	0.5	х
98	Sedge wren	SEWR	X	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0.1	x
99	Sharp-shinned Hawk	SSHA	х	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0.1	х
100	Song Sparrow	SOSP	х	14	12	6	8	10	10	13	11	13	10	12	10	11	11	10.8	х
101	Swainson's Thrush	SWTH	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
102	Swamp Sparrow	SWSP		0	1	2	1	1	1	1	0	1	1	1	0	0	0	0.7	х
103	Tennessee Warbler	TEWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
104	Tree Swallow	TRES	х	5	3	2	27	1	1	2	1	3	4	3	0	9	4	4.6	х
105	Turkey vulture	TUVU	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
106	Warbling vireo	WAVI	х	1	2	2	1	2	0	0	0	1	0	0	4	1	3	1.2	х
107	Western Meadowlark	WEME	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
108	White-breasted Nuthatch	WBNU	х	0	4	2	2	2	1	0	2	2	2	1	2	0	3	1.6	x
109	White-crowned sparrow	WCSP	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
110	White-throated sparrow	WTSP	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
111	Wild Turkey	WITU	х	3	0	0	0	0	3	2	4	3	2	0	8	0	3	2.0	x
112	Willow flycatcher	WIFL		0	0	0	0	0	0	1	0	0	0	0	0	0	0	0.1	x
113	Wilson's Warbler	WIWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
114	Wood duck	WODU		0	6	0	27	1	0	0	0	0	0	0	6	21	1	4.4	x
115	Wood thrush	WOTH	X	1	0	0	1	0	0	0	0	0	0	0	4	1	0	0.5	x
116	Yellow Warbler	YWAR	х	5	6	4	6	5	8	8	5	10	8	8	18	19	15	8.9	х
117	Yellow-bellied Sapsucker	YBSA	х	0	0	0	0	0	1	0	1	1	1	1	0	1	0	0.4	х
118	Yellow-billed cuckoo	YBCU		0	0	1	0	0	0	0	3	1	0	0	0	0	0	0.4	X
119	Yellow-headed blackbird	YHBL	X	0	0	0	0	0	0	0	0	0	0	0	1	2	2	0.4	X
120	Yellow-rumped Warbler	MYWA	х	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.0	
121	Yellow-throated vireo	YTVI	х	0	1	0	1	4	2	1	2	1	1	4	1	4	3	1.8	х
	No. Birds			234	223	209	270	203	170	192	222	220	198	153	289	240	247	215.3	
	No. Species		108	47	46	48	50	45	42	50	49	52	45	36	49	46	48	46.6	79
	No. new species				3	6	2	2	1	4	1	0	1	1	2		1	1.9	
	No. SGCN			6	4	6	4	5	4	5	7	6	4	3	9	5	6	5.3	13



Figure C1. Locations of bird surveys since 2009, used again during 2023 bird surveys.

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APPENDIX D. 2023 POLLINATOR REPORT



Figure D1. Black and gold bumble bee (Bombus auricomus) visiting bee balm (Monarda fistulosa) during pollinator surveys in July 2023.

BACKGROUND

In 2019, FMR conducted the first pollinator surveys of remnant and restored prairie at the Flint Hills Resources bluffland property. These surveys have continued for the past five years. In 2023, the surveys included bumble bees, other native bees, butterflies, and other pollinators. The areas surveyed were approximately 65 acres (Table 1).

This report details pollinator observations and data collected during the 2023 field season. The data can be used to better assess the success of the restoration process, monitor current pollinators and habitat quality, and help improve future habitat for pollinators.



Figure D2. Map of remnant and restored prairie plots where pollinators were surveyed in 2023.

SURVEY METHODS

Pollinator surveys were completed in five plots within the FHR bluffland property (Figure D2; Table D1), and targeted butterflies (including skippers), bumble bees, and other pollinator groups (eg. flies, beetles, wasps). Surveys consisted of time-constrained, 15- or 30-minute, non-destructive, meandering walks throughout each plot; time was dependent on size of plot. During each survey, pollinators were only recorded if they were observed foraging on

flowering plants; butterflies were an exception to this due to their high visibility and comparatively easy identification and were also recorded during flight. A GPS unit was used to avoid meandering through areas of the plot already surveyed that day and to avoid meandering into adjacent plots. All observations were recorded by the same individual surveyor (Julia Leone). Plots were surveyed once per month June - September. All surveys were conducted between 900 hrs and 1730 hrs on clear weather days, over 55 degrees Fahrenheit for favorable conditions for insect activity. All observations were recorded with the most detailed taxonomic level available, based on trained observer ID. Because most native bees require identification under a microscope and cannot be sight-identified in the field using non-destructive methods, these species were grouped at higher taxonomic or functional levels. When possible, photo verification and field guide references were employed.

Plot Name	Approximate Acreage	Survey Duration (mins)
Remnant 1	14	30
Remnant 2	4	15
Remnant 3	5	15
Restoration 1	14	15
Restoration 2	28	30

Table D1: Pollinator survey plots and survey durations per visit.

RESULTS

A total of 588 pollinators were observed on 29 species of flowering plants during surveys, including 9 species of bumble bee and 14 species of butterfly.

Four surveys were conducted on June 15, July 11, August 18, and September 14, 2023. Timed meander surveys were completed in five plots. Twenty-one species or species groups of native bees and wasps (221 individuals), including 9 bumble bee species, were recorded, as well as 14 butterfly species (86 individuals), pollinating beetles (222 individuals), and syrphid flies (33 individuals).

One-hundred eleven bumble bees were observed in 2023, of which the most abundant species was *Bombus impatiens*, closely followed by *Bombus auricomis* (Table D2).

Sixty-six non-bumble bee native bees were recorded during surveys. There are over 500 species of native bees in Minnesota, and most cannot be identified without lethal collection and lab identification. For bees that could not be identified in the field, we grouped native bees into field-identifiable categories based on the Xerces Society for Invertebrate Conservation's 10 groups system, which groups bees with similar morphology and function together. At least 10 distinct species or groups of native bees were observed, including leafcutter bees, mining bees, sweat bees, and cuckoo bees.

SCIENTIFIC NAME	COMMON NAME	COUNT
Bombus auricomus	Black and gold bumble bee	28
Bombus bimaculatus	Two-spotted bumble bee	12
Bombus citrinus	Lemon cuckoo bumble bee	3
Bombus fervidus	Yellow bumble bee	3
Bombus griseocollis	Brown-belted bumble bee	13
Bombus impatiens	Common eastern bumble bee	33
Bombus perplexus	Confusing bumble bee	1
Bombus sandersoni	Sanderson's bumble bee	1
Bombus vagans	Half-black blumble bee	11
Bombus spp.	Unknown bumble bee species	6
TOTAL		111

Table D2: List of bumble bee species and their relative abundances observed in 2023.

SCIENTIFIC NAME	COMMON NAME	COUNT
Ancyloxypha numitor	Least Skipper	2
Celastrina neglecta	Summer Azure	1
Colias eurytheme	Orange Sulphur	1
Colias philodice	Clouded Sulphur	3
Cupido comyntas	Eastern Tailed Blue	10
Danaus plexippus	Monarch	17
Epargyreus clarus	Silver spotted skipper	6
Papilio cresphontes	Giant Swallowtail	2
Phyciodes tharos	Pearl Crescent	2
Pieris rapae	Cabbage White	23
Polygonia comma	Eastern comma	1
Speyeria cybele	Great Spangled Fritillary	12
Vanessa atalanta	Red Admiral	2
Vanessa cardui	Painted Lady	2
Vanessa spp	Unknown Vanessa butterfly	2
TOTAL		86

Table D3: List of butterfly species and their relative abundances observed in 2023.

Of the 14 species of butterfly observed, the monarch butterfly (*Danaus plexippus*) was the second most abundant butterfly species observed; the habitat generalist cabbage white butterfly was the most abundant (Table D3).

Around 38% of observed pollinators observed in 2023 were beetles, primarily the goldenrod soldier beetle (*Chauliognathus pensylvanicus*). Syrphid flies (also known as flower flies) accounted for 6.5% of pollinators and wasps another 5%. Beetles, flies, and wasps can all be effective pollinators and are often overlooked in pollinator assessments. Their distribution and abundance varied between survey plots; honey bees, for example, were primarily observed in Remnant 2 (Table D4).

Pollinator Group	Remnant1	Remnant2	Remnant3	Resto1	Resto2	Total
Native bee	15	8	7	9	27	66
Beetle	75	3	12	50	82	222
Bumble bee	12	17	4	42	36	111
Butterfly	12	32	8	17	11	80
Fly	9	8	9	2	6	34
Honey bee		36	1		1	38
Moth				1		1
Wasp	8	2	1	3	15	29
Total	131	106	42	125	178	582

Table D4: Groups of pollinators differed in their presence and abundance within the 5 plots surveyed for pollinators in 2023. See Figure D2 for plot locations.

Pollinators were observed on 29 different flowering plant species, with the highest total number of observations on field thistle (*Cirsium discolor*), followed by Canada goldenrod (*Solidago canadensis*) (Table D5). Different pollinator groups preferentially visited different flowers. Bumble bees, for example, were most frequently observed visiting bee balm (*Monarda fistulosa*), while syrphid flies were more abundant on prairie onion (*Allium stellatum*).

SCIENTIFIC NAME	COMMON NAME	COUNT
Achillea millefolium	Yarrow	9
Agastache foeniculum	Anise hyssop	3
Ageratina altissima	White snakeroot	12
Allium stellatum	Prairie onion	23
Asclepias tuberosa	Butterfly-weed	6
Asclepias verticillata	Whorled milkweed	62
Berteroa incana	Hoary alyssum	7
Cirsium discolor	Field thistle	105
Dalea purpurea	purple prairie clover	4
Delphinium carolinianum	Prairie larkspur	2
Erigeron spp.	Daisy fleabane	2
Euphorbia corollata	Flowering spurge	8

Helianthus spp	Sunflower	3
Heterotheca villosa	Hairy False Goldenaster	1
Hypericum perforatum	Common St. John's Wort	6
Leucanthemum vulgare	Ox-eye Daisy	1
Liatris punctata	Dotted Blazing Star	48
Lotus corniculatus	Birds-foot Trefoil	5
Mirabilis nyctaginea	Wild Four O'Clock	1
Monarda fistulosa	Bee balm	47
Pseudognaphalium obtusifolium	Sweet everlasting	1
Ratibida pinnata	Gray headed coneflower	12
Rubus occidentalis	Raspberry	1
Scrophularia sp.	Figwort	1
Securigera varia	Crown vetch	1
Solidago canadensis	Canada goldenrod	78
Solidago rigida	Stiff goldenrod	5
Symphyotrichum ericoides	Heath aster	4
Verbena stricta	Hoary vervain	49
Grand Total		507

Table D5: List of flowering plant species that pollinators were observed visiting in 2023. Counts represent number of individual insects that visited that species.

DISCUSSION

Bumble bee and butterfly diversity in 2023 was similar to that of past years. In 2023, additional pollinator groups were surveyed and provide additional information about the diversity of pollinator groups and species using the restored and remnant prairies of the bluffland property for habitat.

Of the native bees recorded, cuckoo bees like those observed in the genus *Sphecodes*, are of special interest because they are kleptoparasitic; they feed their offspring on pollen collected by other bees, especially those in the genera Lasioglossum, Halictus, and Andrena. We observed cuckoo bees in remnant and restored plots at the bluffland property. Kleptoparasitic species tend to be among the last to recolonize restorations, since their host speices must already be established. Their presence, especially in the restored prairies, is an indicator that the bluffland property is providing important habitat for many groups of native bees.

The presence and relative abundance of monarch butterflies (*Danaus plexippus*) is also a positive sign that the blufflands are providing habitat for this iconic and declining pollinator species. Two species of milkweeds (whorled milkweed and butterfly weed), the host plants for monarchs during their larval stages, were recorded as floral resources during pollinator

surveys (Table D5). Anecdotally, monarch larvae were observed on common and whorled milkweed on numerous occasions throughout the growing season.

Skipper butterflies, especially those that feed on native grasses during their larval stages, were noticeably absent or uncommon during pollinator surveys in 2023. Several oncecommon Minnesota species are now federally endangered (Poweshiek skipperling) or threatened (Dakota skipper) and many others are in decline and now considered prairie obligate. At a landscape scale, habitat loss is a major driver of declines. While it is unclear what is driving the low numbers at the blufflands property, boosting native grass coverage may improve the habitat for these species.

No federally endangered rusty-patched bumble bees were documented during 2023 surveys, despite their presence in previous years (2019, 2020). The property possesses high-quality habitat (i.e., diverse floral resources, loose soil with small animal burrows, forest edge and savanna) but the rusty-patched bumble bee appears uncommon absent at the site. We continue to enhance resources throughout the property will improve habitat for rusty-patched bumble bees.



Figure D3 (left). Silver spotted skipper nectaring on vervain in July 2023. Figure D4 (right). Monarch butterfly caterpillar on whorled milkweed in July 2023.



Figure D5. Diverse floral resources in Remnant 2 during July pollinator surveys in 2023.

REFERENCES

Xerces Society for Invertebrate Conservation. 2016. Upper Midwest Citizen Science Monitoring Guide: Native Bees. https://xerces.org/publications/id-monitoring/upper-midwest-citizen-scientist-pollinator-monitoring-guide-native