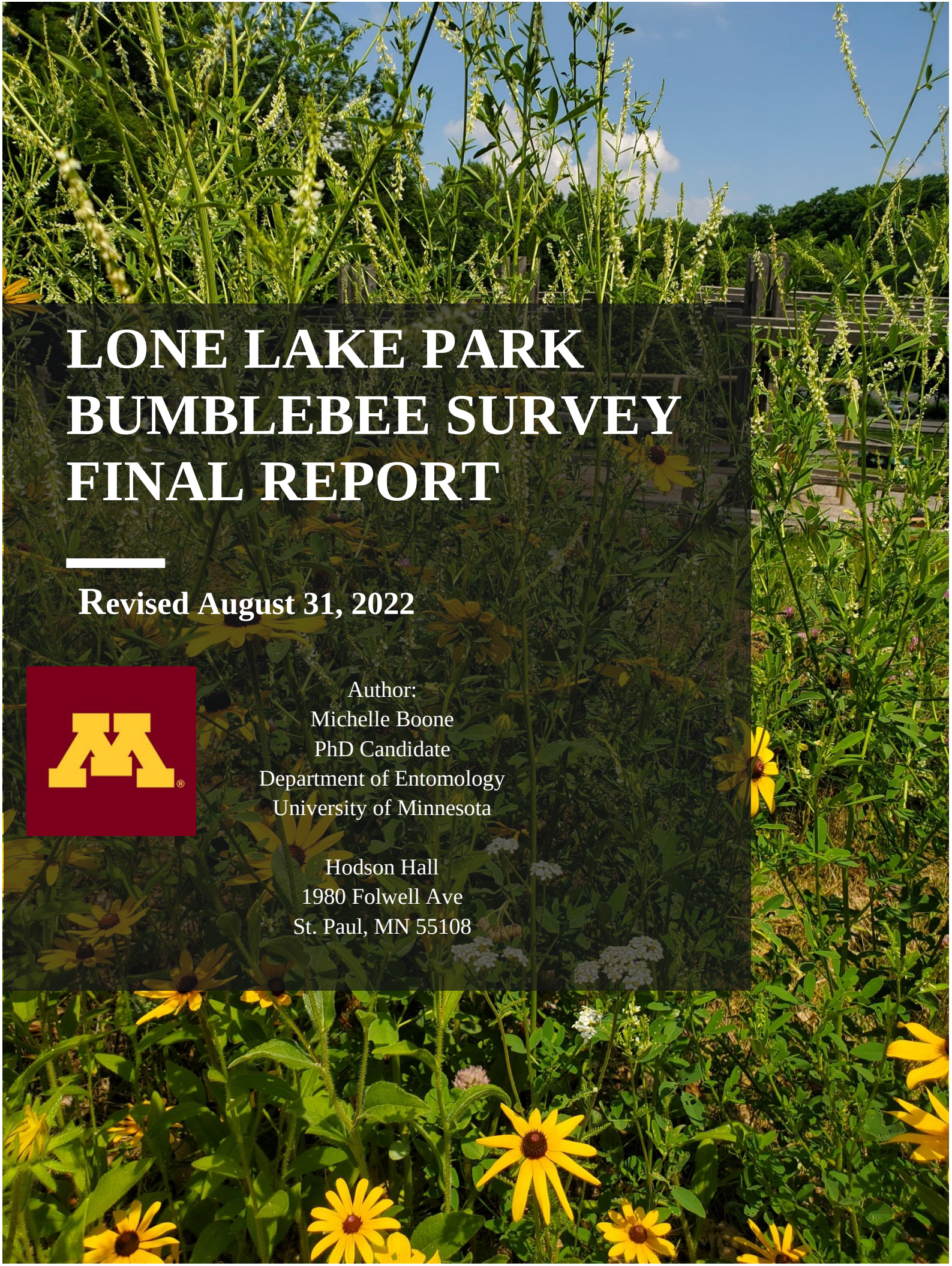

LONE LAKE PARK BUMBLEBEE SURVEY FINAL REPORT

Revised August 31, 2022

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All activities included in this report were conducted under the authority of Scientific Recovery Permit TE30472C-1 (Principal Investigator: E. Evans).

The cover photograph, taken in 2020, shows a prairie restoration in progress near the pickleball court in Lone Lake Park, Minnetonka, MN. Credit: M. Boone.

Executive Summary

This report summarizes the findings of bumble bee surveys conducted in Lone Lake Park, Minnetonka, during the summers of 2020-2022. Non-lethal surveys were conducted at two sites within the park. The objective was to document the bumble bee community within the park, including the federally endangered rusty-patched bumble bee, *Bombus affinis*. Each site was surveyed six times each year between June-August. Ten bumble bee species were documented foraging from 39 plant species over the three-year survey period. In 2020 and 2021, there were 1,033 and 1,137 bumble bees documented, respectively. There were 713 bumble bees documented in 2022. The number of species present remained constant across all three years of surveys. Male and worker rusty-patched bumble bees were detected in Lone Lake Park, representing less than 1% of the observed bumble bees throughout the surveys. There is not enough data on the rusty-patched bumble bee population in Minnesota to assess the proportion of the population present in Lone Lake Park. While the presence of rusty-patched bumble bees foraging in the park has been confirmed, more evidence is needed to determine whether this species uses the park for nesting or overwintering habitat.

Introduction

The rusty-patched bumble bee (*Bombus affinis*) is a federally endangered species found in the Eastern United States, ranging from eastern North Dakota to the Atlantic coast, and south to Tennessee and Georgia (Figure 1). Once a relatively common species, the rusty-patched bumble bee has experienced a drastic decline and has been extirpated from much of its previous range since the 1990's[1]. The species was listed as endangered under the Endangered Species Act[2] in 2017, becoming the first listed bee in the continental U.S. Bumble bees are important pollinators of crops and wild flowering plants.

The U.S. Fish and Wildlife Service (USFWS) delineates areas where rusty-patched bumble bees are likely to be present in suitable habitat (high potential zones), primary dispersal zones (low potential zones), and uncertain zones (low potential zones)[3] (Figure 1). The high potential zones are based on recent (2007-current) sightings of rusty-patched bumble bees, while primary dispersal zones are areas surrounding the high potential zones. Uncertain zones represent slightly older records (2000-2006). Lone Lake Park is located within the high potential zone for rusty-patched bumble bees.

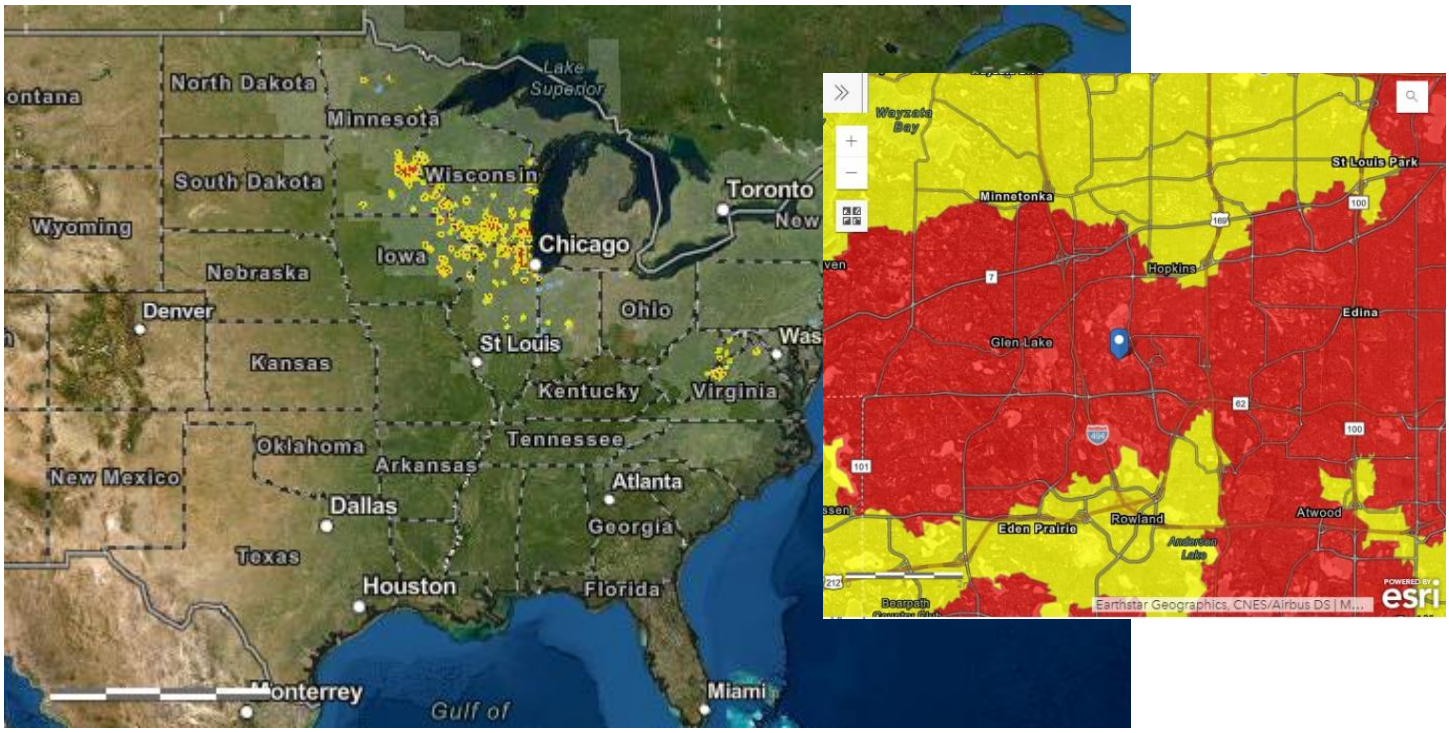

Figure 1. Rusty-patched bumble bee range map. High potential zones are red, primary dispersal zones are yellow, uncertain zones are blue, and the historic range is light green. The map on the right shows Lone Lake Park, represented by the blue arrow. Map courtesy of USFWS[3].

[1] Colla, S.R. and L. Packer (2008) Evidence for decline in eastern North American bumblebees (Hymenoptera: Apidae), with special focus on *Bombus affinis* Cresson. Biodivers Conserv, 17:1379-1391. DOI 10.1007/s10531 008-9340-5
[2] United States. (1983) The Endangered Species Act as amended by Public Law 97-304 (the Endangered Species Act amendments of 1982). Washington: U.S G.P. O).
[3] Range map can be found online at https://www.fws.gov/midwest/endangered/insects/rpbb/rpbbmap.html Last updated Feb. 19, 2020.

Bumble bees require foraging habitat (i.e. blooming flowers), nesting habitat, and overwintering habitat. Rusty-patched bumble bees have been documented foraging on a wide variety of flowers, including both native and non-native species[4]. Foraging areas must be located within the maximum foraging range of the nest site. The maximum documented foraging distance of bumble bees is 9.8 km[5], but they typically forage within 1 km of the nest[6,7,8]. The nesting requirements of *Bombus affinis* are not fully understood, but they have been documented nesting primarily underground, typically in abandoned rodent nests located from six to eighteen inches below the surface[9,10]. Occasionally nests will be constructed on the surface in areas such as clumps of grass on the ground[11]. In recent years, *B. affinis* nests have been documented in urban and natural habitats, including the exterior wall of a private home and underground in a garden, a woody park[17], and the side of a wooded bluff (Boone, unpublished). Due to the variability in their nesting habits and the difficulty in locating nests, it is challenging to predict where nesting will occur. Overwintering habitat requirements are not known for rusty-patched bumble bees but are assumed to be similar to those of other bumble bees, burrowing underground or in rotting logs[12]. The objective of the Lone Lake Park Bumble Bee Survey was to document the bumble bee community present in the park, including verifying the presence of rusty-patched bumble bees.

Survey Methods

The methods used in the Lone Lake Park Bumble Bee Survey can be found in the U.S. Fish and Wildlife Survey Protocols for the Rusty Patched Bumble Bee. The "Project Review" protocol for High Potential Zones was followed. The protocol recommends 1 person-hour per 3 acres of habitat and four equally spaced sampling periods from mid-June to mid-August[13]. Six surveys, rather than four, were conducted at Lone Lake Park to increase the probability of detecting rusty-patched bumble bees in the park if they are present[14]. Surveys were only conducted when temperatures were above 60° F and there was no precipitation. Survey dates are listed in Table 1.

Two areas of suitable habitat were surveyed within Lone Lake Park (Figure 2). These areas are referred to as the east site (or rain garden site), located between the pickleball and tennis courts, and the west site (or nine-mile creek site), located north of Rowland Road. Each site was surveyed for one hour on each date. A timer was started at the beginning of each survey. During each survey at both sites, one

[4] Simanonook, M.P., Otto, C.R., Cornman, R.S., Iwanowicz, D.D., Strange, J.P., & Smith, T.A. (2021). A century of pollen foraging by the endangered rusty patched bumble bee (*Bombus affinis*): Inferences from molecular sequencing of museum specimens. *Biodiversity and Conservation*, *30*(1), 123-137.
[5] Goulson, D., & Stout, J. C. (2001). Homing ability of the bumblebee *Bombus terrestris* (Hymenoptera: Apidae). *Apidologie*, 32(1): 105–111. https://doi.org/10.1051/apido:200111
[6] Dramstad, W.E. (1996) Do bumble bees (Hymenoptera: Apidae) really forage close to their nests? *Journal of Insect Behavior*, 9:163-182.
[7] Osborne, J.L., S.J. Clark, R.J. Morris, I.H. Williams, J.R. Riley, A.D. Smith, D.R. Reynolds, and A.S. Edwards. 1999. A landscape-scale study of bumble bee foraging range and constancy, using harmonic radar. *Journal of Applied Ecology*, 36:519-533.
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[9] Plath, O.E. 1922. Notes on the nesting habits of several North American bumble bees. *Psyche*, 29(5-6):189-202.
[10] Plath, O. E. 1927. Notes on the nesting habits of some of the less common New England bumblebees. *Psyche*, 34: 122-128.
[11] Macfarlane, R. P., K. D. Patten, L. A. Royce, B. K. W. Wyatt, and D. F. Mayer. 1994. Management potential of sixteen North American bumble bee species. *Melanderia*, 50: 1-12
[12] Macfarlane, R.P. 1974. Ecology of *Bombinae* (Hymenoptera: Apidae) of Southern Ontario, with emphasis on their natural enemies and relationships with flowers. PhD, thesis, University of Guelph, Guelph, ON, Canada.
[13] USFWS (2019) Survey Protocols for the Rusty Patched Bumble Bee (*Bombus affinis*). Version 2.2.
[14] Evans, E., Boone, M., & Cariveau, D. (2019). Monitoring and Habitat Assessment of Declining Bumble Bees in Roadsides in the Twin Cities Metro Area of Minnesota.

individual of each bumble bee species observed was netted, chilled on ice, photographed, and released for identification verification. All rusty-patched bumble bees were netted and photographed for documentation. The timer was paused during these activities so that one hour of active surveying occurred. Surveys were conducted along a meandering path in which the observer searched for bees on blooming flowers. The species and sex of all bumble bees observed during the surveys were recorded (Appendix A). Two species, the black and gold bumble bee (*B. auricomus*) and the American bumble bee (*B. pensylvanicus*), appear similar and are challenging to differentiate in the field, so these two species were grouped together during the surveys. The floral species on which bumble bees were observed foraging was also recorded (Appendix B).

Table 1. Bumble bee survey dates in 2020-2022.

	2020	**2021**	**2022**
Survey 1	June 15	June 14	June 14
Survey 2	July 2	June 28	June 27
Survey 3	July 17	July 12	July 12
Survey 4	July 31	July 26	July 26 and July 27*
Survey 5	August 11	August 9	August 9
Survey 6	August 25	August 23	August 25

*For survey 4 in 2022, sites were surveyed across two days due to rain.

Survey Locations

Two locations were surveyed within the park (Figure 2). Locations were selected based on the availability of suitable foraging habitat. Each location was surveyed 6 times per year during the summer. The east site (or rain garden site) has an area of approximately 3.09 acres and includes suitable foraging habitat near the basketball court, parking lot, pickleball court, and the field leading to the tennis court (Figure 2). The west site (or nine-mile creek site) is located north of Rowan Road. It has an area of approximately 2.28 acres and includes suitable habitat near the parking lot, along the trail, and within the prairie restoration running parallel to the south fork of Nine-Mile Creek (Figure 2).

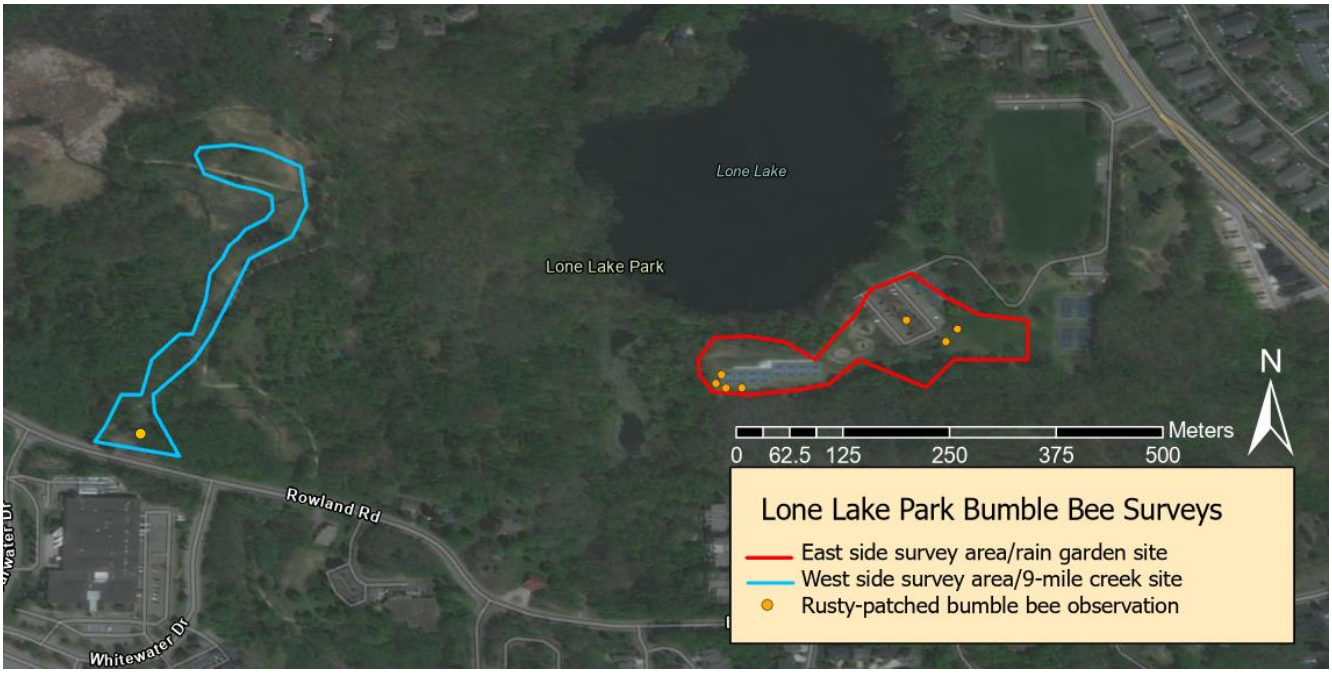

Figure 2. Sites surveyed in Lone Lake Park. The blue outline shows the survey site on the west side of the park (nine-mile creek), while the red outline shows the site on the east side of the park (rain garden). The locations of the rusty-patched bumble bee observations are represented by orange circles. Map created using Esri ArcGIS Pro.

Results

Ten bumble bee species were documented in Lone Lake Park (Table 2; Figure 3) foraging on 39 plant species, including 24 native species and 15 non-native species (Appendix B). A total of 1,033 bumble bees were observed in 2020 and 1,137 bumble bees were observed in 2021 (Table 2). In 2022, there were 713 bumble bees observed. The black and gold bumble bee and American bumble bee are difficult to distinguish in the field, so these two species were grouped together during the surveys for efficiency. Both species were present, as verified by photographs from individuals that were captured and observed up close (Figure 3). Rusty-patched bumble bees were documented at both sites in the park (Figure 2). On July 17, 2020, one male rusty-patched bumble bee was observed foraging on beebalm (*Monarda fistulosa*) in the parking lot rain garden. In 2021, six rusty-patched bumble bees were observed. On July 12, two workers were observed foraging on bee balm (*M. fistulosa*) and bird's-foot trefoil (*Lotus corniculatus*). On July 26, four males were detected foraging on Joe Pye weed (*Eutrochium maculatum*) and fragrant hyssop (*Agastache foeniculum*). In 2022, one rusty-patched worker was observed foraging on bee balm along the edge of the turf grass field on the east side of the park on July 26, while another was seen near the parking lot at the west side of the park on July 27. A few bumble bee nests were observed in the park in abandoned rodent holes and clumps of dead grass, but the species were not identified.

Table 2. Bumble bee species observed foraging in Lone Lake Park. Unidentified species represent individuals which the observer was unable to identify because they flew away too quickly or were missing most of their abdominal hair.

***Bombus* Species**	**Common Name**	**2020 count**	**2020 proportion of total**	**2021 count**	**2021 proportion of total**	**2022 count**	**2022 proportion of total**
B. affinis	Rusty-patched bumble bee	1	<0.001	6	0.005	2	0.003
B. auricomus*/*pensylvanicus	Black and gold/American bumble bee	179	0.173	181	0.159	130	0.182
B. bimaculatus	Two-spotted bumble bee	294	0.285	390	0.343	252	0.353
B. citrinus	Lemon cuckoo bumble bee	76	0.073	115	0.101	73	0.102
B. fervidus	Yellow bumble bee	1	<0.001	16	0.014	1	0.001
B. griseocollis	Brown-belted bumble bee	122	0.118	55	0.048	58	0.081
B. impatiens	Common Eastern bumble bee	279	0.270	282	0.248	117	0.164
B. rufocinctus	Red-belted bumble bee	15	0.015	52	0.046	25	0.035
B. vagans	Half-black bumble bee	60	0.058	38	0.033	55	0.077
unidentified	-	6	0.006	2	0.002	0	0
Total	-	1,033	1.0	1,137	1.0	713	1.0

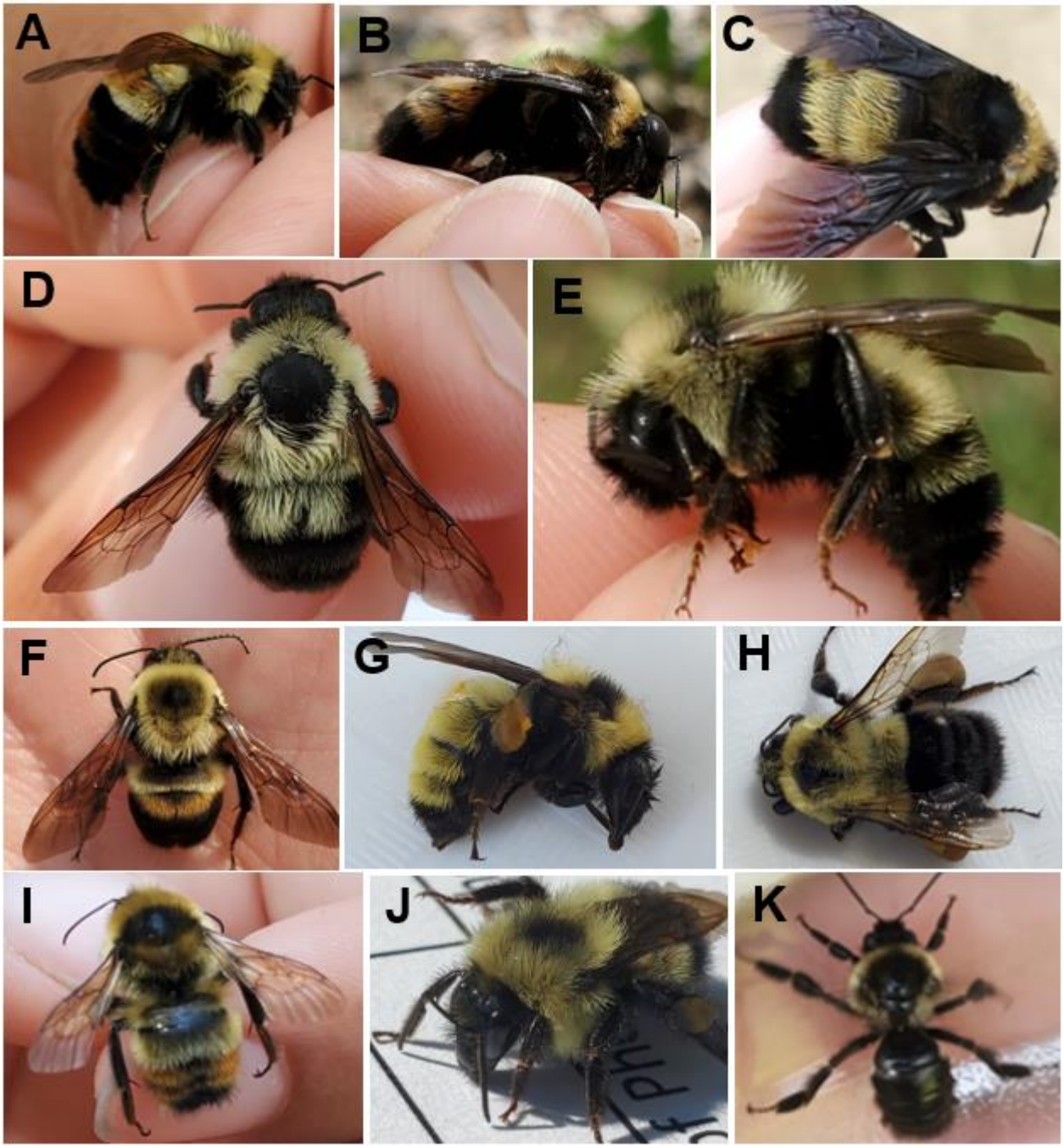

Figure 3. Bumble bee species documented in Lone Lake Park. A) Rusty-patched bumble bee (*B. affinis*); B) black and gold bumble bee (*B. auricomus*); C) American bumble bee (*B. pensylvanicus*); D) two-spotted bumble bee (*B. bimaculatus*); E) lemon cuckoo bumble bee (*B. citrinus*); F) brown-belted bumble bee (*B. griseocollis*); G) yellow bumble bee (*B. fervidus*); H) common eastern bumble bee (*B. impatiens*); I) red-belted bumble bee (*B. rufocinctus*); J) half-black bumble bee (*B. vagans*); and an K) unidentified bumble bee.

Conclusion

This bumble bee survey, along with previous observations[15], have confirmed the presence of rusty-patched bumble bees in Lone Lake Park. The rusty-patched bumble bee represented less than 1% of the total bumble bees documented in Lone Lake Park. For comparison, rusty-patched bumble bees comprised less than 1% of the observed bumble bees in the Minnesota Bumble Bee Survey[16] in parks in the Twin Cities from 2007-2019 overall. The proportion of rusty-patched bumble bees at individual parks ranged from 0-6% of observations (Evans, personal communication). A roadside survey conducted by the University of Minnesota[14] in 2018 found that rusty-patched bumble bees comprised less than 1% of all bumble bee observations. Although there are current bee survey efforts in Minnesota through the University of Minnesota and Minnesota Department of Natural Resources, as well as sightings documented through community science programs such as Bumble Bee Watch and iNaturalist, there are not enough systematic studies to assess the proportion of the statewide rusty-patched bumble bee population represented in Lone Lake Park, as the total population size is unknown at this time. There is, however, evidence that rusty-patched bumble bees forage in the park. Given typical foraging ranges of bumble bees of 1 km, it is possible that rusty-patched bumble bees may also nest within the park. The USFWS compiles data on rusty-patched bumble bees and should be contacted for inquiries regarding current known distribution.

Acknowledgements

Leslie Yetka, City of Minnetonka, coordinated the bumble bee surveys. Dr. Elaine Evans, University of Minnesota, provided data from the Minnesota Bumble Bee Survey.

Appendix A: Bumble bee observations

Survey	*Bombus* species	Female count	Male count	Queen count	Total
6/15/20	*bimaculatus*	47	0	3	50
	auricomus_pensylvanicus	11	0	0	11
	impatiens	4	0	0	4
	griseocollis	2	0	0	2
	vagans	0	0	2	2
	unknown	1	0	0	1
7/2/20	*bimaculatus*	3	0	0	3
	vagans	2	0	0	2
	auricomus_pensylvanicus	4	0	0	4
7/17/20	*impatiens*	44	0	1	45
	auricomus_pensylvanicus	15	0	0	15

[15] There have been 11 verified sightings of rusty-patched bumble bees in Lone Lake Park reported to the citizen science project Bumble Bee Watch since 2015. https://www.bumblebeewatch.org/ Accessed August 8, 2020.
[16] Evans, E. (2019) Minnesota Bumble Bee Survey. http://www.befriendingbumblebees.com/survey.html
[17]Boone, M.L., Evans, E., Wolf, A., Minser, H., Watson, J., & Smith, T.A. (2022) Notes from rusty patched bumble bee (Bombus affinis Cresson) nest observations. Insect Conservation and Diversity, 15(3): 380-384. https://doi.org/10.1111/icad.12564

	bimaculatus	93	112	2	207
	griseocollis	20	12	0	32
	vagans	26	1	0	27
	fervidus	0	1	0	1
	unknown	3	0	0	3
	citrinus	0	8	2	10
	affinis	0	1	0	1
	rufocinctus	7	0	0	7
7/31/20	*impatiens*	119	5	1	125
	bimaculatus	21	8	1	30
	griseocollis	23	48	0	71
	vagans	13	0	0	13
	auricomus_pensylvanicus	89	0	0	89
	citrinus	0	58	0	58
	rufocinctus	1	1	0	2
	unknown	2	0	0	2
8/11/20	*impatiens*	37	16	0	53
	bimaculatus	1	3	0	4
	griseocollis	1	14	0	15
	vagans	4	0	0	4
	auricomus_pensylvanicus	47	1	0	48
	citrinus	0	6	0	6
	rufocinctus	4	0	0	4
8/25/20	*impatiens*	9	43	0	52
	auricomus_pensylvanicus	11	1	0	12
	griseocollis	0	2	0	2
	citrinus	0	1	1	2
	rufocinctus	0	0	2	2
	vagans	7	5	0	12
6/14/21	*fervidus*	1	0	0	1
	bimaculatus	10	0	1	11
	impatiens	1	0	0	1
	griseocollis	1	0	0	1
	auricomus_pensylvanicus	5	0	0	5
6/28/21	*auricomus_pensylvanicus*	6	0	0	6
	rufocinctus	5	0	0	5
	fervidus	4	0	0	4
	impatiens	1	0	0	1
	vagans	2	0	0	2
7/12/21	*bimaculatus*	8	274	2	284
	griseocollis	0	3	0	3
	impatiens	5	1	0	6
	vagans	9	7	0	16
	fervidus	4	0	0	4

	auricomus_pensylvanicus	33	0	0	33
	affinis	2	0	0	2
	rufocinctus	2	0	0	2
7/26/21	*bimaculatus*	40	39	0	79
	impatiens	57	20	1	78
	griseocollis	4	26	1	31
	fervidus	2	2	0	4
	auricomus_pensylvanicus	77	1	1	79
	citrinus	0	53	0	53
	vagans	3	1	0	3
	rufocinctus	2	1	0	3
	affinis	0	4	0	4
8/9/21	*bimaculatus*	15	1	0	16
	impatiens	40	38	1	79
	auricomus_pensylvanicus	54	2	0	56
	fervidus	3	0	0	3
	citrinus	0	31	0	31
	rufocinctus	7	17	0	24
	griseocollis	0	9	0	9
	vagans	5	1	0	6
8/23/21	*impatiens*	39	78	0	117
	rufocinctus	0	18	0	18
	vagans	5	5	0	10
	citrinus	0	27	4	31
	auricomus_pensylvanicus	2	0	0	2
	unidentified	0	1	1	2
	griseocollis	0	11	0	11
6/14/22	*impatiens*	2	0	3	5
	bimaculatus	5	0	0	5
	vagans	0	0	3	3
	auricomus_pensylvanicus	1	0	0	1
	griseocollis	1	0	0	1
	impatiens	1	0	0	1
6/27/22	*vagans*	1	0	0	1
	bimaculatus	3	0	0	3
	auricomus_pensylvanicus	2	0	0	2
7/12/22	*vagans*	13	0	0	13
	rufocinctus	9	1	0	10
	auricomus_pensylvanicus	13	0	0	13
	bimaculatus	5	45	1	51
	impatiens	1	0	0	1
	griseocollis	0	7	1	8
	citrinus	0	2	0	2
7/26/22	*vagans*	11	0	0	11

7/26/22	*bimaculatus*	4	130	1	135
	griseocollis	0	21	2	23
	impatiens	11	1	0	12
	citrinus	0	56	0	56
	auricomus_pensylvanicus	10	0	0	10
	rufocinctus	1	3	0	4
	affinis	1	0	0	1
7/27/22	*impatiens*	41	4	3	48
	bimaculatus	16	32	0	48
	vagans	17	0	1	18
	auricomus_pensylvanicus	54	0	1	55
	griseocollis	0	13	0	13
	rufocinctus	5	1	0	6
	citrinus	0	9	0	9
	affinis	1	0	0	1
8/9/22	*griseocollis*	2	10	0	12
	impatiens	11	4	0	15
	vagans	4	1	0	5
	auricomus_pensylvanicus	35	7	0	42
	bimaculatus	0	4	1	5
	rufocinctus	1	1	0	2
	citrinus	0	4	1	5
8/25/22	*impatiens*	22	12	1	35
	auricomus_pensylvanicus	11	0	1	12
	rufocinctus	1	2	0	3
	vagans	4	0	0	4
	griseocollis	1	0	0	1
	fervidus	0	1	0	0
	citrinus	0	1	0	0

Appendix B: Floral species on which bumble bees were observed foraging

Scientific name	Common name	Status in MN
Agastache foeniculum	Blue giant hyssop	Native
Asclepias incarnata	Swamp milkweed	Native
Baptisia australis	Blue false indigo	Non-native
Chelone lyonii	Pink turtlehead	Non-native
Cirsium altissimum	Tall thistle	Native
Cirsium discolor	Field thistle	Native
Cirsium vulgare	Bull thistle	Non-native
Cornus racemosa	Gray dogwood	Native
Erigeron sp.	Fleabane	Native
Eupatorium perfoliatum	Common boneset	Native

Eutrochium maculatum	Joe-pye weed	Native
Glechoma hederacea	Ground ivy	Non-native
Helenium autumnale	Common sneezeweed	Native
Helianthus occidentalis	Fewleaf sunflower	Native
Helianthus sp.	Sunflower species	Native
Heliopsis helianthoides	Smooth oxeye	Native
Hypericum perforatum	St. Johnswort	Non-native
Leonurus cardiaca	Motherwort	Non-native
Lotus corniculatus	Birds-foot trefoil	Non-native
Lythrum salicaria	Purple loosestrife	Non-native
Melilotus officinalis	Yellow sweet clover	Non-native
Monarda fistulosa	Beebalm	Native
Nepeta cataria	Catnip	Non-native
Penstemon digitalis	Foxglove beardtongue	Native
Persicaria pensylvanica	Pennsylvania smartweed	Native
Physostegia virginiana	Obedient plant	Native
Ratibida pinnata	Gray-headed coneflower	Native
Rosa blanda	Smooth wild rose	Native
Rubus sp.	Raspberry	Native
Rudbeckia hirta	Black-eyed Susan	Native
Securigera varia	Crown vetch	Non-native
Solanum dulcamara	Bittersweet nightshade	Non-native
Solidago canadensis	Canada goldenrod	Native
Thalictrum dasycarpum	Tall meadow rue	Native
Trifolium pretense	Red clover	Non-native
Trifolium repens	White clover	Non-native
Verbena hastata	Blue vervain	Native
Veronicastrum virginicum	Culver’s root	Native
Vicia cracca	Tufted vetch	Non-native