FLORAL AND FAUNAL RESEARCH ON UTILITY RIGHTS-OF-WAY AT STATE GAME LANDS 33, STATE GAME LANDS 103, AND GREEN LANE RESEARCH AND DEMONSTRATION AREAS

Research Report to Cooperators: 2018-2021

PENNSTATE
Altoona

https://sites.psu.edu/transmissionlineecology/

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Cover photographs (clockwise from top left): Right-of-way at State Game Lands (SGL) 33, six-spotted tiger beetle, milk snakes, indigo bunting nestlings. Photographs were taken by research team members during the summers of 2019 and 2020.

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INTRODUCTION

Integrated vegetation management on rights-of way

Electrical rights-of-way (ROW) vegetation management methods arrest plant growth and, therefore, provide early successional habitat that is compatible with electrical powerlines and favored by many floral and faunal species (Komonen et al. 2012, Wagner et al. 2014, Mahan et al. 2020, Russo et al. 2021). One way to achieve this compatible vegetation cover is through Integrated Vegetation Management (IVM). IVM utilizes a variety of management approaches to achieve a desired vegetation community type. These approaches may include chemical, manual, and mechanical techniques (e.g., Johnstone 2008, Mahan et al. 2020). The response of vegetation to IVM is important because vegetation communities can change within a relatively short time due to natural plant succession. In general, the 2 phases of IVM along electrical ROW are: 1) use of a herbicidal spray or mechanical treatment to initially control the density of target (non-compatible) trees, i.e., those that have the potential of growing to a height that is not compatible with safe ROW maintenance, such as maples, hickories, or oaks, and 2) development of a tree-resistant plant cover type to reduce target tree invasion of the ROW. On electrical ROW, the wire zone - border zone method (Figure I-1) is recommended to provide diverse wildlife habitat (Yahner 2004), with low-lying vegetation in the wire zone and taller vegetation in the border zone to create habitat diversity.

The use of IVM to establish early successional habitat under electrical transmission lines supports a taxonomically diverse array of species. These early successional species include numerous grasses, sedges, forbs, pollinators (bees, butterflies, moths, beetles, flies), reptiles, grassland and shrubland birds, mammals, and pollinators (Bramble et al. 1997, Litvaitis et al. 1999, Yahner et al. 2004, 2007, Komonen et al. 2013, Wagner et al. 2014, Mahan et al. 2020, Russo et al. 2021). In the northeastern U.S. and elsewhere, where early successional habitats are decreasing (Litvaitis et al. 1999, DeGraaf and Yamasaki 2003), ROW can provide critical habitat for numerous species of conservation concern that rely on this habitat type (DeGraaf and Yamasaki 2003).

Wildlife response and current research

This research is a continuation of a project that began in 1953 when researchers at The Pennsylvania State University designed an initial study to test the effects of herbicides and other vegetation management approaches on natural resources including plant communities and various wildlife groups (e.g., Bramble and Byrnes 1983) in electrical ROW. The project was initiated on State Game Lands (SGL) 33 in Centre County, Pennsylvania with several partners including Pennsylvania Electric Company (now First Energy Corp.), the Pennsylvania Game Commission, DuPont, AmChem (now Corteva Agriscience) and Asplundh Tree Expert Co.

Similar studies have been conducted at a companion site, Green Lane Research and Demonstration Area (GLR&D), in Montgomery County, Pennsylvania since 1987. For this report, we added a third research site at State Game Lands (SGL) 103 in Centre County, PA. This research area was added to provide an example of a 100-foot-wide transmission line to contrast with the wider 250-ft transmission line corridors at SGL 33 and GLR&D.

The year 2018 marked the 65th year of the original study - making SGL33 the site of the longest continuous study measuring the effects of herbicides and mechanical vegetation management practices on plant diversity, wildlife habitat, and wildlife use within a ROW. This report represents the findings from research conducted from 2018-2021 on the effects of ROW vegetation maintenance on vegetation, bird, snake, beetle, and bee communities (https://sites.psu.edu/transmissionlineecology). For birds, we include date from prior to 2018 to better show breeding bird trends on the ROWs.

Legacy vegetation treatments

For 65 years, multiple methods of vegetation management were evaluated side by side to determine the effects on floral and faunal communities on a ROW at SGL 33 and GLR&D. Manual (and later, mechanical) brush cutting was compared to the use of herbicides in their effectiveness at controlling vegetation. Different types of herbicides and various means of application were also evaluated. Initially, at SGL 33, six mechanical and herbicidal treatment sites (with replicates) were established (Table I-1; legacy treatments). These legacy treatments included: hand-cutting (HC), mowing (M), mowing plus herbicide (MH), foliar spray (F), stem foliar spray (SF), and basal low volume (BLV) (to be precise, basal high volume was used before BLV) (Table I-1). At the GLR&D site, five legacy treatments (no BLV) each with two replicates were established in 1987. In addition, the treatments were managed to include a 50-foot (16 m) border zone on each side with a 75 foot (23 m) wire zone (Figure I-1). Each treatment replicate (unit/plot) was approximately 3 acres (1.2 ha) in size at SGL 33 and 2.5 acres (1 ha) in size at GLR&D. At SGL 103, two units/plots were established along the 100-foot-wide transmission line. These plots were approximately 1.2 acres (0.5 ha) in size and contained 20-foot buffers on each side.

Current vegetation treatment terminology and approaches

Over the years, IVM terminology has changed and current treatment names and approaches reflect this evolution in vegetation management (Table I-1). Current terminology and approaches used in the industry are: mowing cut stubble (MCS) instead of MH, low volume basal (LVB) instead of BLV, and high volume foliar (HVF) instead of foliar spray (F). In addition, IVM has established stable, early successional plant communities that are predominately treated with low-volume foliar (LVF) applications because stem/foliar (SF), a high-volume treatment, is no longer necessary. Mowing and hand-cutting remain consistent in terminology and approach.

Despite these general treatment approaches, *actual* vegetation treatments are adaptive and based on integrated vegetation management (IVM). Therefore, treatment labels and terminology may not reflect the most recent IVM treatment applied---creating some confusion. In general, sites are visited and "reset" once every 4-6 years based on IVM prescriptions with mechanical and chemical treatments applied in order to maintain an early successional stage of vegetation within the ROW. Because prescribed treatments were in response to vegetation composition and structure present on each unit/plot, treatments were not necessarily applied consistently at each 4-6 year vegetation maintenance period (Table I-1). For example, at SGL 33, legacy site '**F**1' which, in current terminology, is a high-volume foliar treatment (HVF), was *actually* maintained in 2016 using the LVF treatment (Table I-1, Figure I-2). These changes have resulted in only three units/plots at SGL 33 that have been consistently managed ---one mowing unit (**M**4) and the two hand cut units (**HC**1, **HC**2). Furthermore, over the years, certain treatment units have been rotated out of use. There is no longer a MCS treatment 2, for example at SGL 33. Treatments were applied at GLR&D in 2014 (versus late 2016 at SGL 33) and have remained consistent over the years (Appendix A). At SGL 103, the transmission line ROW was treated in summer of 2018 and an IVM approach was used. At that time, a **LVF** application was prescribed and an average of 3 gal/acre of herbicide was applied.

In some cases, land managers also visit the ROW bi-annually and spot-treat any incompatible trees that may have been missed during regularly scheduled treatment applications. These inspections are conducted with the priority of ensuring that the vegetation does not interfere with the electrical transmission lines. At these annual visits, herbicide is applied only where it is needed on non-compatible plant species (e.g., potential canopy tree species that have the ability to grow to a height that could interfere with electric lines). Due to these recent developments, we use acronyms to represent the legacy plot names (**M, HC, F, SF, BLV, MH**). However, the reader must remain cognizant that these acronyms do NOT necessarily represent the most recent vegetation management treatment applied. In each section of this report, we remind the reader of the most recent IVM treatment applied to these units/plots. This usage is an artifact of study design and database development. Table I-1, Figure I-2, and Appendix A also should be referenced to understand the most recent treatments at each unit/plot.

Outreach

The data that was, and is, generated from the ROW project continues to be vital and practical in understanding the implications of IVM on ROW maintenance and on floral and faunal communities. Additionally, SGL 33 is regularly toured by vegetation management professionals, conservationists, sportsmen, foresters, policy makers, and students as it exemplifies one of the best, if not the best, representation of long-term study of electrical powerline management techniques. Over the past 3 years, we have shared numerous public outreach, academic, and industry presentations and articles (Appendix B) - continuing a long tradition of disseminating the findings from these important research and demonstration projects (Figure I-3).

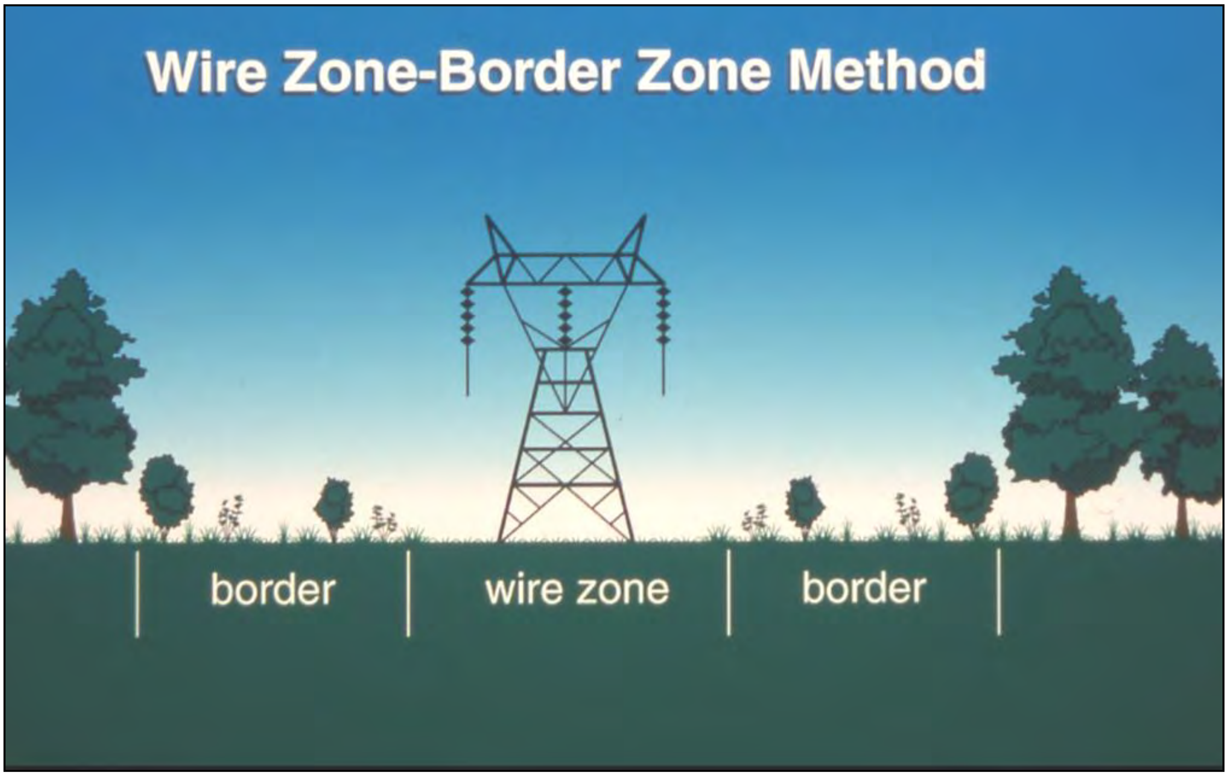

Figure I-1. Wire Zone - Border Zone method of integrated vegetation management at State Game Lands 33 and Green Lane Research and Demonstration Area. The border zone when established in 1987 was approximately 50 feet wide (16 m) on either side of the right-of-way with a 75 foot (23 m) wire zone. In 2016, the border zone was reduced to ~ 20-30 feet in width in order to ensure compliance with new federal standards on transmission line clearances.

Table I-1. History of vegetation acronyms, treatments, terminology, and most recent vegetation treatment applied at State Game Lands 33. For more information about Green Lane Research and Demonstration Area information, see Appendix A.

Legacy acronym and replicate used to identify units/plots	Legacy treatment applied when establishing each unit/plot	Current terminology used in the industry (acronym)	2016 treatment applied
HC1	Hand Cut Unit 1	Hand Cut (HC)	Hand Cut
BLV3	Basal Low Volume Unit 3	Low Volume Basal (LVB)	Low Volume Basal
MH1	Mow Herbicide Unit 1	Mow Cut Stubble (MCS)	Low Volume Foliar
BLV1	Basal Low Volume Unit 1	Low Volume Basal (LVB)	Low Volume Basal
F1	Foliar Spray Unit 1	High Volume Foliar (HVF)	Low Volume Foliar
M1	Mowing Unit 1	Mowing (M)	Low Volume Foliar
BLV4	Basal Low Volume Unit 4	Low Volume Basal (LVB)	Low Volume Basal
HC2	Hand Cut Unit 2	Hand Cut (HC)	Hand Cut
SF1	Stem Foliar Unit 1	Low Volume Foliar (LVF)	Low Volume Foliar
M2	Mowing Unit 2	Mowing (M)	Low Volume Foliar
BLV2	Basal Low Volume Unit 2	Low Volume Basal (LVB)	Low Volume Basal
MH3	Mow with Herbicide Unit 3	Mow Cut Stubble (MCS)	Low Volume Foliar
SF2	Stem Foliar Unit 2	Low Volume Foliar (LVF)	High Volume Foliar
F2	Foliar Spray Unit 2	High Volume Foliar (HVF)	High Volume Foliar
M4	Mowing Unit 4	Mowing (M)	Mowing
C1	Integrated Vegetation Management-LVF	Integrated Vegetation Management (IVM/LVF), no borders	Low Volume Foliar, no borders
C2	Integrated Vegetation Management-LVF	Integrated Vegetation Management (IVM/LVF), no borders	Low Volume Foliar, no borders

Plot	Original Application	2012 Application
HC1	Hand Cut Only	Hand Cut Only
BLV3 (BHV1)	Basal Low Volume	Low Volume Basal
MH1	Mow with Treatment	High Volume Foliar
BLV1	Basal Low Volume	Low Volume Basal
F1	High Volume Foliar	Ultra Low Volume Foliar
M1	Mowing Only	Mowing Only
BLV4 (BHV2)	Basal High Volume	Low Volume Basal
HC2	Hand Cut Only	Hand Cut Only
SF1	Stem Foliar	Ultra Low Volume Foliar
M2	Mowing Only	Mowing Only
BLV2	Basal Low Volume	Low Volume Basal
MH3 (MH2)	Mow with Treatment	Ultra Low Volume Foliar
SF2	Stem Foliar	High Volume Foliar
F2	High Volume Foliar	High Volume Foliar
M4 (M3)	Mowing Only	Mowing Only
C1	Unknown	Unknown
C2	Unknown	Unknown

Figure I-2. Vegetation management treatment history at State Game Lands 33 Right-of-Way study area. Acronyms represent original (legacy) treatment applications. Colored shading on map indicates areas treated with current vegetation management prescriptions in 2016. As indicated, only one mowing (**M4**) and both hand cutting plots/units (**HC1, HC2**) have retained their legacy treatment.

Figure I-3. Project cooperators and researchers visit the right-of-way research and demonstration site at State Game Lands 103 in September 2018.

Novel Coronavirus (COVID 19) Safety Precautions

The 2020 field research was conducted with strict COVID-19 precautions in place. Under our the COVID Safety Plan, all field personnel drove separately to SGL 33 and SGL 103 wore masks for the entirety of their field work, and maintained social distancing at all times. All field personnel were provided with their own supply of masks, disinfectant wipes, and hand sanitizer. Everyone took their temperatures daily, and any illness or potential exposure was reported immediately to the team. In the case of illness/exposure, a quarantine period and a negative COVID test result would be necessary for personnel to return to work. In addition, due to travel restrictions placed by the Commonwealth of Pennsylvania and Penn State, no research was conducted at GLR&D in 2020.

Because of COVID-19 restrictions, neither bee nor beetle identifications were able to be verified in time for this report. Also, non-bee specimens collected in the Hymenoptera Pollinator Survey have been counted, but not all have been identified. ***ALL BEE AND BEETLE IDS IN THIS REPORT ARE "TENTATIVE"***, and therefore diversity indices for bees and beetles have not been calculated, multi-year comparisons of bee taxa richness and diversity for SGL33 have not been made, and the discussion sections will not address potential treatment effects on bees at SGL33 and SGL103, or on beetles at SGL33.

Identifications will be verified later this year, and a complete report on the 2019 Penn State Hymenoptera Pollinator Survey and the 2020 Penn State Ground Beetle (Carabidae) Survey will be completed by 30 June 2022.

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VEGETATION

Methods

Vegetation was measured on the SGL 33, SGL 103, and GLR&D sites in July 2019. We sampled vegetation in late July to correspond to maximum plant emergence at our study sites - realizing the plants with short growing and/or blooming seasons (e.g., spring ephemerals) may be missed. The timing of vegetation sampling represented 3-yr post treatment at SGL 33, 1-yr post treatment at SGL 103, and 5-yr post treatment at GLR&D. We used sampling techniques developed for the research project (see Bramble et al. 1991, Mahan et al. 2020) that, in turn, had been modified from vegetation sampling techniques developed by Braun and Blanquet (see Moore 1962). This vegetation sampling approach is transect-based and species are identified and documented as follows: non-compatible trees at least 1 foot (0.3 m) in height were recorded within 2-3 permanent transect belts (each 66 feet [20.1 m] long x 6.6 feet [2 m] wide) in wire zones and within 2-4 corresponding permanent transect belts (each 33 feet [10.1 m] long x 6.6 feet [2 m] wide) that extended to within adjacent border zones of each unit. Only trees rooted in transect belts were counted, i.e., trees rooted outside the belt with foliar extending into the belt were not counted. We then calculated the total number of non-compatible trees/acre in each treatment unit and zone (a typical transect in a wire zone, was equivalent to 0.10 acre). We noted the maximum height (to the nearest foot) of non-compatible trees in both wire and border zones of each unit in the vicinity of each transect belt. Plant cover types were determined within a 16.5-feet (5 m) radius plot placed in the center of each transect belt in wire and border zones, using the Braun-Blanquet method for estimating abundance and sociability of major plants. From these estimates within each treatment unit, we calculated plant cover type(s) in each unit as forb, grass, shrub, or tree. Furthermore, we calculated the percent cover of the major cover type at each treatment unit. Finally, plant species and relative abundance were noted with each center plot. Where possible, we compared our data to unpublished reports (see Yahner 2012, for example) or past published studies of plant species richness from our study sites (e.g., Yahner and Hutnik 2005, Yahner et al. 2008, Mahan et al. 2020).

Note: For consistency, treatment acronyms for current vegetation management applications are: M=mowing, LVF = low volume foliar, HVF=high volume foliar, LVB=low volume basal, HC=handcutting.

Results

Target tree (non-compatible species) invasion and cover type

<u>State Game Lands 33</u>

Vegetation management treatments were applied at SGL 33 in late August 2016. Invasion by individuals of non-compatible tree species on the ROW increased from July 2016 (4-yrs post treatment) to July 2019 (3-yrs post treatment) in the wire and border zones. Only one unit in the wire zone (**MH**2) had fewer non-compatible trees per acre than in 2016 (Table V-1). As in previous years, wire zone units with the lowest density of non-compatible trees were those treated in 2016 with the LVF and HVF application. The only treatment with no recorded non-compatible trees was the wire zone of **BLV3** treated in 2016 with LVB application (Table V-1). Handcut treatments (**HC**) continued to have the highest density of non-compatible trees in the wire zone. In general, these findings reflect those of earlier studies that indicate that integrated vegetation management is effective at limiting the invasion of non-compatible overstory tree species in ROW compared to mechanical treatments (Yahner and Hutnik 2005, Yahner et al. 2008, Mahan et al. 2020). As expected, border zones, contained higher density of non-compatible tree species compared with the wire zone. As explained earlier in this report, border zones are managed to permit greater shrub and tree growth (promoting wildlife habitat diversity) and, therefore, higher densities of woody vegetation are permitted in these areas. In addition, because border zones are located adjacent to mature forest, there is a greater likelihood for non-compatible tree species to naturally colonize and persist in this zone (Yahner 2012a).

Due to management objectives, border zones across the study area were dominated by the shrub cover type. **HC** units were dominated by trees in the wire zone. All other treatments and units varied in the dominant cover type in the wire zone. In general, however, 75% of the wire zone units (regardless of treatment) were dominated (50% or more by area covered) by forbs during sampling 2019. This cover indicates ecological succession from 2016 where grass dominated the wire zone at **MH** and **SF** units (Table V-1).

<u>Green Lane Research and Demonstration Area</u>

In the wire zone, invasion by individuals of non-compatible tree species on the ROW increased in plots/units sampled in 2016 to those sampled in 2019 when all plots/units were considered together zone but increased in the border zones when all units were considered together (Table V-2). However, when considered individually, all wire zone treatments have essentially the same density of non-compatible tree species with 300-350 trees/acre in each treatment unit. Therefore, we could not differentiate the effect of ROW treatment (mechanical, herbicide) on non-compatible tree invasion within the wire zone at GLR&D. We believe one reason for this lack of differentiation among treatments is due to the complicating effects of the immediately adjacent ROW which is managed by Pennsylvania Power and Light (PPL) electric utilities according to separate ROW maintenance guidelines and schedule. As such, our vegetation treatment replicates are not isolated and, we believe, vegetation response is affected by the vegetation treatment and management on the immediately adjacent ROW.

As expected, border zones contained higher density of non-compatible tree species compared to the wire zone (TableV-2). Border zones are managed to permit greater shrub and tree growth and, therefore, higher densities of woody vegetation persist in these units.

Vegetation succession is advancing in the wire zone at GLR&D with forb or shrub as the dominant ($\geq$ 50% area covered) cover type during sampling in 2019 (Table V-2). During vegetation sampling in 2016, no units/plots were dominated by shrubs in the wire zone and the **MH** unit was dominated by grass.

State Game Lands 103

We did not sample vegetation at SGL 103 prior to 2019 so we have no historical vegetation with which to compare our units/plots (Table V-3). However, the density of non-compatible trees present in the wire zone was higher (850 trees/acre) than in the wire zone of similarly treated units (LVF) at the wider SGL 33 (620 trees/acre). This difference is more striking with the consideration that the units at SGL 103 were sampled 1-yr post treatment and those at SGL 33 were sampled 3-yrs post treatment. The narrower width of the ROW at SGL 103 may make invasion by trees from the adjacent mature forest easier due to seed dispersal.

Maximum tree height

State Game Lands 33

As in past studies, maximum non-compatible tree heights varied among zones and treatment units. As expected, maximum height in border zones was higher than in wire zones (Table V-4). Among wire zone treatments, non-compatible trees were taller in **HC** (20 feet) than in other treatment units. During sampling in 2019, the most commonly encountered tallest non-compatible tree species was black cherry (*Prunus serotina*) replacing oaks (*Quercus*) which were most commonly encountered during sampling in 2016.

Green Lane Research and Demonstration Area

As in past studies, maximum non-compatible tree height varied among zones and treatment units. As expected, maximum height in borders zones was higher than in wire zones (able V-5). Among wire and border zone treatments, there was very little variation among maximum tree height (Table V-5). One note of conservation interest is that white ash (*Fraxinus americana*) continues to persist at the GLR&D area. This is despite wide-spread mortality (~95%) of this tree species due to emerald ash borer—an invasive, non-native insect pest that has been present in PA since 2007 (dcnr.pa.gov). Red cedar continues to be one of the tallest trees in **SF** and **F** treatments indicating natural successional processes at GLR&D (Yahner 2012).

State Game Lands 103

The tallest non-compatible tree species encountered during sampling was black cherry reaching a maximum height of 7 feet in the wire zone and 20 feet in the border zone. A 12-foot red maple (*Acer rubrum*) was also encountered in the wire zone. We expect black cherry to be the most commonly encountered non-compatible tree at this site due to its location along the Allegheny plateau where black cherry comprises 25 % of forest cover (fs.usda.gov).

Compatible plant species richness

Plant species richness of vegetation compatible with ROW management remains highest (84% of plants are native) at SGL 33 as compared to GLR&D (67% native plants) and SGL 103 (72% native plants—see Tables V-7, V-9, V-9). We attribute these differences primarily to landscape-level effects rather than unit/plot vegetation treatment affects. Both SGL 33 and SGL 103 are located within a landscape matrix of continuous mature forest on state-owned lands—therefore disturbance and human traffic (two mechanisms of non-native plant distribution) are minimized. In contrast, GLR&D is located in a suburban landscape matrix within private lands with increased traffic. In addition the immediately-adjacent PPL ROW at our GLR&D site makes the control and management of non-native plants more complicated because the PPL ROW is managed inconsistently from our study. Finally, the width of SGL 33 may make invasion by non-native plants species more difficult as non-native species are more common along edges and within small habitat reserves that have higher public access (see Dolan et al. 2011). One other observation of note at SGL 33 is that the sites without borders (IVM/LVFNB/**C**) had the lowest native plant species richness, perhaps indicating that the presence of border zones contributes to plants species richness within the wire zone.

Discussion

Integrated vegetation management requires basic and applied knowledge coupled with appropriate effort and treatment approaches that include mechanical and chemical approaches (Nowack and Ballard 2005). The overall goal of IVM is to achieve specific management objectives that, in the case of ROW, result in early successional, stable vegetation communities. As noted, chemical application is part of the IVM 'tool box' and our research indicates proper use of herbicides is compatible with supporting native plant communities that, in turn, support a variety of wildlife species.

Selective use of herbicides could assist with the removal of non-native vegetation from the landscape. The increase in non-native plants is especially evident on SGL 33 where the proportion of the plant community has increased over the past decade. The compatibility of native vegetation with selective use of herbicide has been documented in our published research (e.g., Mahan et al. 2020) and in other research in North America. For example, when post-emergent herbicide was applied to research plots with the goal of removing non-native Japanese stiltgrass (*Microstegium vimineum*) in Indiana, forb richness was greater than in untreated plots and was equivalent to hand-weeding and much more efficient (Flory and Clay 2009).

The message of the compatibility of proper herbicide use and wildlife habitat management should not be understated as more areas limit or prevent the use of herbicides in vegetation management. For example, in Quebec, chemical herbicides have been banned on Crown forest lands since 2001 (Thiffault and Roy 2011). This ban has created numerous challenges in terms of increased cost and reduced forest regeneration/productivity despite the fact that herbicides, when used in a targeted and appropriate context, have not been shown to reduce the species richness, diversity, or abundance of vertebrate wildlife in forest ecosystems - especially when compared to agricultural systems (see Sullivan and Sullivan 2002 for a review related to glyphosate; Miller and Miller 2004).

In general, our study supports the findings of other researchers that non-selective mechanical (e.g., mowing, hand-cutting) facilitated the invasion of target trees in transmission line ROW (Mercier et al. 2001; De Blois et al. 2004; Kettenring and Adams 2011). Integrated vegetation management on ROW which includes selective herbicide treatment, provides opportunities for maintaining native plant species richness while limiting the invasion of target tree species. While no rare plants were recorded in our study plots, many common plant species found along the ROW corridor, such as *Rubus* and *Solidago,* have ecological importance in terms of ecosystem function in food webs. *Solidago* (goldenrods), in particular, plays a central role in supplying late-season nectar and pollen for flower visitors (Wagner et al. 2014). In addition, the vegetation structure and native plant species richness maintained under transmission lines, in part, determines what subsets of vertebrates will forage, nest, or shelter along a right-of-way.

Table V-1. Number of non-compatible trees/acre (> 1 foot tall) in wire zones and border zones of 12 treatment units and 5 treatments on the State Game Lands 33 Rights-of-Way Research and Demonstration Area sampled 3-yrs post treatment in 2019. For comparison, data from 2016 (4-yr post treatment) are in parentheses. Percent coverage of major vegetation type (forb, grass, shrub, or tree) for wire zone is also presented. Borders, if present, were all dominated by shrubs or trees (handcut; **HC**).

Legacy Treatment/Plot Acronym	Replicate Treatment Applied 2016-herbicide amount*	Wire Zone	Border Zone	Dominant cover type - wire zone
Mowing/**M**	4 M-0 gal	300 (0)	5200 (1700)	95% Forb (Forb)
Mowing plus herbicide/ **MH**	1 LVF-0.5 gal	500 (200)	3000 (1300)	50% Forb (Grass)
	2 LVF-0.5 gal	100 (300)	2900 (700)	85% Forb (Grass)
Stem foliar/**SF**	2 HVF-25 gal	500 (200)	1500 (1200)	85% Forb (Grass)
Foliar spray/**F**	1 LVF-3.6 gal	300 (100)	3200 (1200)	75% Forb (Forb)
	2 HVF-75 gal	400 (100)	2700 (1000)	95% Forb (Forb)
Basal low volume/**BLV**	1 LVB-2.5 gal	500 (200)	3500 (1400)	50% Forb (Shrub)
	3 LVB-2.9 gal	0 (0)	1900 (700)	95% Forb (Forb)
Hand cut/**HC**	1 HC-0 gal	12000 (4700)	6400 (8200)	50% Tree (Shrub)
	2 HC-0 gal	6600 (1400)	2900 (5100)	60% Tree (Shrub)
Control no border/**C****	1 LVF-3.5 gal	600 (400)	NA	Shrub (Shrub)
	2 LVF-3.5 gal	1600 (1000)	NA	Forb (Forb)

*M=mowing, LVF = low volume foliar, HVF=high volume foliar, LVB=low volume basal, HC=handcutting
**Also referred to as Low Volume Foliar No Border (LVFNB) in other portions of this report.

Table V-2. Number of non-compatible trees/acre (> 1 foot tall) in wire zones and border zones of 10 treatment units and 5 treatments on the Green Lane Rights-of-Way Research and Demonstration Area sampled 5-yrs post treatment in 2019. For comparison, data from 2016 (2-yrs post treatment) are in parentheses. Percent coverage of major vegetation type (forb, grass, shrub, or tree) for wire zone is also presented (for comparison, data from 2012 are in parentheses). Borders were all dominated by shrubs. Although application methods and herbicide concentrations are available for GLR&D site (Appendix A), total amount of herbicide applied per ha were not available for Green Lane.

Legacy Treatment/Acronym	Replicate Treatment Applied 2014-herbicide amount*	Wire Zone	Border Zone	Dominant cover type - wire zone
Mowing/**M**	1 M-0 gal	350 (200)	800 (400)	40% Forb (Forb)
Mowing plus herbicide/ **MH**	1	400 (400)	300 (300)	50% Forb (Grass)
Stem foliar/**SF**	2	450 (400)	450 (400)	70% Shrub (Forb)
Foliar spray/**F**	1	300 (200)	1400 (1400)	80% Forb (Forb)
Hand cut/**HC**	1 HC-0 gal	300 (100)	1700 (100)	60% Shrub (Forb)

*M=mowing, LVF = low volume foliar, HVF=high volume foliar, LVB=low volume basal, HC=handcutting

Table V-3. Number of non-compatible trees/acre (> 1 foot tall) in wire zones and border zones of 2 treatment units and 1 treatment on the State Game Lands 103 100-ft Right-of-Way sampled 1-yr post treatment in 2019. Percent coverage of major vegetation type (forb, grass, shrub, or tree) for wire zone is also presented. Borders were all dominated by shrubs.

Treatment	Replicate Treatment Applied 2018-herbicide amount*	Wire Zone	Border Zone	Dominant cover type - wire zone
Integrated Vegetation Management (IVM)	1 LVF-3 gal	700	3000	55% Forb
	2 LVF-3 gal	1000	1700	90% Forb

* LVF = low volume foliar

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Table V-4. Height (ft) of tallest tree species in wire zones and border zones of 12 treatment units and 5 treatments on the State Game Lands 33 Rights-of-Way Research and Demonstration Area sampled 3-yrs post treatment in 2019. For comparison, data from 2016 (4-yrs post treatment) are in parentheses.

Legacy Treatment/Acronym	Replicate Treatment Applied 2016-herbicide amount*	Wire Zone	Border Zone
Mowing/**M**	4 M-0 gal	3 White Oak (0)	15 Chestnut Oak (12)
Mowing plus herbicide/ **MH**	1 LVF -0.5 gal 3 LVF-0.5 gal	2 Red Maple (1) 3 Hawthorn (2)	25 Red Maple (17) 25 Red Maple (25)
Stem foliar/**SF**	2 HVF-25 gal	6 Black Cherry (5)	22 Red Maple (20)
Foliar spray/**F**	1 LVF-3.6 gal 2 HVF-75 gal	6 Red Oak (6) 6 Hawthorn (6)	25 Red Maple (15) 30 Black Cherry (7)
Basal low volume/ **BLV**	1 LVB-2.5 gal 3 LVB-2.9 gal	10 Red Maple (7) 8 Black Cherry (0)	25 White Oak (15) 10 Black Cherry (6)
Hand cut/**HC**	1 HC-0 gal 2 HC-0 gal	20 Black Cherry (15) 20 Black Cherry (15)	25 Chestnut Oak (15) 30 Black Cherry (15)
Control no border/**C****	1 LVF-3.5 gal 2 LVF-3.5 gal	12 Black Cherry (10) 12 Black Cherry (3)	NA NA

*M=mowing, LVF = low volume foliar, HVF=high volume foliar, LVB=low volume basal, HC=handcutting
**Also referred to as Low Volume Foliar No Border (LVFNB) in other portions of this report.

Table V-5. Height (ft) of tallest tree species in wire zones and border zones of 10 treatment units and 5 treatments on the Green Lane Research and Demonstration Area in 2019 (5 yrs post treatment). For comparison, height [ft] of tallest tree from 2016 (2-yrs post treatment) are in parentheses. Although application methods and herbicide concentrations are available for GLR&D site (Appendix A), total amount of herbicide applied per ha were not available for Green Lane.

Legacy Treatment/ Acronym	Replicate Treatment Applied 2014-herbicide amount	Wire Zone	Border Zone
Mowing/**M**	1 M-0 gal	10 American Elm (6)	15 American Elm (20)
Mowing + herbicide/ **MH**	1	10 Red Oak (3)	10 White Ash (15)
Stem foliar/**SF**	2	10 White Ash (5)	15 Red Cedar (14)
Foliar spray/**F**	1	10 Red Cedar (6)	15 Red Cedar (25)
Hand cut/**HC**	1 HC-0 gal	15 White Ash (4)	25 White Ash (35)

*M=mowing, LVF = low volume foliar, HVF=high volume foliar, LVB=low volume basal, HC=handcutting
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Table V-6. Height (ft) of tallest tree species in wire zones and border zones of 2 treatment units and 1 treatment on the State Game Lands 103 100-ft Right-of-Way sampled 1-yr post treatment in 2019.

Treatment	Replicate Treatment Applied 2018-herbicide amount*	Wire Zone	Border Zone
Integrated Vegetation Management	1 LVF-3 gal	7 Black Cherry	20 Black Cherry
	2 LVF-3 gal	12 Red Maple	20 Black Cherry

*LVF=low volume foliar

Table V-7. Total number of compatible plant species and compatible native plant species in wire and border zones of 12 treatment units and 5 treatments on the State Game Lands 33 Rights-of-Way Research and Demonstration Area sampled 3-yrs post treatment in 2019. For comparison, data 2016 (4-yrs post treatment) are in parentheses.

Legacy Treatment/ Acronym	Replicate Treatment Applied 2016-herbicide amount*	Wire Zone Total	Wire Zone Native; percentage	Border Zone	Border Zone	Average Border Zone Native; percentage
Mowing/**M**	4 M-0 gal	12 (13)	11 (10); 91% (77%)	12	9	9 (9.5); 86% (82%)
Mowing + herbicide/	1 LVF-0.5 gal	10 (11)	9 (8); 90% (73%)	13	9	9 (10.5); 82% (81%)
MH	3 LVF-0.5 gal	9 (13)	7 (8); 78% (62%)	14	9	9 (11.5); 78% (68%)
Stem foliar/**SF**	2 HVF-25 gal	9 (9)	7 (5); 78% (56%)	10	NA	10 (11); 90% (85%)
Foliar spray/**F**	1 LVF-3.6 gal	9 (9)	9 (7); 98% (78%)	9	8	8 (8); 83% (79%)
	2 HVF-75 gal	12 (10)	10 (7); 83% (70%)	10	NA	10 (13); 90% (85%)

Table V-7. (continued).

Legacy Treatment/ Acronym	Replicate Treatment Applied 2016-herbicide amount*	Wire Zone Total	Wire Zone Native; percentage	East Border Zone	West Border Zone	Average Border Zone Native; percentage
Basal low volume/**BLV**	1 LVB-2.5 gal	8 (10)	7 (7); 88% (70%)	13	8	10.5 (10.5); 91% (81%)
	3 LVB-2.9 gal	15 (10)	11 (13); 73% (68%)	15	18	13 (15.5); 79% (83%)
Hand cut/**HC**	1 HC-0 gal	9 (11)	10 (10); 88% (91%)	11	11	11 (11); 91% (85%)
	2 HC-0 gal	11 (25)	10 (20); 90% (80%)	na	12	8 (14); 72% (78%)
Control no border/**C****	1 LVF-3.5 gal	10 (10)	7 (7); 70% (70%)	na	na	na
	2 LVF-3.5 gal	9 (9)	7 (7); 78% (78%)	na	na	na

*M=mowing, LVF = low volume foliar, HVF=high volume foliar, LVB=low volume basal, HC=handcutting
**Also referred to as Low Volume Foliar No Border (LVFNB) in other portions of this report.

Table V-8. Total number of compatible plant species and compatible native plant species in wire and border zones of 5 treatment units and 5 treatments the Green Lane Rights-of-Way Research and Demonstration Area sampled 5 yrs post treatment in 2019. For comparison, data from 2016 (2-yrs post treatment) are in parentheses. Although application methods and herbicide concentrations are available for GLR&D site (Appendix A), total amount of herbicide applied per ha were not available for Green Lane.

Legacy Treatment/ Acronym	Replicate Treatment Applied 2014-herbicide amount*	Wire Zone Total	Wire Zone Native; percentage	Border Zone	Border Zone	Average Border Zone Native; percentage
Mowing/**M**	1 M-0 gal	35 (26)	23; 66% (65%)	13	15	8; 57% (61%)
Mowing plus herbicide/ **MH**	1	16 (20)	12; 75% (80%)	11	11	8; 73% (83%)
Stem foliar/**SF**	2	16 (18)	11; 69% (61%)	12	13	8.5; 68% (70%)
Foliar spray/**F**	1	20 (28)	14; 70% (70%)	13	11	7; 58% (63%)
Hand cut/**HC**	1 HC-0 gal	18 (20)	10; 56% (45%)	11	NA	8; 73% (57%)

*M=mowing, LVF = low volume foliar, HVF=high volume foliar, LVB=low volume basal, HC=handcutting

Table V-9. Total number of compatible plant species and compatible native plant species in wire and border zones of 2 treatment units and 1 treatment on the State Game Lands 103 100-ft Right-of-Way sampled 1-yr post treatment in 2019.

Treatment	Replicate Treatment Applied 2018-herbicide amount*	Wire Zone Total	Wire Zone Native; percentage	Border Zone	Border Zone	Average Border Zone Native; percentage
Integrated Vegetation Management	1 LVF-3 gal	19	15; 79%	9	15	11.5; 90%
	2 LVF-3 gal	9	6; 65%	6	5	5; 83%

*LVF = low volume foliar

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BREEDING BIRDS

Methods

We implemented fixed-width transect singing surveys to determine levels of breeding bird activity and abundance on the Rights-of-Way (ROW) at State Game Lands (SGL) 33 and 103 (Keller *et al.* , 2009). Four surveys were conducted per year during the breeding season between 20 May and 7 July for four consecutive years (2017-20) at SGL 33 and two years 2019-20 at SGL 103. A single 180 m long transect bisecting the wire zone was established on 10 sections contained within a 3 mile (4.6 km) stretch of ROW on SGL 33 in order to allow complete coverage of each ROW section (15 m of wire zone followed by 12 m of border zone were located perpendicular to each side of the transect) and to minimize double counting of individual birds during each survey (Figure I-1). Two sections of ROW on SGL 103 each contained a 250 m long transect that bisected the wire zone in order to allow complete coverage of the ROW sections (9 m of wire zone followed by 6 m of border zone were located perpendicular to each side of the transect). The location of each individual bird was recorded based on where it was first detected. Beginning in late August of 2016, land managers visited ROW sections on SGL 33 to treat vegetation communities based on Integrated Vegetation Management (IVM) prescriptions to maintain an early successional stage of vegetation within the ROW wire zone. We designed our study to incorporate sections of each chemical and mechanical management treatment initiated on SGL 33 in 2016 within the wire zone including high volume foliar (HVF) herbicide application (*n*=2), low volume foliar (LVF) herbicide application (*n*=2), low volume foliar herbicide application without an adjacent border zone/control (LVFNB/**C**) (*n*=2), low volume basal (LVB) herbicide application (*n*=2), hand cutting (HC) (*n*=1), and mowing (M) (*n*=1) (Table I-1; Figure I-2). The LVFNB/**C** ROW sections on SGL 33 that contained a 54 m wire zone and no border zones were included to examine the possible importance of border zones to breeding bird activity—in other words to act as controls (**C**) to examine the potential value of borders to breeding birds.

Beginning in late August of 2018, land managers visited SGL 103 to treat vegetation communities using the LVF herbicide application IVM prescription to maintain an early successional stage of vegetation within the wire zone of the ROW. The LVF sections of ROW on SGL 103 were added to the project to provide comparison of a frequently used IVM prescription on two different sized ROW easements (175 ft [54 m] wide ROW of SGL 33 versus the100 ft [31 m] wide ROW of SGL 103).

To further evaluate breeding bird activity, we conducted surveys during 2017 and 2019 on SGL 33 and during 2019 and 2020 on SGL 103 to assess avian productivity following guidelines established for the Pennsylvania Breeding Bird Atlas project (Laughlin *et al*., 1990; Wilson *et al.* , 2012). Each year two observers spent at least three one hour time periods spaced throughout the breeding season (minimum of six person-hours) at each of the 10 ROW sections on SGL 33 and the two ROW sections on SGL 103 to detect and monitor breeding bird activity and determine the breeding status (probable or confirmed) of each avian species (Laughlin *et al.* , 1990; Yahner *et al.* , 2004; Yahner *et al.* , 2005; Wilson *et al.* , 2012). Additionally, we followed the chronology of active nests that were discovered during the singing and productivity surveys through completion of nesting activity (*e.g.*, when the nest was determined to have been abandoned by the parents, preyed upon, or until nestlings successfully fledged). Each active nest was checked at 2-4 day intervals depending on weather conditions and projected time of nestling fledging (Yahner and Ross, 1995; Ross, 2001). Nesting attempts were deemed successful if any young survived and fledged the nest. In order to get a better understanding of possible nesting success within the different IVM sections (especially those with few nests monitored), we calculated daily survival rates (DSR) [DSR = 1 – (# Failed Nests/Total Nest Exposure Days)] for nests that were monitored on ROW sections at SGL 33 and 103 (Mayfield, 1961; Mayfield, 1975; Jehle *et al*., 204).

Bird singing and productivity surveys as well as nest monitoring conducted on SGL 33 during 2017 occurred prior to the three year time period of this specific project. However, results from these surveys are included because they provide valuable information concerning the first avian breeding season post IVM of the ROW on SGL 33 and can be used for comparison to results of productivity surveys conducted in 2019 that occurred three seasons post-application of the IVM prescriptions.

Results

Researchers detected between an average and standard error of 55.8 $\pm$ 4.7 and 82.5 $\pm$ 3.3 individual birds and 10.0 $\pm$ 0.6 and 11.8 $\pm$ 1.6 species per survey per year from 2017-20 within the entire ROW at SGL 33 (Table B-1). We observed between 24.3 $\pm$ 3.0 and 42.8 $\pm$ 4.9 individuals and 7.0 $\pm$ 0.4 and 7.8 $\pm$ 1.1 species per survey per year within the wire management zone and an average of 25.0 $\pm$ 2.4 and 41.8 $\pm$ 3.1 individuals and 8.0 $\pm$ 0.8 and 10.0 $\pm$ 0.9 species per survey per year within the border management zone of the ROW at SGL 33 from 2017-20 (Table B-1). Additionally, an average and standard error of 6.4 $\pm$ 1.3 and 9.3 $\pm$ 1.4 individual birds and 4.0 $\pm$ 0.7 and 5.0 $\pm$ 0.5 species per IVM section of ROW per survey per year from 2019-20 at SGL 103. Chestnut-sided warbler, field sparrow, eastern towhee, common yellowthroat, and gray catbird, and indigo bunting were the most abundant birds within the wire and border management zones at SGL 33 (Table B-2). Similarly, chestnut-sided warbler, eastern towhee, common yellowthroat, and gray catbird were the most abundant birds within the two low volume foliar wire and accompanying border management zones at SGL 103 (Table B-2).

Abundance and species richness of breeding birds was consistently lower within the mechanically treated wire zone sections of the ROW (Hand Cutting and Mowing) as well as the entire ROW combining the wire and border zone associated with mechanical treatments throughout the first four years of the IVM cycle compared to the IVM utilizing herbicide applications (High and Low Volume Foliar and Low Volume Basal Applications) (Table B-1). After initiating a new IVM cycle in the late summer and early fall of 2016 which included an approximate 10 ft (3 m) reduction in border zone on each side of the ROW, the abundance and species richness of breeding birds within the border management zone remained lower between 2017-20 compared to the more extensive border sections present at SGL 33 during the 2015-16 breeding seasons (Table B-1). The low volume foliar section of ROW without borders contained less individuals and species of breeding birds compared to the low volume foliar wire sections with accompanying borders for all 4 years (2017-2020) (Table B-1). Additionally, the no border section of ROW had the lowest bird abundance and richness of all sections for the first three years of the new IVM management cycle (2017-19) with the exception of the mowing only section that had complete removal of all vegetation within the wire zone and reduction of the border zone during late summer and early fall 2016 (Table B-1).

A new aspect of the current project was inclusion of breeding season bird research conducted on two low volume foliar IVM wire sections and accompanying borders sections of ROW on SGL 103 during 2019-20. Despite each of the SGL 103 ROW sections containing approximately 2000 m^2 less area than the sections of ROW on SGL 33, the abundance and species richness of birds was comparable between the low volume foliar sections of ROW at SGL 33 and 103 with respect to similar time within the five year IVM cycle and during the same calendar year.

Researchers identified a total of 15 (10 within the wire zone and 12 within the border zone) and 14 (7 within the wire zone and 12 within the border zone) species of birds displaying probable or confirmed evidence of breeding on the ROW sections at SGL 33 during 2017 and 2019, respectively (Tables B-2 and B-3). We observed a total of 8 (6 within the wire zone and 4 within the border zone) and 7 (3 within the wire zone and 4 within the border zone) species of birds displaying probable or confirmed evidence of breeding on the ROW at SGL 103 during 2019 and 2020, respectively (Tables B-2 and B-3). Sections of the ROW retaining borders and having the wire zone treated with low volumes of herbicide (low volume foliar and low volume basal) contained the highest average number of probable or confirmed breeding birds per ROW section, while the low volume foliar sections without borders had the lowest average number of bird species displaying evidence of breeding during 2019 (Table B-3). Of the confirmed breeding bird species on the ROW at SGL 33, researchers located and followed activity of 38 nesting attempts (24 located in the wire and 14 in the border management zones) by 11 different bird species during 2017 and 16 nesting attempts (11 located in the wire and 5 in the border management zones) by 7 different bird species during 2019 (Tables B-2 and B-4). Of the confirmed breeding bird species on the ROW at SGL 103, researchers located and followed activity of 7 nesting attempts (4 located in the wire and 3 in the border management zones) by 4 different bird species during 2019 and 8 nesting attempts (5 located in the wire and 3 in the border management zones) by 5 different bird species during 2020 (Tables B-2 and B-4).

Overall nesting success was higher at a 38% success rate (45% success rate in the wire management zone and 20% success rate in the border management zone) during the third breeding season since initiation of the IVM cycle in Fall 2016 compared to 32% success rate (29% success rate in the wire management zone and 36% success rate in the border management zone) during the initial breeding season following onset of the new IVM cycle on the ROW at SGL 33 (Table B-4). Overall nesting success was higher on the more narrow low volume foliar IVM sections of ROW at SGL 103 (60% total nest success in 2019 and 2020 combined) than the low volume foliar IVM sections of ROW at SGL 33 (31% total nest success in 2017 and 2019 combined) (Table B-4). No incidences of nest parasitism by brown-headed cowbird were detected within a total 69 possible nesting attempts initiated by all species combined during 2017 and 2019 at SGL 33 or 2019 and 2020 on SGL 103.

Discussion

In the northeastern United States, bird species using early successional vegetation are declining faster than other groups such as mature forest or water birds. Early successional habitats and their associated breeding bird communities are dramatically declining throughout the United States largely due to changing land use practices and the suppression of natural disturbances that create this type of ecosystem (King and Byers 2002, Schlossberg and King 2015). Electrical transmission ROW comprise approximately 2-3 million ha in the United States (Russell *et al.* 2005). In terms of managed, early successional habitat, electrical utilities can manage more land area than national parks and in New York alone, electric utilities manage nearly 10 times the amount of early successional habitat as land managed by federal, state, and non-governmental organizations (Confer and Pascoe 2003). Artificial disturbances that create and maintain vegetation in a state of permanent early succession such as utility line ROW have been documented as being valuable bird habitat and serve as nesting areas for a diversity of avian species (King and Byers 2002, Confer and Pascoe 2003, Forrester *et al.* 2005, Bulluck and Buehler 2006, Yahner *et al.* 2004, 2005, and 2008). Previous study of bird communities at SGL 33 and along a ROW containing the Green Lane Research and Demonstration Area (GLR&D), in Montgomery County, PA from the early 1980's through 2006 resulted in anywhere between 31-44 species of birds utilizing the ROW per year (Bramble *et al*. 1984 and 1994, Yahner *et al.* 2003 and 2008). During 2015-16, 29 species displayed evidence of breeding within the wire and border management zones at SGL 33 and from 2015-17 we detected between 16-21 species within the wire and 6-11 bird species within the border management zones at GLR&D. Within the current IVM cycle 2017-20 at SGL 33 and 2019-2020 at SGL 103, we detected between 17-21 species within the wire and border zones at SGL 33 and between 8-12 species on the ROW sections at SGL 103. Previously along the SGL 33 and GLR&D ROW and during the current IVM management cycle 2017-20 along both the SGL 33 and 103 ROW, the most abundant birds included early successional habitat obligates such as chestnut-sided warbler, common yellowthroat, eastern towhee, field sparrow, indigo bunting, and prairie warbler. Since artificial disturbances not created solely for natural resource conservation now make up a majority (approximately 80%) of early successional habitats, it is important to make informed decisions about how these areas are created and managed (Forrester *et al.* 2005, Bulluck and Buehler 2006, Schlossberg and King 2015). Therefore, ROW maintained using IVM within the wire zone and including adjacent border zone management such as those at SGL 33, GLR&D, and SGL 103 will be vital to and can be used as examples of early successional habitat management for bird conservation.

In response to public concern - predominantly from hunters - about the impact of vegetation management practices on wildlife habitat within electric transmission ROW, scientific study of the effects of different types of management began at SGL 33 in 1953 and has been accompanied by investigation of the influence IVM has on flora and fauna at GLR&D since 1987 (sites.psu.edu/transmissionlineecology). The effects of herbicide use often are equated to but should not be misconstrued or confused with the effects of pesticide use and the possible harm pesticides may demonstrate toward non-target plants and animals. Throughout the history of the research conducted at SGL 33 and GLR&D, numerous studies have demonstrated that proper use of herbicides via IVM has been compatible with and even beneficial to plant and animal communities (Bramble and Byrnes 1983, Bramble *et al.* 1984, 1997, and 1999, Yahner *et al*. 2001a, 2001b, and 2002, Yahner and Hutnick 2005b, Russo *et al*. 2021). In particular, Bramble et al. (1984) and Yahner *et al*. (2002) emphasized the benefits of IVM and positive response of bird communities to sections of ROW maintained in an early successional state with the proper use of herbicides. Our research findings from 2015-16 and during the current IVM cycle 2017-20 at both SGL 33 and SGL 103 further indicate support for IVM within the wire zone that incorporates the proper use of herbicides and accompanying border zone management before transitioning to mature forest within the surrounding landscape. Low volume foliar and low volume basal herbicide application on sections of SGL with accompanying border zones contained higher abundance and richness of breeding birds than the sites without border zones and hand cutting and mowing sites. Additionally, sections of ROW at both SGL 33 and 103 managed using herbicides were comparable or more beneficial to bird communities in terms of indices of productivity and nesting success than sections maintained via mechanical treatments. On both SGL 33 and 103, the most abundant bird species were either insectivores (chestnut-sided warbler, common yellowthroat, and indigo bunting) or omnivores (eastern towhee, field sparrow, and gray catbird); further highlighting the differences in effects of insecticides versus herbicides and supporting IVM incorporating the proper use of herbicides within the wire zone along ROW.

The wire zone - border zone IVM approach was applied along ROW on SGL in the mid-1980's. The zone located directly under transmission lines (wire zone) is managed to maintain a plant community comprised of grass, forbs and low shrubs in order to minimize reinvasion of tall-statured trees and shrubs that could possibly interfere with electrical transmission lines (Figure I-1). Both sides of the wire zone adjoin a narrow border zone dominated by of low- to medium-sized shrubby vegetation before the ROW transitions to natural forest. Past research on the SGL 33 and GLR&D indicated that within the ROW, nearly four times as many birds were observed in the shrubby border zones as in the wire zones (Yahner *et al*. 2002 and 2003). During 2015-16 and during the current IVM cycle 2017-20, we detected more individuals and more bird species within the border compared to the wire zone for both SGL 33 and 103. Additionally, avian productivity in the form of number of successful nests was comparable between border and wire zones despite the wire zone being more than three times the total area of the border zone in 2017-20. The sections of ROW at SGL 33 that contained no borders had the lowest number of individual birds, species richness, probable and confirmed bird productivity, and number of successful nests compared to the other management types that contain border zones with the exception of the mowing IVM section. The mechanically managed and no border ROW sections were the least beneficial to breeding birds following extensive treatment of the ROW at SGL 33 in the fall of 2016. Hence, the border zone is a very important component of IVM as it adds habitat for bird species that require a combination or mix of herbaceous vegetation, shrubs, and sapling tree species. Federal safety regulations requiring increased clearance between vegetation and the electrical transmission lines, the removal of 10 ft (3 m) of border on each side of the wire zone at SGL 33 in 2016 reduced the benefits of this habitat for breeding birds in the form of lower abundance, species richness, and indices of productivity. Even with reduction of border zone width during the current IVM cycle 2017-20, sections of the ROW containing the smaller borders were most beneficial to breeding birds. A concerted effort needs to be made to retain borders and border vegetation especially with the new federal safety regulations.

In addition to being a vital component of ROW management for bird species requiring shrubby habitat, the border zone can help minimize the impacts of management conducted within the wire zone at the beginning of an IVM cycle. Bramble *et al.* (1992b) and (1994) noted significant declines in bird populations following IVM at both SGL 33 and GLR&D. They also suggested that border zones were responsible for the retention of large and diverse bird populations on the ROW, as the wire zone - border zone method of IVM allowed for retention of shrub cover as the dominant vegetation component within the borders despite extensive changes to vegetation within the wire zone post treatment (Bramble *et al.* 1992a and 1994). We also detected the fewest birds in 2017 at SGL 33 following initiation of a new IVM in fall 2016 and at SGL 103 in 2019 following initiation of a new IVM in fall 2018 as compared to other years of the IVM cycle. Beside changes in avian abundance, breeding bird productivity can fluctuate quite dramatically from year to year and the presence of border zone vegetation may help to retain birds following extensive management within the wire zone (Chasko and Gates 1982). A nesting success rate of 68% was the highest recorded at SGL 33 in 1991-92 combined, whereas Yahner *et al*. (2004) detected differences in nesting success rates of 39% in 2002 compared to 65% in 2003. For comparison, nesting success was 42% at GLR&D within a similar time period (2003-04) and success rates average around 50% for different managed landscapes within Pennsylvania and Maryland (Bramble *et al.* 1994, Yahner *et al*. 2005). Confer and Pascoe (2003) found the probability of shrubland bird nests surviving to fledging was 55% on ROWs in forested regions in New York, Massachusetts and Maine. Estimated probabilities of nest success for prairie warbler, field sparrow and eastern towhee in Connecticut ROWs were less than 21% (Askins *et al.* 2012) and were similar to those calculated at 20% by Kubel and Yahner (2008) for golden-winged warblers (*Vermivora chrysoptera*) in a powerline corridor in Central Pennsylvania and by King *et al*. (2009) at just under 14% for shrubland birds in several ROWs in western Massachusetts. King *et al*. (2009) included data from ROW that were narrower than the ones in our study, however, these narrower ROW had much lower average nest success rates compared to wider corridors in the same region. On the ROW at SGL 33, 33% of nests fledged young in 2017 and 2019 combined (32% of 38 nests in 2017 and 38% of 16 nests in 2019), while 60% of nests fledged young on the two ROW sections at SGL 103 in 2019 and 2020 combined (71% of

7 nests in 2019 and 50% of 8 nests in 2020). Fluctuations in breeding bird productivity and nest success have been attributed to many causes including ambient temperature differences between years that alter plant phenology (availability of nest cover) and nest chronology and varying population levels of different nest predators (Pettingill 1985, Yahner *et al*. 2004). However, differences in both wire zone, border zone, and total ROW nest success rates at SGL 33 likely were due to reduction of available nest cover with changing vegetation characteristics in both zones following the initiation and implementation of a new IVM cycle in the late summer and early fall of 2016 and subsequent vegetation growth through Spring 2020. IVM including the wire zone - border zone method appears beneficial to early successional birds as evidenced by the continued presence of a diverse avian community throughout the history of research conducted at SGL 33 since the onset of these management practices in the early 1980's and current presence of an early successional bird community along the ROW at SGL 103. Low incidences of nest success reported by Kubel and Yahner (2008) and King *et al*. (2009) included narrow ROW corridors (> 100 ft (31 m) wide) and these had much lower average nest success rates compared to wider corridors in the same regions. However, our detection of higher nest success rates and higher daily nest survival rates along the ROW on SGL 103 as compared to similar IVM management sections on the SGL 33 ROW indicate that the combination of IVM and the wire-border zone technique can be utilized to benefit early successional bird populations on multiple sized ROW extending the minimum range to include 100 ft (31 m) easements. Over the next few breeding seasons, it will be important to gain further insight into how bird communities respond to changes in vegetation throughout the course of an IVM cycle along the ROW sections at SGL 103 (early versus late stages of the IVM cycle), as well as track the possible long-term effects the recent reduction of the border zones may have on early successional bird populations on the ROW at SGL 33.

Table B-1. Abundance (average ± standard error number of individuals per survey) and species richness (average ± standard error number of species) of breeding birds within wire and border zones on sections of right-of-way (ROW) managed using Integrated Vegetation Management (IVM) treatments on State Game Lands (SGL) 33 and 103, Centre County, Pennsylvania from 2017-2020.

IVM 2016 TREATMENT/LEGACY ACRONYM REPLICATES	YEAR	WIRE ROW ZONE		BORDER ROW ZONE		TOTAL ROW	
		# INDIVIDUALS	# SPECIES	# INDIVIDUALS	# SPECIES	# INDIVIDUALS	# SPECIES
High Volume Foliar/**F2, SF2**	2017	3.4 ± 1.1	2.1 ± 0.6	2.5 ± 0.5	2.1 ± 0.3	5.9 ± 1.4	3.6 ± 0.6
	2018	4.6 ± 0.6	2.5 ± 0.2	4.1 ± 1.2	2.8 ± 0.6	8.8 ± 1.5	4.1 ± 0.5
	2019	2.3 ± 0.5	1.6 ± 0.4	3.9 ± 0.7	2.6 ± 0.6	6.1 ± 1.0	4.0 ± 0.7
	2020	3.3 ± 0.5	2.4 ± 0.3	5.6 ± 1.1	4.4 ± 0.7	8.9 ± 1.2	5.5 ± 0.6
Low Volume Foliar/**F1, M1**	2017	2.1 ± 0.5	1.8 ± 0.5	5.4 ± 0.7	3.5 ± 0.4	7.5 ± 0.6	4.4 ± 0.3
	2018	3.6 ± 0.6	2.5 ± 0.4	5.4 ± 0.3	3.9 ± 0.2	9.0 ± 0.9	5.4 ± 0.3
	2019	2.9 ± 0.5	2.0 ± 0.2	3.3 ± 0.9	2.3 ± 0.6	6.1 ± 1.3	3.5 ± 0.5
	2020	3.6 ± 0.7	2.5 ± 0.5	5.1 ± 0.6	3.5 ± 0.4	8.8 ± 0.8	4.6 ± 0.4
Low Volume Foliar Without Border Zone/**C1, C2**	2017	2.6 ± 0.3	2.1 ± 0.2	NA	NA	2.6 ± 0.3	2.1 ± 0.2
	2018	7.3 ± 1.1	3.5 ± 0.6	NA	NA	7.3 ± 1.1	3.5 ± 0.6
	2019	5.1 ± 0.5	2.8 ± 0.4	NA	NA	5.1 ± 0.5	2.8 ± 0.4
	2020	7.8 ± 1.1	4.3 ± 0.5	NA	NA	7.8 ± 1.1	4.3 ± 0.5
Low Volume Basal/**BLV1, BLV3**	2017	3.4 ± 1.0	2.3 ± 0.7	4.4 ± 0.8	3.1 ± 0.6	7.9 ± 1.6	4.6 ± 0.9
	2018	3.4 ± 0.6	2.4 ± 0.4	5.6 ± 1.1	3.9 ± 0.6	9.0 ± 0.9	5.0 ± 0.4
	2019	2.5 ± 0.7	1.8 ± 0.5	3.0 ± 0.7	2.4 ± 0.6	5.5 ± 1.1	4.0 ± 0.8
	2020	4.0 ± 1.0	2.3 ± 0.5	4.9 ± 0.8	3.9 ± 0.7	8.9 ± 1.6	5.4 ± 0.8
Hand Cutting/**HC1, HC2**	2017	0.8 ± 0.5	0.8 ± 0.5	5.5 ± 0.5	3.0 ± 0.4	6.3 ± 0.9	3.5 ± 0.3
	2018	2.5 ± 1.0	1.8 ± 0.6	4.8 ± 1.2	2.8 ± 0.5	7.3 ± 0.5	3.8 ± 0.5
	2019	3.3 ± 0.9	2.5 ± 0.3	2.3 ± 0.5	1.8 ± 0.5	5.3 ± 0.9	3.5 ± 0.5
	2020	2.0 ± 1.1	1.5 ± 0.7	3.3 ± 0.5	2.5 ± 0.3	5.3 ± 1.3	3.8 ± 0.5
Mowing/**M4**	2017	0.5 ± 0.5	0.3 ± 0.3	1.5 ± 0.6	1.0 ± 0.4	2.0 ± 0.4	1.3 ± 0.3
	2018	0.8 ± 0.5	0.5 ± 0.3	4.5 ± 3.2	2.8 ± 1.5	5.3 ± 3.3	3.0 ± 1.5
	2019	2.3 ± 0.9	1.3 ± 0.5	2.5 ± 0.6	1.8 ± 0.5	4.8 ± 0.8	2.8 ± 0.5

	2020	1.5 ± 0.6	1.3 ± 0.5	7.3 ± 1.1	5.6 ± 0.9	8.8 ± 0.9	6.0 ± 0.7
SGL 33 Totals	2017	24.3 ± 3.0	7.3 ± 0.5	31.5 ± 2.1	8.0 ± 0.8	55.8 ± 4.7	10.8 ± 0.6
	2018	42.8 ± 4.9	7.5 ± 1.2	39.5 ± 7.0	8.8 ± 1.4	82.3 ± 8.6	10.8 ± 1.9
	2019	31.5 ± 2.3	7.0 ± 0.4	25.0 ± 2.4	8.5 ± 0.9	56.5 ± 4.4	10.0 ± 0.6
	2020	40.8 ± 5.2	7.8 ± 1.1	41.8 ± 3.1	10.0 ± 0.9	82.5 ± 3.3	11.8 ± 1.6
SGL 103 Low Volume Foliar	2019	2.0 ± 0.6	1.5 ± 0.4	4.4 ± 1.0	3.0 ± 0.7	6.4 ± 1.3	4.0 ± 0.7
	2020	3.5 ± 1.0	2.4 ± 0.5	5.4 ± 0.7	3.9 ± 0.4	8.9 ± 1.4	5.0 ± 0.5

Table B-2. List of birds detected during singing surveys, displaying probable and/or confirmed evidence of breeding based on Pennsylvania Breeding Bird Atlas codes, and nesting within wire and border management zones along rights-of-way on State Game Lands (SGL) 33 and 103, Centre County, Pennsylvania from 2017-20.

Common and Scientific Names of Birds	Singing Surveys						Probable and/or Confirmed Breeding (Nest was Monitored*)			
	SGL 33 2017	SGL 33 2018	SGL 33 2019	SGL 33 2020	SGL 103 2019	SGL 103 2020	SGL 33 2017	SGL 33 2019	SGL 103 2019	SGL 103 2020
American Crow (*Corvus brachyrhynchos*)	X	X								
American Goldfinch (*Spinus tristis*)	X	X					X*			
American Redstart (*Setophaga ruticilla*)	X	X	X	X				X		
American Robin (*Turdus migratorius*)	X	X	X	X			X*			
Barn Swallow (*Hirundo rustica*)		X								
Black-and-white Warbler (*Mniotilta varia*)			X	X		X		X		X
Black-billed Cuckoo (*Coccyzus erythropthalmus*)	X						X*			
Black-capped Chickadee (*Poecile atricapillus*)	X	X		X				X		

Black-throated Green Warbler (*Setophaga virens*)		X				X				
Blue Jay (*Cyanocitta cristata*)			X				X*			
Brown-headed Cowbird (*Molothrus ater*)	X	X	X	X			X			
Brown Thrasher (*Toxostoma rufum*)	X		X				X*	X		
Common Yellowthroat (*Geothlypis trichas*)	X	X	X	X	X	X	X	X*	X	X*
Chestnut-sided Warbler (*Setophaga pensylvanica*)	X	X	X	X	X	X	X*	X*	X*	X*
Eastern Towhee (*Pipilo erythrophthalmus*)	X	X	X	X	X	X	X*	X*	X*	X*
Eastern Wood-pewee (*Contopus virens*)		X								
Field Sparrow (*Spizella pusilla*)	X	X	X	X	X	X	X*	X*	X	X
Gray Catbird (*Dumetella carolinensis*)	X	X	X	X	X	X	X*	X*	X*	X*
Hermit Thrush (*Catharus guttatus*)	X						X*	X*		
Hooded Warbler (*Setophaga citrina*)						X				

Indigo Bunting (*Passerina cyanea*)	X	X	X	X	X		X*	X*	X	
Magnolia Warbler (*Setophaga magnolia*)						X				
Northern Flicker (*Colaptes auratus*)					X	X			X*	X*
Ovenbird (*Seiurus aurocapilla*)			X	X			X			
Rose-breasted Grosbeak (*Pheucticus ludovicianus*)				X		X				
Red-eyed Vireo (*Vireo olivaceus*)	X	X	X	X	X	X		X	X	
Ruby-throated Hummingbird (*Archilochus colubris*)	X		X							
Scarlet Tanager (*Piranga olivacea*)	X	X		X						
Song Sparrow (*Melospiza melodia*)	X	X	X	X				X		
Tufted Titmouse (*Baeolophus bicolor*)	X	X	X							
Wild Turkey (*Meleagris gallopavo*)		X					X			
Wood Thrush (*Hylocichla mustelina*)		X		X				X		
TOTALS	20	21	17	17	8	12	15 (11)	14 (7)	8 (4)	7 (5)

Table B-3. Bird species (average ± standard error number of species) displaying probable and/or confirmed evidence of breeding based on Pennsylvania Breeding Bird Atlas codes within wire and border zones on sections of right-of-way (ROW) managed using different Integrated Vegetation Management (IVM) treatments on State Game Lands (SGL) 33 and 103, Centre County, Pennsylvania from 2017-2020.

IVM 2016 TREATMENT/LEGACY ACRONYM REPLICATES	YEAR	WIRE ROW ZONE	BORDER ROW ZONE	TOTAL ROW
		# SPECIES	# SPECIES	# SPECIES
High Volume Foliar/**F2, SF2**	2017	3.5 ± 0.5	1.0 ± 0.0	4.0 ± 0.0
	2019	2.0 ± 1.0	3.5 ± 0.5	5.0 ± 1.0
Low Volume Foliar/**F1, M1**	2017	3.0 ± 1.0	5.5 ± 0.5	6.5 ± 0.5
	2019	3.5 ± 0.5	3.0 ± 0.0	5.0 ± 1.0
Low Volume Foliar Without Border Zone/**C1, C2**	2017	4.5 ± 0.5	NA	4.5 ± 0.5
	2019	2.0 ± 1.0	NA	2.0 ± 1.0
Low Volume Basal/**BLV1, BLV3**	2017	4.0 ± 0.0	2.5 ± 2.5	6.0 ± 2.0
	2019	5.0 ± 1.0	2.5 ± 0.5	6.5 ± 1.5
Hand Cutting/**HC1**	2017	4.0	3.0	5.0
	2019	3.0	1.0	4.0
Mowing/**M4**	2017	3.0	1.0	4.0
	2019	3.0	2.0	5.0
SGL 33 Totals	2017	10.0	12.0	15.0
	2019	7.0	12.0	14.0
SGL 103 Low Volume Foliar	2019	4.5 ± 0.5	3.5 ± 0.5	6.5 ± 0.5
	2020	2.5 ± 0.5	2.5 ± 0.5	5.0 ± 0.0
SGL 103 Totals	2019	6.0	4.0	8.0
	2020	3.0	4.0	7.0

Table B-4. Distribution and outcome of attempted nesting activity by breeding birds within wire and border zones on sections of right-of-way (ROW) managed in 2016 using different Integrated Vegetation Management (IVM) treatments including high volume foliar (HVF), low volume foliar (LVF), low volume foliar without border zones (LVFNB), low volume basal (LVB), hand cutting (HC), and mowing (M) on State Game Lands (SGL) 33 and 103, Centre County, Pennsylvania from 2017-2020. See Tables B-1, B-3 for corresponding legacy acronyms.

IVM	Year	WIRE ROW ZONE				BORDER ROW ZONE				TOTAL ROW			
		# Nests	# Successful Nests	Daily Nest Survival Rate	# Nesting Species	# Nests	# Successful Nests	Daily Nest Survival Rate	# Nesting Species	# Nests	# Successful Nests	Daily Nest Survival Rate	# Nesting Species
HVF	2017	6	1	0.92	2	1	1	1.00	1	7	2	0.93	3
	2019	3	0	0.86	2	2	1	0.95	2	5	1	0.90	4
LVF	2017	6	2	0.92	3	4	0	0.91	2	10	2	0.91	5
	2019	2	2	1.00	2	1	0	0.83	1	3	2	0.95	2
LVFNB	2017	5	3	0.97	3	NA	NA	NA	NA	5	3	0.97	3
	2019	1	1	1.00	1	NA	NA	NA	NA	1	1	1.00	1
LVB	2017	3	0	0.93	2	5	4	0.99	4	8	4	0.97	6
	2019	2	0	0.91	2	2	0	0.90	2	4	0	0.91	4
HC	2017	2	0	0.80	2	3	0	0.92	2	5	0	0.89	4
	2019	2	1	0.96	2	0	0	NA	0	2	1	0.96	2
M	2017	2	1	0.97	2	1	0	0.94	1	3	1	0.96	3
	2019	1	1	1.00	1	0	0	NA	0	1	1	1.00	1
SGL 33 Totals	2017	24	7	0.94	7	14	5	0.95	7	38	12	0.94	11
	2019	11	5	0.95	5	5	1	0.91	4	16	6	0.94	7
SGL 103 LVF	2019	4	4	1.00	3	3	1	0.94	2	7	5	0.98	4
	2020	5	2	0.97	4	3	2	0.99	2	8	4	0.98	5

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SNAKES

Methods

Time-constrained area herpetological surveys were conducted along nine wire zone units/plots of rights-of-way (ROW) located within two state game lands (SGL) in Centre County Pennsylvania: SGL 33 and SGL 103. The nine treatment units/plots differed in their history of vegetation management and amount of cover (rocks and logs) available for snakes. Two researchers surveyed each unit for 60 minutes on clear days during June and July of 2020. Searches were performed between 7 A.M. and 11 A.M. when herpetofauna have the greatest chance of being under cover. Rocks, logs, and any other substrate (> 8 inches) were flipped to find individual snakes. Clickers were used to keep track of the number of flips per substrate type in each ROW unit.

Results

We observed 5 species (71 individuals) of native snakes during our surveys at SGL 33 and SGL 103 (Table S-1). Two individuals were observed in the open, one individual was found under a log, and the remaining 68 snakes were found underneath rocks. We documented 4 of the 5 species of snakes at units that were treated by low volume basal (LVB) and high volume foliar (HLF) in 2016 at SGL 33. We also observed 4 of the 5 species of snakes at SGL 103 where the unit was treated by low volume foliar (LVF) in 2018. We found no snakes in our handcutting unit and only 1 snake in the mowing unit (Table S-1). 70 of the 71 snakes were found in units selectively treated by herbicides.

Discussion

Snakes and other herpetofauna comprise a significant proportion of vertebrate animals in forests of the northeastern United States and are large contributors to the food web and can be used as indicators of habitat quality (Beaupre and Douglas 2011). Unfortunately, populations of numerous reptiles and amphibian species are declining in Pennsylvania from habitat loss (Thorne et al., 1995). Northeastern American herpetofauna generally do not travel far in their lives which makes them especially susceptible to detrimental impacts from forest fragmentation (Enge and Marion, 1986).

Although snake were most abundant along the ROW in units selectively treated by herbicide the greatest predictor of snake abundance was the presence of rock substrate within each unit surveyed. When we controlled our data for the number of rocks flipped per unit, we discovered that the units with the greatest snake abundance and highest species richness also had the highest number of rocks flipped in the 30-minute survey period. However, vegetation composition likely has a secondary influence on snakes. For example, the vegetation within sections managed by hand-cutting and mowing were dominated by shrubs/trees and hay-scented fern (*Dennstaedtia punctilobula*), respectively (Mahan et al. 2020). Tree and shrub cover increases shade which may decrease habitat quality for our native snakes that require basking in sunlight for physiological activity (Seebacher and Franklin 2005). In addition, dense mats of hay-scented fern may be difficult for snakes to navigate. We urge caution when interpreting the quality of habitat for snakes in the handcutting unit. Although no snakes were observed in the hand-cut section during the surveys, snakes have been observed within this ROW unit during other research activities.

Table S-1. Abundance and species of native snakes observed during time-constrained area surveys along transmission line rights-of-way (ROW) at State Game Lands (SGL) 33 and 103 in 2020. The most recent vegetation treatments applied to each unit are listed with legacy acronyms provided. Vegetation was treated at SGL 33 in 2016 and at SGL 103 in 2018.

Species	SGL33 Low volume basal/**MH3**	SGL33 High volume foliar/**SF2**	SGL33 High volume foliar/**F2**	SGL 33 Mow/**M4**	SGL33 Low volume foliar/**MH4**	SGL33 Low volume basal/**BLV3**	SGL 103-1 Low volume foliar	SGL 103-2 Low volume foliar
Northern ringneck snake *(Diadophis punctatus edwardsii)*	11	1	8			7	5	1
Smooth green snake (*Opheodrys vernalis*)	1		1	1			1	
Eastern garter snake (*Thamnophis sirtalis*)	4	2	4				2	
Red-bellied snake (*Storeria occipitomaculata*)	1	6	2			1	7	2
Eastern milksnake (*Lampropeltis triangulum*)					1	1		1

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POLLINATORS

Project Goals and Objectives for 2019

Goals

1. **SGL33:** To collect flower-visiting insects, and then compare the abundance, taxa richness, and diversity of bees among the seven survey plots, which represent five different vegetation management strategies.
2. **SGL103:** To collect flower-visiting insects, and then compare the abundance, taxa richness, and diversity of bees among the two survey plots, both representing a single vegetation management strategy. In addition, to compare the use of a narrower (100-foot wide) transmission line right-of-way by pollinators to the wider (250-foot) ROW at SGL 33.
3. **SGL33:** To compare 2016 vs. 2017 vs. 2019 bee collections.

Objectives

To examine the potential differences in bee populations among different plots and vegetative treatments, and to provide the Project's stakeholders with an analysis of bee abundance, taxa richness, and diversity at SGL33 and at SGL103, which will assist in making management recommendations for the future.

Methods

SGL33 Field and Lab Methods

Field Methods for SGL33 in 2019 were nearly identical to those detailed in the previous reports, with the following exceptions:

<u>M4 Plot added to survey</u>

For 2016 and 2017, we had no data for ROW plots which were "mow only". Beginning in July 2019, the mow only "**M4**" plot was added as a seventh survey plot for SGL33 (Figure P-1).

Figure P-1. Location of “M4” plot at SGL33.

“**M4**” (Figure P-1)

Description of plot location: 460m NW of Hannah Furnace Road
Approximate center of plot: 40.860572, -78.152872
2016 vegetation treatment applied: Mowing (M)-0 gal of herbicide mixture applied.

Note: In addition to **M4** in July and August, the same six plots at SGL33 that were surveyed in 2016 and 2017 were surveyed May through August in 2019. These six plots are: **F2**, **SF2**, **MH3** (a.k.a. **MH2**), **MH1**, **BLV3**, and **HC1**. These acronyms represent the legacy treatments applied when plots were established in 1953 at SGL 33. Vegetation was managed at these plots in 2016 with the following treatments (also see Table I-1; Figure I-2, Appendix A)

“**F2**”
Description of plot location: 355m NW of Hannah Furnace Road
Approximate center of plot: 40.859819, -78.152086
2016 Vegetation treatment: High Volume Foliar (HVF)-75 gal of herbicide mixture applied.

“**SF2**”
Description of plot location: 75m NW of Hannah Furnace Road
Approximate center of plot: 40.857979, -78.149886
2016 vegetation treatment: High Volume Foliar (HVF)-25 gal of herbicide mixture applied.

“**MH3**” (a.k.a. “**MH2**”)
Description of plot location: 75m SE of Hannah Furnace Road
Approximate center of plot: 40.856878, -78.148756
2016 vegetation treatment: Low Volume Foliar (LVF)-0.5 gal of herbicide mixture applied.

“**MH1**”
Description of plot location: 170m NW of Strawband Beaver Road
Approximate center of plot: 40.843722, -78.133597
2016 vegetation treatment: Low Volume Foliar (LVF)-0.5 gal of herbicide mixture applied.

“**BLV3**”
Description of plot location: 40m SE of Strawband Beaver Road
Approximate center of plot: 40.842265, -78.131853
2016 vegetation treatment: Low Volume Basal (LVB)-2.9 gal of herbicide mixture applied.

“**HC1**”
Description of plot location: 205m SE of Strawband Beaver Road
Approximate center of plot: 40.841131, -78.130544
2016 vegetation treatment: Handcutting-0 gal of herbicide mixture applied.

SGL33 Sweep Net Sample Processing

In 2016 and 2017, sweep net samples were transferred from the collectors’ kill jars to small plastic containers, which were frozen until they could be pinned or pointed. However, this resulted in specimens that were coated in a mixture of killing medium (acetone), pollen, insect regurgitant, etc. “Dirty” bee specimens can be nearly impossible to identify, and washing pinned specimens is difficult and time-consuming. To solve this problem, and to ensure that our bee specimens were clean enough to identify, we washed the specimens before freezing them. To do this, we used lidded plastic buckets, filled with soapy water and labeled with the date, time of day, and plot name. These buckets were brought to the field on collection days. After each sampling session, field personnel emptied their kill jars into the corresponding buckets. Upon returning from the field, Dr. Stout removed and dried the specimens, inspected the bees, then put all of the specimens into small plastic containers and stored them in a freezer until pinning/pointing could begin.

<u>Sampling schedule</u> (Figure P-2)

SGL33 BEES
29 May - 22 Aug 2019 (13 weeks)

<u>Four Sample Periods</u>
WEEK 1: 29 & 31 May
WEEK 4/5: 21 & 24 June
WEEK 10: 29 & 31 July
WEEK 13: 19 & 22 August

Figure P-2. Bee sampling schedule at SGL33 for 2019.

SGL103 Field and Lab Methods

Field methods for SGL103 in 2019 were nearly identical to those used at SGL33 in 2019, with the following exceptions:

<u>SGL103 Survey Plots</u>

There were **two** plots surveyed at SGL103 in 2019, all of which were located in Union Township, Centre County, Pennsylvania (Figure P-3): . These plots were known as “**103-1**” and “**103-2**”.

Figure P-3. Location of plots “103-1” and “103-2” at SGL103.

“**103-1**” (Figure P-4)

Description of plot location: 45m NW of Birch Lick/Governors Road
Approximate center of plot: 40.9999, -77.894
2018 vegetation treatment: Low Volume Foliar (LVF)-3 gal herbicide mixture applied.

Figure P-4. Northeast view of Plot 103-1. Photo: H. Stout.

"**103-2**" (Figure P-5)

Description of plot location: 230m NW of Birch Lick/Governors Road
Approximate center of plot: 41.0007, -77.896
2018 vegetation treatment: Low Volume Foliar (LVF)-3 gal herbicide mixture applied.

Figure P-5. Northeast view of Plot 103-2. Photo: H. Stout.

SGL103 Sweep Net Collections

Because there were only two plots at the SGL103 site, each monthly Hymenoptera survey was able to be completed in a single day. SGL103 plots were sampled once in the morning, and then a second time in the afternoon (Figure P-6).

SGL103 BEES **24 May - 20 Aug 2019 (14 weeks)** **<u>Four 72-hr Sample Periods</u>** WEEK 1: 24 May WEEK 5: 20 June WEEK 11: 30 July WEEK 14: 20 August

Figure P-6. Bee sampling schedule at SGL103 for 2019.

Results

Total and monthly lists of the bees collected at SGL33 and at SGL103 in 2019 are located in the Appendices.

SGL33

<u>Bee Families</u>

As stated in previous reports, in most of the world, "bees" are a group of insects comprised of six Hymenoptera Families:

- **Andrenidae** (miner, bare-miner, fairy, and oxaeine bees)
- **Apidae** (cuckoo, bumble, carpenter, digger, honey, and orchid bees)
- **Colletidae** (cellophane, fork-/feather-tongued, and masked bees)
- **Halictidae** (sweat, furrow, nomiine, and short-faced bees)
- **Megachilidae** (leaf-cutter, mason, and resin bees)
- **Melittidae** (melittid bees. RARE.)

(A seventh bee Family, Stenotritidae, is endemic only to Australia.)

During the 2019 field season, all six North American bee Families, including Melittidae, were collected at two SGL33 plots (**F2** [HVF 2016] and **BLV3** [LVB 2016]). Five of the six bee Families were collected at the five remaining plots.

Total Bee Abundance

In 2019, we collected 1736 bees from the seven SGL33 plots. The most bees were collected from the **SF2** plot (HVF 2016), and the fewest bees from the **HC1** plot (Table P-1)(Figure P-7).

Table P-1. Total abundance of bees per plot at SGL33 for 2019.

2019 SGL33 BEE ABUNDANCE - TOTAL	
Plot	**Number of Bees**
M4*	128
F2	205
SF2	**423**
MH3	386
MH1	157
BLV3	385
HC1*	52

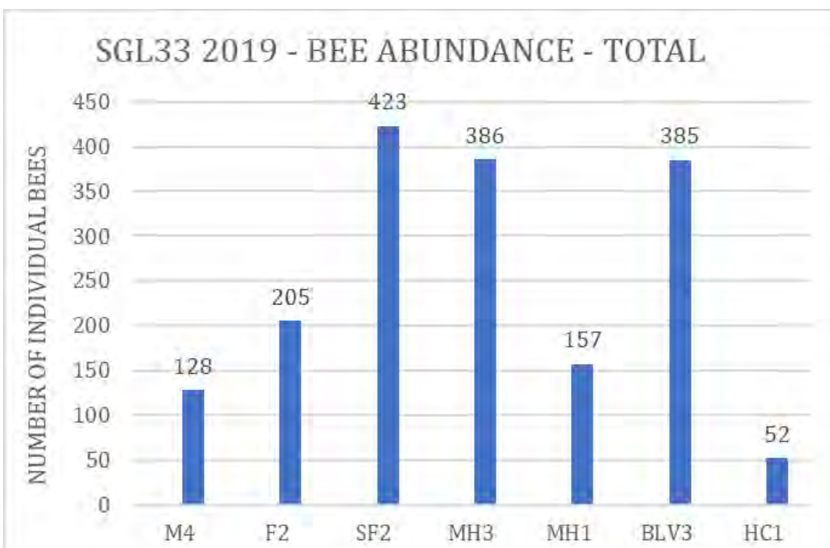

Figure P-7. Total abundance of bees per plot at SGL33 for 2019.

Overall, a total of 3351 specimens—bees and non-bees—were collected at SGL33 in 2019. The most specimens were collected from **MH3** (treated in 2016 with LVF), and the fewest from **HC1** (handcut in 2016).

Total Bee Taxa Richness* (Tentative)

For 2019, we collected 107 tentative bee taxa at SGL33. The most* taxa were collected at **SF2** (treated in 2016 with HVF) and the fewest* were collected at **HC1** (Table P-2)(Figure P-8).

Table P-2. Taxa richness* (*tentative) of bees per plot at SGL33 for 2019.

2019 SGL33 TOTAL BEE TAXA RICHNESS* (*TENTATIVE)	
Plot	Number of Taxa*
M4*	29
F2	46
SF2	**61**
MH3	47
MH1	53
BLV3	47
HC1*	26

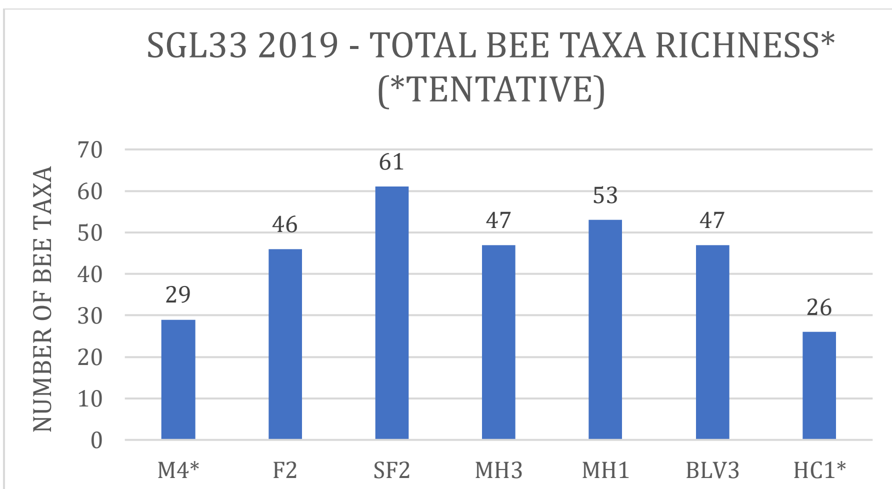

Figure P-8. Taxa richness* (*tentative) of bees per plot at SGL33 for 2019.

Bee Abundance per Month

The months of greatest bee abundance for each SGL33 plot in 2019 were (Table P-3)(Figure P-9):

May - **HC1** (2016 HC)
July - **SF2** (2016 HVF)
August - **M4, F2, MH3, MH1, BLV3** (2016-M, HVF, LVF, LVB, respectively)

Table P-3. Bee abundance per plot by month at SGL33 for 2019.

SGL33 2019 - BEE ABUNDANCE PER PLOT BY MONTH							
	M4	F2	SF2	MH3	MH1	BLV3	HC1
MAY	0	37	89	40	52	62	**18**
JUNE	0	63	16	38	44	46	9
JULY	63	11	**165**	123	8	90	13
AUGUST	**65**	**94**	153	**185**	**53**	**187**	12

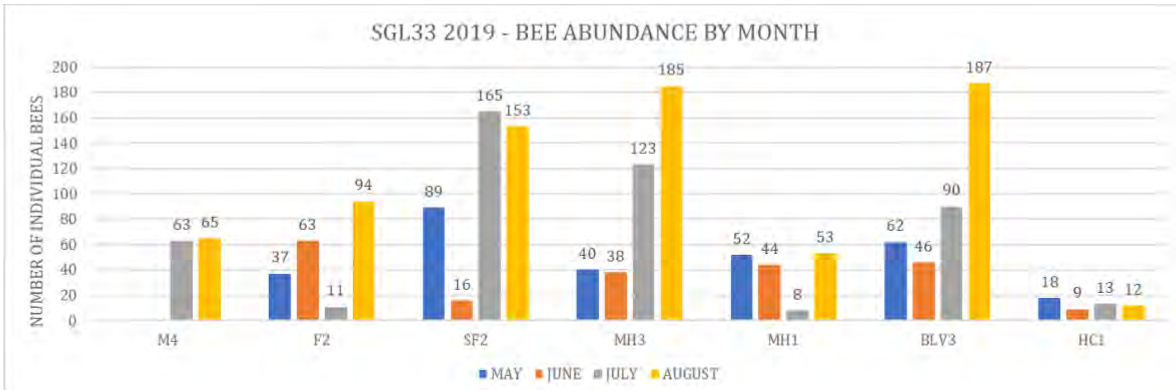

Figure P-9. Bee abundance per plot by month at SGL33 for 2019.

Bee Taxa Richness per Month*

The months of greatest bee taxa richness* for each plot at SGL33 were (Table 4)(Figure P-10):

May - **SF2** (2016 HVF)
June - **F2**, **BLV3** (2016 LVF, LVB)
July - **MH3** (2016 LVF)
August - **M4**, **MH1** (2016 M, LVF)

Bee taxa richness* for **HC1** was fairly consistent throughout the season.

Table P-4. Bee taxa richness* per plot by month at SGL33 for 2019.

SGL33 2019 - BEE TAXA RICHNESS* PER PLOT BY MONTH							
	M4	F2	SF2	MH3	MH1	BLV3	HC1
MAY	0	14	**31**	19	18	18	**9**
JUNE	0	**23**	14	17	19	**19**	5
JULY	18	7	26	**20**	8	18	**9**
AUGUST	**21**	18	21	15	**23**	17	**9**

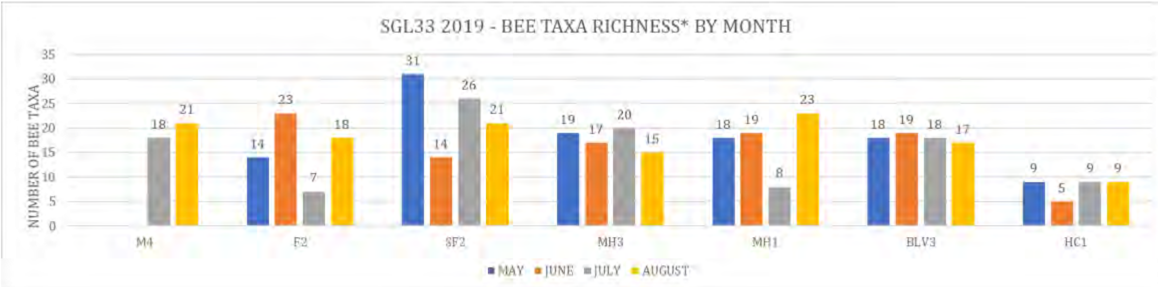

Figure P-10. Bee taxa richness* per plot by month at SGL33 for 2019.

SGL103

Bee Families

During the 2019 field season, five bee Families were collected at both SGL103 plots. Melittidae was not represented at either of the SGL103 plots in 2019.

Total Bee Abundance

We collected 421 bees from the two SGL103 plots in 2019. More bees were collected from the **103-1** plot than from the **103-2** plot (Table P-5)(Figure P-11). Both units/plots were treated in 2018 with LVF.

Table P-5. Abundance of bees per plot at SGL103 for 2019.

2019 SGL103 BEE ABUNDANCE - TOTAL	
Plot	**Number of Bees**
103-1	**345**
103-2	76

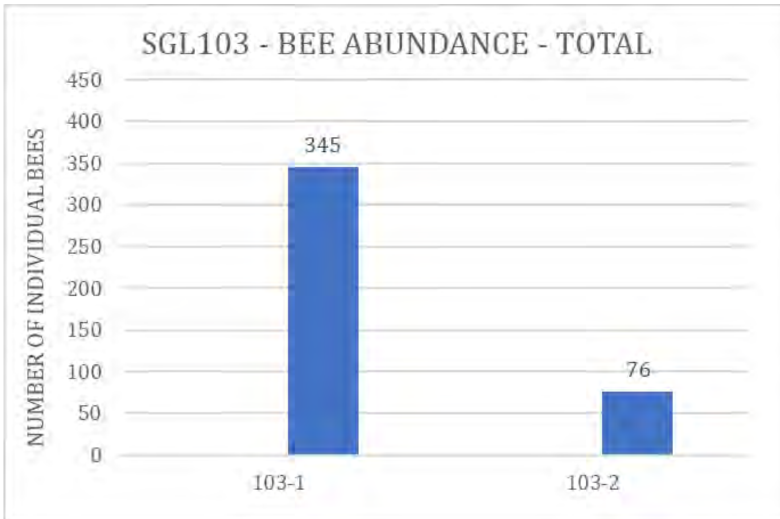

Figure P-11. Abundance of bees per plot at SGL103 for 2019.

A total of 797 specimens—bees and non-bees—were collected at SGL103 in 2019. More specimens were collected from **103-1** than from **103-2** even though both units/plots were treated in 2018 with LVF.

Total Bee Taxa Richness*

For 2019, we collected 61 tentative bee taxa at SGL103. More* taxa were collected at **103-1** than at **103-2** (Table P-6)(Figure P-12).

Table P-6. Bee taxa richness* per plot at SGL103 for 2019.

2019 SGL103 TOTAL BEE TAXA RICHNESS* (*TENTATIVE)	
Plot	**(# of Taxa)**
103-1	**48**
103-2	35

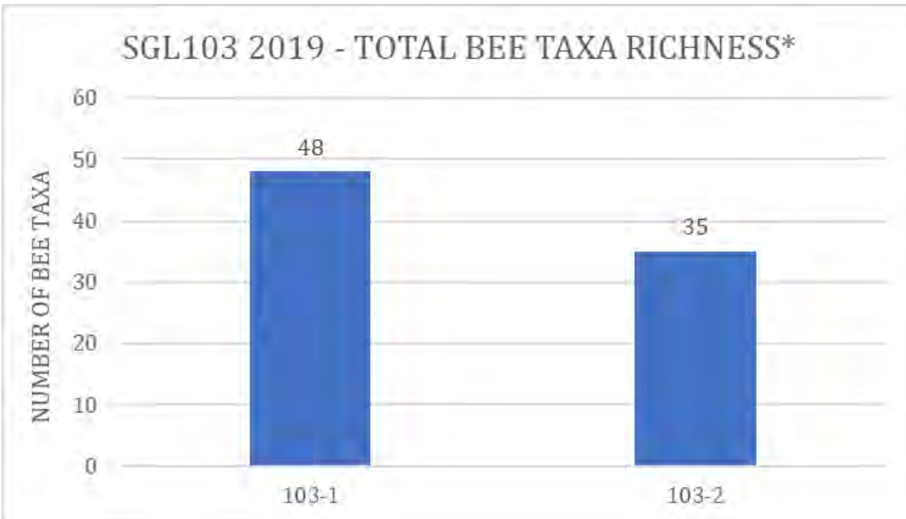

Figure P-12. Bee taxa richness* per plot at SGL103 for 2019.

Bee Abundance per Month

The months of greatest bee abundance for each plot at SGL103 in 2019 were (Table P-7)(Figure P-13):

June - **103-2**
August - **103-1**

Table P-7. Abundance of bees per plot by month at SGL103 for 2019.

SGL103 2019 - BEE ABUNDANCE PER PLOT BY MONTH		
	103-1	**103-2**
MAY	12	25
JUNE	59	**32**
JULY	124	8
AUGUST	**150**	11

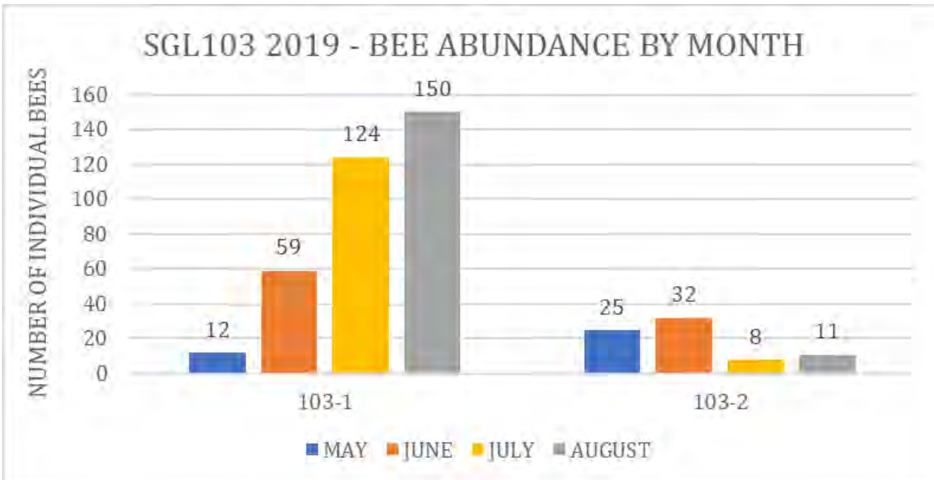

Figure P-13. Abundance of bees per plot by month at SGL103 for 2019.

Bee Taxa Richness* per Month

For both SGL103 plots, **June** was the month of greatest bee taxa richness* (Table P-8)(Figure P-14):

Table P-8. Bee taxa richness* per plot by month at SGL103 for 2019.

SGL103 2019 - BEE TAXA RICHNESS* PER PLOT BY MONTH		
	103-1	**103-2**
MAY	10	13
JUNE	**24**	**19**
JULY	21	6
AUGUST	15	6

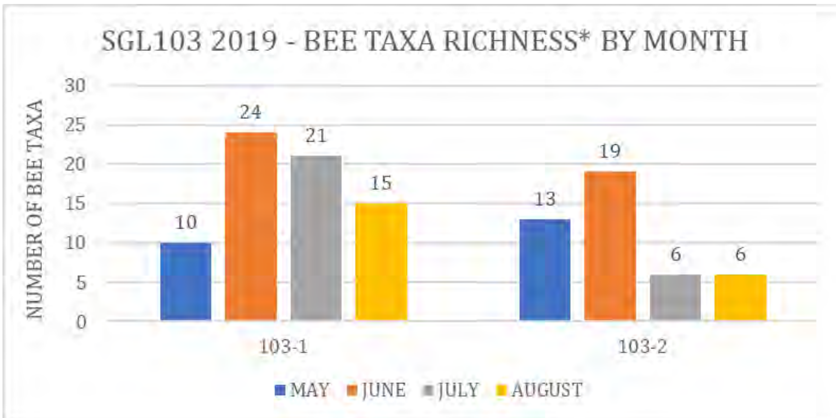

Figure P-14. Bee taxa richness* per plot by month at SGL103 for 2019.

Discussion

SGL33

<u>2019 Bees</u>

Since the **M4** plot was not added to the survey until July, there are no bee data for **M4** for May and June 2019, and therefore the <u>total</u> sampling effort for **M4** was essentially half of the sampling effort as the other six SGL33 plots. Also, as noted in past reports, the sampling effort for the **HC1** plot is not equivalent to that of the other SGL33 plots, as it is difficult to walk or swing a net in the thick and thorny vegetation. For future bee surveys, Dr. Stout has been working on a sampling protocol that would yield equivalent sampling efforts for all SGL33 plots, regardless of terrain.

For 2019, the number of *Bombus* sp. bees that have been identified tentatively as *Bombus impatiens*, the common eastern bumble bee, represent 34.16% (593 of 1736) of the total SGL33 collection and 37.53% (158 of 421) of the total SGL103 collection. Among SGL33 plots, the total prevalence of *B. impatiens* tentatively ranges from 6.37% (**MH1**) to 52.21% (**BLV3**). In previous years, *B. impatiens* was the dominant taxa at just one plot (**BLV3**). However, because the identifications of 2019 specimens are tentative, we expect these numbers to change.

Unlike 2016 and 2017, the “golden Northern bumble bee”, *Bombus fervidus*, which is listed as “Vulnerable” on the IUCN Red List of Threatened Species (iucnredlist.org), was not collected at **MH3**, or at any of the SGL33 plots; however, *Macropis ciliata*, a rare yellow loosestrife bee present in the 2016 and 2017 collections, was again collected—this time at two plots. One male was collected at **F2**, and four females were collected at **BLV3**.

SGL33 Bees: 2016 vs. 2017 vs. 2019

More bees and more bee taxa were collected in 2017 than in 2016 and, although we cannot speculate on richness, that trend for total abundance continued in 2019. This may be due to the addition of the **M4** plot for July and August. The trend of greatest abundance of bees at **BLV3** did not continue in 2019 (Table P-9)(Figure P-15). Instead the greatest abundance of bees was at SF2—a unit treated with HVF in 2016. We may be seeing a recovery response of bees to the vegetation community 3-yrs post treatment. Although the BLV unit did not have the highest bee abundance in 2019, it is interesting to note the consistently high abundance in this unit/plot (treated with LVB in 2016) across all three years post treatment (Table P-9).

Table P-9. Bee abundance per plot for 2016, 2017, and 2019.

SGL33 ABUNDANCE OF BEES (NUMBER OF INDIVIDUALS)			
Plot	**2016**	**2017**	**2019**
M4			128
F2	132	197	205
SF2	188	266	**423**
MH3	235	256	386
MH1	160	143	157
BLV3	**316**	**336**	385
HC1	25	90	52

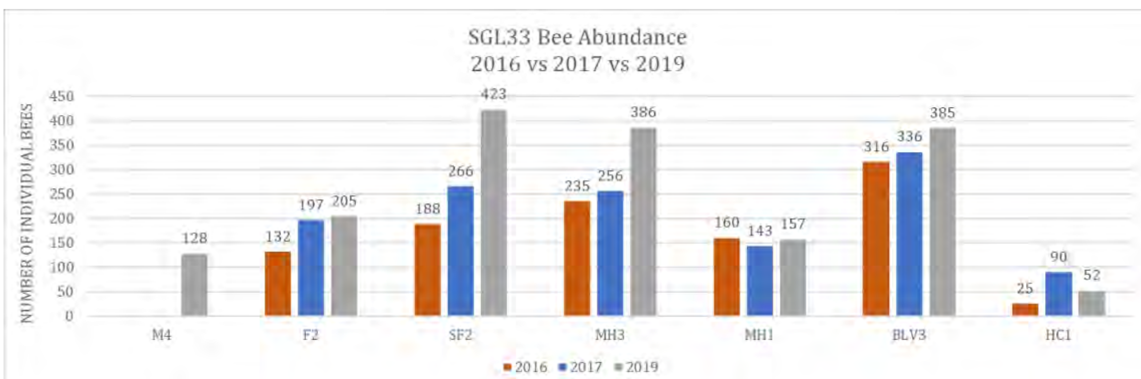

Figure P-15. Bee abundance per plot for 2016, 2017, and 2019.

SGL103

Compared with plots at SGL33 in 2019, the total abundance of bees for the **103-1** plot at SGL103 ranks in the middle—greater than bee abundance at **HC1**, **MH1**, and **F2**, but less than at **SF2**, **MH3**, and **BLV3**. Bee abundance at **103-2** falls just above that of **HC1**. One comparison that cannot be made between SGL103 and SGL33 is total abundance of bees collected at each site. Although our sampling effort per plot is equal, the sampling effort per site is not. We sampled two plots at SGL103 versus six to seven plots at SGL33, which equals 24 total net hours at SGL103 compared with 104 total net hours at SGL33.

Unlike SGL33, the "golden Northern bumble bee", *Bombus fervidus*, was collected at SGL103. One *B. fervidus* male was collected at **103-1** in August 2019. Despite the presence of whorled loosestrife at SGL103, no *Macropis ciliata* bees were observed or collected.

Timed, effort-based net-collecting was used at each plot to ensure the collection of quantitative data. Net-collectors were instructed to collect all insects visiting flowers, but large bees were more prevalent in the collections, which could be due to nests present at the plots, and also due to collector bias toward large taxa (Wagner et al 2014). Also, as noted previously, the sampling effort for the **HC1** plot is not equivalent to that of the other SGL33 plots. Bee bowl collections are known to supplement net-collections as they are not vulnerable to this same bias. Also, our bee bowl "test" in 2016 yielded four species of bees that were not present in the net-collections. For future bee surveys, Dr. Stout is developing a sampling protocol that will utilize only bowl collections. This collection method would ensure that sampling effort is equivalent for all SGL33 plots and could increase the number of bee species that we have recorded at SGL33. Our data continue to suggest that integrated vegetation management (IVM) approaches that include the selective use of herbicides are compatible with native bee abundance and diversity along rights-of-way in central Pennsylvania (Russo et al. 2021). The response of vegetation and pollinators to unit/plot recovery post vegetation treatment presents a temporal component to the response of native bees to IVM on transmission line corridors.

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BugGuide. **http://www.bugguide.net/**

Discover Life. **http://www.discoverlife.org/**

GROUND BEETLES

Project Goals and Objectives for 2020

Goal

1. **SGL33:** To collect beetles of the Carabidae and Staphylinidae Families using pitfall traps, and then compare the abundance, taxa richness, and diversity of ground and rove beetles among the seven vegetation treatment units/plots, which represent five different vegetation management strategies.

Objectives

To examine the potential differences in ground and rove beetle populations among different plots and vegetative treatments, and to provide the Project's stakeholders with an analysis of ground and rove beetle abundance, taxa richness, and diversity at SGL33, which will assist in making management recommendations for the future.

Ground beetles (Coleoptera: Carabidae) have long been used as bioindicators in agricultural systems due to their diverse ecological roles, their relative abundance, and, most notably, their sensitivity to environmental changes. This family of beetles are renowned for their voracious appetite for agricultural pests, weed seeds, etc. Despite their reputation as beneficial insects within agricultural and other "disturbed" landscapes, ground beetles rely on many different habitats for breeding, feeding, and survival, and beetles of this large Family are important members of a variety of natural and artificial ecosystems.

Rove beetles (Coleoptera: Staphylinidae) are another large and ubiquitous group of ground-dwelling predators. Together, the abundance and diversity of these two beetle Families have been studied in a variety of agroecosystems, but also "natural" landscapes such as forests and prairies (Spence et al 1997, Byers et al 2000, Pohl et al 2007). Our study seeks to examine the abundance, richness, and diversity of ground beetles that roam the managed, early successional habitats of SGL33.

Methods

SGL33 Field and Lab Methods

SGL33 Survey Plots

For the 2020 Carabidae study, we sampled at the same locations that were sampled for our pollinator research: **F2**, **SF2**, **MH3**, **MH1**, **BLV3**, and **HC1** (2016 vegetation treatments HVF, HVF, LVF, LVF, LVB, and HC, respectively; Table I-1, Figure I-2). A seventh 50m x 25m plot **M4** (2016 vegetation treatment: mowing) was added in July 2019 for the same study. In May 2020, before installing our beetle traps, our original **BLV3** plot on the South side of Strawband Beaver Road was partially and unexpectedly razed. As the entire **BLV3** treatment area extends onto the North side of Strawband Beaver Road, we used the intact, North side of the **BLV3** area for our 2020 Carabidae study, and we delineated a new "**BLV3a**" plot on 4 June 2020 (Figure C-1).

"**BLV3a**" **-** (Figure C-1)

Description of plot location: 60m NW of Strawband Beaver Road
Approximate center of plot: 40.843026, -78.132756
2016 vegetation treatment: Low Volume Basal (LVB)-2.9 gal of herbicide mixture applied.

Figure C-1. Location of "BLV3a" plot for 2020 Carabidae Survey at SGL33.

2020 Carabidae Study Field Schedule

The 2020 Carabidae Study took place over the course of 13 weeks, from 5 June to 30 August. The 2020 Carabidae Study consisted of four 72-hour sampling periods (Figure C-2).

SGL33 GROUND BEETLES
5 Jun - 30 Aug 2020 (13 weeks)

Four 72-hr Sample Periods
WEEK 1: 5 – 8 June
WEEK 5: 3 – 6 July
WEEK 9: 31 July – 3 August
WEEK 13: 27 - 30 August

Figure C-2. Ground beetle sampling schedule at SGL33 for 2020.

Pitfall trap array

For all seven plots combined, there were a total of 42 pitfall traps installed at SGL33 in 2020. Each of the seven plots at SGL33 contained six pitfall traps, installed in three transects of two (Figure C-3). Within each transect, pitfall traps were spaced approximately 15m apart, and between transects, pitfall traps were spaced approximately 12.5m apart. Trap spacing is important, as each trap needs to separated from neighboring traps by 10-15m, in order to minimize “trap-to-trap interference” (Work et al 2002). Pitfall traps on the edge of the transects were spaced approximately 5m from the long edge of the plot, and approximately 12.5m from the short edge of the plot. Because of the heterogenous landscape of each plot, traps could not be positioned in the perfect grid pattern as shown (hence the “spaced approximately”). All pitfall traps were located within the Wire Zone.

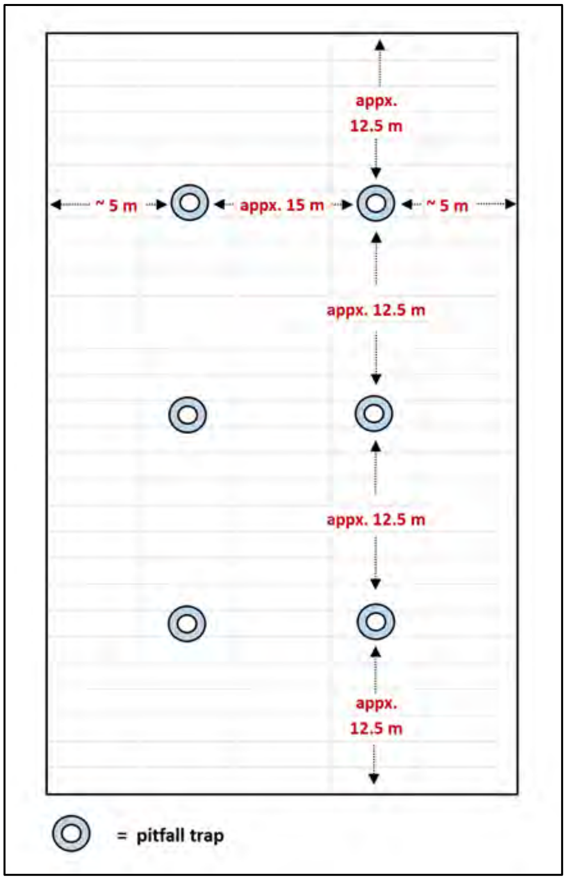

Figure C-3. Pitfall trap array for each plot.

The multiple number of pitfall traps per plot allowed for some sample loss due to events such as extreme weather conditions, or vandalization by curious mammals. In a trial run in 2018, we experienced an average loss of 2 samples per plot. Additionally, a reserve of pitfall trap materials were on hand every month.

<u>Pitfall trap design</u>

Following the design used by Leslie et al (2009), each pitfall trap (Figure C-4, Left) consisted of:

- One large outer container: a 32oz plastic deli container (~14cm depth x ~10.9cm Inside Diameter, or ID), inserted flush with the ground. *This outer container remained in the ground for the entire season.*
- One inner trap sample cup: a 5.5oz plastic souffle cup (~5.5cm depth x 8.2cm ID), placed inside the larger container
- 70mL of preservative solution in the trap sample cup (1:1 mixture of food-grade propylene glycol and 70% denatured ethyl alcohol)

- One funnel: an inverted top of a 2L soda bottle, inserted flush with the ground
- One rain cover: three 1/4-in x 5-in carriage bolts inserted into a 6.48-in diameter plastic lid
- Flagging to mark each trap's location
- Lids for each large outer container <u>and</u> each inner trap sample cup

The purpose of the smaller trap sample cup inside the large outer container was to allow for monthly removal of samples without removing or damaging the pitfall trap. The propylene glycol/ethyl alcohol mixture is non-toxic to mammals and humanely killed and preserved the invertebrates in the pitfall trap. The purpose of the funnel was to trap only small invertebrates, and exclude larger animals such as shrews or amphibians. The elevated rain cover prevented the pitfall trap from filling with rain water.

Figure C-4 . Left: Assembled pitfall trap containing preservative solution. Right: Pitfall trap and rain cover at BLV3a. Photos: H Stout.

Pitfall Trap Installation

Upon arrival at each plot, we used a 100m measuring tape wheel and the pitfall trap array (Figure C-3) to measure and then "mark" the target location of each pitfall trap. We placed an outer container or some other highly visible object at each targeted trap location before moving to measure and mark the next trap. We repeated this until all six trap locations were marked.

Using a dibble bar, we dug at each trap location. The opening for each trap needed to be at least 14.1cm deep with a diameter of 10.9cm, so that the outer container would sit flush or slightly lower than the level of the ground. If an opening of that size could not be dug at the targeted trap location, we searched for a more compatible area that was as close as possible to the original target location.

After the digging was complete and the outer container was set in place. Flagging was tied to tall, stable vegetation within 1m of trap. This was repeated until all six traps were ready to set at each plot.

Monthly Pitfall Trapping

At the start of each of the four collection weeks, traps were inspected and any necessary adjustments to the holes were made. The large outer container was placed into the hole. We added ~70mL of a 1:1 food-grade propylene glycol/denatured ethyl alcohol solution to an inner trap sample cup, which was then set inside the outer container. The inverted funnel was placed into the trap, so that the entire assembly was flush with the ground. We then placed the rain cover over the trap, pressing the carriage bolt supports into the soil until the cover was nearly flush with the ground (Figure C-4, Right). This was repeated until all traps at all plots were set.

72 hours later, we returned to the plots in the same order as three days earlier. At each trap, we removed the rain cover and the funnel, and then the inner trap sample cup. A lid was placed on the inner sample cup, and the lidded trap sample cup was placed into a zip bag labeled with collection week and plot name.

For collection weeks 1, 5 and 9, a lid was then placed on the empty large outer container, and the large outer container was set back into the ground until the next collection week. For collection week 13, the outer container was removed and taken with all trap sampling equipment and materials to offsite storage.

This was repeated at each plot until all six lidded trap sample cups were securely in the plot's zip bag, and until trap sample cups were removed from all seven plots.

End Of Season/Last Day

After all lidded trap sample cups were securely in the zip bag for all seven plots, all pitfall trap materials were removed from the ground and placed into storage.

Specimen Processing

Dr. Stout stored the 168 trap samples for approximately 2 to 4 months before processing.

Each sample cup was arbitrarily assigned a trap identifier, then emptied and rinsed with denatured ethyl alcohol into a sorting tray. Pinnable beetles were removed from the tray, then washed, dried, pinned, and labeled with collection week, plot name, and the trap identifier. Non-beetle invertebrates and beetles that were too small to pin were removed from the sorting tray and placed into 1- or 2-dram glass vials filled with 70-95% denatured alcohol. Each vial contained a label with the sample cup's collection week, plot name, and the trap identifier.

After all specimens had been processed, Dr. Stout began specimen identification.

Specimen Identification

All Carabidae and Staphylinidae were identified to the lowest practical level (LPL). Ground and rove beetles were identified to Species, if possible. The taxonomy of many carabids and staphylinids is in revision, and identification to Genus or Species is sometimes only possible by experts.

Other beetles were identified to Family (or to Genus or Species if the specimen was easily recognizable).

Most non-beetle specimens were identified to Order—exceptions include millipedes (Class Diplopoda), mites/ticks (Superorder Acariformes), and certain groups within the Order Hymenoptera. For Hymenoptera, easily recognizable groups such as ants and ichneumonid wasps were identified to Family (e.g. Formicidae, Ichneumonidae); more difficult groups, such as chalcidoid wasps, were left at the Superfamily level (Chalcidoidea).

Results

Total and monthly lists of the ground beetles, rove beetles, "other" beetles, and non-beetle invertebrates collected at SGL33 in 2020 are located in the Appendices.

Ground and Rove Beetles

Total Ground and Rove Beetle Abundance

In 2020, we collected 153 ground beetles and 290 rove beetles from the seven SGL33 plots. The most ground beetles were collected from the **HC1** plot (2016 treatment: handcutting), and the fewest ground beetles were collected from the **MH1** plot (2016 treatment: LVF, Table C-1, Figure C-5). The most rove beetles were collected from the **M4** plot(2016 treatment: mowing), and the fewest rove beetles from the **MH1** plot (Table C-2, Figure C-6).

Table C-1. Total abundance of ground beetles per plot at SGL33 for 2020.

2020 SGL33 CARABIDAE ABUNDANCE - TOTAL	
Plot	**Number of Ground Beetles**
M4	16
F2	20
SF2	15
MH3	21
MH1	9
BLV3a	15
HC1	**57**

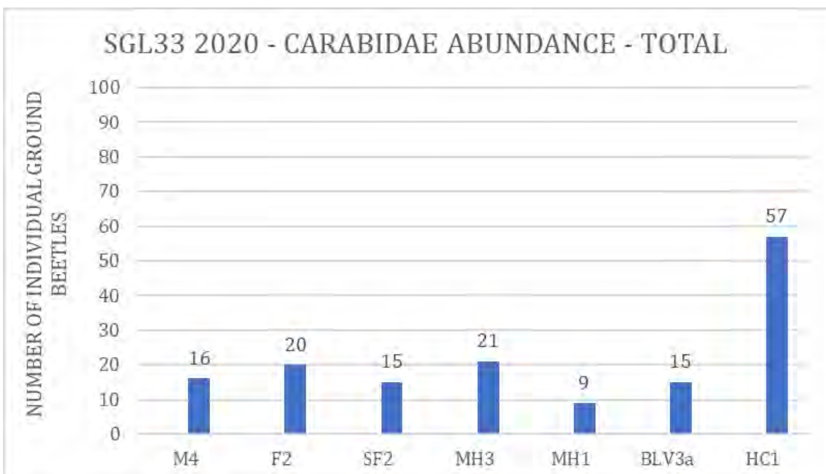

Figure C-5. Total abundance of ground beetles per plot at SGL33 for 2020.

Table C-2. Total abundance of rove beetles per plot at SGL33 for 2020.

2020 SGL33 STAPHYLINIDAE ABUNDANCE - TOTAL	
Plot	**Number of Rove Beetles**
M4	**81**
F2	79
SF2	37
MH3	55
MH1	5
BLV3a	15
HC1	18

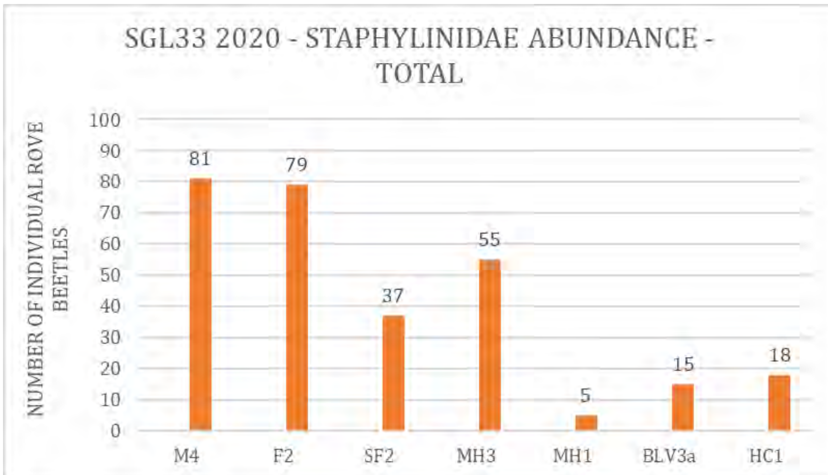

Figure C-6. Total abundance of rove beetles per plot at SGL33 for 2020.

A total of 7847 specimens—ground and rove beetles, "other" beetles, and non-beetle invertebrates—were collected at SGL33 in 2020. The most specimens were collected from **MH3**, and the fewest from **HC1**, but the greatest relative abundance of ground beetles was at **HC1**, and the greatest relative abundance of rove beetles was at **M4**. The lowest relative abundance of both ground and rove beetles was at **MH1** (2016 treatment: LVF, Tables C-3 and C-4).

Table C-3. Relative abundance of ground beetles per plot at SGL33 for 2020.

SGL33 % CARABIDAE OF TOTAL SPECIMENS - MAY-AUG 2020			
Plot	**Total # of Ground Beetles**	**Total # of Specimens**	**Carab = % of Total**
M4	16	1176	1.36%
F2	20	1291	1.55%
SF2	15	1260	1.19%
MH3	21	**1525**	1.38%
MH1	9	810	1.11%
BLV3a	15	997	1.50%
HC1	**57**	788	**7.23%**

Table C-4. Relative abundance of rove beetles per plot at SGL33 for 2020.

SGL33 % STAPHYLINIDAE OF TOTAL SPECIMENS - MAY-AUG 2020			
Plot	**Total # of Rove Beetles**	**Total # of Specimens**	**Staphyl = % of Total**
M4	**81**	1176	**6.89%**
F2	79	1291	6.12%
SF2	37	1260	2.94%
MH3	55	**1525**	3.61%
MH1	5	810	0.62%
BLV3a	15	997	1.50%
HC1	18	788	2.28%

Total Ground and Rove Beetle Taxa Richness*

For 2020, we collected 49 tentative ground bee taxa and 33 tentative rove beetle taxa at SGL33. The most* ground beetle taxa were collected at **MH3** and the fewest* ground beetle taxa were collected at **MH1** (Table C-5 and Figure C-7). The most* rove beetle taxa were collected at **F2** (2016 treatment HVF) and the fewest* rove beetle taxa were collected at **MH1** (Table C-6)(Figure C-8).

Table C-5. Taxa richness* of ground beetles per plot at SGL33 for 2020.

2020 SGL33 TOTAL CARABIDAE TAXA RICHNESS*	
Plot	Number of Taxa*
M4	10
F2	12
SF2	11
MH3	**15**
MH1	6
BLV3a	11
HC1	13

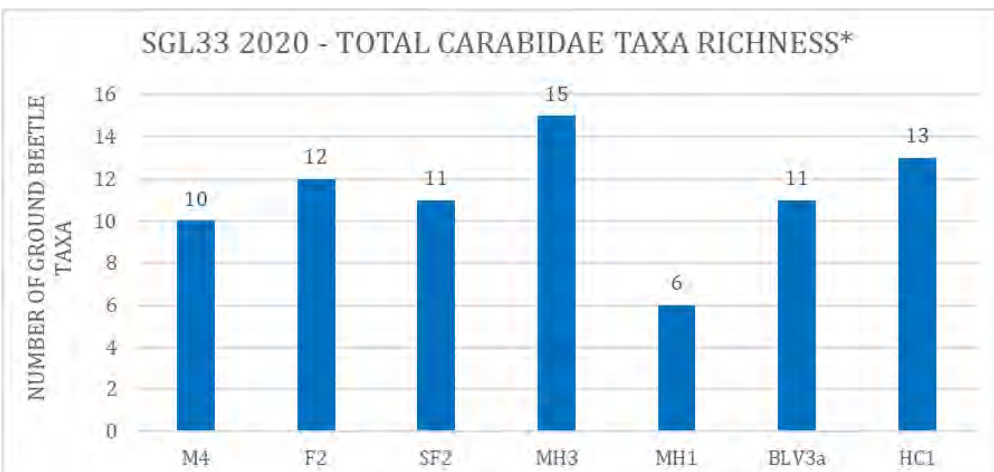

Figure C-7. Taxa richness* of ground beetles per plot at SGL33 for 2020.

Table C-6. Taxa richness* of rove beetles per plot at SGL33 for 2020.

2020 SGL33 TOTAL STAPHYLINIDAE TAXA RICHNESS*	
Plot	**Number of Taxa***
M4	11
F2	**12**
SF2	9
MH3	11
MH1	4
BLV3a	11
HC1	9

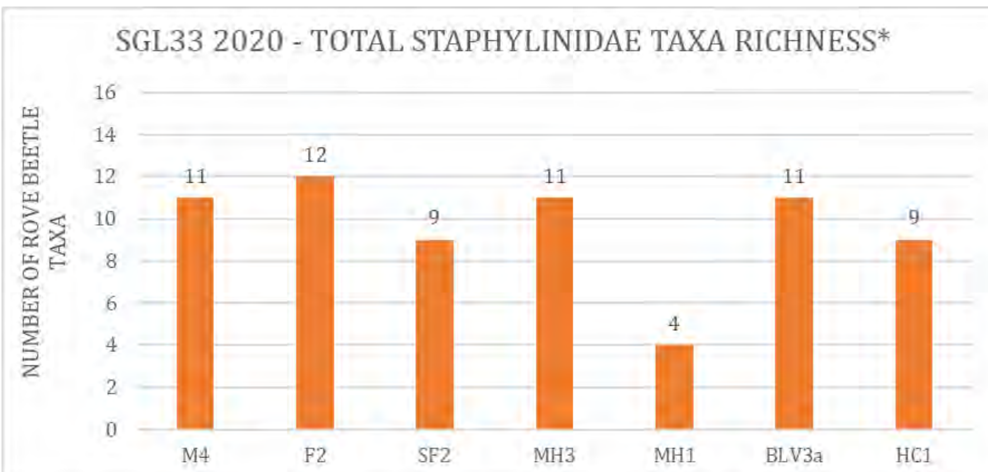

Figure C-8. Taxa richness* of rove beetles per plot at SGL33 for 2020.

Ground and Rove Beetle Abundance per Collection Week

The collection weeks in which the most ground beetles were collected from each plot were (Table C-7)(Figure C-9):

Week 1 - **M4**, **F2**, **SF2**, **MH3**
Week 5 - **MH1**
Week 9 - **HC1**
Week 13 - **BLV3a**

Table C-7. Ground beetle abundance per plot by collection week at SGL33 for 2020.

SGL33 2020 - CARABIDAE ABUNDANCE PER PLOT BY COLLECTION WEEK							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1
WEEK 1	**8**	**13**	**6**	**11**	2	4	8
WEEK 5	2	1	1	3	**4**	2	14
WEEK 9	3	5	3	1	1	4	**21**
WEEK 13	3	1	5	6	2	**5**	14

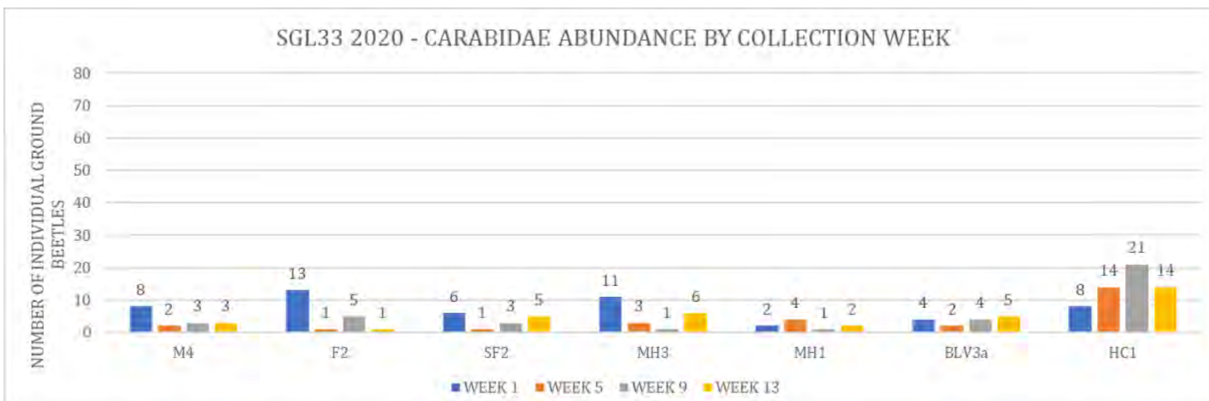

Figure C-9. Ground beetle abundance per plot by collection week at SGL33 for 2020.

The collection weeks in which the most rove beetles were collected from each plot were (Table C-8)(Figure C-10):

Week 1 - **M4**, **F2**, **SF2**, **MH3**, **BLV3a**

Rove beetle abundance for **MH1** was fairly consistent throughout the season, and for **HC1** was highest for collection weeks 1 and 5.

Table C-8. Rove beetle abundance per plot by collection week at SGL33 for 2020.

SGL33 2020 - STAPHYLINIDAE ABUNDANCE PER PLOT BY COLLECTION WEEK							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1
WEEK 1	**72**	**66**	**31**	**45**	2	**9**	**7**
WEEK 5	3	5	1	5	1	2	**7**
WEEK 9	5	8	2	5	2	2	3
WEEK 13	1	0	3	0	0	2	1

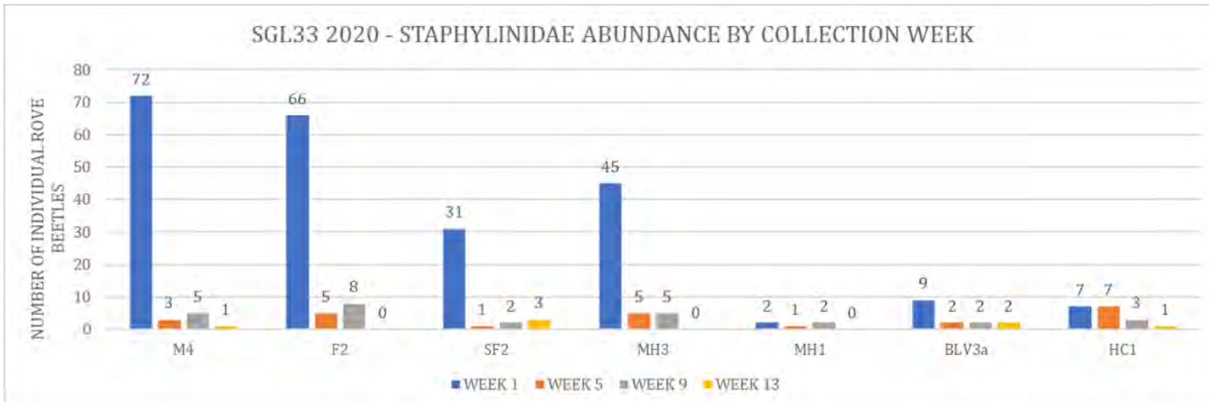

Figure C-10. Rove beetle abundance per plot by collection week at SGL33 for 2020.

<u>Ground and Rove Beetle Taxa Richness* per Collection Week</u>

The collection weeks in which the most ground beetle taxa* were collected from each plot were (Table C-9)(Figure C-11):

Week 1 - **M4**, **F2**, **MH3**
Week 9 - **HC1**
Week 13 - **BLV3a**

Ground beetle taxa richness* for **SF2** was highest for weeks 1 and 13, for **MH1** was fairly consistent throughout the season.

Table C-9. Ground beetle taxa richness* per plot by collection week at SGL33 for 2020.

SGL33 2020 - CARABIDAE TAXA RICHNESS* PER PLOT BY COLLECTION WEEK							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1
WEEK 1	**6**	**8**	**4**	**6**	2	4	4
WEEK 5	1	1	0	3	2	2	5
WEEK 9	2	5	3	1	1	1	**7**
WEEK 13	2	1	**4**	5	2	**5**	4

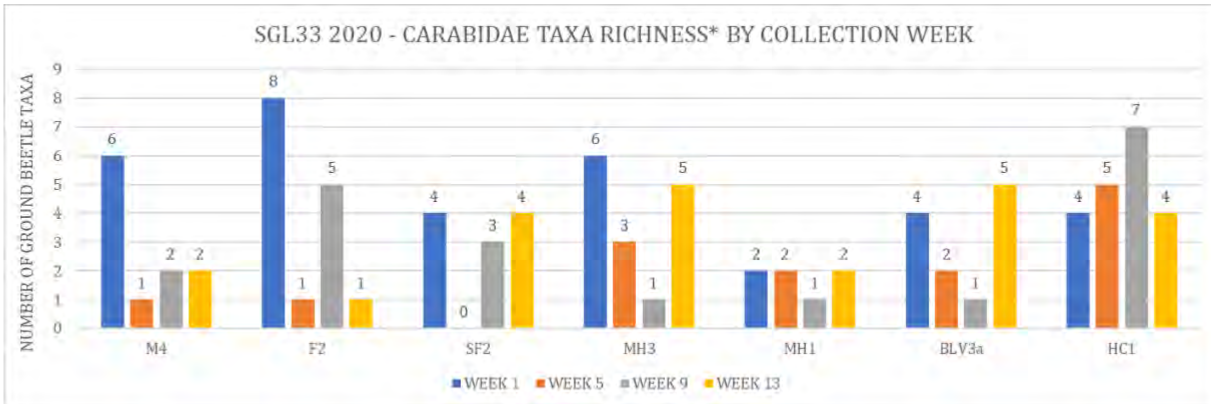

Figure C-11. Ground beetle taxa richness* per plot by collection week at SGL33 for 2020.

The collection weeks in which the most rove beetle taxa* were collected from each plot were (Table C-10)(Figure C-12):

Week 1 - **M4**, **SF2**, **MH3**, **MH1**, **BLV3**
Week 5 - **HC1**
Week 9 - **F2**

Table C-10. Rove beetle taxa richness* per plot by collection week at SGL33 for 2020.

SGL33 2020 - STAPHYLINIDAE TAXA RICHNESS* PER PLOT BY COLLECTION WEEK	M4	F2	SF2	MH3	MH1	BLV3a	HC1
WEEK 1	**6**	5	**4**	**6**	**2**	**5**	2
WEEK 5	2	4	1	2	1	2	**4**
WEEK 9	3	**6**	1	4	1	2	2
WEEK 13	1	0	3	0	0	2	1

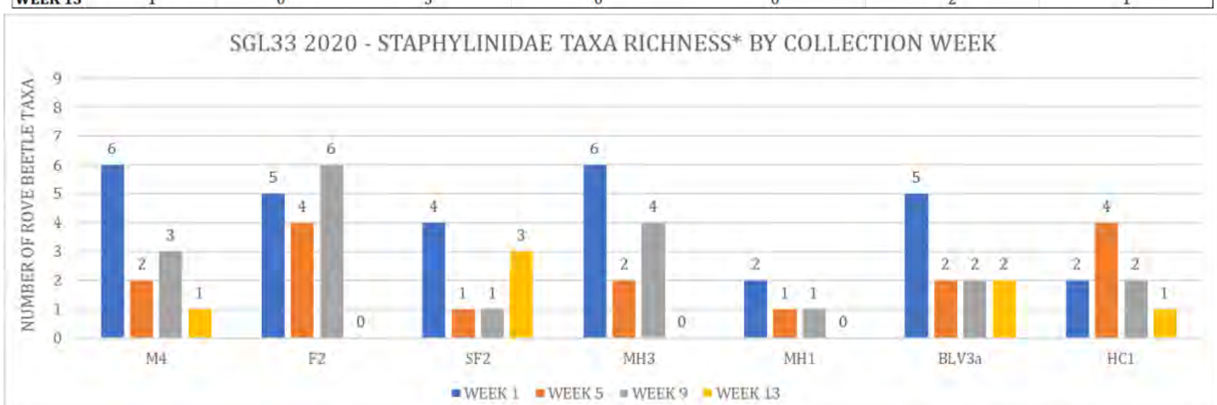

Figure C-12. Rove beetle taxa richness* per plot by collection week at SGL33 for 2020.

Other Beetles and Non-beetle Invertebrates

In addition to ground and rove beetles, in 2020 we collected 307 "other" beetles representing 69 taxa. The most "other" beetles were collected from **MH3** and the fewest from **MH1**. We also collected 7097 "non-beetle invertebrates" representing 62 taxa. "Non-beetle invertebrates" that were collected include: mites/ticks, spiders, centipedes, springtails, millipedes, true flies, snails, true bugs, ants/bees/wasps, isopods, butterflies/moths, scorpionflies, harvestmen, crickets/grasshoppers/katydids, lice, thrips, and one pseudoscorpion. The most non-beetle invertebrates were collected from **MH3** and the fewest from **HC1**.

Discussion

Abundance of Carabidae and Staphylinidae

The number of ground beetles, and the proportion of ground beetles to other taxa, was greatest at **HC1**. Forestland carabid communities have been shown to have higher species richness than those of agroecosystems (Leslie 2014), but verified identifications are needed before speculating on the habitat preferences of the ground beetle taxa collected at **HC1**.

The fewest ground beetles were collected at **MH1** a unit/plot that was treated using LVF application of 0.5 gal of herbicide mixture in 2016. Perhaps this is related to the density and diversity of vegetation at **MH1** relative to the other six plots, or perhaps we are seeing a bottom-up effect due to a reduction in prey species that may or may not have been brought about by vegetation management practices. As with the abundance of ground beetles at **HC1**, verified identifications are needed before further speculation. However, our unit/plot with the highest herbicide application in 2016 (**F2,** 2016 vegetation treatment HVF 75 gal) had abundant rove beetles although low ground beetle abundance.

Taxa Richness of Carabidae and Staphylinidae

Because nearly all of the ground and rove beetle identifications have not yet been verified, conjectures regarding treatment effects that would be based on species richness, diversity, and the ecology of specific carabid and staphylinid taxa cannot be made. However, one carabid ID has been verified: *Rhadine caudata* (Figure C-13).

Figure C-13. *Rhadine caudata* (Coleoptera: Carabidae) collected at SGL33 in 2020. Photo: H. Stout.

We collected one specimen of this striking ground beetle at **BLV3a**. This specimen would not "key out" in our collection of identification manuals and taxonomic keys, so we uploaded several photos of this specimen to the BugGuide website (https://bugguide.net/node/view/1982321), and an expert on the Genus replied quickly with an ID confirmation. Although the species is known to occur in Pennsylvania, no photos of Pennsylvania specimens had ever been uploaded to the BugGuide website. Because of our contribution to BugGuide, the website's data range of the species now includes Pennsylvania (https://bugguide.net/node/view/1027227/data).

Rhadine caudata is a species on the list of "Terrestrial Insects of Greatest Conservation Need", which is part of the Virginia Department of Game and Inland Fisheries' Wildlife Action Plan of 2015 (VDGIF 2015). Interestingly, three other *Rhadine* species are Federally Endangered, as they are endemic only to caves in three counties in Texas (USFWS 2019).

Due to their heterogeneity and relatively diverse plant communities, forests, and forest edges of croplands, appear to be especially important habitats for ground beetles (Leslie 2014, García-Tejero 2018). The early successional habitats that are maintained in the wire zone, combined with the woody hand-cut plots and the ecotone of its forested edges, have been shown to provide habitat for the numerous plant and animal taxa that we have studied previously. As more ground and rove beetle identifications are verified, we expect further insights into the habitats that

SGL33 and other ROW provide, and the potential effects, benefits and/or costs of maintaining those rights-of-way on ground beetle abundance, richness, and diversity.

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Appendix A. Most recent vegetation treatment applications and sample treatment unit photographs at State Game Lands (SGL) 33 and Green Lane Research and Development (GLR&D) right-of-way sites. SGL 33 was treated in late August 2016. GLR&D was last treated 5 yrs ago in 2014.

SGL 33 Legacy Treatment Acronym	SGL 33 Legacy Treatment Unit	SGL 33 2016 Application	SGL 33 Herbicide Gallons Used-wire zone	SGL 33 Total Man Hours	SGL 33 Bar Oil	SGL 33 Gas	SGL 33 Crew
HC1	Hand Cut	Hand Cut	0	70 hours	1.5 gallon	3.5	5
BLV3 (BHV1)	Basal Low Volume	Low Volume Basal	2 gallon 7 pints	4 hours	0	0	3
MH1	Mow plus Herbicide	Low Volume Foliar	2 quarts	40 minutes	0	0	2
BLV1	Basal Low Volume	Low Volume Basal	2.5 gallons	3 hours	0	0	3
F1	Foliar Spray	Low Volume Foliar	3 gallon 5 pints	52 minutes	0	0	2
M1	Mowing	Low Volume Foliar	2 quarts	90 minutes	0	0	3
BLV4 (BHV2)	Basal Low Volume	Low Volume Basal	4 gallon 5 pints	90 minutes	0	0	3
HC2	Hand Cut	Hand Cut	0	25 hours	1 quart	1	5
SF1	Stem Foliar	Low Volume Foliar	5 pints	30 minutes	0	0	1
M2	Mowing	Low Volume Foliar	3 pints	20 minutes	0	0	1
BLV2	Basal Low Volume	Low Volume Basal	4 gallons	6 hours 4 minutes	0	0	3
MH3 (MH2)	Mow with Treatment	Low Volume Foliar	2 gallon	2 hours 10 minutes	0	0	2
SF2	Stem Foliar	High Volume Foliar	25	1 hour 5 minutes	0	0	2
F2	Foliar Spray	High Volume Foliar	75 gallons	4 hours	0	0	2
M4 (M3)	Mowing	Mowing	0	6 hours	0	N/A	2

GLR&D Legacy Treatment Acronym	GLR&D Legacy Treatment Unit	GLR&D 2014 Application	GLR&D Herbicide/treatment used - wire zone
M1, M2	Mowing	Mowing (M)	Mow all woody vegetation.
MH1, MH2	Mowing plus herbicide	Mowing cut stubble (MCS)	Mow all woody vegetation and apply an ultra-low volume broadcast application of 14oz Viewpoint + 7oz Milestone in 15 gallons water applied at 15 gallons per acre.
SF1, SF2	Stem foliar	Low volume foliar (LVF)	Spray all trees and tall shrubs to the point of runoff and their stem with Arsenal 4oz/100gal + Escort XP 1oz/100gal + Milestone 5oz/100gal + Garlon 3A 2qts/100gal+ Clean Cut ½% + 41-A drift control 6oz/100 gal.
F1, F2	Foliar spray	High volume foliar (HVF)	Spray all trees and tall shrubs to coverage with Rodeo 7% + Arsenal 1% + Escort XP 4oz/100gal in Thinvert.
HC1, HC2	Hand cut	Hand cut (HC)	Clear cut all woody vegetation in the wire zone and 15ft outside.

Appendix B. Outreach efforts related to rights-of-way research and demonstration sites at State Game Lands 33, State Game Lands 103, and Green Lane Research and Development area July 2018-June 2021.

Speaking engagements/poster presentations (20):

The effect of vegetation management approaches on electric transmission line rights-of-ways: response of native bees
Rights-of-Way (ROW) 12; Bi-annual Conference
Denver, CO
September 2018

The value of industry/academic partnerships in understanding ecological responses to vegetation management on rights-of-way. Panel discussion w Chris Halle (Sonoma State), Eric Brown (TREE fund), David Krause (Asplundh)
Rights-of-Way (ROW) 12; Bi-annual Conference
Denver, CO
September 2018

Biodiversity along electric transmission rights-of-way managed using integrated vegetation management techniques
North American Transmission Forum (NATF) Conference
Newport, RI
October 2018

Bee diversity on electric transmission rights-of-way: a continuing study
Entomological Society of America, Annual Conference
Vancouver, British Columbia
November 2018

The decline of native bees and Monarch butterflies: are corporate habitats the answer?
Wildlife Habitat Council Annual Conservation Conference
Baltimore, MD
November 2018

Insect pollinators in the human-modified landscape
Entomological Society of America, Eastern Branch Annual Conference
Virginia Tech University, Blacksburg, VA
March 2019

Pollinator report card development-input from State Game Lands 33 pollinator research
Wildlife Habitat Council, Rights-of-Way as Habitat Working Group (Metrics/Targets)
University of Chicago, Chicago, IL
March 2019

Managing rights-of-way in forested landscapes to promote biodiversity
Pennsylvania Private Forest Landowners Conference
The Penn Stater Hotel and Conference Center
University Park, PA
March 2019

Effects of integrated vegetation management along rights-of-way on wildlife: vegetation, birds, bees, and other pollinator effects.
First Sustainability Summit-Energy Industries
The Pennsylvania State University-Penn Stater Hotel
University Park, PA
June 2019

Pollinator habitat on rights-of-way (panel discussion)
2nd Annual Pollinator In-Service Day
The Pennsylvania State University
University Park, PA
July 2019

Rights-of-way as bee habitat
Trees and Utilities Conference
Cincinnati, OH
September 2019

Long-term effects of utility rights-of-way vegetation management on floral and faunal communities
National Wild Turkey Federation Annual Conference
Nashville, TN
February 2020

Women in vegetation management
Utility Arborists Association Workshop
Virtual meeting
September 2020

*Use of electric transmission line rights-of-way by breeding birds in central Pennsylvania: species richness and nest productivity**
State College Bird Club

State College, PA
November 2019

*Also presented at:
Juniata Audubon Society
Bedford, PA Virtual meeting
April 2020

Conserving and managing landscape corridors for wildlife-panel discussion
University of Pennsylvania-Wharton School
Philadelphia, PA Virtual meeting
January 2021

*Understanding how vegetation management practices impact rights-of-way ecosystems***
National Wild Turkey Federation Annual Conference
Virtual meeting
February 2021

**Also presented at:
12^{th} Vegetation Management Workshop
Investment-owned utilities
Virtual meeting
May 2021

Species richness and abundance of snakes in rights-of-way sections of State Game Lands 103, central Pennsylvania, USA
Undergraduate Research and Creative Activities Fair
Virtual meeting-Penn State Altoona
April 2021

Managing rights-of-way with integrated vegetation management improves wildlife habitat
American Petroleum Institute Midstream Conservation Program
Virtual meeting
April 2021

Written communications (11)

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Halle, C., C. Mahan, D. Krause, and E. Brown. 2018. *Future IVM Observatories*. Proceedings ROW 12: 401-406.

Mahan, C., B. Ross, H. Stout, and D. Roberts. 2018. *The effect of VM approaches on electric transmission ROWS bees-pre- and post- treatment.* Proceedings ROW 12: 649-652.

Gamelands 33 and Green Lane research update (Kristin Wild, Asplundh)
December 2018, Asplundh Tree pp. 7-8

Creating sustainable biodiverse habitat on rights-of-way (brochure), Corteva Agrisciences, 2019
Pollinator habitat the focus of first-of-its-kind sustainability summit (news release), Corteva Agrisciences, 2019
Key research findings –summary and update, Corteva Agrisciences, 2019

What's the buzz about pollinators? (Steve Hilbert et al., Asplundh)
Spring 2020, Asplundh Tree

Mahan, C., B. Ross, and R. T. Yahner. 2020. *The effects of integrated vegetation management on richness of native compatible flowering plants and abundance of non-compatible tree species on a right-of-way in central Pennsylvania*. Arboriculture and Urban Forestry 46: 395-401.

Ross, B., J. Berger, and C. Mahan. 2020. *Breeding bird species richness, abundance, and productivity along a powerline right-of-way within a forested landscape, northeastern United States*. American Midland Naturalist, under revision.

Powerful pollinators (Michael T. Crawfort)
PennLines Magazine, pp. 8-11 (Cover story)
June 2020

Science-based strategies improve vegetation management success (Corteva Agrisciences w/ Travis Rogers, Phil Charlton, and Ben Borden)
T&D World Magazine
June 2021

Russo, L., H. Stout, D. Roberts, B. Ross, and C. Mahan. 2021. *Powerline right-of-way management and flower-visiting insects: how vegetation management can promote pollinator diversity.* PLOS One, https://doi.org/10.1371/journal.pone.0245146.

Web features (7)

Utility rights-of-way research at Penn State
Latest research findings: plant and animal response to rights-of-way treatments
https://sites.psu.edu/transmissionlineecology/
On-going

Tree fund grant allows right-of-way research to continue
https://altoona.psu.edu/story/12732/2018/09/04/tree-fund-grant-allows-right-way-research-continue
September 2018

Corteva Agrisciences Pollinator Week Research videos (8 videos-2019, 2020)
https://www.youtube.com/watch?v=GKrLuiedM8g
https://www.youtube.com/watch?v=opn2n4FyjTs
https://www.youtube.com/watch?v=dfGtTc47LGM&t=1s
https://www.youtube.com/watch?v=uRNRmJhEpLA&list=PLRO41MrEV4y519HJ5PjQ-P6S6KNfTOKyv&index=6
https://www.youtube.com/watch?v=4QeH02uyf4M&list=PLRO41MrEV4y519HJ5PjQ-P6S6KNfTOKyv&index=7
https://www.youtube.com/watch?v=ydfmdALAgOI&list=PLRO41MrEV4y519HJ5PjQ-P6S6KNfTOKyv&index=8
https://www.youtube.com/watch?v=SV8JRLr43Zw&list=PLRO41MrEV4y519HJ5PjQ-P6S6KNfTOKyv&index=9
https://www.youtube.com/watch?v=4qBLgXuD9Y0&list=PLRO41MrEV4y519HJ5PjQ-P6S6KNfTOKyv&index=11

Transmission and Distribution World (Sponsored Content): Pollinator habitat the focus of rights-of-way sustainability summit
https://www.tdworld.com/vegetation-management/article/20972904/pollinator-habitat-the-focus-of-rightsofway-sustainability-summit
August 2019

PPL's talking about the birds and the bees (research featured in article); The Morning Call
https://www.mcall.com/business/mc-ppl-electric-pollinator-power-line-research-20190902-lxdq35hqtfczzbvhzdyhkxrfa4-story.html
September 2019

Rights-of-Way Habitat Reclamation Update – Russ Maxwell, CN Utility Consulting, Des Moines, IA
https://wearecnuc.com/blog-row-habitat-reclamation-update/
October 2020

Undergraduate research and creativity fair, Penn State Altoona
https://sites.psu.edu/researchteaching/2021/04/29/urcaf-2021/
April 2021

Site visits (4)

July 2018, 35-participant tour of SGL 33 in conjunction FirstEnergy: attendees included PA utilities, PUC staff, Federal legal, Government regulators, and Union representatives.

July 2019, 50+ participant tour of SGL 33 in cooperation with Sustainability Summit (focus on pollinators); Corteva, FirsEnergy, Asplundh coordinators

June 2020, Tour of SGL 33 research plots with Land and Cover staff PA Game Commission, discussed IVM and its effects on early successional wildlife populations.

August 2020, 10-participant tour of SGL 33 and distribution utility corridors on SGL 176 with Pennsylvania Natural Heritage Program, Pennsylvania Game Commission, FirstEnergy, and Asplundh representatives (focus on wild indigo).

Academic/scholarly partnerships (6)

Center for Pollinator Research at Penn State, Pollinator protection group, University Park, PA

Frost Entomological Museum, University Park, PA

U.S. Geological Survey (USGS) Bee Inventory and Monitoring Database (Sam Droege, Patuxent Research Center, Laurel, MD)

Ground beetle information provided to:
BugGuide (https://bugguide.net/node/view/1027227/data)

Bee specimen information provided to:
Pennsylvania Bee Atlas project, Penn State, University Park, PA
Pollinator Conservation Institute, University of Guelph, Canada

Appendix C.

PRELIMINARY TAXA TABLES FOR POLLINATOR AND GROUND BEETLES SURVEYS

BEES

SGL33 AND SGL103 TOTAL

SGL33 AND SGL103 MONTHLY

MAY - AUGUST 2019	SGL33							SGL 103		
	8 net hours	16 net hours						16 net hours		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
ANDRENIDAE (miner, bare-miner, fairy, and oxaeine bees)										
***Andrena* sp.** (miner bees)										
Andrena bradleyi ("Bradley's miner bee")								1	1	2
Andrena brevipalpis				2						2
Andrena canadensis ("Canada miner bee")								1		1
Andrena carlini ("Carlin's miner bee")			11		3	2			6	22
Andrena carolina ("Carolina miner bee")		2	5		2	4	1	3	5	22
Andrena ceanothi ("Ceanothus miner bee")			13	1	4	8				26
Andrena crataegi ("Hawthorn miner bee")		2			1					3
Andrena cressonii cressonii ("Cresson's miner bee")		1			2					3
Andrena erigeniae ("Spring Beauty miner bee")								1		1
Andrena forbesii ("Forbes' miner bee")		3	6							9
Andrena heraclei/ceanothi					2					2
Andrena hirticincta ("hairy-banded miner bee")		3		4	2	3	1	3		16
Andrena imitatrix			1							1
Andrena kalmiae ("Kalmia miner bee")								1		1
Andrena nasonii ("Nason's miner bee")			2							2
Andrena nivalis ("snowy miner bee")		5	7	1	14	1	1		3	32
Andrena nubecula ("cloudy-winged miner bee")	1				1					2
Andrena nuda ("nude miner bee")			1		1					2
Andrena perplexa ("perplexing miner bee")				1		2				3
Andrena personata				1						1
Andrena platyparia (a "dogwood miner bee")						1				1
Andrena rugosa		2	2					1		5
Andrena sayi					1				1	2
Andrena simplex				1			1			2
Andrena spiraeana		1	1		1	1	2		1	7
Andrena tridens			1							1
Andrena vicina ("neighborly miner bee")		2	3			1		1	1	8
Andrena virginiana ("Virginia miner bee")	2		68	8						78
Andrena w-scripta						1				1
Andrena wheeleri					1					1
Andrena wilkella						4				4
Andrena ziziaeformis		1		14		1				16
***Andrena* (Trachandrena) sp.**			3	1						4
APIDAE (cuckoo, bumble, carpenter, digger, honey, orchid bees)										
***Apis* sp.** (honey bees)										
Apis mellifera ("Western honey bee")	1	1	1	54	1	6	2	3	1	70
***Bombus* sp.** (bumble bees)										
Bombus bimaculatus ("two-spotted bumble bee")	2	3	4	13		3		27	4	56
Bombus fervidus ("golden Northern bumble bee" ***VULNERABLE***)								1		1
Bombus impatiens ("common eastern bumble bee")	34	48	136	158	10	201	6	150	8	751
Bombus perplexus/vagans/sandersoni	1	14	6	16	20	17	1	21	3	99
***Ceratina* sp.** (small carpenter bees)			1							1
Ceratina calcarata ("spurred small carpenter bee")	4	1	1	3	1	4	1	1	1	17
Ceratina calcarata/mikmaqi	1							1		2
Ceratina dupla ("doubled small carpenter bee")	21	8	15	9	5	11	3	13	4	89
Ceratina miqmaki ("Miqmak small carpenter bee")	3	5	4	1	2	6	1	5	1	28
Ceratina strenua ("nimble small carpenter bee")	2	1		2	5	2	1	1		14
***Epeolus* sp.** (cellophane-cuckoo bees)										
Epeolus scutellaris ("notch-backed cellophane-cuckoo bee")					1					1
***Melissodes* sp.** (a genus of long-horned bees)										
Melissodes druriellus ("goldenrod long-horned bee")	3	12	2	1	2					20
***Nomada* sp.** (nomad bees)			1							1
Nomada armatella ("yellow-backed nomad bee")			1						1	2
Nomada banksi					1					1
Nomada bethunei ("Bethune's nomad bee")			1	1			1		1	4
***Nomada bidentata* group**		1	5	4	6	1		1	4	22
Nomada cressonii ("Cresson's nomad bee")		4		1						5
Nomada denticulata ("denticulate nomad bee")				1						1
Nomada depressa			1						1	2
Nomada florilega			1		1					2

MAY - AUGUST 2019	SGL33							SGL 103		
	8 net hours	16 net hours						16 net hours		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
Nomada luteoloides ("black-and-yellow nomad bee")					2				1	3
Nomada MR1 (as yet undescribed nomad bee)				1		1				2
Nomada pygmaea ("pygmy nomad bee")		1							1	2
Nomada sayi/illinoensis			1			1				2
Nomada vicina ("neighborly nomad bee")	1	2		1	1	1	1			7
Xylocopa sp. (large carpenter bees)										
Xylocopa virginica ("Eastern carpenter bee")	2	1	3	1		1		1	1	10
COLLETIDAE (cellophane, fork-/feather-tongued, and masked bees)										
Colletes sp. (cellophane bees)										
Colletes simulans ("spine-shouldered cellophane bee")	1	1	1			1				4
Hylaeus sp. (masked bees)			1		2					3
Hylaeus affinis ("Eastern masked bee")	4	3	4		1	3			1	16
Hylaeus annulatus ("annulate masked bee")	1		1							2
Hylaeus mesillae ("Mesilla masked bee")	9	1	4		1	2		4		21
Hylaeus modestus ("modest masked bee")	13	11	28	23	1	9	7	23	1	116
HALICTIDAE (sweat, furrow, nomiine, and short-faced bees)			1		1					2
Augochlora sp.										
Augochlora pura ("pure green-sweat bee")		1	4	4	6	1	3	4		23
Augochlorella sp.										
Augochlorella aurata ("golden green-sweat bee")	6	7	3	6	1	17	1	4	1	46
Augochloropsis sp.										
Augochloropsis metallica ("metallic epauletted-sweat bee")	1	4		1				1		7
Halictus sp.										
Halictus confusus ("confusing metallic-furrow bee")	1			1	1	1		12		16
Halictus ligatus ("ligated furrow bee")			3	5	2	4		7		21
Halictus rubicundus ("orange-legged furrow bee")					1					1
Lasioglossum sp.			3		1	3		2	1	10
Lasioglossum abanci									1	1
Lasioglossum acuminatum									2	2
Lasioglossum admirandum							1			1
Lasioglossum cinctipes ("band-footed sweat bee")			1							1
Lasioglossum coriaceum ("leathery sweat bee")		5	1	2	4	3		2	1	18
Lasioglossum cressonii ("Cresson's metallic-sweat bee")		28	16	10	18	37	6	10	5	130
Lasioglossum ephialtum				1						1
Lasioglossum foxii			1		1					2
Lasioglossum heterognathum	1	1	17	11	1	1	2			34
Lasioglossum imitatum ("coarse-haired metallic-sweat bee")								1		1
Lasioglossum lineatulum ("lineated metallic-sweat bee")								1		1
Lasioglossum nigroviride ("black-and-green metallic-sweat bee")		1		1	2	1		1	1	7
Lasioglossum pilosum ("hairy metallic-sweat bee")	1				4					5
Lasioglossum quebecense ("Quebec sweat bee")			2		1			1	1	5
Lasioglossum versans	3	4	7	2		1	2	3		22
Lasioglossum versatum ("experienced metallic-sweat bee")								1		1
Lasioglossum (Dialictus) sp. (a subgenus of metallic-sweat bees)		2	3	4	6	5	3	8	6	37
Sphecodes sp. (a cuckoo sweat bee. "blood bees")	3		1		1	1				6
Sphecodes coronus				1				1		2
Sphecodes galerus		1				1	1	1		4
Sphecodes ranunculi ("buttercup cuckoo sweat bee")		2	1		1				2	6
MEGACHILIDAE (leaf-cutter, mason, and resin bees)										
Coelioxys sp. (cuckoo leaf-cutter bees)										
Coelioxys immaculatus				1						1
Coelioxys modestus ("modest cuckoo leafcutter bee")							1			1
Coelioxys rufitarsis ("red-footed cuckoo leaf-cutter bee")							1			1
Coelioxys sayi ("Say's cuckoo leaf-cutter bee")								1		1

MAY - AUGUST 2019		SGL33						SGL 103		
	8 net hours	16 net hours						16 net hours		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
***Heriades* sp.**										
Heriades carinata	1		2				1			4
***Hoplitis* sp.** (small-mason bees)										
Hoplitis pilosifrons				1						1
Hoplitis producta ("produced small-mason bee")		1								1
Hoplitis spoilata ("dilated-horned small-mason bee")			1		1					2
***Megachile* sp.** (leaf-cutter and resin bees)				1				5		6
Megachile brevis ("short leaf-cutter bee")					1					1
Megachile campanulae ("bellflower resin bee")								1		1
Megachile gemula ("small-handed leaf-cutter bee")			1					1		2
Megachile inermis ("unarmed leaf-cutter bee")		1				1				2
Megachile latimanus ("broad-handed leaf-cutter bee")					1	3				4
Megachile mendica ("flat-tailed leaf-cutter bee")	4	3	1	5	3			4		20
Megachile petulans ("petulant leaf-cutter bee")			1					1		2
Megachile pugnata ("pugnacious leaf-cutter bee")								1		1
Megachile relativa ("golden-tailed leaf-cutter bee")			2	3	1	1		6	2	15
Megachile sculpturalis ("sculptured resin bee")	1		2	1						4
***Osmia* sp.** (mason bees)										
Osmia atriventris		1				1		1	1	4
Osmia cornifrons ("hornfaced bee")		1								1
Osmia pumila		1	1	1						3
Osmia taurus ("taurus mason bee")			1							1
MELITTIDAE (melittid bees. ***RARE***)										
***Macropis* sp.** ("yellow loostrife bees")										
Macropis ciliata		1				4				5
TOTAL INDIVIDUAL BEES PER PLOT	128	205	423	386	157	385	52	345	76	2157
MAY - AUGUST 2019										
TOTAL BEE TAXA PER PLOT	35	50	63	49	55	49	28	54	37	122

MAY 2019	0 net hours	SGL33 4 net hrs/plot						SGL 103 4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
ANDRENIDAE (miner, bare-miner, fairy, and oxaeine bees)										
***Andrena* sp.** (miner bees)										
Andrena bradleyi ("Bradley's miner bee")								1	1	2
Andrena brevipalpis				2						2
Andrena canadensis ("Canada miner bee")										
Andrena carlini ("Carlin's miner bee")			11		3	2			6	22
Andrena carolina ("Carolina miner bee")		2	5		2	4	1	3	4	21
Andrena ceanothi ("Ceanothus miner bee")			12	1	3	8				24
Andrena crataegi ("Hawthorn miner bee")					1					1
Andrena cressonii cressonii ("Cresson's miner bee")					2					2
Andrena erigeniae ("Spring Beauty miner bee")								1		1
Andrena forbesii ("Forbes' miner bee")			5							5
Andrena heraclei/ceanothi										
Andrena hirticincta ("hairy-banded miner bee")										
Andrena imitatrix			1							1
Andrena kalmiae ("Kalmia miner bee")										
Andrena nasonii ("Nason's miner bee")			2							2
Andrena nivalis ("snowy miner bee")			7		2				3	12
Andrena nubecula ("cloudy-winged miner bee")										
Andrena nuda ("nude miner bee")			1							1
Andrena perplexa ("perplexing miner bee")						2				2
Andrena personata				1						1
Andrena platyparia (a "dogwood miner bee")						1				1
Andrena rugosa			2							2
Andrena sayi					1				1	2
Andrena simplex										
Andrena spiraeana			1				2			3
Andrena tridens			1							1
Andrena vicina ("neighborly miner bee")			2			1		1		4
Andrena virginiana ("Virginia miner bee")										
Andrena w-scripta										
Andrena wheeleri										
Andrena wilkella										
Andrena ziziaeformis		1		14						15
***Andrena* (Trachandrena) sp.**										
APIDAE (cuckoo, bumble, carpenter, digger, honey, orchid bees)										
***Apis* sp.** (honey bees)										
Apis mellifera ("Western honey bee")									1	1
***Bombus* sp.** (bumble bees)										
Bombus bimaculatus ("two-spotted bumble bee")				1						1
Bombus fervidus ("golden Northern bumble bee" ***VULNERABLE***)										
Bombus impatiens ("common eastern bumble bee")								1		1
Bombus perplexus/vagans/sandersoni										
***Ceratina* sp.** (small carpenter bees)										
Ceratina calcarata ("spurred small carpenter bee")		1		1		1				3
Ceratina calcarata/mikmaqi										
Ceratina dupla ("doubled small carpenter bee")		2	2	3	1		1	1		10
Ceratina miqmaki ("Miqmak small carpenter bee")		4	2	1	1			1		9
Ceratina strenua ("nimble small carpenter bee")					3					3
Epeolus sp. (cellophane-cuckoo bees)										
Epeolus scutellaris ("notch-backed cellophane-cuckoo bee")										
***Melissodes* sp.** (a genus of long-horned bees)										
Melissodes druriellus ("goldenrod long-horned bee")										
***Nomada* sp.** (nomad bees)			1							1
Nomada armatella ("yellow-backed nomad bee")			1						1	2
Nomada banksi										
Nomada bethunei ("Bethune's nomad bee")			1	1			1			3
***Nomada bidentata* group**			4	1	6	1			1	13
Nomada cressonii ("Cresson's nomad bee")		4								4
Nomada denticulata ("denticulate nomad bee")				1						1
Nomada depressa			1							1
Nomada florilega			1		1					2

MAY 2019	0 net hours	SGL33 4 net hrs/plot						SGL 103 4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
Nomada luteoloides ("black-and-yellow nomad bee")					2					2
Nomada MR1 (as yet undescribed nomad bee)				1		1				2
Nomada pygmaea ("pygmy nomad bee")		1							1	2
Nomada sayi/illinoensis			1			1				2
Nomada vicina ("neighborly nomad bee")										
***Xylocopa* sp.** (large carpenter bees)										
Xylocopa virginica ("Eastern carpenter bee")									1	1
COLLETIDAE (cellophane, fork-/feather-tongued, and masked bees)										
***Colletes* sp.** (cellophane bees)										
Colletes simulans ("spine-shouldered cellophane bee")										
***Hylaeus* sp.** (masked bees)										
Hylaeus affinis ("Eastern masked bee")		1								1
Hylaeus annulatus ("annulate masked bee")			1							1
Hylaeus mesillae ("Mesilla masked bee")		1								1
Hylaeus modestus ("modest masked bee")						1	1			2
HALICTIDAE (sweat, furrow, nomiine, and short-faced bees)										
***Augochlora* sp.**										
Augochlora pura ("pure green-sweat bee")			2		2					4
***Augochlorella* sp.**										
Augochlorella aurata ("golden green-sweat bee")		5		1		1		1		8
***Augochloropsis* sp.**										
Augochloropsis metallica ("metallic epauletted-sweat bee")		1								1
***Halictus* sp.**										
Halictus confusus ("confusing metallic-furrow bee")										
Halictus ligatus ("ligated furrow bee")						1				1
Halictus rubicundus ("orange-legged furrow bee")										
***Lasioglossum* sp.**										
Lasioglossum abanci										
Lasioglossum acuminatum										
Lasioglossum admirandum										
Lasioglossum cinctipes ("band-footed sweat bee")										
Lasioglossum coriaceum ("leathery sweat bee")						1				1
Lasioglossum cressonii ("Cresson's metallic-sweat bee")		11	11	5	15	32	6			80
Lasioglossum ephialtum										
Lasioglossum foxii			1							1
Lasioglossum heterognathum			1	2		1	2			6
Lasioglossum imitatum ("coarse-haired metallic-sweat bee")										
Lasioglossum lineatulum ("lineated metallic-sweat bee")										
Lasioglossum nigroviride ("black-and-green metallic-sweat bee")										
Lasioglossum pilosum ("hairy metallic-sweat bee")					4					4
Lasioglossum quebecense ("Quebec sweat bee")			2					1	1	4
Lasioglossum versans			4	1			2			7
Lasioglossum versatum ("experienced metallic-sweat bee")								1		1
***Lasioglossum (Dialictus)* sp.** (a subgenus of metallic-sweat bees)				1	2	2	2		3	10
***Sphecodes* sp.** (a cuckoo sweat bee. "blood bees")										
Sphecodes coronus				1						1
Sphecodes galerus										
Sphecodes ranunculi ("buttercup cuckoo sweat bee")		2	1		1					4
MEGACHILIDAE (leaf-cutter, mason, and resin bees)										
***Coelioxys* sp.** (cuckoo leaf-cutter bees)										
Coelioxys immaculatus										
Coelioxys modestus ("modest cuckoo leafcutter bee")										
Coelioxys rufitarsis ("red-footed cuckoo leaf-cutter bee")										
Coelioxys sayi ("Say's cuckoo leaf-cutter bee")										

MAY 2019		SGL33						SGL 103		
	0 net hours	4 net hrs/plot						4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
***Heriades* sp.**										
Heriades carinata										
***Hoplitis* sp.** (small-mason bees)										
Hoplitis pilosifrons										
Hoplitis producta ("produced small-mason bee")										
Hoplitis spoilata ("dilated-horned small-mason bee")										
***Megachile* sp.** (leaf-cutter and resin bees)										
Megachile brevis ("short leaf-cutter bee")										
Megachile campanulae ("bellflower resin bee")										
Megachile gemula ("small-handed leaf-cutter bee")										
Megachile inermis ("unarmed leaf-cutter bee")										
Megachile latimanus ("broad-handed leaf-cutter bee")										
Megachile mendica ("flat-tailed leaf-cutter bee")										
Megachile petulans ("petulant leaf-cutter bee")										
Megachile pugnata ("pugnacious leaf-cutter bee")										
Megachile relativa ("golden-tailed leaf-cutter bee")										
Megachile sculpturalis ("sculptured resin bee")										
***Osmia* sp.** (mason bees)										
Osmia atriventris						1			1	2
Osmia cornifrons ("hornfaced bee")		1								1
Osmia pumila			1	1						2
Osmia taurus ("taurus mason bee")			1							1
MELITTIDAE (melittid bees. ***RARE***)										
***Macropis* sp.** ("yellow loostrife bees")										
Macropis ciliata										
TOTAL INDIVIDUAL BEES PER PLOT	0	37	89	40	52	62	*18*	*12*	25	**335**
MAY 2019										
TOTAL BEE TAXA PER PLOT	0	18	33	21	20	20	*11*	16	**15**	**67**

JUNE 2019	0 net hours	SGL33 4 net hrs/plot						SGL 103 4 net hrs/plot		
BEE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3**	**HC1**	**103-1**	**103-2**	**# individuals per taxon:**
ANDRENIDAE (miner, bare-miner, fairy, and oxaeine bees)										
***Andrena* sp.** (miner bees)										
Andrena bradleyi ("Bradley's miner bee")										
Andrena brevipalpis										
Andrena canadensis ("Canada miner bee")										
Andrena carlini ("Carlin's miner bee")										
Andrena carolina ("Carolina miner bee")									1	1
Andrena ceanothi ("Ceanothus miner bee")			1		1					2
Andrena crataegi ("Hawthorn miner bee")		2								2
Andrena cressonii cressonii ("Cresson's miner bee")		1								1
Andrena erigeniae ("Spring Beauty miner bee")										
Andrena forbesii ("Forbes' miner bee")		3	1							4
Andrena heraclei/ceanothi					2					2
Andrena hirticincta ("hairy-banded miner bee")										
Andrena imitatrix										
Andrena kalmiae ("Kalmia miner bee")								1		1
Andrena nasonii ("Nason's miner bee")										
Andrena nivalis ("snowy miner bee")		5		1	12	1	1			20
Andrena nubecula ("cloudy-winged miner bee")										
Andrena nuda ("nude miner bee")					1					1
Andrena perplexa ("perplexing miner bee")				1						1
Andrena personata										
Andrena platyparia (a "dogwood miner bee")										
Andrena rugosa		2						1		3
Andrena sayi										
Andrena simplex										
Andrena spiraeana		1			1	1			1	4
Andrena tridens										
Andrena vicina ("neighborly miner bee")		2	1						1	4
Andrena virginiana ("Virginia miner bee")										
Andrena w-scripta						1				1
Andrena wheeleri					1					1
Andrena wilkella						4				4
Andrena ziziaeformis						1				1
***Andrena* (Trachandrena) sp.**										
APIDAE (cuckoo, bumble, carpenter, digger, honey, orchid bees)										
***Apis* sp.** (honey bees)										
Apis mellifera ("Western honey bee")					1					1
***Bombus* sp.** (bumble bees)										
Bombus bimaculatus ("two-spotted bumble bee")									3	3
Bombus fervidus ("golden Northern bumble bee" ***VULNERABLE***)										
Bombus impatiens ("common eastern bumble bee")		1			6	3		1	3	14
Bombus perplexus/vagans/sandersoni					1			1		2
***Ceratina* sp.** (small carpenter bees)										
Ceratina calcarata ("spurred small carpenter bee")				2		1		1	1	5
Ceratina calcarata/mikmaqi										
Ceratina dupla ("doubled small carpenter bee")		2		1		3	1	1		8
Ceratina miqmaki ("Miqmak small carpenter bee")			1			2	1	1		5
Ceratina strenua ("nimble small carpenter bee")				2		1				3
***Epeolus* sp.** (cellophane-cuckoo bees)										
Epeolus scutellaris ("notch-backed cellophane-cuckoo bee")										
***Melissodes* sp.** (a genus of long-horned bees)										
Melissodes druriellus ("goldenrod long-horned bee")										
***Nomada* sp.** (nomad bees)										
Nomada armatella ("yellow-backed nomad bee")										
Nomada banksi										
Nomada bethunei ("Bethune's nomad bee")									1	1
***Nomada bidentata* group**		1		3				1	3	8
Nomada cressonii ("Cresson's nomad bee")				1						1
Nomada denticulata ("denticulate nomad bee")										
Nomada depressa									1	1
Nomada florilega										

JUNE 2019	SGL33							SGL 103		
	0 net hours	4 net hrs/plot						4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
Nomada luteoloides ("black-and-yellow nomad bee")									1	1
Nomada MR1 (as yet undescribed nomad bee)										
Nomada pygmaea ("pygmy nomad bee")										
Nomada sayi/illinoensis										
Nomada vicina ("neighborly nomad bee")										
***Xylocopa* sp.** (large carpenter bees)										
Xylocopa virginica ("Eastern carpenter bee")								1		1
COLLETIDAE (cellophane, fork-/feather-tongued, and masked bees)										
***Colletes* sp.** (cellophane bees)										
Colletes simulans ("spine-shouldered cellophane bee")										
***Hylaeus* sp.** (masked bees)										
Hylaeus affinis ("Eastern masked bee")										
Hylaeus annulatus ("annulate masked bee")										
Hylaeus mesillae ("Mesilla masked bee")						1		1		2
Hylaeus modestus ("modest masked bee")		8	1	4		3	5	14	1	36
HALICTIDAE (sweat, furrow, nomiine, and short-faced bees)										
***Augochlora* sp.**										
Augochlora pura ("pure green-sweat bee")			1	2	2			2		7
***Augochlorella* sp.**										
Augochlorella aurata ("golden green-sweat bee")		1	1	5		9		3		19
***Augochloropsis* sp.**										
Augochloropsis metallica ("metallic epauletted-sweat bee")		1						1		2
***Halictus* sp.**										
Halictus confusus ("confusing metallic-furrow bee")								5		5
Halictus ligatus ("ligated furrow bee")			1					1		2
Halictus rubicundus ("orange-legged furrow bee")										
***Lasioglossum* sp.**									1	1
Lasioglossum abanci									1	1
Lasioglossum acuminatum										
Lasioglossum admirandum							1			1
Lasioglossum cinctipes ("band-footed sweat bee")										
Lasioglossum coriaceum ("leathery sweat bee")		4	1	2	4	2		1	1	15
Lasioglossum cressonii ("Cresson's metallic-sweat bee")		17	2	5	3	5		10	4	46
Lasioglossum ephialtum										
Lasioglossum foxii					1					1
Lasioglossum heterognathum			1	4						5
Lasioglossum imitatum ("coarse-haired metallic-sweat bee")								1		1
Lasioglossum lineatulum ("lineated metallic-sweat bee")										
Lasioglossum nigroviride ("black-and-green metallic-sweat bee")		1		1	2	1		1	1	7
Lasioglossum pilosum ("hairy metallic-sweat bee")										
Lasioglossum quebecense ("Quebec sweat bee")					1					1
Lasioglossum versans		4				1		3		8
Lasioglossum versatum ("experienced metallic-sweat bee")										
***Lasioglossum (Dialictus)* sp.** (a subgenus of metallic-sweat bees)		2	2	1	2	2		5	3	17
***Sphecodes* sp.** (a cuckoo sweat bee. "blood bees")										
Sphecodes coronus								1		1
Sphecodes galerus										
Sphecodes ranunculi ("buttercup cuckoo sweat bee")									2	2
MEGACHILIDAE (leaf-cutter, mason, and resin bees)										
***Coelioxys* sp.** (cuckoo leaf-cutter bees)										
Coelioxys immaculatus				1						1
Coelioxys modestus ("modest cuckoo leafcutter bee")										
Coelioxys rufitarsis ("red-footed cuckoo leaf-cutter bee")										
Coelioxys sayi ("Say's cuckoo leaf-cutter bee")										

JUNE 2019		SGL33						SGL 103		
	0 net hours	4 net hrs/plot						4 net hrs/plot		
BEE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3**	**HC1**	**103-1**	**103-2**	**# individuals per taxon:**
***Heriades* sp.**										
Heriades carinata										
***Hoplitis* sp.** (small-mason bees)										
Hoplitis pilosifrons										
Hoplitis producta ("produced small-mason bee")		1								1
Hoplitis spoilata ("dilated-horned small-mason bee")										
***Megachile* sp.** (leaf-cutter and resin bees)										
Megachile brevis ("short leaf-cutter bee")					1					1
Megachile campanulae ("bellflower resin bee")										
Megachile gemula ("small-handed leaf-cutter bee")			1							1
Megachile inermis ("unarmed leaf-cutter bee")										
Megachile latimanus ("broad-handed leaf-cutter bee")										
Megachile mendica ("flat-tailed leaf-cutter bee")		1			1					2
Megachile petulans ("petulant leaf-cutter bee")			1							1
Megachile pugnata ("pugnacious leaf-cutter bee")										
Megachile relativa ("golden-tailed leaf-cutter bee")				2	1			1	2	6
Megachile sculpturalis ("sculptured resin bee")										
***Osmia* sp.** (mason bees)										
Osmia atriventris		1								1
Osmia cornifrons ("hornfaced bee")										
Osmia pumila		1								1
Osmia taurus ("taurus mason bee")										
MELITTIDAE (melittid bees. ***RARE***)										
***Macropis* sp.** ("yellow loostrife bees")										
Macropis ciliata		1				4				5
TOTAL INDIVIDUAL BEES PER PLOT		63	16	38	44	46	*9*	59	*32*	**307**
JUNE 2019										
TOTAL BEE TAXA PER PLOT		27	16	19	21	21	*7*	30	*21*	**64**

JULY 2019	SGL33 4 net hrs/plot							SGL 103 4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
ANDRENIDAE (miner, bare-miner, fairy, and oxaeine bees)										
***Andrena* sp.** (miner bees)										
Andrena bradleyi ("Bradley's miner bee")										
Andrena brevipalpis										
Andrena canadensis ("Canada miner bee")										
Andrena carlini ("Carlin's miner bee")										
Andrena carolina ("Carolina miner bee")										
Andrena ceanothi ("Ceanothus miner bee")										
Andrena crataegi ("Hawthorn miner bee")										
Andrena cressonii cressonii ("Cresson's miner bee")										
Andrena erigeniae ("Spring Beauty miner bee")										
Andrena forbesii ("Forbes' miner bee")										
Andrena heraclei/ceanothi										
Andrena hirticincta ("hairy-banded miner bee")										
Andrena imitatrix										
Andrena kalmiae ("Kalmia miner bee")										
Andrena nasonii ("Nason's miner bee")										
Andrena nivalis ("snowy miner bee")										
Andrena nubecula ("cloudy-winged miner bee")					1					1
Andrena nuda ("nude miner bee")										
Andrena perplexa ("perplexing miner bee")										
Andrena personata										
Andrena platyparia (a "dogwood miner bee")										
Andrena rugosa										
Andrena sayi										
Andrena simplex										
Andrena spiraeana										
Andrena tridens										
Andrena vicina ("neighborly miner bee")										
Andrena virginiana ("Virginia miner bee")	1		45	8						54
Andrena w-scripta										
Andrena wheeleri										
Andrena wilkella										
Andrena ziziaeformis										
***Andrena* (Trachandrena) sp.**			3	1						4
APIDAE (cuckoo, bumble, carpenter, digger, honey, orchid bees)										
***Apis* sp.** (honey bees)										
Apis mellifera ("Western honey bee")				20		5	2			27
***Bombus* sp.** (bumble bees)										
Bombus bimaculatus ("two-spotted bumble bee")	2	3	3	11		3		27	1	50
Bombus fervidus ("golden Northern bumble bee" ***VULNERABLE***)										
Bombus impatiens ("common eastern bumble bee")	11	2	61	27		40	2	32	2	177
Bombus perplexus/vagans/sandersoni	1	2	5	13		12	1	14	1	49
***Ceratina* sp.** (small carpenter bees)										
Ceratina calcarata ("spurred small carpenter bee")	2		1			1				4
Ceratina calcarata/mikmaqi								1		1
Ceratina dupla ("doubled small carpenter bee")	14		6	4		4		7	2	37
Ceratina miqmaki ("Miqmak small carpenter bee")	1					4		3	1	9
Ceratina strenua ("nimble small carpenter bee")						1	1	1		3
Epeolus sp. (cellophane-cuckoo bees)										
Epeolus scutellaris ("notch-backed cellophane-cuckoo bee")										
***Melissodes* sp.** (a genus of long-horned bees)										
Melissodes druriellus ("goldenrod long-horned bee")					1					1
***Nomada* sp.** (nomad bees)										
Nomada armatella ("yellow-backed nomad bee")										
Nomada banksi										
Nomada bethunei ("Bethune's nomad bee")										
***Nomada bidentata* group**			1							1
Nomada cressonii ("Cresson's nomad bee")										
Nomada denticulata ("denticulate nomad bee")										
Nomada depressa										
Nomada florilega										

JULY 2019	SGL33							SGL 103		
	4 net hrs/plot							4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
Nomada luteoloides ("black-and-yellow nomad bee")										
Nomada MR1 (as yet undescribed nomad bee)										
Nomada pygmaea ("pygmy nomad bee")										
Nomada sayi/illinoensis										
Nomada vicina ("neighborly nomad bee")										
***Xylocopa* sp.** (large carpenter bees)										
Xylocopa virginica ("Eastern carpenter bee")			2							2
COLLETIDAE (cellophane, fork-/feather-tongued, and masked bees)										
***Colletes* sp.** (cellophane bees)										
Colletes simulans ("spine-shouldered cellophane bee")										
***Hylaeus* sp.** (masked bees)			1							1
Hylaeus affinis ("Eastern masked bee")	3		2		1				1	7
Hylaeus annulatus ("annulate masked bee")										
Hylaeus mesillae ("Mesilla masked bee")	8		2							10
Hylaeus modestus ("modest masked bee")	7		3	16	1	4		4		35
HALICTIDAE (sweat, furrow, nomiine, and short-faced bees)			1							1
***Augochlora* sp.**										
Augochlora pura ("pure green-sweat bee")			1	2	1	1	3	2		10
***Augochlorella* sp.**										
Augochlorella aurata ("golden green-sweat bee")	3	1				6	1			11
***Augochloropsis* sp.**										
Augochloropsis metallica ("metallic epauletted-sweat bee")				1						1
***Halictus* sp.**										
Halictus confusus ("confusing metallic-furrow bee")	1			1	1	1		5		9
Halictus ligatus ("ligated furrow bee")			1	5		1		6		13
Halictus rubicundus ("orange-legged furrow bee")										
***Lasioglossum* sp.**			3			3		2		8
Lasioglossum abanci										
Lasioglossum acuminatum										
Lasioglossum admirandum										
Lasioglossum cinctipes ("band-footed sweat bee")			1							1
Lasioglossum coriaceum ("leathery sweat bee")										
Lasioglossum cressonii ("Cresson's metallic-sweat bee")			1							1
Lasioglossum ephialtum				1						1
Lasioglossum foxii										
Lasioglossum heterognathum	1	1	12	4	1					19
Lasioglossum imitatum ("coarse-haired metallic-sweat bee")										
Lasioglossum lineatulum ("lineated metallic-sweat bee")										
Lasioglossum nigroviride ("black-and-green metallic-sweat bee")										
Lasioglossum pilosum ("hairy metallic-sweat bee")	1									1
Lasioglossum quebecense ("Quebec sweat bee")										
Lasioglossum versans	3		2	1						6
Lasioglossum versatum ("experienced metallic-sweat bee")										
***Lasioglossum (Dialictus)* sp.** (a subgenus of metallic-sweat bees)			1	1		1		3		6
***Sphecodes* sp.** (a cuckoo sweat bee, "blood bees")										
Sphecodes coronus										
Sphecodes galerus										
Sphecodes ranunculi ("buttercup cuckoo sweat bee")										
MEGACHILIDAE (leaf-cutter, mason, and resin bees)										
***Coelioxys* sp.** (cuckoo leaf-cutter bees)										
Coelioxys immaculatus										
Coelioxys modestus ("modest cuckoo leafcutter bee")							1			1
Coelioxys rufitarsis ("red-footed cuckoo leaf-cutter bee")							1			1
Coelioxys sayi ("Say's cuckoo leaf-cutter bee")								1		1

JULY 2019 BEE TAXA	SGL33 4 net hrs/plot M4	F2	SF2	MH3	MH1	BLV3	HC1	SGL 103 4 net hrs/plot 103-1	103-2	# individuals per taxon:
***Heriades* sp.**										
Heriades carinata	1		2				1			4
***Hoplitis* sp.** (small-mason bees)										
Hoplitis pilosifrons				1						1
Hoplitis producta ("produced small-mason bee")										
Hoplitis spoilata ("dilated-horned small-mason bee")			1		1					2
***Megachile* sp.** (leaf-cutter and resin bees)				1				5		6
Megachile brevis ("short leaf-cutter bee")										
Megachile campanulae ("bellflower resin bee")								1		1
Megachile gemula ("small-handed leaf-cutter bee")								1		1
Megachile inermis ("unarmed leaf-cutter bee")		1				1				2
Megachile latimanus ("broad-handed leaf-cutter bee")						1				1
Megachile mendica ("flat-tailed leaf-cutter bee")	2	1		4				2		9
Megachile petulans ("petulant leaf-cutter bee")										
Megachile pugnata ("pugnacious leaf-cutter bee")								1		1
Megachile relativa ("golden-tailed leaf-cutter bee")			2	1		1		5		9
Megachile sculpturalis ("sculptured resin bee")	1		2							3
***Osmia* sp.** (mason bees)										
Osmia atriventris								1		1
Osmia cornifrons ("hornfaced bee")										
Osmia pumila										
Osmia taurus ("taurus mason bee")										
MELITTIDAE (melittid bees. ***RARE***)										
***Macropis* sp.** ("yellow loostrife bees")										
Macropis ciliata										
TOTAL INDIVIDUAL BEES PER PLOT	63	11	165	123	*8*	90	13	124	*8*	**605**
JULY 2019										
TOTAL BEE TAXA PER PLOT	24	*9*	28	22	10	20	11	27	*8*	**51**

AUGUST 2019	SGL33 4 net hrs/plot							SGL 103 4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
ANDRENIDAE (miner, bare-miner, fairy, and oxaeine bees)										
***Andrena* sp.** (miner bees)										
Andrena bradleyi ("Bradley's miner bee")										
Andrena brevipalpis										
Andrena canadensis ("Canada miner bee")								1		1
Andrena carlini ("Carlin's miner bee")										
Andrena carolina ("Carolina miner bee")										
Andrena ceanothi ("Ceanothus miner bee")										
Andrena crataegi ("Hawthorn miner bee")										
Andrena cressonii cressonii ("Cresson's miner bee")										
Andrena erigeniae ("Spring Beauty miner bee")										
Andrena forbesii ("Forbes' miner bee")										
Andrena heraclei/ceanothi										
Andrena hirticincta ("hairy-banded miner bee")		3		4	2	3	1	3		16
Andrena imitatrix										
Andrena kalmiae ("Kalmia miner bee")										
Andrena nasonii ("Nason's miner bee")										
Andrena nivalis ("snowy miner bee")										
Andrena nubecula ("cloudy-winged miner bee")	1									1
Andrena nuda ("nude miner bee")										
Andrena perplexa ("perplexing miner bee")										
Andrena personata										
Andrena platyparia (a "dogwood miner bee")										
Andrena rugosa										
Andrena sayi										
Andrena simplex				1			1			2
Andrena spiraeana										
Andrena tridens										
Andrena vicina ("neighborly miner bee")										
Andrena virginiana ("Virginia miner bee")	1		23							24
Andrena w-scripta										
Andrena wheeleri										
Andrena wilkella										
Andrena ziziaeformis										
***Andrena* (Trachandrena) sp.**										
APIDAE (cuckoo, bumble, carpenter, digger, honey, orchid bees)										
***Apis* sp.** (honey bees)										
Apis mellifera ("Western honey bee")	1	1	1	34		1		3		41
***Bombus* sp.** (bumble bees)										
Bombus bimaculatus ("two-spotted bumble bee")			1	1						2
Bombus fervidus ("golden Northern bumble bee" ***VULNERABLE***)								1		1
Bombus impatiens ("common eastern bumble bee")	23	45	75	131	4	158	4	116	3	559
Bombus perplexus/vagans/sandersoni		12	1	3	19	5		6	2	48
***Ceratina* sp.** (small carpenter bees)			1							1
Ceratina calcarata ("spurred small carpenter bee")	2				1	1	1			5
Ceratina calcarata/mikmaqi	1									1
Ceratina dupla ("doubled small carpenter bee")	7	4	7	1	4	4	1	4	2	34
Ceratina miqmaki ("Miqmak small carpenter bee")	2	1	1		1					5
Ceratina strenua ("nimble small carpenter bee")	2	1			2					5
***Epeolus* sp.** (cellophane-cuckoo bees)										
Epeolus scutellaris ("notch-backed cellophane-cuckoo bee")					1					1
***Melissodes* sp.** (a genus of long-horned bees)										
Melissodes druriellus ("goldenrod long-horned bee")	3	12	2	1	1					19
***Nomada* sp.** (nomad bees)										
Nomada armatella ("yellow-backed nomad bee")										
Nomada banksi					1					1
Nomada bethunei ("Bethune's nomad bee")										
***Nomada bidentata* group**										
Nomada cressonii ("Cresson's nomad bee")										
Nomada denticulata ("denticulate nomad bee")										
Nomada depressa										
Nomada florilega										

AUGUST 2019	SGL33 4 net hrs/plot							SGL 103 4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
Nomada luteoloides ("black-and-yellow nomad bee")										
Nomada MR1 (as yet undescribed nomad bee)										
Nomada pygmaea ("pygmy nomad bee")										
Nomada sayi/illinoensis										
Nomada vicina ("neighborly nomad bee")	1	2		1	1	1	1			7
***Xylocopa* sp.** (large carpenter bees)										
Xylocopa virginica ("Eastern carpenter bee")	2	1	1	1		1				6
COLLETIDAE (cellophane, fork-/feather-tongued, and masked bees)										
***Colletes* sp.** (cellophane bees)										
Colletes simulans ("spine-shouldered cellophane bee")	1	1	1			1				4
***Hylaeus* sp.** (masked bees)					2					2
Hylaeus affinis ("Eastern masked bee")	1	2	2			3				8
Hylaeus annulatus ("annulate masked bee")	1									1
Hylaeus mesillae ("Mesilla masked bee")	1		2		1	1		3		8
Hylaeus modestus ("modest masked bee")	6	3	24	3		1	1	5		43
HALICTIDAE (sweat, furrow, nomiine, and short-faced bees)					1					1
***Augochlora* sp.**										
Augochlora pura ("pure green-sweat bee")		1			1					2
***Augochlorella* sp.**										
Augochlorella aurata ("golden green-sweat bee")	3		2		1	1			1	8
***Augochloropsis* sp.**										
Augochloropsis metallica ("metallic epauletted-sweat bee")	1	2								3
***Halictus* sp.**										
Halictus confusus ("confusing metallic-furrow bee")								2		2
Halictus ligatus ("ligated furrow bee")			1		2	2				5
Halictus rubicundus ("orange-legged furrow bee")					1					1
***Lasioglossum* sp.**					1					1
Lasioglossum abanci										
Lasioglossum acuminatum									2	2
Lasioglossum admirandum										
Lasioglossum cinctipes ("band-footed sweat bee")										
Lasioglossum coriaceum ("leathery sweat bee")		1						1		2
Lasioglossum cressonii ("Cresson's metallic-sweat bee")			2						1	3
Lasioglossum ephialtum										
Lasioglossum foxii										
Lasioglossum heterognathum			3	1						4
Lasioglossum imitatum ("coarse-haired metallic-sweat bee")										
Lasioglossum lineatulum ("lineated metallic-sweat bee")								1		1
Lasioglossum nigroviride ("black-and-green metallic-sweat bee")										
Lasioglossum pilosum ("hairy metallic-sweat bee")										
Lasioglossum quebecense ("Quebec sweat bee")										
Lasioglossum versans			1							1
Lasioglossum versatum ("experienced metallic-sweat bee")										
***Lasioglossum (Dialictus)* sp.** (a subgenus of metallic-sweat bees)				1	2		1			4
***Sphecodes* sp.** (a cuckoo sweat bee. "blood bees")	3		1		1	1				6
Sphecodes coronus										
Sphecodes galerus		1				1	1	1		4
Sphecodes ranunculi ("buttercup cuckoo sweat bee")										
MEGACHILIDAE (leaf-cutter, mason, and resin bees)										
***Coelioxys* sp.** (cuckoo leaf-cutter bees)										
Coelioxys immaculatus										
Coelioxys modestus ("modest cuckoo leafcutter bee")										
Coelioxys rufitarsis ("red-footed cuckoo leaf-cutter bee")										
Coelioxys sayi ("Say's cuckoo leaf-cutter bee")										

AUGUST 2019	SGL33 4 net hrs/plot							SGL 103 4 net hrs/plot		
BEE TAXA	M4	F2	SF2	MH3	MH1	BLV3	HC1	103-1	103-2	# individuals per taxon:
***Heriades* sp.**										
Heriades carinata										
***Hoplitis* sp.** (small-mason bees)										
Hoplitis pilosifrons										
Hoplitis producta ("produced small-mason bee")										
Hoplitis spoilata ("dilated-horned small-mason bee")										
***Megachile* sp.** (leaf-cutter and resin bees)										
Megachile brevis ("short leaf-cutter bee")										
Megachile campanulae ("bellflower resin bee")										
Megachile gemula ("small-handed leaf-cutter bee")										
Megachile inermis ("unarmed leaf-cutter bee")										
Megachile latimanus ("broad-handed leaf-cutter bee")					1	2				3
Megachile mendica ("flat-tailed leaf-cutter bee")	2	1	1	1	2			2		9
Megachile petulans ("petulant leaf-cutter bee")								1		1
Megachile pugnata ("pugnacious leaf-cutter bee")										
Megachile relativa ("golden-tailed leaf-cutter bee")										
Megachile sculpturalis ("sculptured resin bee")				1						1
***Osmia* sp.** (mason bees)										
Osmia atriventris										
Osmia cornifrons ("hornfaced bee")										
Osmia pumila										
Osmia taurus ("taurus mason bee")										
MELITTIDAE (melittid bees. ***RARE***)										
***Macropis* sp.** ("yellow loostrife bees")										
Macropis ciliata										
TOTAL INDIVIDUAL BEES PER PLOT	65	94	153	185	53	187	*12*	150	*11*	**910**
AUGUST 2019										
TOTAL BEE TAXA PER PLOT	27	20	23	17	25	19	*11*	21	*8*	**50**

GROUND BEETLES (COLEOPTERA: CARABIDAE)

SGL33 TOTAL

SGL33 BY COLLECTION WEEK

MAY - AUGUST 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
CARABIDAE								
CARABINAE								
Carabini								
Carabus goryi				1				1
Carabus serratus			1			1		2
Cychrini *(incl. "small snail-eating ground beetles")*								
Sphaeroderus canadensis					1			1
Sphaeroderus canadensis canadensis					1			1
Sphaeroderus stenostomus						1	2	3
Sphaeroderus stenostomus lecontei					1		2	3
CICINDELINAE *(tiger beetles)*								
Cicindelini *(flashy tiger beetles)*								
Cicindela sexguttata *(six-spotted tiger beetle)*	5	5	3	5				18
Cicindela tranquebarica *(oblique-lined tiger beetle)*					3			3
Cicindelidia rufiventris *(Eastern red-bellied tiger beetle)*					1			1
HARPALINAE								
Chlaeniini *(incl. "vivid metallic ground beetles")*								
Chlaenius emarginatus	1	1	1				17	20
Harpalini								
Agonoleptus conjunctus		1		1				2
Anisodactylus harrisii		1						1
Harpalus erythropus				1				1
Harpalus faunus				1				1
Harpalus pensylvanicus *(Pennsylvania dingy ground beetle)*		1		1				2
Harpalus somnulentus	1	2						3
***Harpalus* sp.**				1		1		2
Stenolophus humidus/plebeius *(a species of "seedcorn beetle")*	1							1
Trichotichinus autumnalis	1					1		2
Lebiini								
***Apristus* sp.**	1							1
Cymindis americana		1						1
Lebia ornata *(a species of "colorful foliage ground beetle")*		1						1
***Microlestes* sp.**	2	2						4
Licinini *(incl. "notched-mouth ground beetles")*								
Dicaelus dilatatus				1				1
Dicaelus dilatatus dilatatus			1					1
Dicaelus politus			1					1
***Dicaelus* sp. (larva)**			1					1
Platynini								
Agonum palustre							1	1
Platynus angustatus						1		1
Rhadine caudata						1		1
undet. Platynini							2	2
Pterostichini *(woodland ground beetles)*								
Cyclotrachelus sodalis				1				1
Myas cyanescens	1							1
Poecilus lucublandus			1	2		1	1	5
Pterostichus adoxus							5	5
Pterostichus coracinus							3	3
Pterostichus lachrymosus							1	1
Pterostichus mutus	1						2	3
Pterostichus permundus				1				1
Pterostichus rostratus				1				1
Pterostichus stygicus				1				1
Pterostichus tristis							2	2
***Pterostichus* sp.**	1	2	1	1	1	2	5	13
Sphodrini								
Calathus opaculus		1						1
***Calathus* sp.**				1		1		2
Synuchus impunctatus			1			1	8	10
NEBRIINAE								
Notiophilini								
Notiophilus aeneus						1		1
***Notiophilus* sp.**			1					1
TRECHINAE								
Bembidiini								
Elaphropus vernicatus		2	1					3
undet. CARABIDAE adult	1		1			1	5	8
undet. CARABIDAE larva			1	1	1	2	1	6
MAY - AUGUST 2020 GROUND BEETLE TAXA	**PITFALL TRAP COLLECTIONS** *(288 total trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**total individuals:**
TOTAL INDIVIDUAL GROUND BEETLES PER PLOT	16	20	15	21	9	15	57	153
								total taxa:
TOTAL GROUND BEETLE TAXA PER PLOT	10	12	11	15	6	11	13	49

WEEK 1: 5-8 JUN 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
CARABIDAE								
CARABINAE								
Carabini								
Carabus goryi				1				1
Carabus serratus								
Cychrini (incl. "small snail-eating ground beetles")								
Sphaeroderus canadensis								
Sphaeroderus canadensis canadensis								
Sphaeroderus stenostomus						1	2	3
Sphaeroderus stenostomus lecontei					1			1
CICINDELINAE (tiger beetles)								
Cicindelini (flashy tiger beetles)								
Cicindela sexguttata (six-spotted tiger beetle)	3	5	3	5				16
Cicindela tranquebarica (oblique-lined tiger beetle)					1			1
Cicindelidia rufiventris (Eastern red-bellied tiger beetle)								
HARPALINAE								
Chlaeniini (incl. "vivid metallic ground beetles")								
Chlaenius emarginatus		1					4	5
Harpalini								
Agonoleptus conjunctus		1		1				2
Anisodactylus harrisii		1						1
Harpalus erythropus				1				1
Harpalus faunus								
Harpalus pensylvanicus (Pennsylvania dingy ground beetle)								
Harpalus somnulentus	1	1						2
***Harpalus* sp.**								
Stenolophus humidus/plebeius (a species of "seedcorn beetle")	1							1
Trichotichinus autumnalis	1							1
Lebiini								
***Apristus* sp.**								
Cymindis americana								
Lebia ornata (a species of "colorful foliage ground beetle")								
***Microlestes* sp.**		1						1
Licinini (incl. "notched-mouth ground beetles")								
Dicaelus dilatatus								
Dicaelus dilatatus dilatatus								
Dicaelus politus			1					1
***Dicaelus* sp. (larva)**								
Platynini								
Agonum palustre								
Platynus angustatus								
Rhadine caudata								
undet. Platynini								
Pterostichini (woodland ground beetles)								
Cyclotrachelus sodalis				1				1
Myas cyanescens	1							1
Poecilus lucublandus			1	2		1		4
Pterostichus adoxus								
Pterostichus coracinus								
Pterostichus lachrymosus							1	1
Pterostichus mutus	1							1
Pterostichus permundus								
Pterostichus rostratus								
Pterostichus stygicus								
Pterostichus tristis								
***Pterostichus* sp.**		2				1	1	4
Sphodrini								
Calathus opaculus								
***Calathus* sp.**								
Synuchus impunctatus								
NEBRIINAE								
Notiophilini								
Notiophilus aeneus						1		1
***Notiophilus* sp.**								
TRECHINAE								
Bembidiini								
Elaphropus vernicatus		1	1					2
undet. CARABIDAE adult								
undet. CARABIDAE larva								

WEEK 1: 5-8 JUN 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	total individuals:
TOTAL INDIVIDUAL GROUND BEETLES PER PLOT	8	13	6	11	2	4	8	52
								total taxa:
TOTAL GROUND BEETLE TAXA PER PLOT	6	8	4	6	2	4	4	22

WEEK 5: 3-6 JUL 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS (72 trap-hours per plot) M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
CARABIDAE								
CARABINAE								
Carabini								
Carabus goryi								
Carabus serratus								
Cychrini *(incl. "small snail-eating ground beetles")*								
Sphaeroderus canadensis					1			1
Sphaeroderus canadensis canadensis								
Sphaeroderus stenostomus								
Sphaeroderus stenostomus lecontei								
CICINDELINAE *(tiger beetles)*								
Cicindelini *(flashy tiger beetles)*								
Cicindela sexguttata *(six-spotted tiger beetle)*	2							2
Cicindela tranquebarica *(oblique-lined tiger beetle)*					2			2
Cicindelidia rufiventris *(Eastern red-bellied tiger beetle)*								
HARPALINAE								
Chlaeniini *(incl. "vivid metallic ground beetles")*								
Chlaenius emarginatus							7	7
Harpalini								
Agonoleptus conjunctus								
Anisodactylus harrisii								
Harpalus erythropus								
Harpalus faunus								
Harpalus pensylvanicus *(Pennsylvania dingy ground beetle)*								
Harpalus somnulentus								
***Harpalus* sp.**						1		1
Stenolophus humidus/plebeius *(a species of "seedcorn beetle")*								
Trichotichinus autumnalis						1		1
Lebiini								
***Apristus* sp.**								
Cymindis americana								
Lebia ornata *(a species of "colorful foliage ground beetle")*		1						1
***Microlestes* sp.**								
Licinini *(incl. "notched-mouth ground beetles")*								
Dicaelus dilatatus				1				1
Dicaelus dilatatus dilatatus								
Dicaelus politus								
***Dicaelus* sp. (larva)**								
Platynini								
Agonum palustre							1	1
Platynus angustatus								
Rhadine caudata								
undet. Platynini								
Pterostichini *(woodland ground beetles)*								
Cyclotrachelus sodalis								
Myas cyanescens								
Poecilus lucublandus								
Pterostichus adoxus								
Pterostichus coracinus								
Pterostichus lachrymosus								
Pterostichus mutus							1	1
Pterostichus permundus				1				1
Pterostichus rostratus								
Pterostichus stygicus								
Pterostichus tristis								
***Pterostichus* sp.**				1			4	5
Sphodrini								
Calathus opaculus								
***Calathus* sp.**								
Synuchus impunctatus							1	1
NEBRIINAE								
Notiophilini								
Notiophilus aeneus								
***Notiophilus* sp.**								
TRECHINAE								
Bembidiini								
Elaphropus vernicatus								
undet. CARABIDAE adult								
undet. CARABIDAE larva			1		1			2
WEEK 5: 3-6 JUL 2020 GROUND BEETLE TAXA	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)* **M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	
TOTAL INDIVIDUAL GROUND BEETLES PER PLOT	2	*1*	*1*	3	4	2	14	**total individuals:** 27
TOTAL GROUND BEETLE TAXA PER PLOT	1	1	*0*	3	2	2	5	**total taxa:** 13

WEEK 9: 31 JUL - 3 AUG 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
CARABIDAE								
CARABINAE								
Carabini								
Carabus goryi								
Carabus serratus			1			1		2
Cychrini *(incl. "small snail-eating ground beetles")*								
Sphaeroderus canadensis								
Sphaeroderus canadensis canadensis								
Sphaeroderus stenostomus								
Sphaeroderus stenostomus lecontei							2	2
CICINDELINAE *(tiger beetles)*								
Cicindelini *(flashy tiger beetles)*								
Cicindela sexguttata *(six-spotted tiger beetle)*								
Cicindela tranquebarica *(oblique-lined tiger beetle)*								
Cicindelidia rufiventris *(Eastern red-bellied tiger beetle)*					1			1
HARPALINAE								
Chlaeniini *(incl. "vivid metallic ground beetles")*								
Chlaenius emarginatus			1				6	7
Harpalini								
Agonoleptus conjunctus								
Anisodactylus harrisii								
Harpalus erythropus								
Harpalus faunus								
Harpalus pensylvanicus *(Pennsylvania dingy ground beetle)*								
Harpalus somnulentus		1						1
***Harpalus* sp.**				1				1
Stenolophus humidus/plebeius *(a species of "seedcorn beetle")*								
Trichotichinus autumnalis								
Lebiini								
***Apristus* sp.**								
Cymindis americana		1						1
Lebia ornata *(a species of "colorful foliage ground beetle")*								
***Microlestes* sp.**	2	1						3
Licinini *(incl. "notched-mouth ground beetles")*								
Dicaelus dilatatus								
Dicaelus dilatatus dilatatus								
Dicaelus politus								
***Dicaelus* sp. (larva)**								
Platynini								
Agonum palustre								
Platynus angustatus								
Rhadine caudata								
undet. Platynini							2	2
Pterostichini *(woodland ground beetles)*								
Cyclotrachelus sodalis								
Myas cyanescens								
Poecilus lucublandus							1	1
Pterostichus adoxus							1	1
Pterostichus coracinus							2	2
Pterostichus lachrymosus								
Pterostichus mutus							1	1
Pterostichus permundus								
Pterostichus rostratus								
Pterostichus stygicus								
Pterostichus tristis								
***Pterostichus* sp.**	1		1					2
Sphodrini								
Calathus opaculus		1						1
***Calathus* sp.**								
Synuchus impunctatus								
NEBRIINAE								
Notiophilini								
Notiophilus aeneus								
***Notiophilus* sp.**								
TRECHINAE								
Bembidiini								
Elaphropus vernicatus		1						1
undet. CARABIDAE adult						1	5	6
undet. CARABIDAE larva						2	1	3

WEEK 9: 31 JUL - 3 AUG 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	
TOTAL INDIVIDUAL GROUND BEETLES PER PLOT	3	5	3	*1*	*1*	4	21	total individuals: 38
TOTAL GROUND BEETLE TAXA PER PLOT	2	5	3	*1*	*1*	*1*	7	total taxa: 16

WEEK 13: 27-30 AUG 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
CARABIDAE								
CARABINAE								
Carabini								
Carabus goryi								
Carabus serratus								
Cychrini (incl. "small snail-eating ground beetles")								
Sphaeroderus canadensis								
Sphaeroderus canadensis canadensis					1			1
Sphaeroderus stenostomus								
Sphaeroderus stenostomus lecontei								
CICINDELINAE (tiger beetles)								
Cicindelini (flashy tiger beetles)								
Cicindela sexguttata (six-spotted tiger beetle)								
Cicindela tranquebarica (oblique-lined tiger beetle)								
Cicindelidia rufiventris (Eastern red-bellied tiger beetle)								
HARPALINAE								
Chlaeniini (incl. "vivid metallic ground beetles")								
Chlaenius emarginatus	1							1
Harpalini								
Agonoleptus conjunctus								
Anisodactylus harrisii								
Harpalus erythropus								
Harpalus faunus				1				1
Harpalus pensylvanicus (Pennsylvania dingy ground beetle)		1		1				2
Harpalus somnulentus								
***Harpalus* sp.**								
Stenolophus humidus/plebeius (a species of "seedcorn beetle")								
Trichotichinus autumnalis								
Lebiini								
***Apristus* sp.**	1							1
Cymindis americana								
Lebia ornata (a species of "colorful foliage ground beetle")								
***Microlestes* sp.**								
Licinini (incl. "notched-mouth ground beetles")								
Dicaelus dilatatus								
Dicaelus dilatatus dilatatus			1					1
Dicaelus politus								
***Dicaelus* sp. (larva)**			1					1
Platynini								
Agonum palustre								
Platynus angustatus						1		1
Rhadine caudata						1		1
undet. Platynini								
Pterostichini (woodland ground beetles)								
Cyclotrachelus sodalis								
Myas cyanescens								
Poecilus lucublandus								
Pterostichus adoxus							4	4
Pterostichus coracinus							1	1
Pterostichus lachrymosus								
Pterostichus mutus								
Pterostichus permundus								
Pterostichus rostratus				1				1
Pterostichus stygicus				1				1
Pterostichus tristis							2	2
***Pterostichus* sp.**					1	1		2
Sphodrini								
Calathus opaculus								
***Calathus* sp.**				1		1		2
Synuchus impunctatus			1			1	7	9
NEBRIINAE								
Notiophilini								
Notiophilus aeneus								
***Notiophilus* sp.**			1					1
TRECHINAE								
Bembidiini								
Elaphropus vernicatus								
undet. CARABIDAE adult	1		1					2
undet. CARABIDAE larva				1				1

WEEK 13: 27-30 AUG 2020 GROUND BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	
TOTAL INDIVIDUAL GROUND BEETLES PER PLOT	3	*1*	5	6	2	5	14	total individuals: 36
TOTAL GROUND BEETLE TAXA PER PLOT	2	*1*	4	5	2	5	4	total taxa: 18

ROVE BEETLES (COLEOPTERA: STAPHYLINIDAE)

SGL33 TOTAL

SGL33 BY COLLECTION WEEK

MAY - AUGUST 2020 **ROVE BEETLE TAXA**	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
STAPHYLINIDAE								
EUAESTHETINAE								
Euaesthetini								
***Edaphus* sp.**	1							1
***Euaesthetus* sp.**			1					1
Stictocraniini								
Stictocranius puncticeps					1			1
OMALIINAE *(ocellate rove beetles)*								
Eusphalerini								
***Eusphalerum* sp.**			1	1				2
OXYTELINAE *(spiny-legged rove beetles)*								
Blediini								
***Bledius* sp.**		1						1
Oxytelini								
***Anotylus* sp.**			1			1		2
***Anotylus/Oxytelus* sp.**		3		1				4
***Apocellus* sp.**	1		1	4				6
PAEDERINAE								
Lathrobiini								
Astenus americanus							1	1
Scopaeus sp.				1		1		2
undet. Paederinae						1		1
PSELAPHINAE *(ant-loving beetles)*								
undet. Pselaphinae			1	11	1			13
SCAPHIDIINAE *(shining fungus beetles)*								
Scaphisomatini								
undet. Scaphisomatini	2	1				2	3	8
SCYDMAENINAE *(ant-like stone beetles)*								
Glandulariini								
Brachycepsis subpunctatus	3	1		1				5
***Brachycepsis* sp.**		1		1		1		3
***Euconnus (Napochus)* sp.**		1						1
***Euconnus* sp.**							1	1
***Stenichnus* sp.**		1		7	1	1		10
STAPHYLININAE *(large rove beetles)*								
Staphylinini								
***Acylophorus* sp.**		1						1
***Belonuchus* sp.**	1							1
Bisnius blandus							1	1
Gabrius micropthalmus		1						1
***Neobisnius* sp.**	1	1						2
***Philonthus* sp.**	1						2	3
***Philonthus/Bisnius* sp.**						1	3	4
Platydracus fossator *(red-spotted rove beetle)*	1		1	2		1		5
Platydracus maculosus	1	3	1		1	1		7
Platydracus zonatus							1	1
***Quedius* sp.**						1	1	2
TACHYPORINAE *(crab-like rove beetles)*								
Mycetoporini								
***Bolitobius* sp.**						1		1
Tachyporini								
***Sepedophilus* sp.**	1			1			1	3
Tachinus fimbriatus	1		1					2
***Tachyporus* sp.**		1	1	1				3
undet. STAPHYLINIDAE adult	67	62	28	22	1	3	4	187
undet. STAPHYLINIDAE larva		1		2				3

MAY - AUGUST 2020 **ROVE BEETLE TAXA**	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**total individuals:**
TOTAL INDIVIDUAL ROVE BEETLES PER PLOT	81	79	37	55	5	15	18	290
								total taxa:
TOTAL ROVE BEETLE TAXA PER PLOT	11	12	9	11	4	11	9	33

WEEK 1: 5-8 JUN 2020 ROVE BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
STAPHYLINIDAE								
EUAESTHETINAE								
Euaesthetini								
***Edaphus* sp.**	1							1
***Euaesthetus* sp.**								
Stictocraniini								
Stictocranius puncticeps					1			1
OMALIINAE *(ocellate rove beetles)*								
Eusphalerini								
***Eusphalerum* sp.**			1	1				2
OXYTELINAE *(spiny-legged rove beetles)*								
Blediini								
***Bledius* sp.**		1						1
Oxytelini								
***Anotylus* sp.**			1					1
***Anotylus/Oxytelus* sp.**								
***Apocellus* sp.**				3				3
PAEDERINAE								
Lathrobiini								
Astenus americanus								
Scopaeus sp.				1		1		2
undet. Paederinae								
PSELAPHINAE *(ant-loving beetles)*								
undet. Pselaphinae				11				11
SCAPHIDIINAE *(shining fungus beetles)*								
Scaphisomatini								
undet. Scaphisomatini	1	1				2		4
SCYDMAENINAE *(ant-like stone beetles)*								
Glandulariini								
Brachycepsis subpunctatus								
***Brachycepsis* sp.**								
***Euconnus (Napochus)* sp.**								
***Euconnus* sp.**							1	1
***Stenichnus* sp.**				7	1	1		9
STAPHYLININAE *(large rove beetles)*								
Staphylinini								
***Acylophorus* sp.**		1						1
***Belonuchus* sp.**	1							1
Bisnius blandus								
Gabrius micropthalmus								
***Neobisnius* sp.**	1	1						2
***Philonthus* sp.**								
***Philonthus/Bisnius* sp.**						1	3	4
Platydracus fossator *(red-spotted rove beetle)*								
Platydracus maculosus	1	1	1			1		4
Platydracus zonatus								
***Quedius* sp.**								
TACHYPORINAE *(crab-like rove beetles)*								
Mycetoporini								
***Bolitobius* sp.**								
Tachyporini								
***Sepedophilus* sp.**	1			1				2
Tachinus fimbriatus								
***Tachyporus* sp.**			1					1
undet. STAPHYLINIDAE adult	66	61	27	21		3	3	181
undet. STAPHYLINIDAE larva								

WEEK 1: 5-8 JUN 2020 ROVE BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	
TOTAL INDIVIDUAL ROVE BEETLES PER PLOT	72	66	31	45	2	9	7	total individuals: **232**
TOTAL ROVE BEETLE TAXA PER PLOT	6	5	4	6	2	5	2	total taxa: **18**

WEEK 5: 3-6 JUL 2020 **ROVE BEETLE TAXA**	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)*							
STAPHYLINIDAE	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
EUAESTHETINAE								
Euaesthetini								
***Edaphus* sp.**								
***Euaesthetus* sp.**			1					1
Stictocraniini								
Stictocranius puncticeps								
OMALIINAE *(ocellate rove beetles)*								
Eusphalerini								
***Eusphalerum* sp.**								
OXYTELINAE *(spiny-legged rove beetles)*								
Blediini								
***Bledius* sp.**								
Oxytelini								
***Anotylus* sp.**								
***Anotylus/Oxytelus* sp.**		1						1
***Apocellus* sp.**	1			1				2
PAEDERINAE								
Lathrobiini								
Astenus americanus								
Scopaeus sp.								
undet. Paederinae								
PSELAPHINAE *(ant-loving beetles)*								
undet. Pselaphinae								
SCAPHIDIINAE *(shining fungus beetles)*								
Scaphisomatini								
undet. Scaphisomatini	1						3	4
SCYDMAENINAE *(ant-like stone beetles)*								
Glandulariini								
Brachycepsis subpunctatus								
***Brachycepsis* sp.**								
***Euconnus (Napochus)* sp.**		1						1
***Euconnus* sp.**								
***Stenichnus* sp.**		1						1
STAPHYLININAE *(large rove beetles)*								
Staphylinini								
***Acylophorus* sp.**								
***Belonuchus* sp.**								
Bisnius blandus							1	1
Gabrius micropthalmus								
***Neobisnius* sp.**								
***Philonthus* sp.**								
***Philonthus/Bisnius* sp.**								
Platydracus fossator *(red-spotted rove beetle)*						1		1
Platydracus maculosus		1			1			2
Platydracus zonatus							1	1
***Quedius* sp.**								
TACHYPORINAE *(crab-like rove beetles)*								
Mycetoporini								
***Bolitobius* sp.**						1		1
Tachyporini								
***Sepedophilus* sp.**							1	1
Tachinus fimbriatus								
***Tachyporus* sp.**				1				1
undet. STAPHYLINIDAE adult	1	1		1			1	4
undet. STAPHYLINIDAE larva				2				2

WEEK 5: 3-6 JUL 2020 **ROVE BEETLE TAXA**	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**total individuals:**
TOTAL INDIVIDUAL ROVE BEETLES PER PLOT	3	5	1	5	1	2	7	**24**
								total taxa:
TOTAL ROVE BEETLE TAXA PER PLOT	2	4	1	2	1	2	4	**13**

WEEK 9: 31 JUL - 3 AUG 2020 ROVE BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
STAPHYLINIDAE								
EUAESTHETINAE								
Euaesthetini								
***Edaphus* sp.**								
***Euaesthetus* sp.**								
Stictocraniini								
Stictocranius puncticeps								
OMALIINAE *(ocellate rove beetles)*								
Eusphalerini								
***Eusphalerum* sp.**								
OXYTELINAE *(spiny-legged rove beetles)*								
Blediini								
***Bledius* sp.**								
Oxytelini								
***Anotylus* sp.**						1		1
***Anotylus/Oxytelus* sp.**		2		1				3
***Apocellus* sp.**								
PAEDERINAE								
Lathrobiini								
Astenus americanus							1	1
Scopaeus sp.								
undet. Paederinae								
PSELAPHINAE *(ant-loving beetles)*								
undet. Pselaphinae			1		1			2
SCAPHIDIINAE *(shining fungus beetles)*								
Scaphisomatini								
undet. Scaphisomatini								
SCYDMAENINAE *(ant-like stone beetles)*								
Glandulariini								
Brachycepsis subpunctatus	3	1		1				5
***Brachycepsis* sp.**		1		1		1		3
***Euconnus (Napochus)* sp.**								
***Euconnus* sp.**								
***Stenichnus* sp.**								
STAPHYLININAE *(large rove beetles)*								
Staphylinini								
***Acylophorus* sp.**								
***Belonuchus* sp.**								
Bisnius blandus								
Gabrius micropthalmus		1						1
***Neobisnius* sp.**								
***Philonthus* sp.**							2	2
***Philonthus/Bisnius* sp.**								
Platydracus fossator *(red-spotted rove beetle)*	1			2				3
Platydracus maculosus		1						1
Platydracus zonatus								
***Quedius* sp.**								
TACHYPORINAE *(crab-like rove beetles)*								
Mycetoporini								
***Bolitobius* sp.**								
Tachyporini								
***Sepedophilus* sp.**								
Tachinus fimbriatus	1							1
***Tachyporus* sp.**		1						1
undet. STAPHYLINIDAE adult			1		1			2
undet. STAPHYLINIDAE larva		1						1

WEEK 9: 31 JUL - 3 AUG 2020 ROVE BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	total individuals:
TOTAL INDIVIDUAL ROVE BEETLES PER PLOT	5	8	*2*	5	*2*	*2*	3	27
								total taxa:
TOTAL ROVE BEETLE TAXA PER PLOT	3	6	*1*	4	*1*	2	2	12

WEEK 13: 27-30 AUG 2020 ROVE BEETLE TAXA	PITFALL TRAP COLLECTIONS (72 trap-hours per plot)							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
STAPHYLINIDAE								
EUAESTHETINAE								
Euaesthetini								
***Edaphus* sp.**								
***Euaesthetus* sp.**								
Stictocraniini								
Stictocranius puncticeps								
OMALIINAE *(ocellate rove beetles)*								
Eusphalerini								
***Eusphalerum* sp.**								
OXYTELINAE *(spiny-legged rove beetles)*								
Blediini								
***Bledius* sp.**								
Oxytelini								
***Anotylus* sp.**								
***Anotylus/Oxytelus* sp.**								
***Apocellus* sp.**			1					1
PAEDERINAE								
Lathrobiini								
Astenus americanus								
Scopaeus sp.								
undet. Paederinae						1		1
PSELAPHINAE *(ant-loving beetles)*								
undet. Pselaphinae								
SCAPHIDIINAE *(shining fungus beetles)*								
Scaphisomatini								
undet. Scaphisomatini								
SCYDMAENINAE *(ant-like stone beetles)*								
Glandulariini								
Brachycepsis subpunctatus								
***Brachycepsis* sp.**								
***Euconnus (Napochus)* sp.**								
***Euconnus* sp.**								
***Stenichnus* sp.**								
STAPHYLININAE *(large rove beetles)*								
Staphylinini								
***Acylophorus* sp.**								
***Belonuchus* sp.**								
Bisnius blandus								
Gabrius micropthalmus								
***Neobisnius* sp.**								
***Philonthus* sp.**	1							1
***Philonthus/Bisnius* sp.**								
Platydracus fossator *(red-spotted rove beetle)*			1					1
Platydracus maculosus								
Platydracus zonatus								
***Quedius* sp.**						1	1	2
TACHYPORINAE *(crab-like rove beetles)*								
Mycetoporini								
***Bolitobius* sp.**								
Tachyporini								
***Sepedophilus* sp.**								
Tachinus fimbriatus			1					1
***Tachyporus* sp.**								
undet. STAPHYLINIDAE adult								
undet. STAPHYLINIDAE larva								

WEEK 13: 27-30 AUG 2020 ROVE BEETLE TAXA	PITFALL TRAP COLLECTIONS (72 trap-hours per plot)							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	total individuals:
TOTAL INDIVIDUAL ROVE BEETLES PER PLOT	1	0	3	0	0	2	1	7
								total taxa:
TOTAL ROVE BEETLE TAXA PER PLOT	1	0	3	0	0	2	1	6

OTHER BEETLES (COLEOPTERA)

SGL33 TOTAL

SGL33 BY COLLECTION WEEK

MAY - AUGUST 2020	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
OTHER BEETLE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
ANTHICIDAE *(ant-like flower beetles)*								
undet. Anthicidae	1	2						3
Tomoderinae								
***Tomoderus* sp.**			1	25		1		27
CHRYSOMELIDAE *(leaf beetles)*								
undet. Chrysomelidae			1					1
Cryptocephalinae *(case-bearing leaf beetles)*								
undet. Cryptocephalinae				1	1			2
Eumolpinae								
***Paria* sp.**	3	2	1	5	1	1		13
undet. Eumolpinae	4							4
Galerucinae *(skeletonizing and flea leaf beetles)*								
***Capraita* sp.**	1							1
***Chaetocnema* sp.**		1	1	8		1		11
***Crepidodera* genus gr.**	1					1	1	3
***Mantura* sp.**				1				1
undet. Galerucinae	1							1
CIIDAE *(minute tree-fungus beetles)*								
Ciinae								
Octotemnus glabriculus	1							1
COCCINELLID GROUP *(8 Families that resemble/incl. lady beetles)*								
undet. Coccinellid gr.	1							1
CORYLOPHIDAE *(minute hooded beetles)*								
***Sericoderus* sp.**	1							1
undet. Corylophidae		2	1	1		1		5
ENDOMYCHIDAE *(handsome fungus beetles)*								
undet. Endomychidae				1				1
LATRIDIIDAE *(minute brown scavenger beetles)*								
undet. Latridiidae	1	2	3	4	2	1		13
Corticariinae								
***Melanophthalma* sp.**	1							1
undet. Corticariinae	2				1			3
Latridiinae								
undet. Latridiinae	5		1	2				8
CURCULIONOIDEA *(8 Families of snout and bark beetles)*								
undet. Curculionoidea *(undet. weevil)*	2	1	7	12	1	13	4	40
CURCULIONIDAE *(snout and bark beetles)*								
Cryptorhynchinae *(hidden snout weevils)*								
undet. Cryptorhynchinae			2					2
Molytinae								
***Rhyssomatus* sp.**				1				1
Scolytinae *(bark and ambrosia beetles)*								
***Anisandrus* sp.**	1			1				2
***Monarthrum* sp.**			1					1
***Xyleborinus* sp.**	3	4	1	4		2		14
***Xyleborus* sp.**		1						1
***Xylosandrus* sp.**	9	1	3	1	5	5	3	27
DYTISCIDAE *(predaceous diving beetles)*								
undet. Dytiscidae					1			1
ELATEROIDEA *(12 Families of click, firefly, and soldier beetles)*								
undet. Elateroidea (larva)	1	1						2
ELATERIDAE *(click beetles)*								
Agrypninae								
***Conoderus* sp.**					1			1
Dendrometrinae								
Limonius agonus			1					1
Elaterinae								
Melanotus sagittarius	2							2
LAMPYRIDAE *(fireflies)*								
undet. Lampyridae (larva)			2	2		3	1	8
LYCIDAE *(net-winged beetles)*								
undet. Lycidae (larva)	3	2	1	1	1			8
EROTYLIDAE *(pleasing fungus beetles)*								
Xenoscelinae								
Loberus impressus					1			1
Toramus pulchellus						2		2
HISTERIDAE *(clown beetles)*								
Histerinae								
***Margarinotus* sp.**							1	1
Saprininae								
***Euspilotus* sp.**	1							1
ISCHALIIDAE *(broad-hipped flower beetles)*								
Ischaliinae								
Ischalia costata	1							1
LEIODIDAE *(round fungus beetles)*								
Cholevinae *(small carrion beetles)*								
***Ptomaphagus* sp.**			1	1			3	5
Leiodinae								
***Anisotoma* sp.**		1						1
***Leiodes* sp.**				2				2

MAY - AUGUST 2020 **OTHER BEETLE TAXA**	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
MELOIDAE *(blister beetles)*								
Meloinae								
***Meloe* sp.** *(oil beetles)*			1					1
MONOTOMIDAE *(minute clubbed beetles)*								
undet. Monotomidae					1			1
MORDELLIDAE *(tumbling flower beetles)*								
undet. Mordellidae		1		1		1		3
NITIDULIDAE *(sap-feeding beetles)*								
undet. Nitidulidae	1	1						2
Cryptarchinae								
Glischrochilus fasciatus							1	1
Glischrochilus sanguinolentus	1						1	2
Nitidulinae								
***Phenolia* complex**	1	3	1			6		11
***Stelidota* sp.**	1							1
PTILIDAE *(feather-winged beetles)*								
undet. Ptilidae		1						1
PTILODACTYLIDAE *(toe-winged beetles)*								
***Ptilodactyla* sp.**						1		1
SCARABAEOIDEA *(12 Families of scarab, stag, and bess beetles)*								
undet. Scarabaeoidea			2					2
GEOTRUPIDAE *(earth-boring scarab beetles)*								
Geotrupes balyi *(Baly's earth-boring beetle)*	1							1
Geotrupes semiopacus		1						1
Geotrupes splendidus *(splendid earth-boring beetl*	1			1				2
SCARABAEIDAE *(scarab beetles)*								
Aphodiinae								
Dialytes striatulus			1				2	3
***Oscarinus* sp.**			3					3
undet. Aphodiinae	1			1			2	4
Cetoniinae *(fruit and flower chafers)*								
Euphoria fulgida *(emerald Euphoria)*						1		1
Melolonthinae *(May beetles and June bugs)*								
***Phyllophaga* sp.** *(May beetles)*				2				2
Scarabaeinae *(dung beetles)*								
Onthophagus hecate *(scooped scarab)*	2	1		1				4
Onthophagus orpheus		1						1
SILPHIDAE *(carrion beetles)*								
Necrophila americana *(American carrion beetle)*				1		1		2
undet. Silphidae (larva)	1	3						4
TENEBRIONIDAE *(darkling beetles)*								
undet. Tenebrionidae (larva)				1				1
Lagriinae *(long-jointed beetles)*								
***Anaedus* sp.**				2				2
Tenebrioninae								
Meracantha contracta				1				1
undet. OTHER BEETLE larva	1		5	15		1	1	23

MAY - AUGUST 2020 **OTHER BEETLE TAXA**	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**total individuals:**
TOTAL INDIVIDUAL OTHER BEETLES PER PLOT	57	32	41	99	*16*	42	20	**307**
								total taxa:
TOTAL OTHER BEETLE TAXA PER PLOT	33	21	22	28	12	17	*11*	**70**

WEEK 1: 5-8 JUN 2020	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)*							
OTHER BEETLE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
ANTHICIDAE *(ant-like flower beetles)*								
undet. Anthicidae	1	2						3
Tomoderinae								
***Tomoderus* sp.**			1	10				11
CHRYSOMELIDAE *(leaf beetles)*								
undet. Chrysomelidae								
Cryptocephalinae *(case-bearing leaf beetles)*								
undet. Cryptocephalinae				1				1
Eumolpinae								
***Paria* sp.**		2		2				4
undet. Eumolpinae								
Galerucinae *(skeletonizing and flea leaf beetles)*								
***Capraita* sp.**								
***Chaetocnema* sp.**		1	1	3		1		6
***Crepidodera* genus gr.**								
***Mantura* sp.**				1				1
undet. Galerucinae	1							1
CIIDAE *(minute tree-fungus beetles)*								
Ciinae								
Octotemnus glabriculus								
COCCINELLID GROUP *(8 Families that resemble/incl. lady beetles)*								
undet. Coccinellid gr.	1							1
CORYLOPHIDAE *(minute hooded beetles)*								
***Sericoderus* sp.**								
undet. Corylophidae		1						1
ENDOMYCHIDAE *(handsome fungus beetles)*								
undet. Endomychidae								
LATRIDIIDAE *(minute brown scavenger beetles)*								
undet. Latridiidae		1						1
Corticariinae								
***Melanophthalma* sp.**								
undet. Corticariinae					1			1
Latridiinae								
undet. Latridiinae								
CURCULIONOIDEA *(8 Families of snout and bark beetles)*								
undet. Curculionoidea *(undet. weevil)*			1	4		9	3	17
CURCULIONIDAE *(snout and bark beetles)*								
Cryptorhynchinae *(hidden snout weevils)*								
undet. Cryptorhynchinae			2					2
Molytinae								
***Rhyssomatus* sp.**				1				1
Scolytinae *(bark and ambrosia beetles)*								
***Anisandrus* sp.**								
***Monarthrum* sp.**								
***Xyleborinus* sp.**	2	3	1	4		2		12
***Xyleborus* sp.**		1						1
***Xylosandrus* sp.**	5	1	3	1	4	5	3	22
DYTISCIDAE *(predaceous diving beetles)*								
undet. Dytiscidae					1			1
ELATEROIDEA *(12 Families of click, firefly, and soldier beetles)*								
undet. Elateroidea (larva)								
ELATERIDAE *(click beetles)*								
Agrypninae								
***Conoderus* sp.**					1			1
Dendrometrinae								
Limonius agonus								
Elaterinae								
Melanotus sagittarius								
LAMPYRIDAE *(fireflies)*								
undet. *Lampyridae (larva)*								
LYCIDAE *(net-winged beetles)*								
undet. *Lycidae (larva)*								
EROTYLIDAE *(pleasing fungus beetles)*								
Xenoscelinae								
Loberus impressus					1			1
Toramus pulchellus								
HISTERIDAE *(clown beetles)*								
Histerinae								
***Margarinotus* sp.**								
Saprininae								
***Euspilotus* sp.**	1							1
ISCHALIIDAE *(broad-hipped flower beetles)*								
Ischaliinae								
Ischalia costata	1							1
LEIODIDAE *(round fungus beetles)*								
Cholevinae *(small carrion beetles)*								
***Ptomaphagus* sp.**			1					1
Leiodinae								
***Anisotoma* sp.**		1						1
***Leiodes* sp.**								

WEEK 1: 5-8 JUN 2020 / **OTHER BEETLE TAXA**	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)* M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
MELOIDAE *(blister beetles)*								
Meloinae								
***Meloe* sp.** *(oil beetles)*								
MONOTOMIDAE *(minute clubbed beetles)*								
undet. Monotomidae					1			1
MORDELLIDAE *(tumbling flower beetles)*								
undet. Mordellidae								
NITIDULIDAE *(sap-feeding beetles)*								
undet. Nitidulidae	1	1						2
Cryptarchinae								
Glischrochilus fasciatus							1	1
Glischrochilus sanguinolentus	1						1	2
Nitidulinae								
***Phenolia* complex**	1	1				2		4
***Stelidota* sp.**								
PTILIDAE *(feather-winged beetles)*								
undet. Ptilidae		1						1
PTILODACTYLIDAE *(toe-winged beetles)*								
***Ptilodactyla* sp.**								
SCARABAEOIDEA *(12 Families of scarab, stag, and bess beetles)*								
undet. Scarabaeoidea								
GEOTRUPIDAE *(earth-boring scarab beetles)*								
Geotrupes balyi *(Baly's earth-boring beetle)*								
Geotrupes semiopacus								
Geotrupes splendidus *(splendid earth-boring beetle)*								
SCARABAEIDAE *(scarab beetles)*								
Aphodiinae								
Dialytes striatulus								
***Oscarinus* sp.**								
undet. Aphodiinae							1	1
Cetoniinae *(fruit and flower chafers)*								
Euphoria fulgida *(emerald Euphoria)*						1		1
Melolonthinae *(May beetles and June bugs)*								
***Phyllophaga* sp.** *(May beetles)*				2				2
Scarabaeinae *(dung beetles)*								
Onthophagus hecate *(scooped scarab)*		1		1				2
Onthophagus orpheus								
SILPHIDAE *(carrion beetles)*								
Necrophila americana *(American carrion beetle)*						1		1
undet. Silphidae (larva)	1	1						2
TENEBRIONIDAE *(darkling beetles)*								
undet. Tenebrionidae (larva)								
Lagriinae *(long-jointed beetles)*								
***Anaedus* sp.**				2				2
Tenebrioninae								
Meracantha contracta								
undet. OTHER BEETLE larva								0

WEEK 1: 5-8 JUN 2020 / **OTHER BEETLE TAXA**	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)* M4	F2	SF2	MH3	MH1	BLV3a	HC1	
TOTAL INDIVIDUAL OTHER BEETLES PER PLOT	16	18	10	32	9	21	9	total individuals: **115**
TOTAL OTHER BEETLE TAXA PER PLOT	13	15	8	13	7	8	6	total taxa: **38**

WEEK 5: 3-6 JUL 2020	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
OTHER BEETLE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
ANTHICIDAE *(ant-like flower beetles)*								
undet. Anthicidae								
Tomoderinae								
***Tomoderus* sp.**				5				5
CHRYSOMELIDAE *(leaf beetles)*								
undet. Chrysomelidae								
Cryptocephalinae *(case-bearing leaf beetles)*								
undet. Cryptocephalinae					1			1
Eumolpinae								
***Paria* sp.**	1			2	1			4
undet. Eumolpinae	3							3
Galerucinae *(skeletonizing and flea leaf beetles)*								
***Capraita* sp.**	1							1
***Chaetocnema* sp.**				5				5
***Crepidodera* genus gr.**								
***Mantura* sp.**								
undet. Galerucinae								
CIIDAE *(minute tree-fungus beetles)*								
Ciinae								
Octotemnus glabriculus								
COCCINELLID GROUP *(8 Families that resemble/incl. lady beetles)*								
undet. Coccinellid gr.								
CORYLOPHIDAE *(minute hooded beetles)*								
***Sericoderus* sp.**								
undet. Corylophidae				1				1
ENDOMYCHIDAE *(handsome fungus beetles)*								
undet. Endomychidae								
LATRIDIIDAE *(minute brown scavenger beetles)*								
undet. Latridiidae								
Corticariinae								
***Melanophthalma* sp.**								
undet. Corticariinae	2							2
Latridiinae								
undet. Latridiinae								
CURCULIONOIDEA *(8 Families of snout and bark beetles)*								
undet. Curculionoidea *(undet. weevil)*			3	1	1	1	1	7
CURCULIONIDAE *(snout and bark beetles)*								
Cryptorhynchinae *(hidden snout weevils)*								
undet. Cryptorhynchinae								
Molytinae								
***Rhyssomatus* sp.**								
Scolytinae *(bark and ambrosia beetles)*								
***Anisandrus* sp.**								
***Monarthrum* sp.**								
***Xyleborinus* sp.**	1	1						2
***Xyleborus* sp.**								
***Xylosandrus* sp.**	3				1			4
DYTISCIDAE *(predaceous diving beetles)*								
undet. Dytiscidae								
ELATEROIDEA *(12 Families of click, firefly, and soldier beetles)*								
undet. Elateroidea (larva)								
ELATERIDAE *(click beetles)*								
Agrypninae								
***Conoderus* sp.**								
Dendrometrinae								
Limonius agonus			1					1
Elaterinae								
Melanotus sagittarius	2							2
LAMPYRIDAE *(fireflies)*								
undet. Lampyridae (larva)			1				1	2
LYCIDAE *(net-winged beetles)*								
undet. Lycidae (larva)			1					1
EROTYLIDAE *(pleasing fungus beetles)*								
Xenoscelinae								
Loberus impressus								
Toramus pulchellus						1		1
HISTERIDAE *(clown beetles)*								
Histerinae								
***Margarinotus* sp.**							1	1
Saprininae								
***Euspilotus* sp.**								
ISCHALIIDAE *(broad-hipped flower beetles)*								
Ischaliinae								
Ischalia costata								
LEIODIDAE *(round fungus beetles)*								
Cholevinae *(small carrion beetles)*								
***Ptomaphagus* sp.**							3	3
Leiodinae								
***Anisotoma* sp.**								
***Leiodes* sp.**								

WEEK 5: 3-6 JUL 2020 **OTHER BEETLE TAXA**	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
MELOIDAE *(blister beetles)*								
Meloinae								
***Meloe* sp.** *(oil beetles)*								
MONOTOMIDAE *(minute clubbed beetles)*								
undet. Monotomidae								
MORDELLIDAE *(tumbling flower beetles)*								
undet. Mordellidae				1		1		2
NITIDULIDAE *(sap-feeding beetles)*								
undet. Nitidulidae								
Cryptarchinae								
Glischrochilus fasciatus								
Glischrochilus sanguinolentus								
Nitidulinae								
***Phenolia* complex**		2	1			1		4
***Stelidota* sp.**	1							1
PTILIDAE *(feather-winged beetles)*								
undet. Ptilidae								
PTILODACTYLIDAE *(toe-winged beetles)*								
***Ptilodactyla* sp.**						1		1
SCARABAEOIDEA *(12 Families of scarab, stag, and bess beetles)*								
undet. Scarabaeoidea								
GEOTRUPIDAE *(earth-boring scarab beetles)*								
Geotrupes balyi *(Baly's earth-boring beetle)*								
Geotrupes semiopacus								
Geotrupes splendidus *(splendid earth-boring beetle)*								
SCARABAEIDAE *(scarab beetles)*								
Aphodiinae								
Dialytes striatulus								
***Oscarinus* sp.**								
undet. Aphodiinae								
Cetoniinae *(fruit and flower chafers)*								
Euphoria fulgida *(emerald Euphoria)*								
Melolonthinae *(May beetles and June bugs)*								
***Phyllophaga* sp.** *(May beetles)*								
Scarabaeinae *(dung beetles)*								
Onthophagus hecate *(scooped scarab)*	1							1
Onthophagus orpheus		1						1
SILPHIDAE *(carrion beetles)*								
Necrophila americana *(American carrion beetle)*								
undet. Silphidae (larva)		2						2
TENEBRIONIDAE *(darkling beetles)*								
undet. Tenebrionidae (larva)								
Lagriinae *(long-jointed beetles)*								
***Anaedus* sp.**								
Tenebrioninae								
Meracantha contracta				1				1
undet. OTHER BEETLE larva				1				1
WEEK 5: 3-6 JUL 2020 **OTHER BEETLE TAXA**	**PITFALL TRAP COLLECTIONS** *(72 trap-hours per plot)*							
	M4	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**total individuals:**
TOTAL INDIVIDUAL OTHER BEETLES PER PLOT	15	6	7	17	4	5	6	**60**
								total taxa:
TOTAL OTHER BEETLE TAXA PER PLOT	11	5	6	8	5	6	5	**27**

WEEK 9: 31 JUL - 3 AUG 2020	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
OTHER BEETLE TAXA	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
ANTHICIDAE *(ant-like flower beetles)*								
undet. Anthicidae								
Tomoderinae								
***Tomoderus* sp.**				3		1		4
CHRYSOMELIDAE *(leaf beetles)*								
undet. Chrysomelidae								
Cryptocephalinae *(case-bearing leaf beetles)*								
undet. Cryptocephalinae								
Eumolpinae								
***Paria* sp.**			1					1
undet. Eumolpinae	1							1
Galerucinae *(skeletonizing and flea leaf beetles)*								
***Capraita* sp.**								
***Chaetocnema* sp.**								
***Crepidodera* genus gr.**								
***Mantura* sp.**								
undet. Galerucinae								
CIIDAE *(minute tree-fungus beetles)*								
Ciinae								
Octotemnus glabriculus								
COCCINELLID GROUP *(8 Families that resemble/incl. lady beetles)*								
undet. Coccinellid gr.								
CORYLOPHIDAE *(minute hooded beetles)*								
***Sericoderus* sp.**								
undet. Corylophidae								
ENDOMYCHIDAE *(handsome fungus beetles)*								
undet. Endomychidae								
LATRIDIIDAE *(minute brown scavenger beetles)*								
undet. Latridiidae								
Corticariinae								
***Melanophthalma* sp.**								
undet. Corticariinae								
Latridiinae								
undet. Latridiinae	5		1	2				8
CURCULIONOIDEA *(8 Families of snout and bark beetles)*								
undet. Curculionoidea *(undet. weevil)*	2	1	2	7		1		13
CURCULIONIDAE *(snout and bark beetles)*								
Cryptorhynchinae *(hidden snout weevils)*								
undet. Cryptorhynchinae								
Molytinae								
***Rhyssomatus* sp.**								
Scolytinae *(bark and ambrosia beetles)*								
***Anisandrus* sp.**	1			1				2
***Monarthrum* sp.**			1					1
***Xyleborinus* sp.**								
***Xyleborus* sp.**								
***Xylosandrus* sp.**	1							1
DYTISCIDAE *(predaceous diving beetles)*								
undet. Dytiscidae								
ELATEROIDEA *(12 Families of click, firefly, and soldier beetles)*								
undet. Elateroidea (larva)	1	1						2
ELATERIDAE *(click beetles)*								
Agrypninae								
***Conoderus* sp.**								
Dendrometrinae								
Limonius agonus								
Elaterinae								
Melanotus sagittarius								
LAMPYRIDAE *(fireflies)*								
undet. Lampyridae (larva)				1				1
LYCIDAE *(net-winged beetles)*								
undet. Lycidae (larva)		2		1	1			4
EROTYLIDAE *(pleasing fungus beetles)*								
Xenoscelinae								
Loberus impressus								
Toramus pulchellus						1		1
HISTERIDAE *(clown beetles)*								
Histerinae								
***Margarinotus* sp.**								
Saprininae								
***Euspilotus* sp.**								
ISCHALIIDAE *(broad-hipped flower beetles)*								
Ischaliinae								
Ischalia costata								
LEIODIDAE *(round fungus beetles)*								
Cholevinae *(small carrion beetles)*								
***Ptomaphagus* sp.**				1				1
Leiodinae								
***Anisotoma* sp.**								
***Leiodes* sp.**								

WEEK 9: 31 JUL - 3 AUG 2020 OTHER BEETLE TAXA	PITFALL TRAP COLLECTIONS (72 trap-hours per plot) M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
MELOIDAE *(blister beetles)*								
Meloinae								
***Meloe* sp.** *(oil beetles)*								
MONOTOMIDAE *(minute clubbed beetles)*								
undet. Monotomidae								
MORDELLIDAE *(tumbling flower beetles)*								
undet. Mordellidae		1						1
NITIDULIDAE *(sap-feeding beetles)*								
undet. Nitidulidae								
Cryptarchinae								
Glischrochilus fasciatus								
Glischrochilus sanguinolentus								
Nitidulinae								
***Phenolia* complex**						3		3
***Stelidota* sp.**								
PTILIDAE *(feather-winged beetles)*								
undet. Ptilidae								
PTILODACTYLIDAE *(toe-winged beetles)*								
***Ptilodactyla* sp.**								
SCARABAEOIDEA *(12 Families of scarab, stag, and bess beetles)*								
undet. Scarabaeoidea								
GEOTRUPIDAE *(earth-boring scarab beetles)*								
Geotrupes balyi *(Baly's earth-boring beetle)*								
Geotrupes semiopacus		1						1
Geotrupes splendidus *(splendid earth-boring beetl*	1			1				2
SCARABAEIDAE *(scarab beetles)*								
Aphodiinae								
Dialytes striatulus							1	1
***Oscarinus* sp.**								
undet. Aphodiinae	1			1				2
Cetoniinae (fruit and flower chafers)								
Euphoria fulgida *(emerald Euphoria)*								
Melolonthinae (May beetles and June bugs)								
***Phyllophaga* sp.** *(May beetles)*								
Scarabaeinae (dung beetles)								
Onthophagus hecate *(scooped scarab)*	1							1
Onthophagus orpheus								
SILPHIDAE *(carrion beetles)*								
Necrophila americana *(American carrion beetle)*								
undet. Silphidae (larva)								
TENEBRIONIDAE *(darkling beetles)*								
undet. Tenebrionidae (larva)								
Lagriinae (long-jointed beetles)								
***Anaedus* sp.**								
Tenebrioninae								
Meracantha contracta								
undet. OTHER BEETLE larva			5	12			1	18

WEEK 9: 31 JUL - 3 AUG 2020 OTHER BEETLE TAXA	PITFALL TRAP COLLECTIONS (72 trap-hours per plot) M4	F2	SF2	MH3	MH1	BLV3a	HC1	
								total individuals:
TOTAL INDIVIDUAL OTHER BEETLES PER PLOT	14	6	10	30	1	6	2	69
								total taxa:
TOTAL OTHER BEETLE TAXA PER PLOT	11	6	5	10	2	5	2	21

WEEK 13: 27-30 AUG 2020	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
OTHER BEETLE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
ANTHICIDAE *(ant-like flower beetles)*								
undet. Anthicidae								
Tomoderinae								
***Tomoderus* sp.**				7				7
CHRYSOMELIDAE *(leaf beetles)*								
undet. Chrysomelidae			1					1
Cryptocephalinae *(case-bearing leaf beetles)*								
undet. Cryptocephalinae								
Eumolpinae								
***Paria* sp.**	2			1		1		4
undet. Eumolpinae								
Galerucinae *(skeletonizing and flea leaf beetles)*								
***Capraita* sp.**								
***Chaetocnema* sp.**								
***Crepidodera* genus gr.**	1					1	1	3
***Mantura* sp.**								
undet. Galerucinae								
CIIDAE *(minute tree-fungus beetles)*								
Ciinae								
Octotemnus glabriculus	1							1
COCCINELLID GROUP *(8 Families that resemble/incl. lady beetles)*								
undet. Coccinellid gr.								
CORYLOPHIDAE *(minute hooded beetles)*								
***Sericoderus* sp.**	1							1
undet. Corylophidae		1	1			1		3
ENDOMYCHIDAE *(handsome fungus beetles)*								
undet. Endomychidae				1				1
LATRIDIIDAE *(minute brown scavenger beetles)*								
undet. Latridiidae	1	1	3	4	2	1		12
Corticariinae								
***Melanophthalma* sp.**	1							1
undet. Corticariinae								
Latridiinae								
undet. Latridiinae								
CURCULIONOIDEA *(8 Families of snout and bark beetles)*								
undet. Curculionoidea *(undet. weevil)*			1			2		3
CURCULIONIDAE *(snout and bark beetles)*								
Cryptorhynchinae *(hidden snout weevils)*								
undet. Cryptorhynchinae								
Molytinae								
***Rhyssomatus* sp.**								
Scolytinae *(bark and ambrosia beetles)*								
***Anisandrus* sp.**								
***Monarthrum* sp.**								
***Xyleborinus* sp.**								
***Xyleborus* sp.**								
***Xylosandrus* sp.**								
DYTISCIDAE *(predaceous diving beetles)*								
undet. Dytiscidae								
ELATEROIDEA *(12 Families of click, firefly, and soldier beetles)*								
undet. Elateroidea (larva)								
ELATERIDAE *(click beetles)*								
Agrypninae								
***Conoderus* sp.**								
Dendrometrinae								
Limonius agonus								
Elaterinae								
Melanotus sagittarius								
LAMPYRIDAE *(fireflies)*								
undet. Lampyridae (larva)			1	1		3		5
LYCIDAE *(net-winged beetles)*								
undet. Lycidae (larva)	3							3
EROTYLIDAE *(pleasing fungus beetles)*								
Xenoscelinae								
Loberus impressus								
Toramus pulchellus								
HISTERIDAE *(clown beetles)*								
Histerinae								
***Margarinotus* sp.**								
Saprininae								
***Euspilotus* sp.**								
ISCHALIIDAE *(broad-hipped flower beetles)*								
Ischaliinae								
Ischalia costata								
LEIODIDAE *(round fungus beetles)*								
Cholevinae *(small carrion beetles)*								
***Ptomaphagus* sp.**								
Leiodinae								
***Anisotoma* sp.**								
***Leiodes* sp.**				2				2

WEEK 13: 27-30 AUG 2020 OTHER BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)* M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
MELOIDAE *(blister beetles)*								
Meloinae								
***Meloe* sp.** *(oil beetles)*			1					1
MONOTOMIDAE *(minute clubbed beetles)*								
undet. Monotomidae								
MORDELLIDAE *(tumbling flower beetles)*								
undet. Mordellidae								
NITIDULIDAE *(sap-feeding beetles)*								
undet. Nitidulidae								
Cryptarchinae								
Glischrochilus fasciatus								
Glischrochilus sanguinolentus								
Nitidulinae								
***Phenolia* complex**								
***Stelidota* sp.**								
PTILIDAE *(feather-winged beetles)*								
undet. Ptilidae								
PTILODACTYLIDAE *(toe-winged beetles)*								
***Ptilodactyla* sp.**								
SCARABAEOIDEA *(12 Families of scarab, stag, and bess beetles)*								
undet. Scarabaeoidea			2					2
GEOTRUPIDAE *(earth-boring scarab beetles)*								
Geotrupes balyi *(Baly's earth-boring beetle)*	1							1
Geotrupes semiopacus								
Geotrupes splendidus *(splendid earth-boring beetle)*								
SCARABAEIDAE *(scarab beetles)*								
Aphodiinae								
Dialytes striatulus			1				1	2
***Oscarinus* sp.**			3					3
undet. Aphodiinae							1	1
Cetoniinae *(fruit and flower chafers)*								
Euphoria fulgida *(emerald Euphoria)*								
Melolonthinae *(May beetles and June bugs)*								
***Phyllophaga* sp.** *(May beetles)*								
Scarabaeinae *(dung beetles)*								
Onthophagus hecate *(scooped scarab)*								
Onthophagus orpheus								
SILPHIDAE *(carrion beetles)*								
Necrophila americana *(American carrion beetle)*				1				1
undet. Silphidae (larva)								
TENEBRIONIDAE *(darkling beetles)*								
undet. Tenebrionidae (larva)				1				1
Lagriinae *(long-jointed beetles)*								
***Anaedus* sp.**								
Tenebrioninae								
Meracantha contracta								
undet. OTHER BEETLE larva	1			2		1		4

WEEK 13: 27-30 AUG 2020 OTHER BEETLE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)* M4	F2	SF2	MH3	MH1	BLV3a	HC1	
TOTAL INDIVIDUAL OTHER BEETLES PER PLOT	12	2	14	20	2	10	3	**total individuals:** 63
TOTAL OTHER BEETLE TAXA PER PLOT	10	3	10	9	2	7	4	**total taxa:** 23

NON-BEETLE INVERTEBRATES (MISCELLANEOUS)

SGL33 TOTAL

SGL33 BY COLLECTION WEEK

MAY - AUGUST 2020 NON-BEETLE INVERTEBRATE TAXA	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
ACARIFORMES *(mites and ticks)*	72	261	200	215	107	92	136	1083
ARANEAE *(spiders)*	67	86	97	178	161	108	125	822
CHILOPODA *(centipedes)*		1	1	1	2	1		6
COLLEMBOLA *(springtails)*	485	436	394	457	173	278	171	2394
DIPLOPODA *(millipedes)*	17	24	34	35	42	53	32	237
DIPTERA *(true flies)*	112	53	54	31	40	111	79	480
GASTROPODA *(slugs and snails)*								
snails			1	1			1	3
HEMIPTERA *(true bugs)*	76	71	73	103	30	30	15	398
APHIDIDAE (aphids)			1	4		1	1	7
ENICOCEPHALIDAE (unique-headed bugs)			1					1
THYREOCORIDAE (ebony bugs)		1						1
HYMENOPTERA *(ants, bees, sawflies, and wasps)*	2	1			2			5
Aculeata *(ants, bees, and stinging wasps)*								
APIDAE (incl. bumble bees)								
Bombus perplexus *(perplexing bumble bee)*					1			1
BETHYLIDAE (flat wasps)				2		1		3
DRYINIDAE (pincer wasps)				1				1
FORMICIDAE (ants)	114	136	223	186	134	118	55	966
HALICTIDAE (sweat bees)								
Halictus ligatus *(ligated furrow bee)*			1					1
MUTILLIDAE (velvet ants)		2			1			3
POMPILIDAE (spider wasps)						1		1
Parasitica *(parasitoid wasps)*	23	36	11	32	4	4	11	121
Ceraphronoidea								
CERAPHRONIDAE	1		1					2
Chalcidoidea	1	6	4	6	2	2		21
EUPELMIDAE		2					1	3
PTEROMALIDAE								
Chalcedectus **sp.**				1				1
Cynipoidea					1			1
CYNIPIDAE (gall wasps)							1	1
FIGITIDAE								
Eucoilinae			1					1
Diaprioidea								
DIAPRIIDAE	1			1			1	3
Ichneumonoidea								
BRACONIDAE (braconid wasps)			1					1
ICHNEUMONIDAE (ichneumon wasps)			2	1	1			4
Platygastroidea								
SCELIONIDAE						1		1
Scelioninae				1	1			2
Baeus **sp.**			2			1		3
Proctotrupoidea								
PROCTOTRUPIDAE	1						1	2
Symphyta *(horntails, sawflies, and wood wasps)*		1	2			1		4
XYELIDAE (xyelid sawflies)						1		1
ISOPODA *(isopods, pillbugs, and sowbugs)*	1			2	5	58	28	94
LEPIDOPTERA *(butterflies and moths)*	4	2	2	9	4	4	3	28
EREBIDAE								
Arctiini *(tiger moths)*	2							2
MECOPTERA *(scorpionflies and hangingflies)*								
Panorpa **sp.** *(a common scorpionfly)*			1				1	2
OPILIONES *(harvestmen)*	17	24	25	17	25	20	4	132
ORTHOPTERA *(crickets, grasshoppers, and katydids)*	22	16	29	61	35	30	24	217
PSEUDOSCORPIONES *(pseudoscorpions)*						1		1
PSOCODEA *(barklice, booklice, and parasitic lice)*	4			2	1	3	3	13
THYSANOPTERA *(thrips)*			4	1	6	4		15
undet. NON-BEETLE adult					1			1
undet. NON-BEETLE larva or pupa		1	2	2	1	1		7

MAY - AUGUST 2020 NON-BEETLE INVERTEBRATE TAXA	PITFALL TRAP COLLECTIONS *(288 total trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	total individuals:
TOTAL INDIVIDUAL NON-BEETLES PER PLOT	1022	1160	1167	1350	780	925	*693*	7097
								total taxa:
TOTAL NON-BEETLE TAXA PER PLOT	*19*	*19*	26	25	24	25	20	62

WEEK 1: 5-8 JUN 2020 NON-BEETLE INVERTEBRATE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)* M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
ACARIFORMES *(mites and ticks)*	10	80	46	55	20	13		224
ARANEAE *(spiders)*	37	64	54	71	88	66	77	457
CHILOPODA *(centipedes)*					1			1
COLLEMBOLA *(springtails)*	22	19	26	37	17	21	24	166
DIPLOPODA *(millipedes)*	2	4	5	12	14	11	1	49
DIPTERA *(true flies)*	20	20	13	10	22	68	44	197
GASTROPODA *(slugs and snails)*								
snails								
HEMIPTERA *(true bugs)*	15	6	27	16	2	5		71
APHIDIDAE (aphids)								
ENICOCEPHALIDAE (unique-headed bugs)								
THYREOCORIDAE (ebony bugs)		1						1
HYMENOPTERA *(ants, bees, sawflies, and wasps)*								
Aculeata *(ants, bees, and stinging wasps)*								
APIDAE (incl. bumble bees)								
Bombus perplexus *(perplexing bumble bee)*								
BETHYLIDAE (flat wasps)								
DRYINIDAE (pincer wasps)								
FORMICIDAE (ants)	19	47	40	45	38	36	21	246
HALICTIDAE (sweat bees)								
Halictus ligatus *(ligated furrow bee)*								
MUTILLIDAE (velvet ants)					1			1
POMPILIDAE (spider wasps)						1		1
Parasitica *(parasitoid wasps)*								
Ceraphronoidea								
CERAPHRONIDAE								
Chalcidoidea		5	2	3	2	2		14
EUPELMIDAE		1						1
PTEROMALIDAE								
Chalcedectus **sp.**								
Cynipoidea								
CYNIPIDAE (gall wasps)								
FIGITIDAE								
Eucoilinae								
Diaprioidea								
DIAPRIIDAE								
Ichneumonoidea								
BRACONIDAE (braconid wasps)								
ICHNEUMONIDAE (ichneumon wasps)			2	1				3
Platygastroidea								
SCELIONIDAE								
Scelioninae								
Baeus **sp.**								
Proctotrupoidea								
PROCTOTRUPIDAE								
Symphyta *(horntails, sawflies, and wood wasps)*								
XYELIDAE (xyelid sawflies)								
ISOPODA *(isopods, pillbugs, and sowbugs)*						2	3	5
LEPIDOPTERA *(butterflies and moths)*	1	1			1	3		6
EREBIDAE								
Arctiini *(tiger moths)*								
MECOPTERA *(scorpionflies and hangingflies)*								
Panorpa **sp.** *(a common scorpionfly)*			1					1
OPILIONES *(harvestmen)*	14	19	4	6	18	8		69
ORTHOPTERA *(crickets, grasshoppers, and katydids)*	1	3	2	4	2	2	2	16
PSEUDOSCORPIONES *(pseudoscorpions)*								
PSOCODEA *(barklice, booklice, and parasitic lice)*						1	1	2
THYSANOPTERA *(thrips)*								
undet. NON-BEETLE adult								
undet. NON-BEETLE larva or pupa								

WEEK 1: 5-8 JUN 2020 NON-BEETLE INVERTEBRATE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)* M4	F2	SF2	MH3	MH1	BLV3a	HC1	
								total individuals:
TOTAL INDIVIDUAL NON-BEETLES PER PLOT	*141*	270	222	260	226	239	173	1531
								total taxa:
TOTAL NON-BEETLE TAXA PER PLOT	10	13	12	11	13	14	*8*	20

WEEK 5: 3-6 JUL 2020 NON-BEETLE INVERTEBRATE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
ACARIFORMES *(mites and ticks)*	5	25	19	20	10	3	1	83
ARANEAE *(spiders)*	11	8	16	26	39	21	33	154
CHILOPODA *(centipedes)*						1		1
COLLEMBOLA *(springtails)*	32	17	32	32	22	21	26	182
DIPLOPODA *(millipedes)*	9	3	5	5	9	7	9	47
DIPTERA *(true flies)*	25	15	8	10	5	26	20	109
GASTROPODA *(slugs and snails)*								
snails								
HEMIPTERA *(true bugs)*	31	12	11	22	11	9	9	105
APHIDIDAE (aphids)			1	4		1	1	7
ENICOCEPHALIDAE (unique-headed bugs)			1					1
THYREOCORIDAE (ebony bugs)								
HYMENOPTERA *(ants, bees, sawflies, and wasps)*								
Aculeata *(ants, bees, and stinging wasps)*								
APIDAE (incl. bumble bees)								
Bombus perplexus *(perplexing bumble bee)*								
BETHYLIDAE (flat wasps)								
DRYINIDAE (pincer wasps)								
FORMICIDAE (ants)	35	42	42	61	38	31	13	262
HALICTIDAE (sweat bees)								
Halictus ligatus *(ligated furrow bee)*								
MUTILLIDAE (velvet ants)								
POMPILIDAE (spider wasps)								
Parasitica *(parasitoid wasps)*								
Ceraphronoidea								
CERAPHRONIDAE			1					1
Chalcidoidea	1	1	2	3				7
EUPELMIDAE		1					1	2
PTEROMALIDAE								
Chalcedectus **sp.**				1				1
Cynipoidea					1			1
CYNIPIDAE (gall wasps)							1	1
FIGITIDAE								
Eucoilinae			1					1
Diaprioidea								
DIAPRIIDAE				1			1	2
Ichneumonoidea								
BRACONIDAE (braconid wasps)								
ICHNEUMONIDAE (ichneumon wasps)								
Platygastroidea								
SCELIONIDAE						1		1
Scelioninae				1	1			2
Baeus **sp.**								
Proctotrupoidea								
PROCTOTRUPIDAE							1	1
Symphyta *(horntails, sawflies, and wood wasps)*			1			1		2
XYELIDAE (xyelid sawflies)						1		1
ISOPODA *(isopods, pillbugs, and sowbugs)*					3	4	4	11
LEPIDOPTERA *(butterflies and moths)*					1		1	2
EREBIDAE								
Arctiini *(tiger moths)*								
MECOPTERA *(scorpionflies and hangingflies)*								
Panorpa **sp.** *(a common scorpionfly)*								
OPILIONES *(harvestmen)*	2		5	2	1	1		11
ORTHOPTERA *(crickets, grasshoppers, and katydids)*	4	5	8	25	8	12	3	65
PSEUDOSCORPIONES *(pseudoscorpions)*								
PSOCODEA *(barklice, booklice, and parasitic lice)*	2			2	1	2		7
THYSANOPTERA *(thrips)*								
undet. NON-BEETLE adult								
undet. NON-BEETLE larva or pupa						1		1

WEEK 5: 3-6 JUL 2020 NON-BEETLE INVERTEBRATE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	total individuals:
TOTAL INDIVIDUAL NON-BEETLES PER PLOT	157	129	153	215	150	143	*124*	1071
								total taxa:
TOTAL NON-BEETLE TAXA PER PLOT	11	*10*	15	15	14	16	15	28

WEEK 9: 31 JUL - 3 AUG 2020 NON-BEETLE INVERTEBRATE TAXA	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
	M4	F2	SF2	MH3	MH1	BLV3a	HC1	# individuals per taxon:
ACARIFORMES *(mites and ticks)*	14	75	50	73	55	46	82	395
ARANEAE *(spiders)*	16	8	18	65	24	11	8	150
CHILOPODA *(centipedes)*		1						1
COLLEMBOLA *(springtails)*	78	96	96	120	68	98	66	622
DIPLOPODA *(millipedes)*	1	13	14	8	2	11	13	62
DIPTERA *(true flies)*	60	10	27	6	10	15	11	139
GASTROPODA *(slugs and snails)*								
snails				1			1	2
HEMIPTERA *(true bugs)*	20	42	21	44	14	8	3	152
APHIDIDAE (aphids)								
ENICOCEPHALIDAE (unique-headed bugs)								
THYREOCORIDAE (ebony bugs)								
HYMENOPTERA *(ants, bees, sawflies, and wasps)*	1	1			1			3
Aculeata *(ants, bees, and stinging wasps)*								
APIDAE (incl. bumble bees)								
Bombus perplexus *(perplexing bumble bee)*					1			1
BETHYLIDAE (flat wasps)						1		1
DRYINIDAE (pincer wasps)								
FORMICIDAE (ants)	42	31	93	68	45	27	15	321
HALICTIDAE (sweat bees)								
Halictus ligatus *(ligated furrow bee)*								
MUTILLIDAE (velvet ants)		1						1
POMPILIDAE (spider wasps)								
Parasitica *(parasitoid wasps)*	14	17	5	14	3	3	8	64
Ceraphronoidea								
CERAPHRONIDAE	1							1
Chalcidoidea								
EUPELMIDAE								
PTEROMALIDAE								
***Chalcedectus* sp.**								
Cynipoidea								
CYNIPIDAE (gall wasps)								
FIGITIDAE								
Eucoilinae								
Diaprioidea								
DIAPRIIDAE	1							1
Ichneumonoidea								
BRACONIDAE (braconid wasps)			1					1
ICHNEUMONIDAE (ichneumon wasps)								
Platygastroidea								
SCELIONIDAE								
Scelioninae								
***Baeus* sp.**			2			1		3
Proctotrupoidea								
PROCTOTRUPIDAE								
Symphyta *(horntails, sawflies, and wood wasps)*			1					1
XYELIDAE (xyelid sawflies)								
ISOPODA *(isopods, pillbugs, and sowbugs)*				1	1	23	5	30
LEPIDOPTERA *(butterflies and moths)*	2	1	1	5	2	1	1	13
EREBIDAE								
Arctiini *(tiger moths)*	2							2
MECOPTERA *(scorpionflies and hangingflies)*								
***Panorpa* sp.** *(a common scorpionfly)*								
OPILIONES *(harvestmen)*		1	3	1		3	1	9
ORTHOPTERA *(crickets, grasshoppers, and katydids)*	9	6	11	17	16	6	4	69
PSEUDOSCORPIONES *(pseudoscorpions)*								
PSOCODEA *(barklice, booklice, and parasitic lice)*	2							2
THYSANOPTERA *(thrips)*			3		5	3		11
undet. NON-BEETLE adult								
undet. NON-BEETLE larva or pupa								

WEEK 9: 31 JUL - 3 AUG 2020
NON-BEETLE INVERTEBRATE TAXA
PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*

	M4	F2	SF2	MH3	MH1	BLV3a	HC1	
								total individuals:
TOTAL INDIVIDUAL NON-BEETLES PER PLOT	263	303	346	423	247	257	218	2057
								total taxa:
TOTAL NON-BEETLE TAXA PER PLOT	15	14	15	13	14	15	13	26

WEEK 13: 27-30 AUG 2020	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
NON-BEETLE INVERTEBRATE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	**# individuals per taxon:**
ACARIFORMES *(mites and ticks)*	43	81	85	67	22	30	53	381
ARANEAE *(spiders)*	3	6	9	16	10	10	7	61
CHILOPODA *(centipedes)*			1	1	1			3
COLLEMBOLA *(springtails)*	353	304	240	268	66	138	55	1424
DIPLOPODA *(millipedes)*	5	4	10	10	17	24	9	79
DIPTERA *(true flies)*	7	8	6	5	3	2	4	35
GASTROPODA *(slugs and snails)*								
snails			1					1
HEMIPTERA *(true bugs)*	10	11	14	21	3	8	3	70
APHIDIDAE (aphids)								
ENICOCEPHALIDAE (unique-headed bugs)								
THYREOCORIDAE (ebony bugs)								
HYMENOPTERA *(ants, bees, sawflies, and wasps)*	1				1			2
Aculeata *(ants, bees, and stinging wasps)*								
APIDAE (incl. bumble bees)								
Bombus perplexus *(perplexing bumble bee)*								
BETHYLIDAE (flat wasps)				2				2
DRYINIDAE (pincer wasps)				1				1
FORMICIDAE (ants)	18	16	48	12	13	24	6	137
HALICTIDAE (sweat bees)								
Halictus ligatus *(ligated furrow bee)*			1					1
MUTILLIDAE (velvet ants)		1						1
POMPILIDAE (spider wasps)								
Parasitica *(parasitoid wasps)*	9	19	6	18	1	1	3	57
Ceraphronoidea								
CERAPHRONIDAE								
Chalcidoidea								
EUPELMIDAE								
PTEROMALIDAE								
***Chalcedectus* sp.**								
Cynipoidea								
CYNIPIDAE (gall wasps)								
FIGITIDAE								
Eucoilinae								
Diaprioidea								
DIAPRIIDAE								
Ichneumonoidea								
BRACONIDAE (braconid wasps)								
ICHNEUMONIDAE (ichneumon wasps)					1			1
Platygastroidea								
SCELIONIDAE								
Scelioninae								
***Baeus* sp.**								
Proctotrupoidea								
PROCTOTRUPIDAE	1							1
Symphyta *(horntails, sawflies, and wood wasps)*		1						1
XYELIDAE (xyelid sawflies)								
ISOPODA *(isopods, pillbugs, and sowbugs)*	1			1	1	29	16	48
LEPIDOPTERA *(butterflies and moths)*	1		1	4			1	7
EREBIDAE								
Arctiini *(tiger moths)*								
MECOPTERA *(scorpionflies and hangingflies)*								
***Panorpa* sp.** *(a common scorpionfly)*							1	1
OPILIONES *(harvestmen)*	1	4	13	8	6	8	3	43
ORTHOPTERA *(crickets, grasshoppers, and katydids)*	8	2	8	15	9	10	15	67
PSEUDOSCORPIONES *(pseudoscorpions)*						1		1
PSOCODEA *(barklice, booklice, and parasitic lice)*							2	2
THYSANOPTERA *(thrips)*			1	1	1	1		4
undet. NON-BEETLE adult					1			1
undet. NON-BEETLE larva or pupa		1	2	2	1			6

WEEK 13: 27-30 AUG 2020	PITFALL TRAP COLLECTIONS *(72 trap-hours per plot)*							
NON-BEETLE INVERTEBRATE TAXA	**M4**	**F2**	**SF2**	**MH3**	**MH1**	**BLV3a**	**HC1**	
TOTAL INDIVIDUAL NON-BEETLES PER PLOT	461	458	446	452	157	286	178	**total individuals:** 2438
TOTAL NON-BEETLE TAXA PER PLOT	14	12	15	16	15	13	14	**total taxa:** 26

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