Burlington Vermont Mammal Tracking Project

Prepared for the City of Burlington

By the Burlington Trackers of UVM, May 2017

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The UNIVERSITY of VERMONT

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Acknowledgements

The Burlington Trackers would like to thank Sophie Mazowita for her great guidance and training throughout the duration of the project. Special thanks to Jed Murdoch and Dan Cahill for providing camera traps. Lastly, we would also like to thank UVM for providing this opportunity to work on such an enjoyable and enlightening project.

Executive Summary

This report was prepared in May of 2017 for the City of Burlington. The main goal of this paper is to show the full scope of our community project, while displaying our findings in a way that allows one to clearly see where our project left off, and where it could be potentially be picked up again.

Burlington, Vermont provides a wonderful medley of habitats as well as bustling communities of urban wildlife. The Burlington Mammal Tracking Project provides an outlet for people to investigate those communities and build a database of urban mammal accounts. The Burlington Trackers, in collaboration with the Burlington Mammal Tracking Project, attempted to expand the wildlife database and expand the city's awareness of the project. We set out to expand the wildlife database by camera trapping and tracking within six chosen focal areas within the Burlington boundaries. These focal areas were Arthur Park, Centennial Woods, Crescent Park, Ethan Allen Park, the Intervale, and Rock Point. Of the 11 known mammals to have been within the Burlington area, we were able to add nine to the Burlington Mammal Tracking Project database (bobcat and black Bear missing). These accounts of the nine mammals came in various forms (resident/citizen account, tracks, photos) and in various numbers (white-tailed deer most recorded species). Expanding the city's awareness of the project came through club promotion, tabling at an event, and an introduced affiliation between the UVM Wildlife and Fisheries Society and the Burlington Mammal Tracking Project,.

For any future work in collaboration with the Burlington Mammal Tracking Project, we show a review of each of our focal area's characteristics, our wildlife accounts, and our use of Circuitscape. We also specify recommendations that should be considered when tracking/camera trapping in Burlington as well as recommendations when trying to expand the city's awareness of the project.

Introduction

Project Description & Background

Interest in the urban mammals of Burlington has been present for many years. Some milestones that have presented information known on the urban mammals and habitats of Burlington include studies from *Alicia Daniel and Mark Ward* in 2000, and also more recently *Charley Eiseman* in 2007. These studies set the groundwork in mapping the habitat connectivity of Burlington and gave us writing that allows our peers to better understand the mammals/habitats of Burlington. Although these writings give us an awesome outlet to connect to the mammals and habitats of Burlington there is still a limited amount of resources that allow the residents of Burlington to become aware of the critters around them. A more recent milestone that began to address this issue came in 2015, when Sophie Mazowita (currently a Youth Programs Director and Naturalist for Crow's Path) established the Burlington Mammal Tracking Project. The project began with a goal of mapping, sharing, and celebrating the accounts of urban mammals in the greater Burlington Area. Since the project's formation, there have been many substantial advancements already accomplished. A few of these advancements include the Burlington Wildlife Tracking Club, the Burlington Vermont Mammal Records (displays documented accounts of urban wildlife, see Figure 1), and the Burlington VT Mammal Tracking iNaturalist page (citizen science platform). Our team partnered with Sophie on February 24th, 2017, and were given an opportunity with two overarching areas of need:

1. Filling the urban mammal data gaps of the many under-surveyed natural areas.
2. Raising the Burlington public's awareness of urban wildlife, habitat connectivity, and the Burlington Mammal Tracking Project.

Goals and Objectives

To address the first need, our goal was to to gather significant accounts of wildlife to help update the Burlington wildlife directory. This was a commitment to providing as much wildlife data points as possible within our created focal areas. To address the second need, our goal was to encourage residents and outdoor enthusiasts to contribute to the efforts of the Burlington Mammal Tracking Project. This was a commitment to expanding the city's knowledge of the Burlington Mammal Tracking Project through multiple medias (social media, iNaturalist, tabling at events etc.).

Methods

We addressed this project as an opportunity to contribute more observations to the current Burlington mammal record in order to create a more complete record of our wild

residents. In order to evaluate our success in meeting this goal, we decided to set a goal of contributing 30 observations with at least half of these observations being of focal species. The following table exhibits our self-evaluation of success in meeting our first goal:

Table 1. Self-evaluation of success in meeting Goal 1.

Number of Observations/Stories	Self-Assessment
0-10 (with a minimum of 5 focal species observations)	More time in the field needed (unsatisfactory)
11-20 (with a minimum of 10 focal species observations)	Partially successful (goal not reached)
21-30 (with a minimum of 15 focal species observations)	Successful (satisfactory and goal reached)

In order to meet this goal, we first identified six focal areas that we would spend time at over the course of the semester. These were comprised of a mix of areas that were previously undersampled, and those which had some sampling but could use additional records. Over the course of the semester, observations were collected via trail cameras, active observation, and collection of observations from community members. Four Moultrie trail cameras were obtained from Jed Murdoch, a wildlife biology professor in the Rubenstein School of Environment and Natural Resources. In addition, two Wild Games Innovation cameras were purchased and a third Bushnell camera was provided by our community partner, Sophie Mazowita. Trail cameras were placed in specific areas within parks and natural areas based on animal sign (scat, tracks, visible game trails, chewed trees, etc.) or other intriguing features that might create concentrated movement of mammals (ie. gaps under fences, culverts, etc.). Cameras were checked on a weekly basis, with all footage being saved onto a laptop that was carried into the field. Sightings of animals, tracks, and other sign were collected as observations through active tracking as well. In addition, observations of focal species from community members were collected through conversations both in the field and at the Burlington Geographic meeting, *Where the Wild Things Are*, on March 23rd. All of these observations were documented on inaturalist.org in the Burlington VT Mammal Tracking Project.

Our second goal aimed to increase interest and awareness in Burlington wildlife and encourage wildlife enthusiasts to contribute observations of their own to the wildlife directory/database. In order to meet this goal, we tabled at the previously mentioned Burlington Geographic meeting. Here, we displayed a slideshow for public viewing that included footage of focal species we had captured on trail camera. Also on display at this tabling event was a large map of Burlington in

which we encouraged community members to mark areas where they had observed focal species. We encouraged community members to join the inaturalist project as well as attend the monthly excursions with the Burlington Tracking Club that is led by Sophie. Flyers that we made containing information about the tracking club and inaturalist page were provided to all community members that attended our tabling event. Additional flyers advertising the tracking project were also hung up in the Dudley H. Davis Center, George D. Aiken Building, and Bailey Howe Library on the UVM campus. Community outreach also involved reaching out to the Wildlife and Fisheries Society at UVM, who agreed to promote the tracking club and project moving into the future.

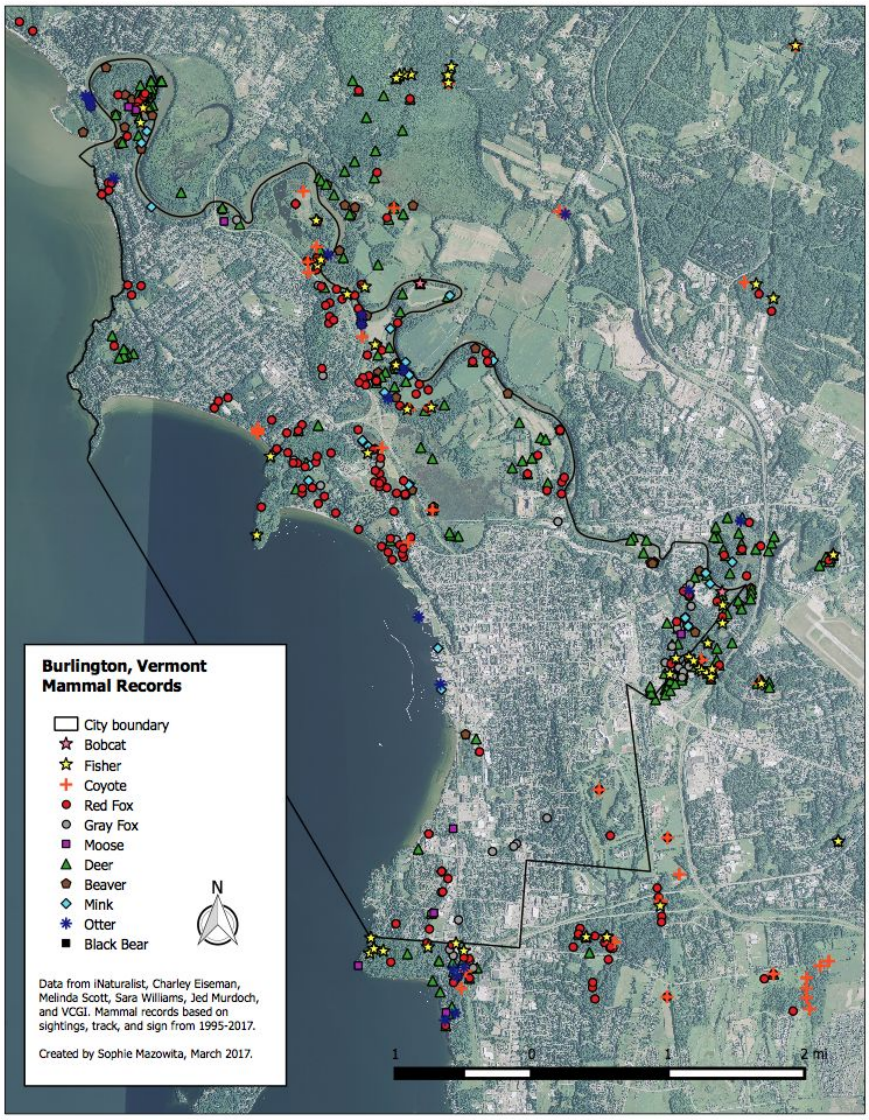

Figure 1 . Most recently updated account of Burlington, Vermont's mammal records. The map includes a key of all of the focal species as well as the city's boundary.

Results/Deliverables

Accounts of Burlington Mammals

Over the course of our project, we have gained an assemblage of information on our 6 focal areas of study. The goal of this section is to provide a review of our focal areas to the public. The review of the focal areas will provide:

- Description of area
- Camera trap zones
- Observations and sign
- Barriers
- Possible areas/trails of high faunal activity
- Recommendations for future camera trap success

Table 2. Observations by method and focal species throughout the course of the semester.

Species	**Method Used**				
	camera trap	sign (tracks/scat)	sighting	community observation	total
white-tailed deer	10	18	1	-	29
beaver	1	8	1	-	10
gray fox	4	-	-	-	4
red fox	3	-	1	1	5
mink	-	1	-	1	2
fisher	1	-	-	-	1
river otter	-	-	-	1	1
coyote	-	1	-	1	2
bobcat	-	-	-	-	0
moose	-	-	-	1	1
black bear	-	-	-	-	0

The total number of focal species observations was 55 which exceeded the goal for total number of observations (30) of which at least half should have been focal species (15). Table does not include non-focal species observations (raccoon, Virginia opossum, etc.)

Arthur Park

This natural community displays a variety of ecological and geomorphic aspects, including the narrow pond with surrounding marshland, the western side of heavily wooded area, and the eastern side of grassy open field. On top of all of the natural substance, there is major

involvement from developed lands with two highly active roads on either side of the park (North Ave. and Interstate 127) and Burlington High School in the immediate vicinity. Our areas of camera trapping were concentrated into the Northwestern quarter of the park. In our exploration of the area during the snowy months of the winter, it was clear that there was a trail being actively used by house cat and raccoon at the very least (track sign). The trail straddles the shoreline, just past the heavy marsh area riddled with cattails and high grass. The raccoons using this trail are suspicious of any clearly visible trail cams, with many coming up to the cameras and one individual actually ripping a camera off its tree. We caught one animal of our 11 focal species on camera. A lone red fox was caught on video using the trail on April 29th. It was heading from the Northern end of the park moving towards the Southern end. Other than this individual, only raccoons and house cats were caught on camera, regularly utilizing this "highway," as we would call it. Suspected fox scat was also found at the bases of multiple large trees. The obvious barriers to the park were the active roads surrounding the extent of the park. With this being said there are still potential areas where individuals could be crossing through developed areas to reach a new habitat. For example, along certain points of Arthur Park's western edge, a quick crossing of North Avenue would put an animal directly into some of the interior habitat that Rock Point offers. Since the mammal records indicate that there is still potential to find other focal species sign in Arthur, we suggest further tracking with more concentration on the northern and southern extremes of the park. These areas were not explored in our excursions.

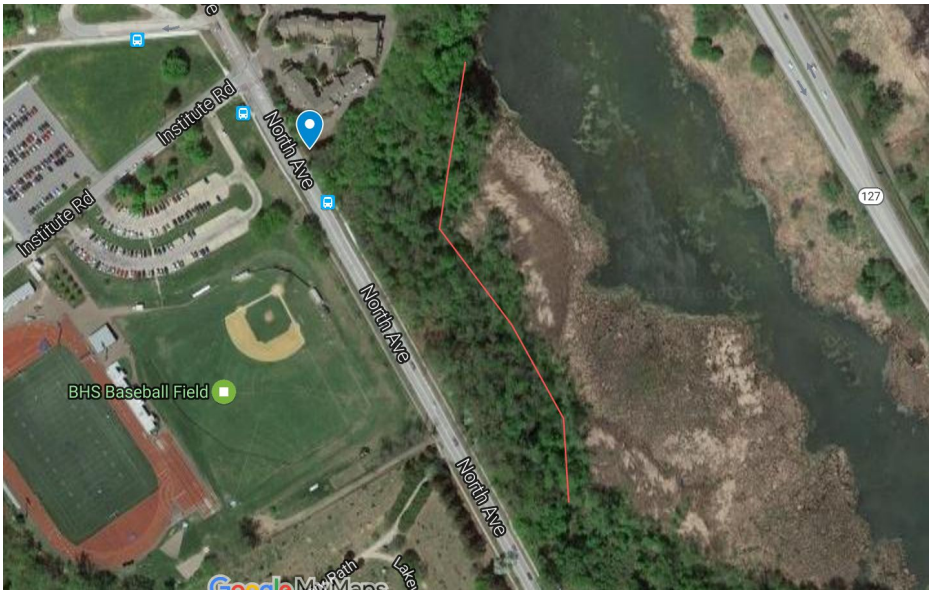

Figure 2. Approximate route that trail of high faunal activity follows (red line). Blue point references entrance to park we used. Source of map from Google Maps.

Figure 3. Red fox caught on video in Arthur Park.

Centennial Woods Natural Area

This area had one of the highest concentrations of mammal observations in Burlington, prior to us selecting it as a one of our focal areas. With this being said, we only concentrated our efforts in this focal area for a short period of time. Trail cameras were hung in late January and were taken down in early March. This period of time overlapped with the breeding season of many of our resident carnivores, potentially explaining the high abundance of carnivoran observations we had at this site in a short period of time. Focal species that we obtained footage of at this site included fisher, gray fox, and white-tailed deer. Other focal species that have been observed in Centennial Woods Natural Area include red fox, moose, mink, beaver, and river otter. Our efforts were concentrated around one particular spot in the natural area which was selected upon the basis that it was a visibly evident deer runway. This approximate location of this site was (44.475393, -73.187248). Other mammalian species that were recorded at this site included raccoon, *Peromyscus spp.*, gray squirrel, and red squirrel. Important habitat features of this natural area include Centennial Brook which bisects the natural area in two places, and nearby retaining ponds which provide key habitat and travel corridors for both aquatic and terrestrial mammals. In addition, this natural area has high canopy closure in many areas, providing suitable habitat for fisher and overwintering habitat for white-tailed deer. It is possible that white-tailed deer are immigrating to this area from less wooded areas such as McKenzie Park to overwinter. Centennial Woods also contains fairly heterogeneous topographic features and diverse land-use histories which influence the overstory and understory composition found there.

As a result, important wildlife food sources such as raspberry bushes and acorns from red oak can be found there, while dense stands of hemlock provide good cover. This is also a fairly large wooded area when compared to other wooded areas in Burlington. With this being said, the high level of mammals observed here may not only be attributed to the intensity of sampling that has been undertaken, but also to the quality of the habitat. This area seems to include all five components that are important to habitat; food, cover, water, space, and arrangement. Potential barriers for mammal movement that are associated with this site include Main Street and I-89 to the south and southeast, and Route 2 to the southwest. Other surrounding roads such as Grove Street may serve as a barrier, but receive less traffic and are surrounded by additional wooded areas/riverine habitat which may provide a greater opportunity for dispersal and habitat.

Figure 4. Gray fox caught on trail camera in Centennial Woods Natural Area.

Figure 5. White-tailed deer using game trail in south corner of Centennial Woods Natural Area.

Figure 6. Fisher using same game trail in Centennial Woods that's also used by deer and gray fox.

Crescent Park

Crescent Park was one of our focal areas that proved to be difficult to access as it is a narrow strip of forest that lies amongst the neighborhood cul-de-sacs extending West to East from Route 7 (South Willard St.) up towards the Golf Course and Country Club on South Prospect at the Southern end of UVM's campus. Deer are regularly seen on the golf course itself, as are woodchucks, (observed commonly by golfers and students), however our group did not want to put cameras on the course without permission and risk losing cameras to maintenance.

Our actual focal site for the southern border of Burlington instead switched to the Eastern side of the golf course and south along Spear Street to the back end of UVM's Dairy Farm property across from the forestry research center. We learned from students that the dairy farm disposes of deceased cattle carcasses in the back end of the property bordering Interstate 89. We hypothesized that it would be a potential spot to set a gamer camera to film coyote, who may come to the boneyard to scavenge. Previous experiences and tracking classes with Michael Kessler have led us to believe there is a wildlife corridor extending from the Green Mountains, through Jericho Forest, and across I-89, (just south of Burlington), towards the Winooski River Valley and Lake Champlain. We located a large hole in the fence from the highway/potential game trail that looked promising for our suspicions but it yielded no photos, (which could have also been due to harsh climate conditions at the time). We did find old scat near the boneyard that very closely resembled coyote however we still need expert confirmation and potentially more concrete evidence.

Ethan Allen Park (EAP)

EAP is an interesting prospect for wildlife activity. The park is quite isolated from other wooded areas with VT-127 cutting past the northern edge of the park and the rest of the limits of the park being highly developed. Our camera trap efforts were concentrated in the northern end of the park, fairly close to the interstate, with 1-2 camera traps being set through the latter half of March and about a week and a half of April. The only focal species that was caught on camera and tracked was red fox. Looking at the Burlington, Vermont Mammal Records map, red fox is the most observed species in the park, but it seems that there is still potential to find other species that have been observed in the area like gray fox, white-tailed deer, and possibly even fisher which was found just over the interstate. The barriers within EAP are in abundance, especially in the northern end, where a heavy fence line (doubling up at times) surrounds the limits of the Northwest corner and runs parallel to the interstate for some time. Although these barriers are strong, there are still many points along the northern edge of the park where fauna could feasibly get into the park through downed fence. The high amount of development also poses as a strong restrictor to animal movement. A memorable part of our time tracking in this park was the discovery of a culvert being used by at least one fox (and possibly more species) to pass under the interstate (located at 44.515859, -73.239436). A fox's tracks were found using the

cross-country ski path to travel through EAP, and they eventually ended directly at a culvert opening (see Figure 3). The far end of the culvert hangs over the edge of the river bank, but when frozen, individuals can cross the ice and enter the end of the culvert that would usually be inaccessible to terrestrial species. One of our unsuccessful objectives was to have a camera trap at both entryways, with the hope of catching an animal going in one side and exiting the other. The two videos or photos could then be spliced together, creating an inventive example of urban wildlife behavior. This potential video or photo is definitely a venture to consider in the future. Below are pictures of the culvert's two entryways, a photo of a red fox observing the culvert when it had been flooded due to snow melt and was most likely unusable, and a photo of an unidentifiable canid exiting the EAP end of the culvert. The riverside entryway photo shows a very faint showing of animal tracks leading into the opening of the culvert.

Figure 7. Red fox inspecting EAP culvert

Figure 8. Unidentifiable canid exiting EAP culvert.

Figure 9. EAP entryway of culvert with camera trap

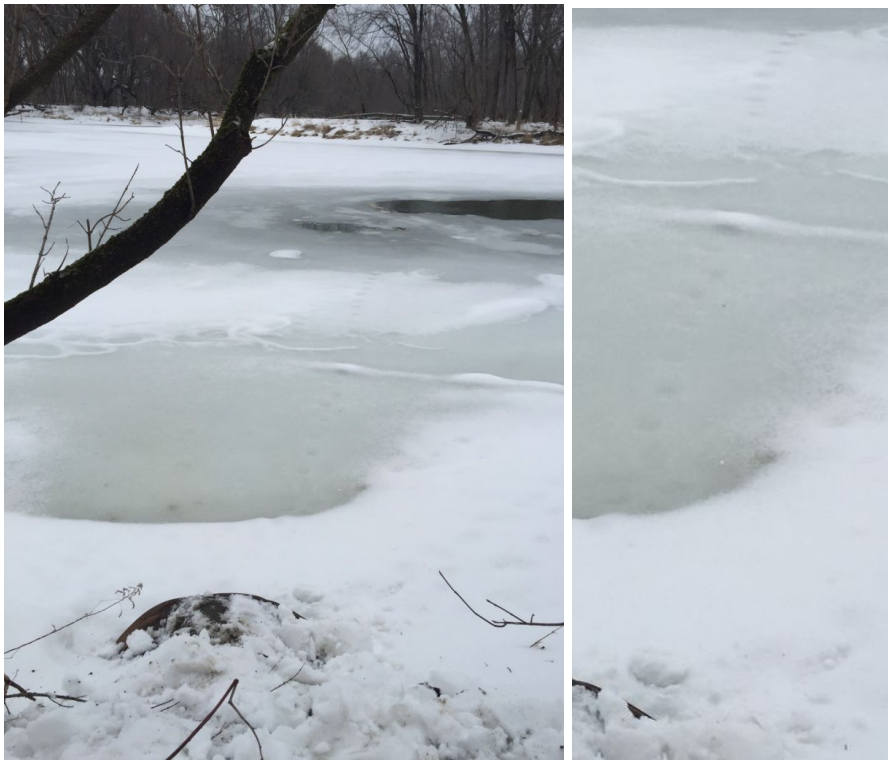

Figure 10. Winooski Riverside entryway of culvert with vague tracks leading into the opening.

Intervale

Intervale Avenue tracking site appeared promising as a major corridor site. It starts at the bike path from Burlington towards Colchester/Ethan Allen Park and is the site of the old landfill, (which was filled in and is now a green space), and borders the large expanse of swampland that ultimately extends to the Winooski River. The unfortunate challenge is that there was a large amount of human interference in the accessible, (non swampland), portion along the bike path and throughout the old landfill, where we concentrated the majority of our tracking. Homeless camps were seen throughout the woods, and debris and evidence of humans camping likely meant that animals would be deterred from the area during the night when people were camping. In addition many households especially on Intervale Avenue have house cats that roam outside, (some elderly women often leave out food on the sidewalks attracting the cats which I believe also has a negative impact on the local wildlife.

The area did not yield any footage of wildlife however there was an abundance of deer droppings, skunk and raccoon prints, possible muskrat/beaver sign, and even the remains of a cardinal indicating a possible red fox kill, (or house cat). The soft mud alongside the tributaries that ran throughout the swamp offered good substrate for prints. If one looked through the phragmite reeds you could make out clear sign of game trails where wildlife had plowed through the reeds and left “tunnels.” Unfortunately it was impossible to obtain tracks underwater in the swamp when following these “tunnels” and no further observations could be made.

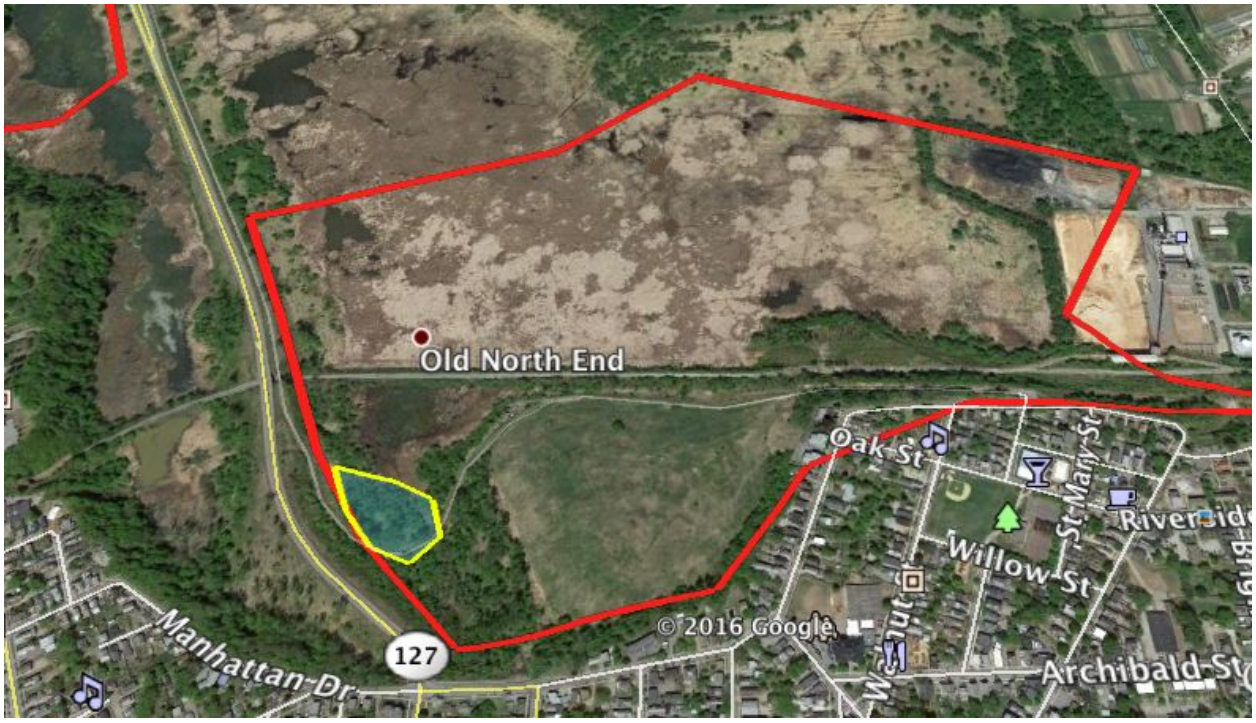

Figure 11. Map of the Intervale Green Space, yellow and blue outlines the track observation site. The large brown mass to the north is the phragmite reeds that indicate the swamp lands bordering the bike bath to Ethan Allen park and and the Winooski River tributaries. The light green mass is the grass meadow that is the old site of the north end landfill, (The thin gray line separating the two substrates is the bike path).

McKenzie Park

McKenzie Park is our focal area that received the most attention over the course of the semester. This area was prioritized over other focal areas based on the fact that it is one of the Burlington Parks that has historically received the least sampling and consequently has very few observations on the Burlington Mammal Tracking Project. This area is comprised of a mixture of wildlife habitats including closed canopy forest, riverine habitat, and open field. The mixture of open field and forested areas in McKenzie Park/surrounding farmland provides great edge habitat for mesopredators such as red fox and species that do well in disturbed areas such as white-tailed deer. Aquatic habitat in the form of the Winooski River, provides the potential for river otter and mink. Mink tracks have been observed in this area by ourselves and others, however, we have failed to capture camera footage of one. Observations of river otter have been recorded along the banks of the Winooski River to the west in Ethan Allen Homestead and to the southeast (parallel to Riverside Avenue). Beaver sign is prominent along the edge of the river in McKenzie Park, with the highest concentration of sign occurring on the northern tip of the property. Trail cameras were placed in four different locations throughout the course of the

semester, with the first being put up in early March. One trail camera currently remains at the northern tip (beach area) of McKenzie Park (Figure .). The focal species recorded on game cameras throughout the course of the semester were beaver, white-tailed deer, and red fox. Other important findings regarding red fox for this area are that we saw them while conducting field work and there are currently pups being reared near a field that is part of the Intervale Community Farm property. Other species that were recorded included raccoon and Virginia opossum. This area provides some interesting potential for seasonal wildlife movement with surrounding areas. For instance, white-tailed deer occur in high densities here which can be seen by the amount of evident sign, but this area is not ideal for overwintering habitat due to the low canopy closure and open fields. It is possible that white-tailed deer are dispersing in the winter to areas such Centennial Woods. In addition, there are other wooded areas closeby such as Ethan Allen Homestead, Ethan Allen Park, and Arthur Park. This area is also part of the Winooski River Corridor which provides connectivity between Burlington and the Green Mountains. This is particularly important when considering dispersal of rarer species such as moose and black bear. One community member that we talked to told us they had seen two moose in this park several years ago. Potential barriers for wildlife movement include the Winooski River which may prevent some more terrestrial species from moving between McKenzie Park and adjacent farmland during the warm months. Also Route 127 serves as a prominent barrier between this park and surrounding parks that lie on the west side of the highway such as Ethan Allen Park and Arthur Park.

Figure 12. Map of trail camera locations in McKenzie Park and surrounding farmland.

Figure 13. Red fox crossing frozen Winooski River at 7:23 AM on 3/17/17 from direction of residential area on Valleyfield Drive to Pitchfork Farm property, SE of McKenzie Park.

Figure 14. White-tailed deer inspecting trail camera, SE of McKenzie Park.

Figure 15. North American beaver using "beach area" at the northern tip of McKenzie Park. Time of capture was 5:13 AM on 4/10/17

Rock Point

This focal area ended up receiving less attention compared to other areas (e.g. McKenzie, Centennial). Our only observation at Rock Point came from a mink that we had tracked with our community partner Sophie. It had travelled from the main parking lot (near the solar panel field) to a closeby frozen stream, eventually following the stream onto a shoreline of Lake Champlain. We had set two camera traps within the northernmost secondary peninsula that hangs off of the main point without any luck. The cameras were active for 2-3 weeks in the early stages of winter (regular snowfall, up to a foot in mid-February). Our lack of attention given to Rock Point is disappointing because it does stand as a data gap in the current mammal records. This is true especially for the far end of the large peninsula which has just one red fox observation and one fisher observation. Why this data gap exists could be due to a number of things. There may be less people logging observations in this area due to the lessened accessibility to people, or maybe there are less animals selecting to venture to the point. Hopefully, a continuation of tracking/camera trapping will reveal the source of the Rock Point data gap.

Figure 16. Mink track found at Rock point

Circuitscape: A Possible Endeavor for the GIS Familiar

Circuitscape, an open-source program using circuit theory, provides a promising opportunity to estimate the likely corridors used by mammal species within Burlington, Vermont. Imagine a bolt of electricity moving from one node to another node. The current of electricity is going to take the easiest and least restrictive routes to get to the end node. This is similar to how an animal would select a route that is the least restrictive based upon the species' capabilities of movement. After trying out the program, my group and I have confidence that Circuitscape has a possible role in mapping the potential routes an animal may choose on their treks through the city. This could be helpful in choosing where to track, where to set up camera traps, and possibly much more.

With our use of Circuitscape, we created a model displaying the connectivity of green space within Burlington and loosely showed how a fairly vagile terrestrial species like a fox or deer may choose to travel through Burlington. This was done by subjectively analyzing and valuing (1-10) the green spaces of Burlington based upon their proximity to other green spaces as well as their total area. For example, a very large sector of green area with many other green areas surrounding it, like the intervale or rock point, would receive a higher rating of 10. A highly isolated and small area would receive a low score of 1 or 2. When all of these natural communities were finished being valued, they provide a map showing the resistance/compliance of travel for an animal. In other words, an animal is likely to choose a path that follows along the higher valued natural communities because they represent more green area and more connectivity. The map creates a heat map displaying the areas of high current density which are displayed by the warmer colors (red and orange) (see figure 18 & 19). The softer colors (yellow and light blue) mean that currents are travelling through the area but just not at a high density, so there is more space for the current to spread out. The area with the coldest color (navy blue in our instance) means that there were no currents passing through the area because of very high resistance (e.g. highly developed areas).

This next paragraph explains the process of Circuitscape to GIS familiar readers. In ArcMap, the process for creating a resistance map was adding a new field to a 2013 natural community inventory shapefile. This new field is where each polygon's new value of resistance was given. After having a complete resistance field within your attribute table, Circuitscape requires two raster layers: one layer displaying your focal nodes (with a positive integer applied to each) and one being your resistance layer, displaying the valued areas of green. Focal nodes are your areas where you want the program to shoot circuits to and from. You can have many nodes, but this results in a long wait for the program to run and produce outputs. The outputs received through the ArcGis add-on are a cumulative current raster map showing circuit routes between every node and then individual current maps for every combination of nodes. An ArcGIS add-on is provided by Circuitscape as a download so that the program can be run directly through ArcMap or ArcCatalog. Below is the Circuitscape tool's window and examples of some of the results obtained with our endeavor into the program.

The issue with our current results are that they are too general. With the current results, one cannot say confidently that this accurately displays how a certain species would move through the city. It would be better to narrow in on a specific species and set up a systematic approach to rating the city's opens spaces and natural communities based on how well they match with the species' mobility capabilities. Basically, any approach that is less subjective than this preliminary effort and would offer a more concrete and scientific batch of results.

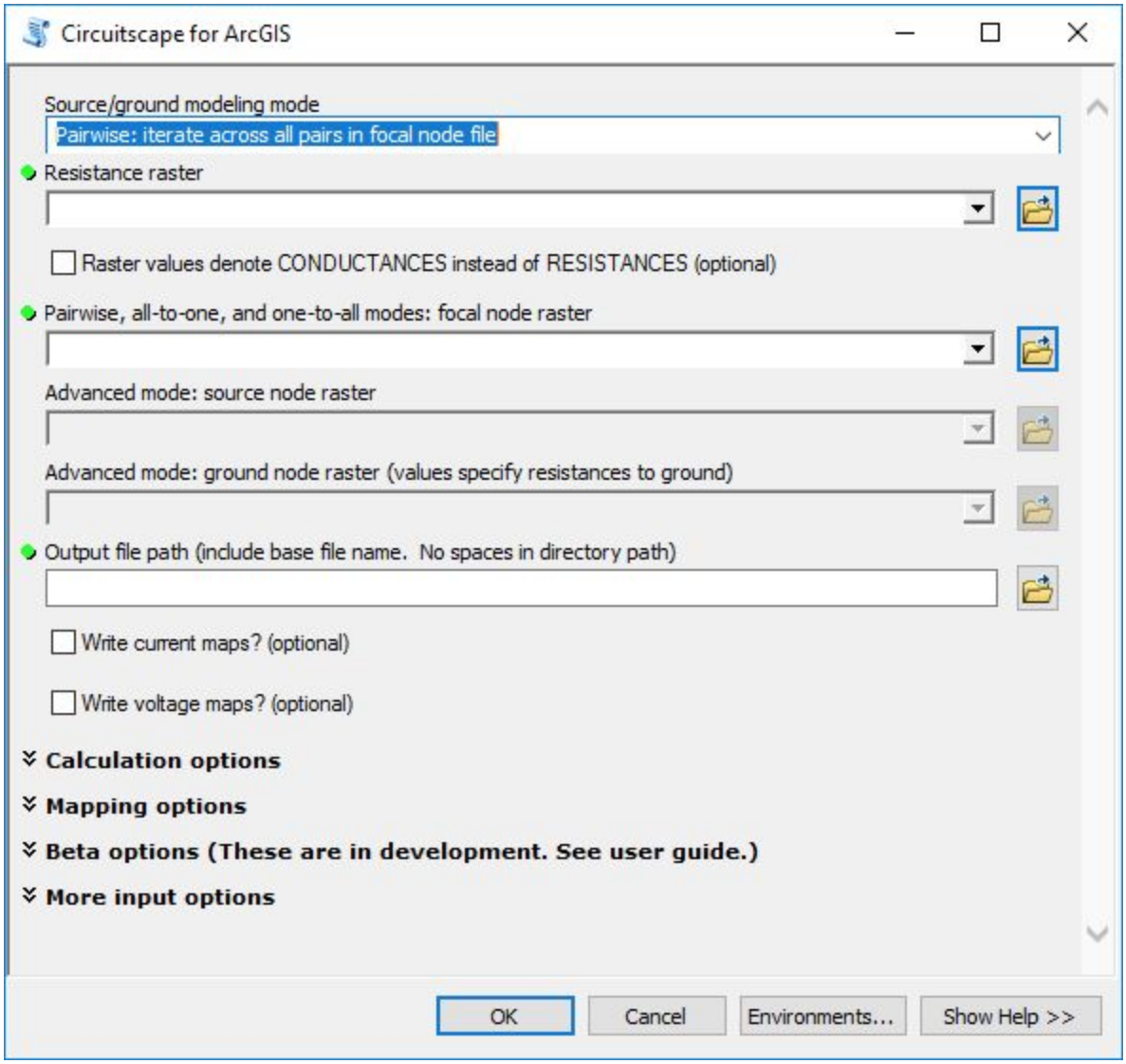

Figure 17. Circuitscape/ArcGis tool window showing where your resistance raster is inputted and where your focal node raster is inputted. The "source/ground modeling mode" drop down menu asks for your preferred calculation mode, explained by Circuitscape's User Guide (pairwise recommended). Checking "conductances instead of resistances" (also explained in user guide) indicates that the higher the cell value is, the less resistant it is to current activity.

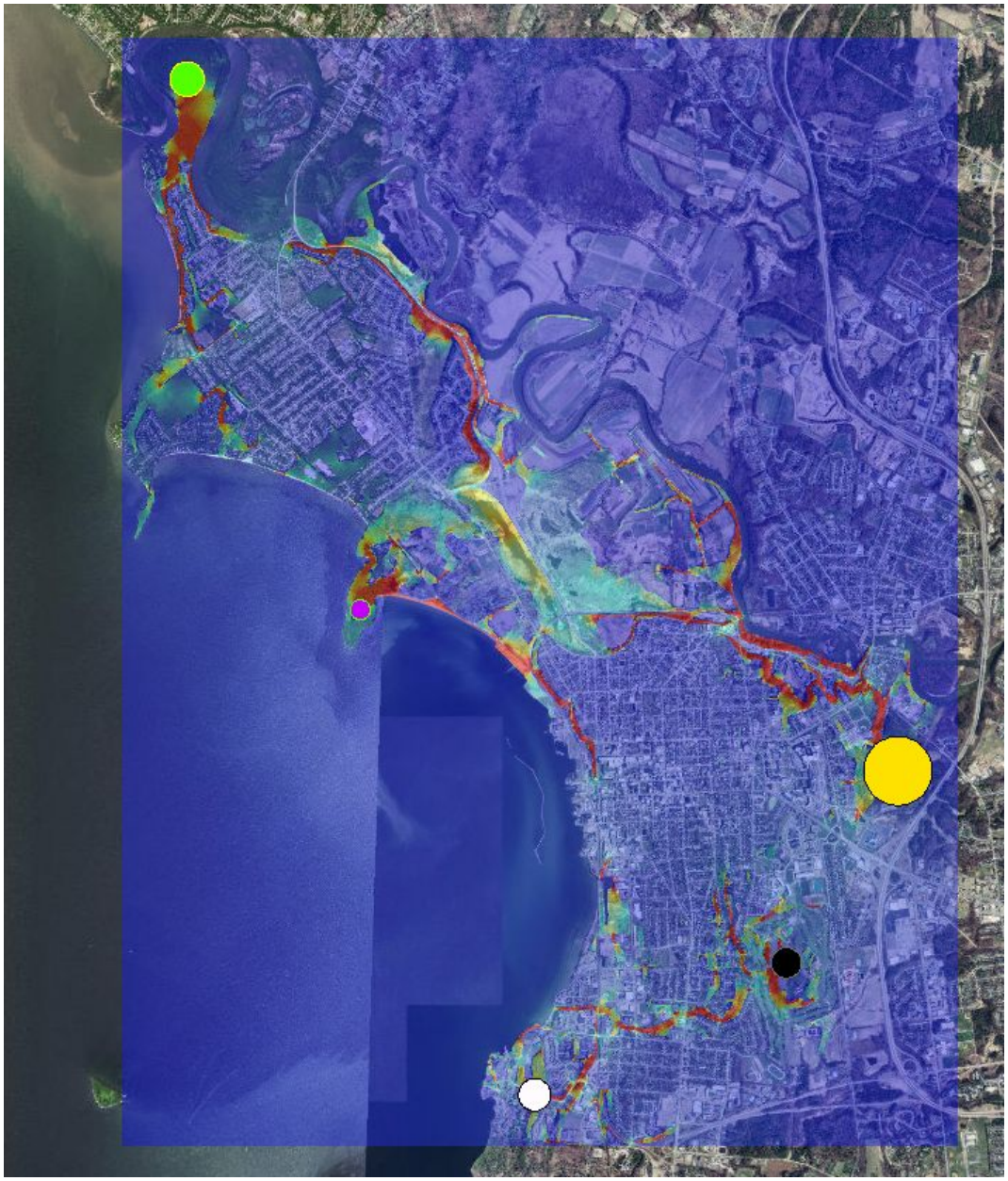

Figure 18. Semi-transparent Circuitscape map showing possible urban corridors of Burlington, Vermont. Warmer colors like red and yellow indicate higher current densities. Red areas are pinch points, or areas where the electrical currents sent from one node are highly likely to congregate to get to another node. The five nodes are oriented as such:

- White -- South End
- Black -- Burlington Country Club
- Yellow -- Centennial Woods
- Purple -- Rock Point
- Green -- Derway Island

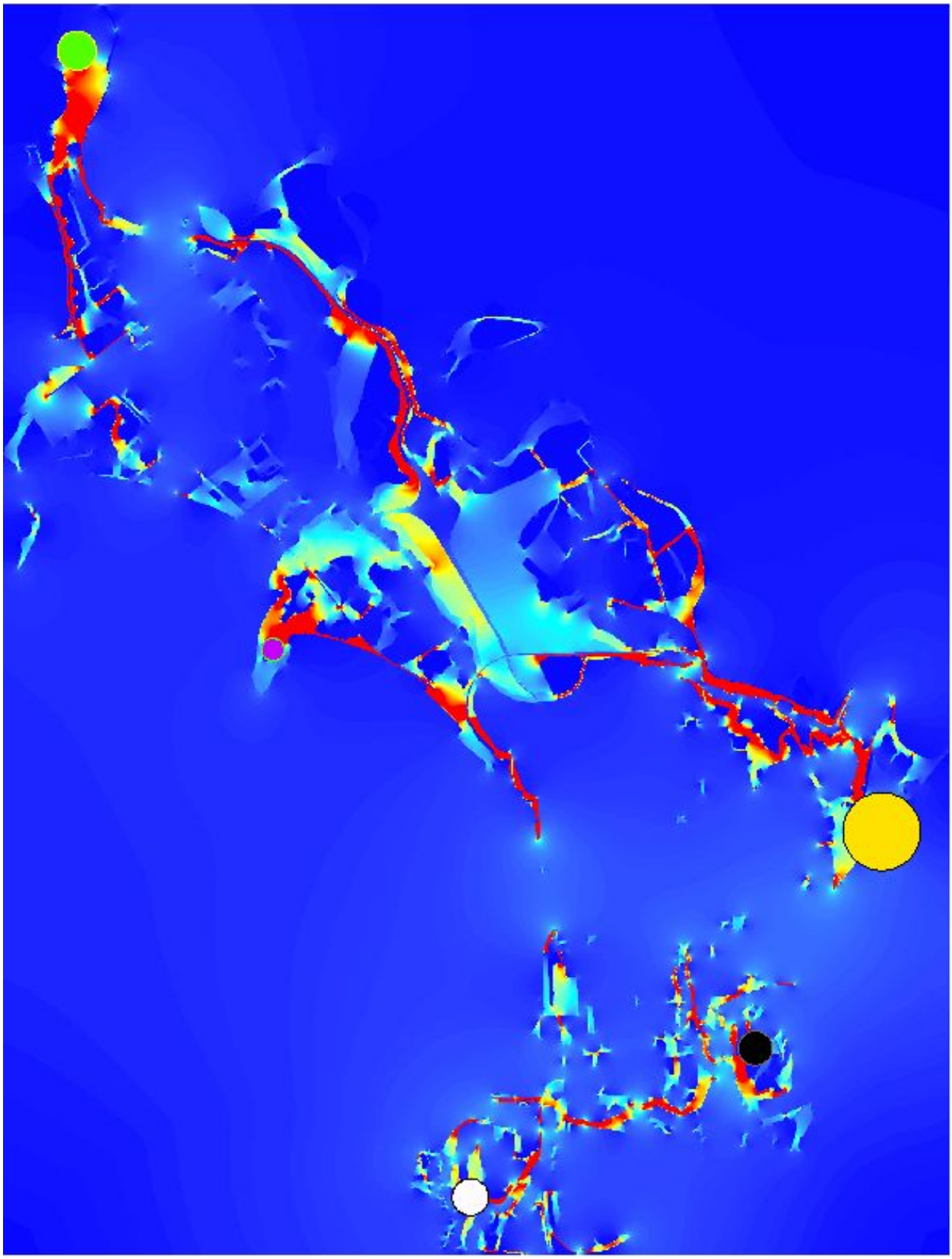

Figure 19. Circuitscape map without a Burlington basemap.

Discussion

Achievements

Our team was successful on both fronts in acquiring data for the Burlington Mammal Tracking project and helping to increase public interest in Burlington residents towards contributing towards the project.

Acquiring data for Burlington Mammal Tracking Project

Our initial goal was to each obtain ten data observations over the course of the semester to contribute to the Burlington Mammal Tracking project. We surpassed this goal by acquiring, (as a group), as of May 1st, 2017 over 52 focal species observations, nearly double our goal of 30 observations. At the beginning of the project we predicted we would come by most of our observations by active tracking and recording sign in the mud and snow. Fortunately Jed Murdoch loaned our team 4 trail cameras, and with an additional 3 cameras from Jack Leonard and Sophie Mazowita we were able to collect impressive footage of Burlington Wildlife to display to our peers on our presentation day, and most importantly use as concrete evidence of mammal activity on iNaturalist. On top of the collected data points and the review of our focal areas presented in this report, Circuitscape also became a deliverable. This resource could potentially provide future groups with a new and exciting GIS program to take on. Not only this, the program could be very useful to tracking, urban corridor identification, and even conservation efforts.

Increasing Awareness of the Burlington Mammal Tracking Project and Urban Wildlife

The Burlington Geographic Meeting on March 23rd, 2017 proved to be a success in spreading awareness to the goals of our project to the Burlington public. We tabled in the back for approximately 30 minutes after Sophie's presentation and entertained guests with a slideshow of our game camera footage. We actively encouraged visitors to send Sophie emails of their wildlife experiences and come to the tracking club meetings. Additionally, we printed out a map of the current Burlington Mammal Records Map (see figure 1 in Methods section) and encouraged visitors to mark with stickers where they had seen wildlife activity. All stickered points were added into the iNaturalist page and some of the resident's advice allowed us to investigate new areas we may not have been interested in before the meeting.

Other ventures with increasing the awareness of the Burlington public to the Burlington Mammal Tracking Project and urban wildlife came from posting fliers around the UVM campus as well as the introduced affiliation with the UVM Wildlife and Fisheries Society. This partnership should hopefully result in many subsequent classes of UVM students to become aware of all of the platforms of the Burlington Mammal Tracking Project.

Figure 20. Flier that was posted around UVM campus

Figure 21. Photo of Burlington Geographic "Where The Wild Things Are" Meeting.

Figure 22. Lucian Murphy tabling at the Burlington Geographic meeting 03/23/2017.

Problems/Obstacles & Suggestions

The largest problem we observed with our project, and possibly where we fell short in our intended proposal, was our intention to increase awareness and encourage more participation in the Burlington Mammal Tracking Project from the Burlington public/residents. We at first planned on creating an instagram page to cater to the younger generations and college students, however it was decided that this would undermine the already very functional and available iNaturalist media and Facebook Group, which was already linked to the project. Instead we planned on encouraging our audience at the Burlington Geographic meeting to join iNaturalist on their cellular devices. Surprisingly, (even in this modern era), many of our visitors to our table admitted they did not have a phone, (both young adults in their 20s-30s and the elderly residents). We settled for encouraging participation in Sophie's tracking club and handing out fliers with the club email list and facebook page. For future work, it may be helpful to focus in on a certain demographic. For example, if we had set out to target younger people at the beginning of the project, we may have had better brainstorming and strategy planning. For example, if we were to target a younger demographic, we could present the Burlington Mammal Tracking Project to school's science classes.

Organize and Improve Tracking/Field Observation Method

Inexperienced trackers who wish to participate from the comfort of the classroom/library/GIS lab can dedicate themselves to organizing and grid-mapping the city in a way that would better organize tracking sites and camera set-ups so that the woods can be more systematically covered. In addition focus on identifying corridors and reading the landscape to identify and map out potential areas for higher track yield sites, would likely help eliminate guess work as to where mammals are.

We recommend trying to focus all effort in less sites and see how well one can get to know an area. Our data could likely have been more conclusive if we remained in a few spots and tracked for the entirety of the semester rather than try to cover the whole city.

Literature Cited

Daniel, A. & Ward, M. (2000). *Where The Wild Things Are: Large Mammal Habitat And Corridors In Burlington, Vermont*. (Rep.).

Eiseman, C. (2007). *Wildlife Habitat And Corridors In The Winooski Valley Park District's Communities.* (Rep.).