

Enticing Community Members to Explore and Enhance Local Green Spaces through Technology

By

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Table of Contents

1 Introduction and Motivation	3
2 Related Work/Background.....	4
3 Research Methods.....	7
4 Data Analysis	9
5 Findings.....	11
5.1 Analysis of sightings data from 2011 to 2013	11
5.2 Interview data	23
6 Discussion, Implications, Reflections.....	30
7 Limitations	33
8 Future Work	33
9 Conclusions.....	34
References.....	35
Appendices.....	38
Appendix A: FOSC Sighting Observation Form	38
Appendix B: Most Recent Sightings Displayed on the FOSC Website	39
Appendix C: IRB-Approved Interview Consent Form	40
Appendix D: Semi-Structured Interview Questions	43
Appendix E: Information Visualizations of Sightings	45
Appendix F: Print Materials That Encourage Seasonal Observation at Sligo Creek	48

Enticing Community Members to Explore and Enhance Local Green Spaces through Technology

We cannot protect something we do not love, we cannot love what we do not know, and we cannot know what we do not see. Or hear. Or sense.

Richard Louv in *The Nature Principle: Human Restoration and the End of Nature-Deficit Disorder*

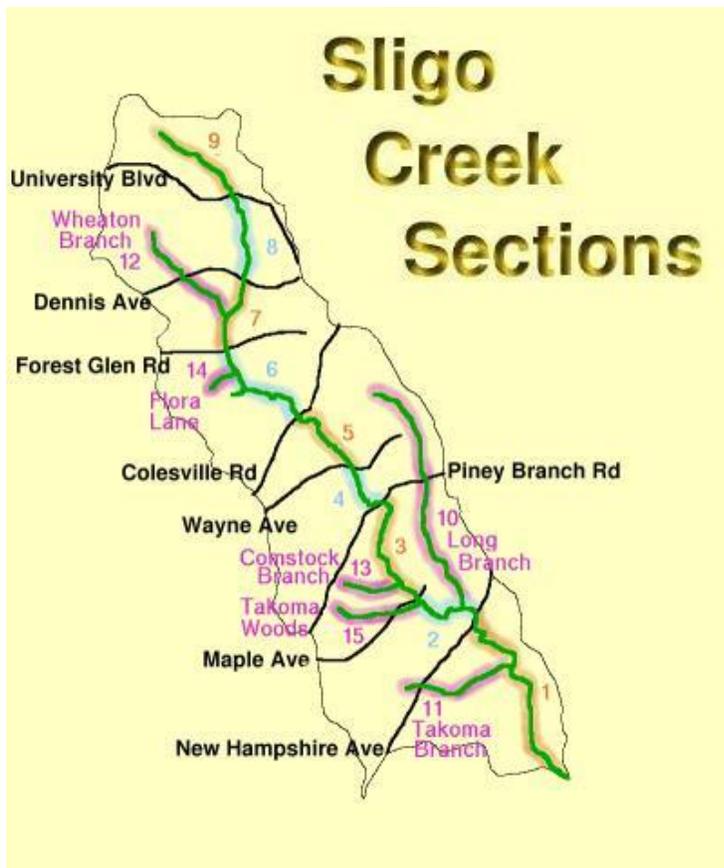
1. Introduction and Motivation

About a year ago I attended a lecture at Brookside Gardens in Wheaton called “Network for Life: Your Role in Stitching Together the Natural World” by Doug Tallamy, chair of Entomology and Wildlife Ecology at the University of Delaware. The first part consisted of the standard, depressing statistics about the loss of habitat and species we are undergoing today, while the second took a more hopeful turn. Tallamy argued that while it is essential to preserve as many undeveloped swaths of land as possible to support biodiversity, we also need to start getting very strategic about protecting the pathways between them—including waterways and even ditches and power line corridors—so that living things can flow between them. He further emphasized that residential lawns and gardens can be important links in that flow, particularly if people start planting native plants that insects love, since they are critical to the food chain. I left that lecture quite uplifted at the thought that there was some small, practical good I could do—and promptly planted a river birch and goldenrod in my Silver Spring backyard.

Any one person’s efforts need to be joined with others in order to create a true network for life, yet environmental conservation and preservation efforts compete with many other priorities for people’s attention. In fact, psychologists suggest that that our brains simply aren’t wired to respond to long-term, gradual threats. We have trouble knowing what to do when we can’t pin a problem on one bad guy, when there are complex causes, or when we think it’s someone else’s problem. If it looks like solutions would require us to change too much or we start feeling disturbed, anxious, or powerless, we tend to turn away from the subject altogether (Gifford, 2011; Gilbert, 2006). Still, it’s hard to ignore evidence that climate change and loss of habitat are imperiling plant and animal life on the planet.

Rather than wallowing in despair, I find myself turning to the more hopeful literature (e.g., Louv, 2012; Rosenzweig, 2003; Tallamy, 2009) that suggests that individuals can become re-engaged with the natural world and become advocates for its flourishing. I am particularly interested in focusing on how technology is, and can be, used to raise awareness of the plant and animal life in our midst in the hope that such awareness leads to the adaptation of better conservation and sustainability practices.

My Capstone project is a hyperlocal formative study situated along the riparian corridors (biology-speak for waterways) of Sligo Creek, a nine-mile-long creek that begins in the Kemp Mill neighborhood of Silver Spring and flows into the Northwest Branch in Hyattsville (see Figure 1). It is a subwatershed of the Anacostia River. A 10-mile-long, hard surface trail maintained by Montgomery Parks runs through the stream valley and is shared by hikers, joggers, and bikers.



In 2003, a nonprofit community organization called Friends of Sligo Creek (FOSC) was founded with a mission to “restore to health the water quality, natural habitat, and ecological well-being of the Sligo Creek watershed by bringing neighbors together to build awareness, improve natural habitat, and protect our community’s heritage.” FOSC has maintained a website at <http://www.fosc.org/fosc.htm> since then. The webmaster reports roughly 20,000 visits per month to the site.

As Figure 2 shows, the website includes news, meeting notes, and reports as well as sections reflecting data collection by members, including indicators of water quality, animal and plant inventories, and the animal and plant sightings that are the focus of this report.

Figure 1: Map of Sligo Creek

I focus particularly on these sightings to understand how members of this community document and interpret their encounters with the natural world and to explore how technology might further support them in efforts to document their ecosystem and adopt more sustainable practices. Taking an in-depth look at one part of the website of an organization that arose organically from the community and exists to support and highlight a specific place on the map—Sligo Creek Park and its ecosystem—seems like the culmination of our HCIM program’s emphasis on user-centered design. Understanding what these contributors are doing and what their current relation with technology is provides an essential first step toward a design solution that could broaden participation there and in other parks.

2. Related Work/Background

This section explores the rationale for attempting to increase people’s involvement in nature and reports on ways that technology is already being used toward this end. My use of the word *technology* encompasses hardware such as webcams and tabletops and software such as mobile apps, websites, and social media. I then look at extant guidelines from the HCI literature for designing in natural settings. This context forms the backdrop for my own study.



Figure 2: Home page of the Friends of Sligo Creek website. Individuals may share observations and photos in the Sightings section.

There is value in focusing on ways to support and increase human interaction with the outdoors. It is well established that involvement with nature is highly beneficial to people’s cognition, mental health, and well-being, reducing stress, improving mood, and increasing mental focus (White, Alcock, Wheeler, & Depledge, 2013; Hull & Michael, 1995; Kaplan, 1995; Ulrich et al., 1991). Evidence also suggests that spending time in nature improves physical functioning and reduces disease (Singh, Siahpush, & Kogan, 2010; Park et al., 2010; Li et al., 2008). In addition, there is an important reciprocal effect: people who frequent natural places often become interested in conservation and preservation efforts (Halpenny, 2010; Cooper, Dickinson, Phillips, & Bonney, 2007; Vaske & Kobrin, 2001; Evans et al., 2005).

Individuals who study parks, recreation, and tourism refer to a five-phase model for any outdoor experience: anticipation, travel to the site, time at the site, travel from the site, and recollection (Clawson and Knetsch, 1966). This model appears useful for framing technology use in natural settings as well. My study shows that while there are websites that individuals consult for information before and after their outdoor experiences, during the time they are actually immersed in natural settings, they are more likely to use technology only to document something about their experience or environment. McKay, Brownlee, and Hallo (2012) call the experience of spending time viewing, observing, studying, or photographing in natural environments “appreciative recreation.” They have documented that time spent outdoors may be further subdivided into a preparation stage, as individuals shift their awareness from their personal concerns to the environment around them; an immersive experience, when they are fully engaged in the outdoors; and then a separation phase, perhaps while they are walking back to their car,

when they begin to refocus their attention on the rest of their day. I find it helpful to think about this temporal framework in relation to the various types of technology that have been designed to facilitate people's interactions with the natural world.

One type of technology doesn't require individuals to go outdoors themselves at all. Animal cams are relatively simple and passive devices that support casual observations over distance via the Internet (Swann, Hass, Dalton, & Wolf, 2004 and see <http://www.nps.gov/photosmultimedia/webcams.htm> for a list of webcams deployed at U.S. national parks). Some webcams also support live chats and social media sharing. Explore.org (<http://explore.org/>), for example, is a collection of live animal cams trained both on fairly exotic (e.g., bison, seal, jelly fish) and domestic animals (e.g., cat and dog rescue operation) around the clock. Viewers can discuss sightings and share snapshots from these cameras on their own social networks.

Many individuals share their own photos after an outdoor experience and ask for help with identification of the plants and animals they encounter through online sites such as iNaturalist (iNaturalist.org), iSpot (ispotnature.org), and Project Noah (projectnoah.org). This activity seems to occur after their outdoor experiences have ended and they are in the recollection phase of the five-phase model discussed in the park and recreation literature. While photosharing and identification websites encompass a large geographic range and include interaction through asynchronous comments and chats, they do not encourage the hyperlocal focus that the FOSC website does.

In addition to observation and identification activities carried out by individuals, mobile apps are increasingly being developed to allow motivated volunteers to collect their own environmental data in support of various citizen science projects, including measurement of water quality (Sunyoung, Mankoff, & Paulos, 2013; Sunyoung et al., 2011). The FOSC website, for example, includes a section on water quality monitoring. Sensors in mobile phones are also being deployed for data collection in informal science learning settings (Heggen, 2012). Once individuals collect data, large, visually oriented platforms such as tabletops can further support nature-oriented observation, discovery, data collection, and collaboration; they are also attractive tools that motivate and engage groups (Louw & Crowley, 2013; Valdes et al., 2012).

A few systems and applications have been developed particularly to help engage visitors with natural life during their visits to public parks. NatureNet is a multi-platform system (tabletop and mobile phone) that allows park visitors to collect and pool their nature observations, including photographs, audio recordings, and notes (Maher et al., 2014). An application developed for use in Swiss national parks by Krug, Mountain, and Phan (2003) provided users with information about species and habitats in their vicinity using geolocation. According to the study, users liked to receive species information associated with their location (e.g., nearby animals) or just ahead (e.g., plants expected to be visible in the next half hour). They were least interested in learning more about places they could not easily see themselves. This provides a tantalizing hint about what users of the FOSC website may wish to see when they look at each other's sightings and ways their sightings might be grouped to benefit others headed outdoors.

It appears that some individuals are looking for personal connections with other species. Wild Me (<http://www.wildme.org/wordpress/>) is an example of a social media app that allows

individuals to upload sightings of specific animals based on identification marks to a database to enable scientists to understand the size of the population, its behaviors, and its range. Whale sharks and manta rays are currently being studied in this way. Individuals can receive updates from “their” animals via Facebook. While this level of personalization is not supported on the FOSC website, it is clear that various observers notice the activities of particular animals over time and comment when they are present or absent from their customary places.

Another category of resources includes websites that are related peripherally to a location or species. For example, Streamer (<http://nationalatlas.gov/streamer/Streamer/welcome.html>) is a federally funded, map-based site that enables users to trace larger streams and rivers upstream and downstream; Yardmap (www.yardmap.org) is a beta site sponsored by Cornell Lab of Ornithology that allows individuals to experiment with backyard landscaping of their properties (based on Google Maps) to increase bird habitat. Neither of them documents actual plant and animal life in public parks and how it might be supported by residential practices, but both would help park visitors understand how a particular place fits into a larger ecosystem. I would view links to such resources as valuable in a hyperlocal nature-based system because in truth, all local systems are part of a larger web.

Turning to design guidelines for technology in natural settings, Bates and Marquit (2011) recommend incorporating varied natural elements in systems wherever people congregate and including opportunities both for passive viewing of nature and active engagement with it and with other like-minded people. Ryan, Hughes, and Chirgwin (2000) remind us that some people will always seek a holistic sense of peace and wonder in nature more than any details about specific plants and animals, so good technology design supports both affective and educational experience. Bidwell and Browning (2010) make a case for integrating settings and people’s associated stories and memories and being aware of the landmarks and references that people use when they navigate natural places. They also seek to connect individuals and communities to natural events, cycles, and rhythms in an unobtrusive way, so that people can make their own discoveries without harming a fragile ecosystem or eroding the spiritual importance that nature has for some people.

An awareness of extant technology and design guidelines informed the questions I asked of experts during this study as well as my approach to understanding FOSC sightings data. The contribution of this study arises from taking a long and deep look at hyperlocal user activities and weaving that data with expert recommendations to arrive at place-sensitive design guidelines for developing technology for urban green spaces.

3. Research Methods

To learn more about the plant and animal sightings contributed to the FOSC website and what role technology might play in supporting this activity in this and other green spaces in the future, I adopted a mixed-media approach that included:

a) a descriptive analysis, visualization, and content analysis of three years’ worth of plant/animal observations (total of 278 observations from 96 unique observers between January 2011 and December 2013) downloaded from the Friends of Sligo Creek website; and

b) an inductive thematic analysis of 9 interviews with wildlife, technology, and park and recreation experts and active members of the Friends of Sligo Creek community.

Additional details about each method are provided here.

Descriptive analysis, visualization, and content analysis. Any individual may upload plant and animal sightings in the Sligo Creek area by using an online form available from the FOSC website (see Appendix A). The form offers blank text boxes for the sightings details of what, where, and when, as well as a place for the observer’s name, optional e-mail address, and comments. Individuals are also encouraged to e-mail photographs and other information separately.

The observations are posted online after the webmaster reviews them (see Figure 3 for an example sighting and Appendix B for the most recent 2014 sightings as they appear at <http://www.fosc.org/sightings.htm>). Cumulative sightings from previous years are available for download in spreadsheet form.

Pair of Red-tailed Hawks	Atop a snag (dead tree) at the Kemp Mill stormwater ponds, located just north (upstream) from Univ. Blvd.	Dusk Mon, Feb 17, 2014	Michael Wilpers	I've seen Red-shouldered Hawks here before but this my first Red-tailed. I didn't notice them in the dimming light until one of the pair flew off. Thanks to Susan Hunt for help with the ID. Photo by Michael Wilpers
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For purposes of this study, I downloaded spreadsheets of sightings for 2011, 2012, and 2013. I then cleaned the data by eliminating duplicates, standardizing names, and cross-checking the entries against the online version in cases where text had inadvertently been cut off. I used hand-coding to determine:

- Number of sightings by month
- Classification of sightings (e.g., mammals, birds, amphibians, reptiles, insects, plants, and other)
- Type of documentation included, if any (e.g., observer’s photograph, file photograph, sound recording, link to website, etc.)

Figure 3: Sample sighting on FOSC website

I then created CSV files for each year to import to Gephi software to create a visualization of the names of observers and the animal or plant species each observed. Finally, I used open coding to create a system by which to classify each comment contributed by an observer to determine what he or she found noteworthy and what the intent appeared to be in submitting an observation.

Inductive thematic analysis. The 9 interviewees were recruited from personal contacts, outreach to identified experts, and snowball sampling. They included the following:

- A plant expert from the University of Maryland
- A wildlife expert from Clemson University

- A citizen science expert associated with the Cornell Lab of Ornithology
- A project leader for a website/mobile app related to increasing backyard habitat
- A public affairs officer at Montgomery County Parks
- A park manager at Montgomery County Parks
- A teacher leading hikes in Montgomery County Parks
- The FOOSC web manager
- The FOOSC natural history chair

For purposes of anonymization, the interviewees appear in a different order here than when they are identified in the Findings section as P-1 through P-9.

After completing IRB-approved consent forms (see Appendix C), the participants engaged in semi-structured interviews designed to elicit their perceptions about, and experiences with, individuals' outdoor observations, as well as the role of technology in supporting them. The questions listed in Appendix D served as the springboard for additional discussion based on participants' responses. The semi-structured interviews were held between February and April 2014 in participants' homes, offices, or park settings. Six were in person; two were conducted by phone, and one took place over Google Hangout. They ranged in length from 30 to 90 minutes. During each interview, I took notes by hand and also created a recording for later transcription, coding, and analysis.

4. Data Analysis

The two types of research methods described above yielded a substantial amount of quantitative and qualitative data. My aim in analyzing the data from 2011-2013 sightings was to come to an understanding of **what people were actually doing** when they took photos and provided descriptions of plant and animal sightings. This seems an essential first step to understanding the nature of any technology that might be of use to them. I focused on such questions as, Who were the most frequent contributors? When did they conduct their observations? What categories of flora and fauna did they observe most frequently? How did they document their sightings? What appeared to be the rationale for their selections? How do these data change over the three-year period under study?

My interviews with habitat and park experts and technology designers were intended to augment the descriptive data and provide **more insight into the observation activity** and the **motivations and behaviors of those who practice it**. Interviewees also contributed to an **understanding of the technology** that supports current observation activities and how technology might be deployed in the future to further support observations.

The analysis of descriptive data from 2011-2013 began with a straightforward tally of numbers of discrete observers by month, their plant and animal sightings, and how/whether their written observations were supplemented with pictures, links, or recordings. Getting at their rationale for making observations required coding their written comments for content analysis (Pandit, 1996). I made multiple passes through the 2013 data to develop and apply the non-exclusive categories in my coding scheme described in Table 1, then applied them to 2011 and 2012 observation data as well.

Category	Features	Example
Description of Behavior	Usually depicted by action words ending in <i>-ing</i> or <i>-ed</i>	<i>Grey fox trotting through the neighborhood</i>
Description of the Web of Life	Mention of two species interacting (e.g., predator-prey)	<i>Huge flock of nighthawks...more gnats than usual all around. I think these things were connected.</i>
Description of Sounds	Sound-related adjectives and verbs; sometimes attempts to capture exact sound	<i>Heard a screeing noise [hawks]; sounds to me like "please, please, please, have it with ketchup" [northern waterthrush song]</i>
Description of Identifying Characteristics	Noting details of species sighted, such as whether they are male or female, adult or juvenile; sometimes with reference to identifying characteristics or sources such as guidebooks	<i>The hawk was a Red-shouldered and the Wood Duck was male, thanks to ID by birder Mary Singer.</i>
Observation of Frequency	Referring to the ongoing observation of a species in a certain place or over a period of time	<i>I have seen [the coyote] in my yard twice before going after the squirrels.</i>
Observation of Quantity	Mention of pairs or multiples or quantity indicators such as <i>abundant</i> , <i>huge flock</i>	<i>Mother wood-duck shepherding her seven ducklings</i>
Description of Something Rare or Unusual	Signaled with such words as <i>I've never seen</i> , <i>the first</i> , <i>I was surprised to see</i>	<i>I was surprised, on a cold February evening, to see a water skeeter emerge from what seemed to be its den in a small pile of leaves, and trudge rather than skeet across the water.</i>
Anthropomorphism	Attribution of human characteristics to non-humans	<i>[The eel] swam aggressively toward us, the coyotes brazenly hung out, the [chipmunk] posed</i>
Expression of Appreciation, Wonder, or Awe	Emotional indicators spotted through use of upper-case words and exclamation points as well as through word sentiment analysis	<i>It was so COOL to see our National Bird less than a mile from our house!</i>
Reinforcement of Human Social Ties	References to observer's family, neighbors, or community; story-telling	<i>Several of us have been watching this young hawk develop. The hawk had two siblings. Both of them died. One of them was emaciated, according to Second Chance Wildlife, which rescued it.... Raptor rehabilitator Suzanne Shoemaker of the Owl Moon Raptor Center is watching over things, and we hope this young one survives.</i>

Table 1: Coding scheme for comments made by observers who shared sightings on the Friends of Sligo Creek website

While I did not locate any similar coding schemes in the literature, the relatively straightforward categories relative to behavior, sounds, frequency, quantity, and identifying characteristics are similar to those found in wildlife identification guides. The more emotive categories of

Expression of Appreciation, Wonder, or Awe and Anthropomorphism were validated by the wildlife expert interviewee.

Turning to the interview data, I read the 9 transcripts successively twice to identify major themes. I identified the following dimensions as most salient and proceeded to apply them to the transcripts, arranging relevant portions of the transcripts under each dimension and then identifying subthemes for presentation.

- Hyperlocality
- Sustainability practices
- Teaching and learning about nature—who and how
- Technology used or proposed at various times and contexts
- Values associated with the technology—positive, neutral, negative

Results of the analysis are presented in the section below.

5. Findings

5.1. Analysis of sightings data from 2011 to 2013

Data for sightings from January 2011 through December 2013 were analyzed by year and then combined to create a more complete picture of recent activities. In this section I present the data for sightings by month; classification of observations by species; and types of documentation included with observations; as well as some characteristics of the observers themselves. I also present some interpretations and implications that may inform the design of websites for people interested in hyperlocal nature observations.

In the three-year period under study, there were 278 observations logged on the FOSC website: 104 in 2011, 88 in 2012, and 86 in 2013. Because contributors are asked to provide the date of their sighting, it is possible to determine the number of sightings per month. As Figure 4 indicates, sightings are most common between the months of February and August, a period that roughly coincides with the return of spring and the summer vacation months. I would expect that the peak sightings month for each year (March in 2011, February in 2012, and June in 2013) might have something to do with the weather and also the cycles of nature. Anecdotally, sunny, dry days that aren't too hot really bring people outdoors, and animals and plants are simply more abundant and visible during the warmer months when they reproduce. Also, Sligo Creek draws a number of migratory birds that fly south in the fall and return in the spring. If a community wished to increase participation in observations in the slower months, it might be helpful to provide guides to the kinds of plant and animal life still present in the colder months.

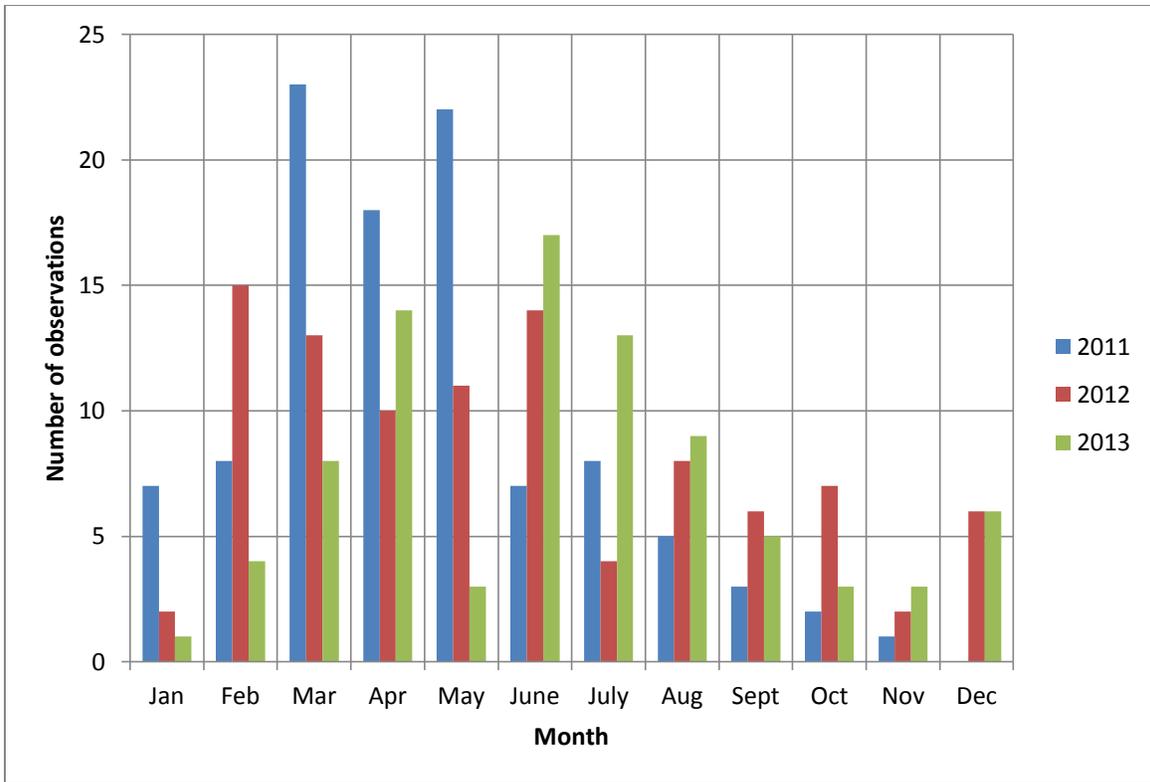


Figure 4: Number of observations contributed to the FOSC website by month, from 2011 to 2013

The Friends of Sligo Creek website includes inventories of the various kinds of plants and animals that are expected to be found on site, along with their status (confirmed, expected, possible, unlikely). As seen in Figure 5, birds are the most common class represented among the sightings contributed to the FOSC website over the three-year period. Mammals and plants are next most common, with insects and reptiles following.

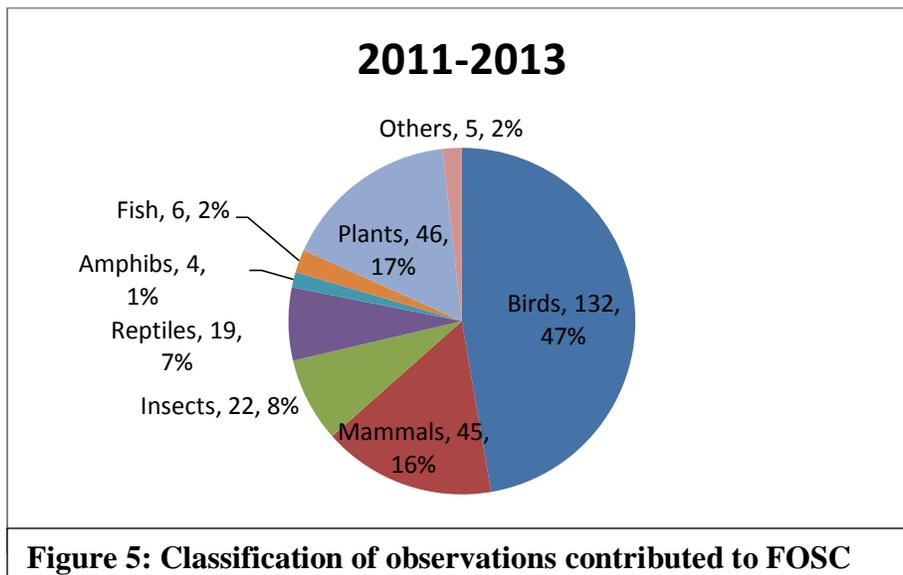
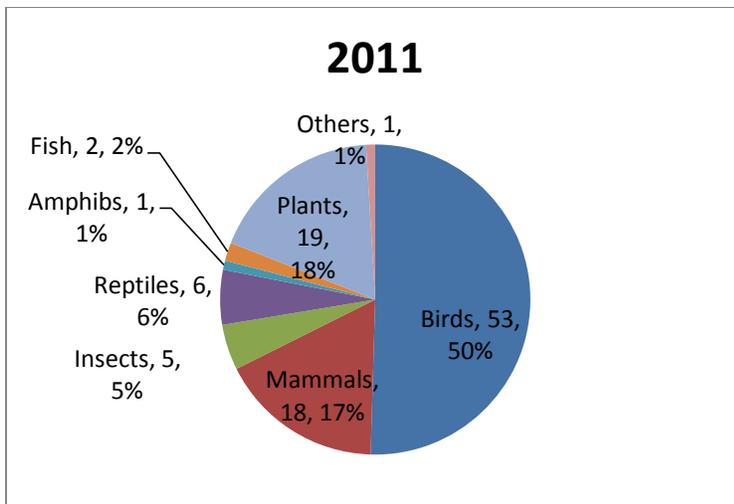
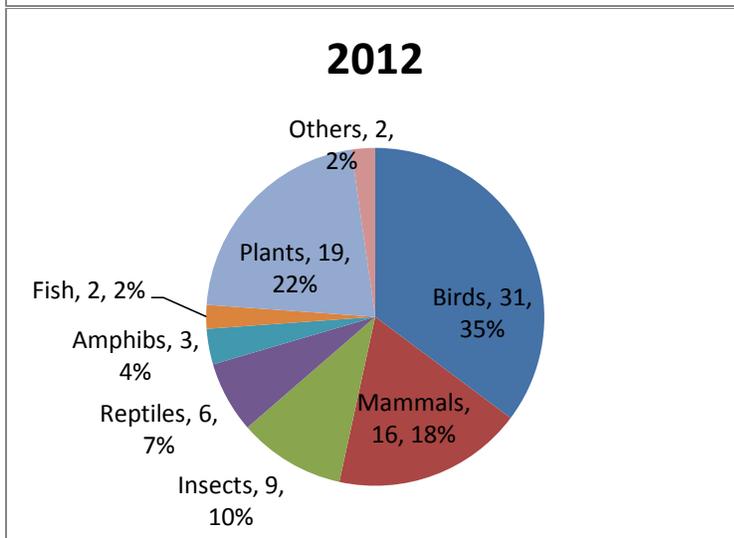


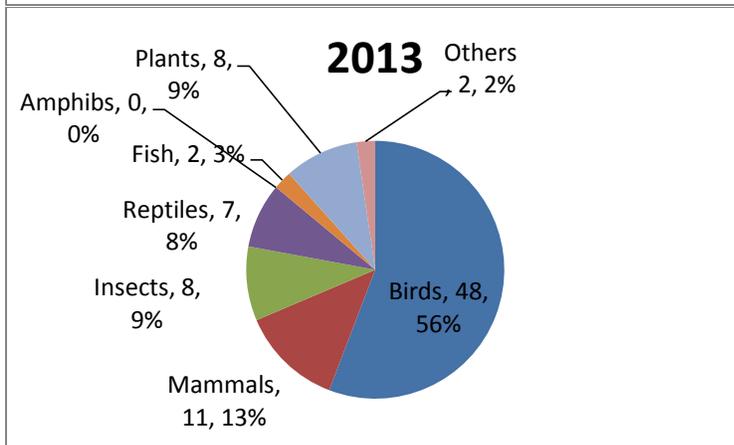
Figure 5: Classification of observations contributed to FOSC



As the pie graphs that make up Figure 6 show, there were some variations and fluctuations in what people observed over the course of three years, yet birds, mammals, and plants predominated. Fish and amphibians were least observed.



There are likely several reasons for this: The creek is the dominant feature of the environment, and water birds and shore birds flock to it. Also, as three of my interviewees noted, birders are very energetic and persistent observers. It may be that they simply go out with an eye for birds. Cognitive science tells us that expectations about what we will see can actually shape our perceptions; we see what we expect to see (and miss other things that we are not expecting). Further, we choose to pay attention to things that we find relevant to our personal motivations, and pay less attention to things we do not find salient (Summerfield & Egner, 2009).



Some research suggests that humans like to look at other mammals, and plants do us the favor of being stationary for observation. The dearth of amphibian and fish sightings is likely related to the fact that amphibians everywhere are particularly vulnerable to die-offs due to habitat loss, climate change, pollution, and fungal diseases. Fish have suffered too from toxic run-off in Sligo Creek, though there is an optimistic effort to reintroduce some species.

Figure 6: Comparison of FOSC observations according to classification, by year

The design implications of what people are observing point to the potential usefulness of alerting people to the range of plant and animal life they might expect to see and where in order to prime their awareness and observational skills.

As is apparent in the sample sighting presented in Figure 3 and those listed in Appendix B, photos, links, and recordings are used in varying degrees to augment contributors' text-based observations. About half the time, it appears that observers are taking their own photographs; another portion of the time, photos from previous sightings or elsewhere on the web are used by way of illustration. Figure 7 shows the evolution of documentation over the past three years. By 2013, leaders of the Friends of Sligo Creek organization decided to have the webmaster include file photos or other links for every observation. Sound recordings and video recordings remain most infrequently used, though they have high potential for being engaging and educational. Their paucity probably reflects the fact that the mobile phones that people carry with them in the outdoors aren't great at capturing high-quality multimedia. This suggests an opportunity for website developers to provide links to externally produced media files on the sightings page.

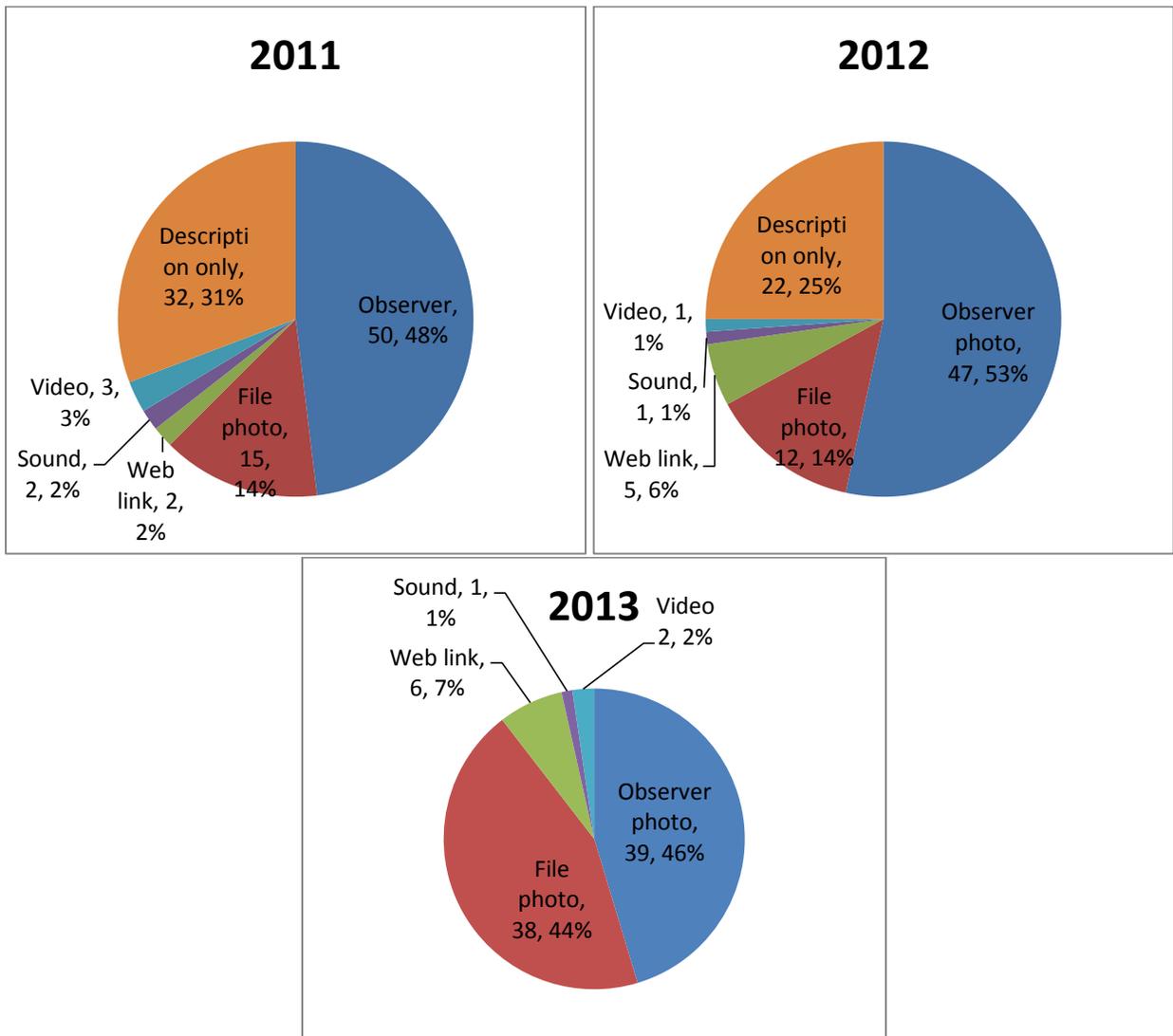


Figure 7: Types of documentation provided with text observations by year

Figures 8 through 10 illustrate how the inclusion of photos, multimedia files, and links adds value to text observations.

Northern Water Snake	Downstream from the Maple Avenue bridge	5pm, Sun, Sep 16, 2012	Julius Kassoic	I was sitting on a shower stool in the creek, photographing a leaf when the snake swam into the leaf and over a small waterfall (over an old sewer pipe going across the stream), landing on my boot. I managed to get just this shot of him/her before s/he swam off downstream. Size was at least 36-40 inches. Photo by Julius Kassoic
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Figure 8: Sighting of northern water snake with pictures contributed by the observer

Robinson's Cicada	North of Dennis Avenue, east of Sligo Parkway	Sat, July 20, 2013	Laura Mol	This annual species of cicada is reported to have a "patchy distribution" across the SE USA, so notable to hear in the Sligo watershed. This one was singing upland up to ~500 feet from the Creek (lat 39.026 long -77.027), 6-6:30P, a muggy 91°F. He was calling way overhead, moving from tree to tree, variously 60-120 feet apart, first heard in two yards along Tenbrook Drive, then from the wooded edges of the kids-sledding hill, and also from each of the two tulip trees in the mown center of the hill. Each "song" was long—from about two to about three-and-a-half minutes, based on an estimated rate of 34 pulses/minute. It sounded just like this (but longer): www.insectsingers.com/100th_meridian_cicadas/songs/07.US.VA.BOY.T06.Tibicen_robinsonianus_filtered.mp3
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Figure 9: Sighting of a cicada includes link to audio files plus details about the conditions under which the singing can be heard. Live links available below:

http://www.insectsingers.com/100th_meridian_cicadas/songs/07.US.VA.BOY.T06.Tibicen_robinsonianus_filtered.mp3

http://www.insectsingers.com/100th_meridian_cicadas/songs/07.US.VA.BOY.T06.Tibicen_robinsonianus_filtered.mp3

A bat	Between Univ. Blvd and the Dennis Ave. recreation area, flying south over the Parkway	Dusk, Mon, Mar 10, 2014	Michael Wilpers	The bat had a wing span of about 10-12 inches and a fairly steady flight path approximately 15-20 feet above the Parkway. It was flying south about 100 feet in front of my car and stayed directly above the Parkway for about 200 yards before I lost track of it. All our bats (7 species considered "expected" or "possible") are insectivores, so it seems likely that some adult moths are already flying about. Bats of Sligo Creek
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Mammals of Sligo Creek Park



LIKELIHOOD: C = Confirmed direct sighting of one or more individuals, or evidence of that species' presence through prints, burrows, tunnels, scat, gnawed vegetation, etc.)
E = Expected
P = Possible
U = Unlikely but not impossible

RECORDED SIGHTING: All indicate sighting of one or more live animals, except when followed by:
S (sign or track) or
X (carcass)

Click on underlined common name for photo and additional information.

BATS			
Unspecified bats		6 1 10	multiple 2005 2005
<u>Little Brown Bat</u> <i>Myotis lucifugus</i>	E		
<u>Eastern Red Bat</u> <i>Lasiurus borealis</i>	C	4	2007
<u>Big Brown Bat</u> <i>Eptesicus fuscus</i>	E		
<u>Hoary Bat</u> <i>Lasiurus cinerusi</i> >	E		
<u>Northern Long-eared Bat</u> <i>Myotis septentrionalis</i>	P		
<u>Silver-haired Bat</u> <i>Lasionycteris noctivagans</i>	P		
<u>Evening Bat</u> <i>Nyctecius humeralis</i>	P		
<u>Small-footed Bat</u> <i>Myotis leibii</i>	U		

Figure 10: Description of a bat sighting contributed to the FOSC website is linked to an inventory of bats because the identification is uncertain

To develop a broader understanding of observers and what they saw, I used Gephi software to visualize the relationship between observers and their reported sightings. Nodes were colored and sized according to how many observations each person contributed and how many times each animal or plant was observed. The information visualizations for 2011, 2012, and 2013 are included in Appendix E. The key takeaways for this study are the following:

- A few contributors were responsible for a high percentage of the observations each year; however, the much more typical contribution was one or two observations. Interestingly the number of men and women making observations was roughly equal, but men were more likely to include photographs with their text-based descriptions.
- A small group of birds and animals garnered the most sightings across three years. These included Yellow Crowned Night Herons, Wood Ducks, Black Crowned Night Herons, Great Blue Herons, Red-Shouldered Hawks, Deer, Beaver, Wild Turkey, Bald Eagles, and Foxes. Biologists sometimes speak of *charismatic megafauna*—animals that visitors find attractive and are willing to travel to see (Skibins, Powell, & Hallo, 2013). While a green space near a densely populated urban area is not likely to yield animals as glamorous as those in national parks, people do seem to gravitate toward the larger, more interesting and eye-catching species. (I've included pictures of some of what may constitute the charismatic megafauna associated with Sligo Creek Park below.)



2012 photo of a fox taken by Anthony Brown



2012 photo of a stag taken by Stuart Armstrong



2013 photo of a red-shouldered hawk eating a wood duck taken by George Zipf



2013 photo of a yellow-crowned night heron taken by Jim Anderson



2011 photo of wood duck pair taken by Don Olson

Based on analysis of the comments observers made over the three-year period, I believe the two types of night herons were of particular note because they had large broods each year, and many people enjoyed watching the families swim in the creek during spring and summer. Wood ducks are quite fetching; they easily stand out among the water birds. Great blue herons and red-shouldered hawks are good-sized solitary creatures that are easy to see when the foliage drops in the fall. Deer are simply ubiquitous in our area, but the sight of a many-pointed buck or a stag is still breath-taking.

Beavers are quite easy to spot as they move in the water, and the trees they gnaw to make their dens are easy to spot. I think wild turkeys and bald eagles are noteworthy to us precisely because they are not expected. As the wildlife expert I interviewed noted, “Most people when they think of turkeys think of the Butterball at Thanksgiving—a food object and not a feathered being...but if they see a wild one, the new experience creates a memory and a connection.”

Over the three-year period I studied, there were a fair number of sightings that observers speculated were of a coyote rather than a fox; however, there were no definitive pictures, and coyotes have been thought to be out of range for this area. There were also reported sightings of copperheads (but no pictures). The same wildlife expert offered an interesting insight regarding these observations, suggesting that humans want to be amazed:

Awe takes us out of our comfort zone. If we see something bigger than us, or something we are in fear of, we feel awe... If we see a coyote from a distance, for example in a car, we feel fairly safe and only a little bit scary.

As described in the Data Analysis section, I coded the text descriptions (generally 1 to 3 sentences long) for each of the 278 observations submitted to the FOSC website between 2011 and 2013. I classified each into as many categories as appropriate, drawing from 10 classes created using an open coding approach. Table 2 shows the number/percentage of observations in each category.

Category	2011	2012	2013
Describe behaviors	30/104 (29%)	37/88 (42%)	50/86 (58%)
Describe web of life	12/104 (12%)	15/88 (17%)	14/86 (16%)
Describe sounds	8/104 (8%)	6/88 (7%)	8/86 (9%)
Make identifications	42/104 (40%)	43/88 (49%)	20/86 (23%)
Observe frequency	14/104 (13%)	13/88 (15%)	9/86 (10%)
Observe quantity	31/104 (30%)	24/88 (27%)	22/86 (26%)
Observe something rare or unusual	9/104 (9%)	17/88 (19%)	17/86 (20%)
Anthropomorphize	3/104 (3%)	3/88 (3%)	5/86 (6%)
Express appreciation/wonder/awe	4/104 (4%)	6/88 (7%)	13/86 (15%)
Reinforce social ties	11/104 (11%)	13/88 (15%)	18/86 (21%)

Table 2: Categories observed in content analysis of FOSC sightings over three years

The most common categories for observations in all three years, as shown with numbers highlighted in red, were describing behaviors, making identifications, and observing quantities. I would hypothesize that describing behaviors is the highest incidence activity undertaken by observers precisely because we are wired to take interest in detecting sudden motion (Yantis & Jonides, 1990). While it is beyond the scope of this report to describe all the behaviors observed across sightings, Table 3 provides a quick look at the many movements and activities that caught people's eye in one year, and the sheer exuberance of life in an admittedly degraded piece of wilderness preserved within a densely populated area.

Making identifications (e.g., describing species-distinguishing characteristics or the presence of adult vs. juvenile, male vs. female) is common behavior for amateur and professional naturalists and enthusiasts. When we note pairs, family groupings, and quantities such as herds or flocks, we may be reacting with enthusiasm to the presence of relationships or abundance. Indeed, one observation that stays in my mind is a speculation from someone who observed a solitary wild turkey in 2013 and found it odd, because he had previously seen flocks of 10 to 12 in Connecticut and Quebec. "Could this individual be a kind of avian sociopath, or a social outcast? Or maybe it's only a youngster who has yet to establish a place for itself in a flock..." Contrast this with the excitement noted by an observer of a yellow-crowned night heron family of 7 who wrote in 2013: "Five bobbing heads. Looks like a lively, happy family that thus far has survived the frequently sighted barred owl and many a hawk. Hopeful!"

What are the design implications of the three high-incidence categories? The Friends of Sligo Creek Sighting Observation Form currently supports unstructured data entry through text boxes (see Appendix A). It might be useful to provide a pop-up list of activities after an individual enters the name of the species observed, particularly in the case of plants, which, although they don't move in a conventional way, do exhibit active phases such as budding, blossoming, blooming, leafing out, and fruiting. To help people make identifications based on color, size, and markings, there could be an option to look at pictures of males/females, juveniles/adults, winter/summer coloration, etc. Information about quantities of a species observed could be organized as structured data; however, people do make generalizations such as *many*, *a large number*, and *several*, which are hard to quantify.

I also note with great interest the number of references to people's family members, friends, neighbors, and community members that are made in the text descriptions. While the act of observing appears to be a largely solitary activity (of 96 discrete observers responsible for the 278 sightings over 2011-2013, just five were in pairs: one husband-wife team, two parent-child teams, and two pairs of women; the rest were apparently alone), it seems to take place within a social context. Here are a few example text descriptions that buttress this claim: "A nice lady saw me with my camera and ask[ed] me if I had seen the owl, when I said no she turned around and took me back down the path to show me where it was." "My neighbor said she saw YCNHs [yellow-crowned night herons] two weeks prior (+/-March 20), near the same location." "Absolutely unfazed by the crowd of about 10 walkers who gathered to watch this beautiful bird [pileated woodpecker]." "We've seen three [nesting heron] pair close by, but only two nests. Has anyone had sightings of the third?"

It seems to me that the social aspect of observing plants and animals in a hyperlocal setting could be amplified in several ways. For example, the home page of the website could feature a crawler with “Seen today near Sligo Creek.” Individuals who submit an observation could be asked if they wish to receive notifications of others’ sightings of the same species, or of other plants and animals in the same area. People could have the option of turning their observation into a tweet or Facebook post with a link back to the sightings page. There may be neighbors or other interested parties at a distance who don’t spend much time outdoors themselves, but would appreciate more options to view and comment on the observations of others.

Based on my experience of showing one of the most active contributors (who was also an interviewee) my Gephi visualizations, I think there could be high interest among contributors to see who else is active and how many sightings they have contributed. My interviewee was thrilled to see herself at the center of one of the visualizations, and also made a point of looking to see how she compared to a few other people she knew. She also wondered about the names of a few people who were unfamiliar to her. It might therefore be a nice opt-in activity to allow one’s contributions to be visualized on the FOSC website. This would serve as acknowledgement of sorts, and perhaps also as a motivator to encourage others to participate and/or communicate with people who share a common interest. (It seems strange to think that people who like to observe in nature have a competitive streak, but I know anecdotally that birders often compare progress on their “life lists.”)

Now that I have a clearer picture of the FOSC audience, it would be interesting to explore these design options with three types of users: casual users who’ve submitted 1-2 observations, moderate users (3-7 observations) and “super users” who’ve contributed 10 or more sightings over the past 3 years. (The three most active users in the long tail that is not visible in Figure 11 contributed 22, 24, and 43 observations.)

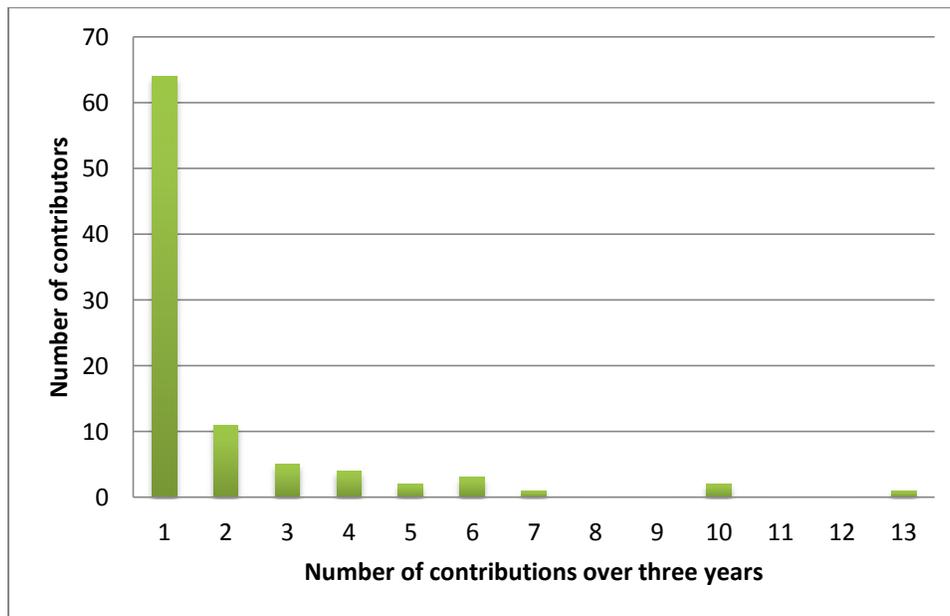


Figure 11: Range of contributions made by FOSC contributors between 2011 and 2013

Activity	
Moving	
<p>In the water: Gathering mid-day in the Bennington Tributary Paddling about the creek Swam across the creek Swam happily away Swimming (2x) Swimming aggressively Swimming in the northmost stormwater pond-cell Swimming in the pond Trudging (skeeter in winter)</p> <p>On the ground: Crossing the middle of the soccer field Headed towards the street Moving rather quickly northward Racing across the road Running along Jefferson Avenue Slithered Took off fast Trotting through the neighborhood Walked across the street Walking on the sidewalk on Myrtle Avenue Walking through the woods Went into its den Working its way thru the yard</p>	<p>In the air: Fledged Flew into the woods Flew off Flew out Flew south following the creek Flew up into a low branch Fluttering madly Flying Flying about Flying low in a neighbor's yard Flying over soccer fields Returning home Soaring out over the hiker-biker trail Struggling to find a way out Zipping over the water</p>
Steady State/Resting	
<p>Animals: Brazenly hanging out in our front yard Occasionally perching Posed (2x) Resting on a tree branch Sitting in brush Sitting on one of the wood posts Sitting on the ground (person) Sitting on the nest Sitting quietly in the tree Standing "hunched" in creek Standing in the creek Standing on the side yard Sunning themselves in the morning Waiting</p>	<p>Plants: Dangling (seed capsule) Just opening Blooming (2x)</p>
Grooming	
Stretching their wings, puffed their feathers, groomed	
Observing	
Scanning the stream for minnows, exploring the ground	
Hunting/Feeding	
<p>Vegetarian: Nectaring Eating various vegetation Eating some branches</p>	<p>Carnivores: Dove down and caught the fish Finding grubs Just digested something Lunged for dinner Pecking at the ground Waded forward and then speared a fish Was very busy fishing</p>
Interacting with Others	
Shepherding her ducklings, driving one another away, stepping on top of each other, [deer] following [turkey] everywhere, mating	
Making Sounds	
Squawking, singing upland, calling way overhead, singing, calling all day	

Table 3: Behaviors noted in 86 plant and animal sightings in 2013

5.2. Interview data

The interviews were a rich source of data about reasons why people might make observations in natural settings and how technology might be able to assist people them. The organizing themes are introduced in Table 4 and elaborated upon below.

Theme	Overview
Hyperlocality	People are interested in understanding and connecting to their immediate environment because it is accessible and relevant to them and gives them a sphere in which to make a difference.
Sustainability	Individuals are becoming aware of practices to create a smaller environmental footprint; indeed, for some people it is even trendy, yet it hasn't become a widely held cultural value.
Teaching & Learning About Nature	Most children don't grow up with a strong sense of their immediate natural environment; however, teachers, mentors, and institutions, including schools and scouts, can help them become directly engaged through meaningful projects.
Potentially Useful Technologies	There are roles for technology in at least five areas: 1) viewing and displaying images, 2) conducting citizen science, 3) making and sharing identifications, 4) navigating outdoor terrain, and 5) communicating about and involving others in participation in outdoor activities. Technology is used variably before, during, and after actual outdoor experiences.
Values Associated with Technology Use	Technology is viewed as positive for its potential to engage younger audiences, provide richer supplemental learning experiences, and extend communication. Technology is viewed with skepticism or disdain for its potential to interfere with direct immersive experience, bore people who might otherwise respond to a great in-person guide, jeopardize a delicate ecosystem, or introduce security concerns. There is an emphasis on determining appropriate use for a given context.

Table 4: Overview of Themes Arising from Expert Interviews

Hyperlocal Is the Unit That Matters

Interviewees were united in their belief that focusing on one's immediate natural surroundings was of great practical value in getting people to care about the environment. Participant 2 observed that once people put down roots in a place (for example, by buying property), they have a genuine sense of investment in the land and community. As Participant 1 noted, "If it's in your backyard you tend to care about it more. So the localization thing could be pretty important. People buy in and get way more involved when it's something that has value to them and their everyday life." Participant 9 found that convenience is a good reason to focus on the local, "We live at such a hectic pace; people should find that passion in everyday connections. They should go exploring in their backyards; it doesn't have to be Yellowstone or Yosemite."

Further, people generally understand the immediate importance of water to life. Participant 8 said it eloquently: "All water drains into my creek—so I am very invested in that creek." Participant 3 reported that over just the past 11 years since Friends of Sligo Creek was founded, people have become much more aware of the creek and its needs, as evidenced by use of the website and participation in creek sweeps (clean-up days). To Participant 1, a watershed

organizes people more meaningfully than any political boundaries such as city or county. She said that those in the birding community tend to refer to water basins as reference points for their sightings.

Interviewees had several practical recommendations for people interested in developing a more sustainable local lifestyle. On the home front, they recommended growing native plants, installing rain barrels, and investing in geothermal heating and cooling if resources allowed. On the community level, they suggested removing invasive plants (after proper training) and participating in citizen science projects. Interestingly, some suggested that efforts toward a more sustainable lifestyle actually begin with developing an appreciation of nature. As Participant 8 observed, “If people develop a relationship with nature, then it turns into affection, a desire to care for it, to be healthy, and see how we are connected.” Participant 1 noted,

they have to realize that it is something that is of value, and that there is something that they can do. Once you can get people to pay attention, then you can get them to take on stewardship, but they have to pay attention first.

Focusing on the hyperlocal seems to invest and empower people to take action. According to Participant 1, “There is this attribution issue that my little piece is too little to make a difference, but on a very small scale, on the local level, in the backyard, you can see that difference, and it’s meaningful.” And once people become knowledgeable about the plants and animals that share their space, more meaning and connection ensue: “Once I got to a level of fluency (which was hard and could be frustrating), then it was like there was another layer of reality I had access to, an extra dimension that other people didn’t know about.” (P-1) “Knowing the name of a species is the door handle to open the door to rooms of knowledge...to enter the room of people who use scientific language. It lets me piggyback on other people’s experience and knowledge.” (P-7)

“Technology Should Not Be a Substitute for Nature”: The Role of Teachers, Mentors, and Guides

Seven of the nine interviewees made specific reference to the potential role of mentors and guides in engaging people in nature, including parents who take their children hiking or to visit parks (P-1, P-7, P-8, P-9), teachers who incorporate local flora and fauna into their lessons (P-1, P-2, P-7), and retirees with gardening experience who help urban youth set up community gardens (P-4). Participant 1, recalling her own childhood introduction to the outdoors, noted, “Somebody’s got to prompt you to [look at nature]—your folks, teachers, community groups, religious person, whatever; someone’s got to prompt your interest. Most people don’t just stumble onto it.” Participant 2, a university instructor who says she can get students excited about moss and lichens, said, “You have to have someone interested in it to share their interest. If you just go out you won’t see anything exciting.” Participant 9 reported that he involves his young children in outdoor life by planting a garden with them and taking them out to look for salamanders.

This recognition of the primacy of good teachers made most respondents skeptical that technology alone could entice novices into becoming interested in nature. Participant 2 delivered the majority opinion when she said, “Technology should not be a substitute for nature.”

Participant 7 was most concerned that technology would be a barrier to the development of outdoor literacy:

As our technobrain expands, our skills contract. ... I really don't want to encourage people to spend more time on their screens. I want them to come outside and look at what's up. I don't think you fall in love with images on a computer screen unless you already know how to fall in love with them here.

Joining a Community: The Role of Institutions

Four interviewees expressed a belief that schools were key to teaching people more about nature in their local areas, while indicating that they have not traditionally done so. Participant 7 noted, "The school focus is incredibly weird. We were teaching them about whales and dinosaurs and we weren't teaching them to differentiate between mourning cloaks and question marks" (two types of butterflies found here). Participant 2 reported that that may change because Maryland has introduced a new curriculum focused more on the environment. Participant 1 suggested that one practical activity a class could undertake is to do a plant survey of their neighborhood. Participant 8, a special education teacher and parent, noted that more outdoor activities can only benefit students: "Green, physical activities are a great prescription for people with learning disabilities. They get their energy out and their confidence and self-esteem rises."

Other groups that participants believed should be responsible for teaching people about local flora and fauna and sustainable practices were community groups (P-1, P-2), Scouts, (P-1), park-based nature centers (P-2, P-6), and the most nebulous one—culture. Participant 1 said, "It is interesting and complex to get that value [of getting people outdoors] developed where the culture doesn't necessarily support it." Participant 2 believed the cultural change might come in time:

There has been a cultural shift in recycling. I don't think that has necessarily gone to practices about planting trees, wanting to encourage green infrastructure and understanding why that is important even if it costs more. There's lot of work to do to change people's cultures. It's something that becomes engrained in the way you are thinking, and that's hard to do.

Several participants indicated that online communities and listservs could play an important role in encouraging pro-environmental behaviors:

One of the things that does impact adoption of conservation behaviors is feeling like you are joining a community of people who are also adopting those conservation behaviors...or sort of seeing that other people around you, or not even around you but in general, also do those behaviors. Having access to that social information ... is a mechanism that might do more for the adoption of behavior than just telling people about correct behaviors. (P-4)

Participant 1 noted that “by providing tools and social transparencies you can get people to talk to each other about not using pesticides, etc.” Participant 7 reported getting assistance with plant and insect identifications from local listservs and the Friends of Sligo Creek website.

What Tools and Technologies Are Currently in Use To Support Nature Activities in Parks?

The nine interviewees identified a range of technologies that they use or are familiar with in relation to parks. These technologies fall into the following functional categories:

- 1) View and display images (before, during, or after outdoor activities)
- 2) Conduct citizen science activities (during or after outdoor activities)
- 3) Look up identification information and/or share sightings (during or after outdoor activities)
- 4) Navigate the terrain (during outdoor activities)
- 5) Support communications and involvement (before outdoor activities)

Figure 12 shows the times at which the various activities are likeliest to occur. This model collapses the five-phase Clawson and Knetsch model into three phases by considering anticipation and travel to a site to be part of the before-outdoor-activity phase and the travel from the site and recollection to be part of the after-outdoor-activity phase.

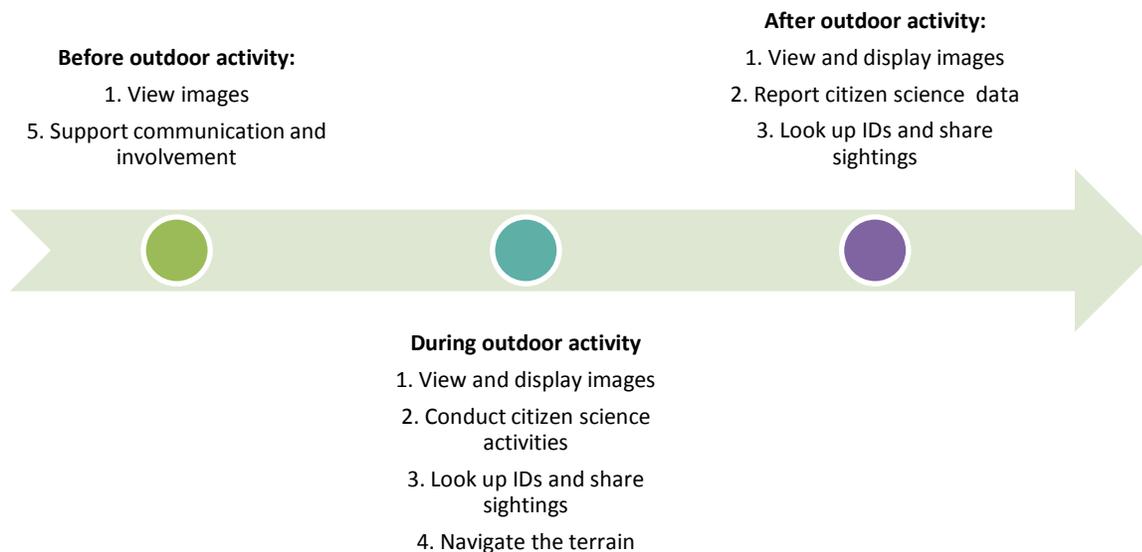


Figure 12: Technology use before, during, and after outdoor activity

There is some overlap among the categories: for instance, cameras may be used to create images and also to participate in citizen science activities; however, I have drawn some logical distinctions for purpose of discussion. There are, of course, many other nature-oriented websites and mobile apps than those listed here; these are simply the ones that interviewees noted.

1. Technology to view and display images

Interviewees were very positive about the use of technology to view and display images, including the use of webcams trained on wildlife to stream live feed to viewers (P-1, P-2), and the use of cameras by individuals to document what they see in the field (P-6, P-8, P-9). As Participant 9 noted, “The process of taking a picture gives some importance to an item...inherently it’s the beginning of a memory. Sharing our memories keeps them fresh.” Participant 9 particularly recommended the Go-Pro wearable, waterproof camera for recreational use; Participants 2 and 7 recommended sharing images on such sites as Flickr, which the websites of organizations such as Encyclopedia of Life and the Maryland Biodiversity Project crawl.

The use of technology to create, view, and share images appears to have a strong social component as well as an educational component. As Participant 8 suggested,

A great way to use technology in the parks is with a camera or a parent sharing a cell phone with a camera with their child so he can take several shots of what he is observing or finding. It lets them see nature through their own eyes.

Participant 1 reported,

You would not believe the emotional outpouring and connection that people have to the birds they are watching on these cams. It’s like reality TV—it’s life and death for those birds...and you can see every day what it is they eat, so you know that chipmunks are a food source for them and this year they’re going after the house sparrows...and the food sources change over time. It tells you something about that area.

2. Mobile apps and websites for citizen science

Five interviewees named specific mobile apps and websites that enable individuals to capture local data to share with scientists who are aggregating data over place and time:

- Geocaching/Floracaching/Project Budburst mobile apps (P-1, P-2)
- Citizen science projects with good, up-to-date apps and/or websites for data collection and entry, such as eBird (P-1, P-2, P-4, P-7), iNaturalist (P-4), Project Noah (P-4), WildMe (P-9), and Yard Map (P-1, P-4)

3. Websites, mobile apps, and other technology to support identifications

Four interviewees indicated that they used technology to make or validate an identification of a plant or animal noted during an observation. Specific technologies mentioned included:

- Species-oriented sites such as bugguide.net (P-7)
- Large-scale projects such as the Maryland Biodiversity Project and Encyclopedia of Life (P-7)

- Image recognition-based electronic guides such as LeafSnap (P-6)
- General search engines such as Google (P-7)
- Local listservs; species-specific listservs (P-7); location-based websites such as Friends of Sligo Creek (P-3, P-7) and apps with the capacity to identify and share plant observations by ZIP code (P-4)
- QR codes about park flora and fauna and history (could be included in park signage) (P-6)

4. Websites, mobile apps, and other technology to assist in navigating terrain

Three interviewees reported on technologies that they used in park settings to guide their activities. These included:

- Wild Montgomery, part of the Montgomery County Parks website (P-5)
- EveryTrail, a GPS-supported map that allows users to map a trail and designate waypoints (<http://www.everytrail.com/>) (P-8)
- Map My Fitness (<http://www.mapmyfitness.com/us/>), which provides an elevation profile and mileage (P-8)
- Weather apps (P-6)
- Kiosks in parks (e.g., Dominion-funded effort in state parks in Virginia)—provide GPS-based trail info, printable maps and guides, wildlife spotting guides, and virtual tours (P-5)

5. Websites and social media to support communication and involvement

Four interviewees noted the role of technology for use in sharing information or calling others to action. The social media they mentioned included:

- Facebook, Twitter, Meetup (P-2, P-5, P-7, P-8)
- Blogs and postings to community listservs and websites such as Friends of Sligo Creek (P-5, P-7, P-8)

Who Might Use Technology to Support Nature Activities?

Interviewees reported patterns of audience engagement that are familiar to me from the citizen science literature; namely, that those most intensely involved in nature-related observation and conservation activities tend to be white, well-educated, suburban (or quasi-rural), economically comfortable retirees in their 60s and beyond. (In some studies, women are also more active than men; however, in my descriptive analysis of FOSC sightings, women are only slightly more highly represented than men as observers.) Absent any hard data about ages and races of contributors to the FOSC sightings pages and/or users of Sligo Creek Park, some interviewees (P-2, P-3, P-4, P-7) speculated that certain groups—parents of young children, adults with working-class backgrounds, and older professionals still in the workforce—might be under-represented among those actively participating in nature observations due to time demands, although they might use the park for other forms of recreation. I did note that a few sightings indicated parent-child dyads, including one in which a mother and son were playing in the creek

and noticed an American eel “swimming aggressively” toward them and another in which a boy and his father found and posed with a wood turtle.

In terms of potential new audiences for some sort of technology to support nature observation activities in parks, interviewees identified these additional groups as potentially under-served:

- **Urban/suburban teens** (P-1, P-4). Citizen science projects such as Celebrating Urban Birds for inner-city black and Latino kids have been successful in motivating adolescents and enabling them to develop expertise with local species and make contributions to science.
- **Hipsters** (P-4). Among an “indie” subculture of individuals born between the late 1980s and 2000, there is a back-to-nature movement. Participant 4 observed, “Embracing an agrarian lifestyle and having control over your own food sources is becoming a status symbol now.”
- **Runners and bikers** who use the paved trails near nature areas such as Sligo Creek (P-6). Because they are already in the park for their activities, they might become interested in further explorations.

Values Related to Technology Use in Nature

As noted above, interviewees logged a good range of technologies, encompassing hardware (e.g., kiosks, cameras), as well as websites, mobile apps, and social media. In discussing the positive aspects of technology use, they noted such attributes as:

- **Appeals to young people** (P-1, P-2, P-9): “It’s a way in...for this generation, obviously there is some value there.” (P-1)
- **Ideal for sharing information and communicating** (e.g., FB, Twitter, blogs, Meetup) (P-2, P-3, P-7, P-8)
- Can be used to **disseminate techniques for on-site teaching** (e.g., Sam Droege’s YouTube video about preserving insects in bottles of hand sanitizer) (P-7)
- Can be a **source for images and recordings** that can be used to “illustrate” local observations (P-3, P-7): “It’s enormously helpful for the aural. Where you can hear bird sounds, insect sounds. We can ‘steal’ those things from online and reference them locally. We could never, ever provide that for people (e.g., can get the sound of a pileated woodpecker from Cornell Ornithological Lab and add to a FOSC observation of a sighting). (P-7)

They also expressed concerns about technology use, including the following:

- **Boredom factor:** People are less interested in the non-charismatic (P-1, P-7). “You’ve heard the expression that something is as dull as watching grass grow—it can be pretty boring...it’s a hard dilemma when plants tend to be static. How do you make them exciting at other times?” (P-2) Observing that information kiosks aren’t engaging in themselves, P-9 observed, “We have shorter attention spans now, to get people engaged, it needs to be interactive or personalized.”
- **Potential to disturb nature or other observers:** If technology displays specific coordinates, people might dig up a rare or fragile plant or disturb an animal that is highlighted. (P-1) People can also use technology in a way that distracts or detracts from

others' experience, which Participant 9 observed when visitors to the Grand Canyon used flashing personal location beacons unnecessarily.

- **Security issues:** Webcams need to be made secure from theft and vandalization. (P-1)

6. Discussion, Implication, Reflections

In an influential paper from 2006, Dunn, Gavin, Sanchez, and Solomon made a case that the future health of the environment may depend on urban dwellers. They note that most people live in urbanized areas, and that while we know direct exposure to nature creates a pro-environmental stance, it's easy for people living in densely populated areas to take an "out of sight, out of mind" attitude toward nature. In order to encourage a positive, protective attitude toward the environment among the largest proportion of the planet's population, we need to make sure they have opportunities to enjoy nature right where they are. People who live near and enjoy the Sligo Creek area seem to have created such an opportunity organically for themselves through the vehicle of sharing sightings of plants and animals on the Friends of Sligo Creek website. To understand how technology currently serves them and might serve them in the future, I took a deep look at their current practices by analyzing three years' worth of sightings data and interviewing 9 experts, including FOSC leaders.

From this research, I have gained a focused sense of when their activities unfold, what types of animals and plants capture their attention (with perhaps some insight as to why), and how they document their observations with images, links, and texts. I see that to serve them well, technology must support close observation of behaviors and the ability to make identifications through characteristic features. I also see that while observation tends to be a solitary activity, it is deeply embedded in a community context that could itself be supported by social networking to increase social capital on the hyperlocal level (see, for example, Masden et al., 2014).

When I first envisioned my Capstone project, I imagined conducting a formative study that would include expert interviews and a survey of FOSC website users, followed by one or more design sessions to create a prototype of some sort of technology to support their activities. I see now what a very ambitious plan that was. After nearly a year's worth of preparation and research, I can only now say that I have a reasonable (and hard-won) grasp of the characteristics and needs of the users for whom I was so eager to design.

Most interviewees saw a positive (if constrained) role for technology in engaging visitors in urban parks, including for communication, citizen science activities, navigation, identifications, and sharing of images and experiences. They indicated that there are rich sites available to people via the Internet to help make and share identifications, but expressed concern that too much information conveyed in situ via technology (possibly in a boring way) might detract from the actual experience of observing in nature. They believed that technological tools such as cameras and tools for navigation could be beneficial on site and indicated that more technology use might be engaging for younger people. Participant 9 may have been speaking for all when he said, "Find where [technology] is appropriate; make use of it in a beneficial, controlled way, at a time and place that is appropriate."

Toward that end, I have developed research-based guidelines for future work in this area. These guidelines are organized according to logistical, content-oriented, and social implications and include references to my data analysis activities and interviews. Table 4 provides a summary.

Logistical	Content	Social
<ul style="list-style-type: none"> • Time sensitive • Weather resistant • Seasonally appropriate • Mobile • Map-based 	<ul style="list-style-type: none"> • Feature high-interest, highly visible species • Feature least observed, most endangered species • Highlight anomalies (out of season or range) • Cover megafauna to micro-organisms • Include the fear-inducing and/or novel • Accommodate behavior, ID, and frequency data • Introduce multi-sensory experiences 	<ul style="list-style-type: none"> • Capitalize on human expertise and storytelling • Support hyperlocal social networks • Use social media for event alerting • Use information visualization for reporting on contributors • Deploy social media to reach out to new audiences

Table 4: Summary of Technology Guidelines Resulting from This Research

Logistical

- Remember that people may use technology to **support diverse outdoor activities at a range of times**: before, during, and after their actual immersive experiences. (P-2, P-9)
- **Make any outdoor tool weather-resistant**. (P-5, P-9)
- **Be mindful of patterns of use and consider ways to encourage “off-season” activity**: For example, Sligo Creek observations were especially high in spring and summer months; parks are generally busiest in the warmer months (June-September) and during after school and weekend hours. Saturday mornings are prime for walkers. (P-3, P-5, P-6, P-7) If there is a desire to increase observation activity at other times, it would be wise to use technology to help people identify what they might see in the off-season and to communicate about activities that bring them together in real time. An example of how this is already done effectively using graphics on park kiosks and print handouts is included as Appendix F. Some 250-300 of the handouts are picked up from 9 kiosks located along Sligo Creek and are refreshed at three-week intervals. (P-7).
- **Consider connectivity and convenience for devices used outdoors**. As Participant 4 said, “Capitalize on an urban area’s superiority in terms of faster Internet speeds. A lot of them skip using websites and go straight to mobile.” (P-4)
- **Consider showing people where certain animals and plants are commonly found** through online maps to aid their enjoyment and observation (but not to the endangerment of nature). The sightings data currently displayed on the FOOSC website gives cross-

streets and landmarks, but an interactive map could convey this information in a more beneficial way for other park visitors. (P-5, P-6, data analysis)

Content-oriented

- ***Provide direct and accessible information about high-interest, highly visible flora and fauna to alert visitors about what they can expect. Include information for novices and experts alike.*** This type of information can be augmented with links to additional sources for follow-up. (P-2, P-6, P-8, P-9, data analysis)
- ***Provide information about the least-observed, most-endangered animals*** (fish and amphibians in the case of Sligo Creek) because it appears that people are interested in what is rare and unusual, plus understanding why these are hard to find contributes to an understanding of sustainability issues such as controlling run-off. (data analysis)
- ***Spotlight anomalies in sightings data.*** Hyperlocal observers focus on what seems unusual or out of place to them. These anomalies (e.g., early blooming, early return of migratory birds) observed by people deeply familiar with an area may be of interest to scientists (and to citizens and policymakers) to the extent that they indicate something about climate change (e.g., changes in range and distribution of species and in timing of life cycle events). (P-1, P-2, P-9)
- Think not only in terms of ***highlighting*** the largest, most interesting animals in the ecosystem that people naturally gravitate toward, but also the ***microorganisms such as bacteria and fungi***—largely unknown yet widespread and essential to the health of an ecosystem. (P-1, P-7)
- Consider these ***lures to interest people***:
Fear: “There’s a lot of people scared of forests. The fear can be helpful to get them interested. It heightens awareness. ... People enjoy [bugs and snakes] in a safe situation.” (P-2)
Novelty: Animals that are atypical for this area, including bats, copperheads, wild turkeys, and coyotes, are particularly interesting to people. (P-3, P-6, P-9, data analysis)
- ***Accommodate people’s priority activities*** (e.g., in the Sligo Creek area it is describing behaviors and making identifications, followed by keeping track of quantities of species viewed). Technology should support users in this, perhaps by providing a built-in dictionary of descriptive behaviors and identification tools (e.g., image recognition; links to other resources focused on salient features). (data analysis)
- Understand ***that people’s primary orientation is visual***, but consider ***ways to incorporate other senses***—sound, and even smells someday (e.g., the skunk cabbage that smells like scat in order to attract pollinators). In the immediate term, adding multimedia links to text descriptions increases engagement and educational value. (P-2, P-3, P-7, data analysis)

Social

- **Support hyperlocal social networking.** Though making observations is a largely solitary activity, people do so in a context of awareness of others’ sightings, their

previous sightings, and activities reported in their neighborhood. (P-4, P-5, P-7, data analysis)

- Use social media to **communicate about activities before they occur** and to share high-interest data after an outdoor activity. (P-3, P-4, P-5, P-7)
- Experiment with **sharing information about active contributors and their sightings** to spur motivation and engagement. (P-1, P-3, P-4, P-7)
- Consider **reaching out to non-traditional audiences**, including educators and parents, and working with them to adapt activities to suit their needs. (P-1, P-4, P-8)

I enjoyed the opportunity to work in an area of great personal interest, interview interesting people, and use some of the data analysis and information visualization skills gained in coursework on research methods and social networks. (I also got to taste a ramp, see my first yellow-crowned night heron, and learn the names of some spring flowers while doing an outdoor interview.) I learned that it is much easier to coordinate projects for others (or do worker bee pieces) than it is to do it all solo. As ever, I smacked into my own over-optimistic plans for what could be accomplished in a semester and ended up staying in more of an investigative, exploratory role than a design one after it became clear that I needed a better understanding of what people were doing when they made observations. Until I completed the descriptive analysis, information visualization, content analysis, and interviews, I simply didn't have a clear enough picture to design technology responsive to user needs. Now that I have that, the clock is winding down on the degree program. It's a great pleasure to come full circle on the importance of user-centered design, though. I'll end with warmest appreciation for talented, supportive instructors all the way through.

7. Limitations

As with any work that examines the activities of one particular place, this research cannot be assumed to be generalizable. Maryland suburbs skew wealthier and more educated than many other parts of the country, so residents may have more time for (and more awareness of) environmental issues and a predisposition to community involvement, along with access to good parks. Interviewing a small number of experts, a majority from the mid-Atlantic region, may have introduced bias. For reasons of time and resources, I was the only coder of my interviews; ideally they should be coded by two or more people to increase the reliability of the coding system. Based on input from existing interviewees, including more parent, teachers, and contributors to FOSC would have provided additional useful perspectives.

8. Future Work

Several people commented about the relative dearth of minorities in nature-oriented activities in this area. Some offered theories, but this seems to be an area ripe for study on the local level. Any design guidelines should be refined in consultation with individuals from emergent target audiences, including families with young children, teachers focused on local nature observations as part of the redesigned Maryland science curriculum, urban homesteaders, and bikers and joggers who use trails for recreational purposes.

It would be beneficial to gather more data from and about Sligo Creek Park users and visitors to the FOSC website. Toward that end, I have developed and piloted a survey focused on individuals' sources of information about local flora and fauna and their motivation for participating in nature observations or viewing others' sightings. Future work could include fielding the survey and prototyping and evaluating technology with multiple user groups.

9. Conclusion

My study focused on the hyperlocal in order to begin gathering ideas about the role of technology in engaging people with their urban parkways and encouraging them to adopt pro-environmental behaviors in support of plant and animal habitat. It is important to do this work both for the preservation of our immediate natural world and to combat our sense of disempowerment and overwhelm when we think about the magnitude of environmental problems. This work offers some suggestions for proceeding.

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Appendices

Appendix A: FOSC Sighting Observation Form

	Report a Sighting on Sligo Creek	 Longnose Dace
Please e-mail photos or other information.		
What did you see or hear? <input type="text"/>		
Where did you see or hear it? Please be specific, e.g. downstream of Maple Ave under the Carroll Ave bridge. Map Location Web page can be used to specify latitude & longitude. <input type="text"/>		
When did you see or hear it? <input type="text"/>		
Your name <input type="text"/>		
E-mail address (optional — will not display on the Sightings page, but will be useful for possible follow-up questions from the webmaster or Natural History group) <input type="text"/>		
Comments <input type="text"/>		
<input type="submit" value="Submit"/>		

Appendix B: Most Recent Sightings Displayed on the FOSC Website

What	Where	When	Reported by	Comments
Blood root flowering; cut-leaf toothwort; Dutchman breeches; and trout lily	Blood root was found blooming in Section 4 below Piney Branch Road and in the woods along Dale Drive above the playing field. The cut-leaf toothwort, Dutchman breeches and trout lily were found in the woods between the Creek and the inside path.	April 9, 2014 (blood root), others on April 16, 2014	James Anderson	There are lots of patches of trout lily in most areas of Sligo Creek Park. Unfortunately, lesser celandine is over growing most areas where there are early blooming plants in Sligo Creek. Photos by James Anderson
Common Ribbonsnake	Trail near the Kemp Mill shopping mall	2:45pm, Sun, Apr 13, 2014	Will K.	Large for the species (30+ inches I think), and very active, moving quickly through the brush near the trail. Healthy-looking animal. Web Photo
American Bittern	Close to the Parkway, just downstream from Schuyler Road, in a tuliptree adjacent to the tree with the Yellow-crowned Night-Heron nest	9:30am-7:30pm, Sun, Apr 13, 2014	Susan Hunt	Seems unusual to see a bittern in a tree but it was quite unmistakable, viewed by many passersby and birders. Web Photo
Two Yellow-crowned Night Herons	Slightly downstream of where Windham comes into the path, in a tree right next to the Parkway - section 8	8am, Thu, Apr 10, 2014	Susan Hunt	They were sitting close together on a small pile of sticks, fairly high in the tree--looks like nesting behavior to me File Photo by Don Olson
Great Blue Heron	Upstream from Dennis Ave, section 8	2pm, Wed, Apr 9, 2014	M. Faigin	Amazing! It's a huge bird! Saw it swallow a large fish in one gulp. Photo by Don Olson May 2009
Kestrels mating, Red-bellied Woodpecker tending nest, Towhee singing, 2 Black Vultures soaring	In the Pepco powerline corridor along Sligo (btw NH Ave and EW Highway)	Sun, Apr 6, 2014	Michael Wilpers	The two Kestrels were on a horizontal branch about 20 feet up across from the 16th Pl entrance to the corridor, along the S border of the meadow. Further W along that border, the woodpecker was venturing into and out of a perfectly round hole at the top (30-ft up) of a decapitated Sycamore. The Towhee was singing from a branch about 15 ft up right where 16th Pl. meet the powerline corridor, but it sooned dashed into dense brush to the east. The vultures were circling high in the sky, eventually disappearing from sight. American Kestrel File Photo
Yellow-crowned Night Herons	Schuyler Road and Sligo Creek Parkway just upstream from Wayne Ave	Tue, Apr 1, 2014	Pamela Maslen	There are two herons nesting together. Photo by Pamela Maslen
Eastern Bluebirds	Section 9 along the bike path at the intersection of the path into the Kemp Mill Shopping Center	2pm, Mon, Mar 31, 2014	Leah Haygood	Two bluebirds (a pair?) were softly singing. Also a Phoebe nearby -- the first I've seen this season File Photo
In flower: Spicebush, Persian speedwell, Corn speedwell, Common chickweed, Purple dead-nettle, Hairy bitter cress, Lesser celandine	Lower Sligo, between New Hampshire Ave. and East West Highway	Sat, Mar 15, 2014	Michael Wilpers	The Spicebush flowers might be males, but difficult to tell as it looked like the reproductive parts had not yet emerged. The celandine is a highly invasive alien. The rest are naturalized non-invasives and were restricted to the mown areas on either side of the paved hiker-biker trail at the Pepco powerline corridor. Photos by Michael Wilpers
A bat	Between Univ. Blvd and the Dennis Ave. recreation area, flying south over the Parkway	Dusk, Mon, Mar 10, 2014	Michael Wilpers	The bat had a wing span of about 10-12 inches and a fairly steady flight path approximately 15-20 feet above the Parkway. It was flying south about 100 feet in front of my car and stayed directly above the Parkway for about 200 yards before I lost track of it. All our bats (7 species considered "expected" or "possible") are insectivores, so it seems likely that some adult moths are already flying about. Bats of Sligo Creek
Smooth Alder bush (Alnus serrulata)	Just below the first parking lot downstream (south) of Univ. Blvd., on the right (stream) side of the Parkway	Mon, Feb 17, 2014	Michael Wilpers	This shrub in the Birch family is listed as "uncommon" in the 2003 inventory of native plants of Sligo. I hadn't seen it here before. The dried fruits look like tiny pine cones. This particular plant had retained most of its leaves (all gnarled up), even at this late date(see photo), like some Ironwood trees I noticed this year (C. caroliniana), also a birch. Photo 1 by Michael Wilpers Photo 2 by Michael Wilpers
Pair of Red-tailed Hawks	Atop a snag (dead tree) at the Kemp Mill stormwater ponds, located just north (upstream) from Univ. Blvd.	Dusk Mon, Feb 17, 2014	Michael Wilpers	I've seen Red-shouldered Hawks here before but this my first Red-tailed. I didn't notice them in the dimming light until one of the pair flew off. Thanks to Susan Hunt for help with the ID. Photo by Michael Wilpers
Active Hawk Nest	between Park Valley Rd and Piney Branch	Sat, Mar 8, 2014	Kit Gage	Huge nest, high up in a medium sized sycamore tree. Will try to determine the kind of hawk. Photo by Kit Gage

Appendix C: IRB-Approved Interview Consent Form

Project Title	Exploring and Enhancing Local Green Spaces Through Technology
Purpose of the Study	This research is being conducted by Carol Boston, with faculty advisors Jennifer Golbeck and Marshini Chetty at the University of Maryland, College Park. We are inviting you to participate in interviews related to this research project because of your experience in the area of parks and/or habitat preservation and/or sustainable practices. The purpose of this research project is to understand how technology can be used to encourage people to explore their local parks and trails and make beneficial changes to support plant and animal life.
Procedures	<p>The procedure involves participating in an in-person or phone interview conducted by the investigator at a time and place of your convenience to clarify survey responses and/or gain a more in-depth understanding of the research topic. Interviews are expected to last between 10 minutes and 45 minutes, with the shorter times for typical park users and the longer times associated with experts in the area of parks, habitats, and sustainable practices. You may see the questions in advance if you wish; sample interview questions include:</p> <ol style="list-style-type: none"> 1. If you wanted to look up information about a plant or animal species found in this area, where would you look? Why? 2. What is your current level of use of parks and trails? Which of the following, if any, might encourage you (or others—if you work in the area of parks and recreation) to spend more time in a park or on a trail? <ul style="list-style-type: none"> Participating in an organized event or project Going with a guide Going with a friend or family member Knowing more about the plants and animals I might see Getting some kind of reward or prize for participating (such as _____) Being able to use some type of mobile device <p>The investigator may take notes on paper or computer as you speak.</p>
Potential Risks and Discomforts	There are no risks from participating in this research study.
Potential Benefits	There are no direct benefits to you from participation in this research. However, the results may help the investigators learn more about how technology can be used to entice/engage people to explore their local parks and trails and make beneficial changes in their own backyards and balconies to support plant and animal life. The data collected may someday help in the development of a website or app that supports such efforts.

Confidentiality	<p>Only the Principal Investigator, Carol Boston, and advisors Jennifer Golbeck and Marshini Chetty, will have access to all collected data. Any potential loss of confidentiality will be minimized by storing interview notes in print form in a locked office, and using a password-protected computer for notes transcribed online.</p> <p>If we write a report or article about this research project, your identity will be protected to the maximum extent possible. No participant will be identified by name in any report of the data. Your information may be shared with representatives of the University of Maryland, College Park or governmental authorities if you or someone else is in danger or if we are required to do so by law.</p>
Right to Withdraw and Questions	<p>Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.</p> <p>If you decide to stop taking part in the study, if you have questions, concerns, or complaints, or if you need to report an injury related to the research, please contact the investigator:</p> <p style="text-align: center;"><i>Carol Boston</i> <i>Room 4105, Hornbake Building South Wing, College Park MD 20742</i> <i>301-204-3675; cboston@umd.edu</i></p> <p style="text-align: center;"><i>Faculty Advisors: Jen Golbeck, 2117K Hornbake Building, South Wing,</i> <i>College Park, MD 20742</i> <i>301-405-7185; golbeck@cs.umd.edu</i></p> <p style="text-align: center;"><i>Marshini Chetty, 2117K Hornbake Building, South Wing</i> <i>College Park, MD 20742</i> <i>301-405-2043; marshini@umd.edu</i></p>
Participant Rights	<p>If you have questions about your rights as a research participant or wish to report a research-related injury, please contact:</p> <p style="text-align: center;">University of Maryland College Park Institutional Review Board Office 1204 Marie Mount Hall College Park, Maryland, 20742 E-mail: irb@umd.edu Telephone: 301-405-0678</p> <p>This research has been reviewed according to the University of Maryland, College Park IRB procedures for research involving human subjects.</p>
Statement of	Your signature indicates that you are at least 18 years of age; you have

Consent	<p>read this consent form or have had it read to you; your questions have been answered to your satisfaction and you voluntarily agree to participate in this research study. You will receive a copy of this signed consent form.</p> <p>If you agree to participate, please sign your name below.</p>	
Signature and Date	NAME OF PARTICIPANT [Please Print]	
	SIGNATURE OF PARTICIPANT	
	DATE	

Appendix D: Semi-Structured Interview Questions

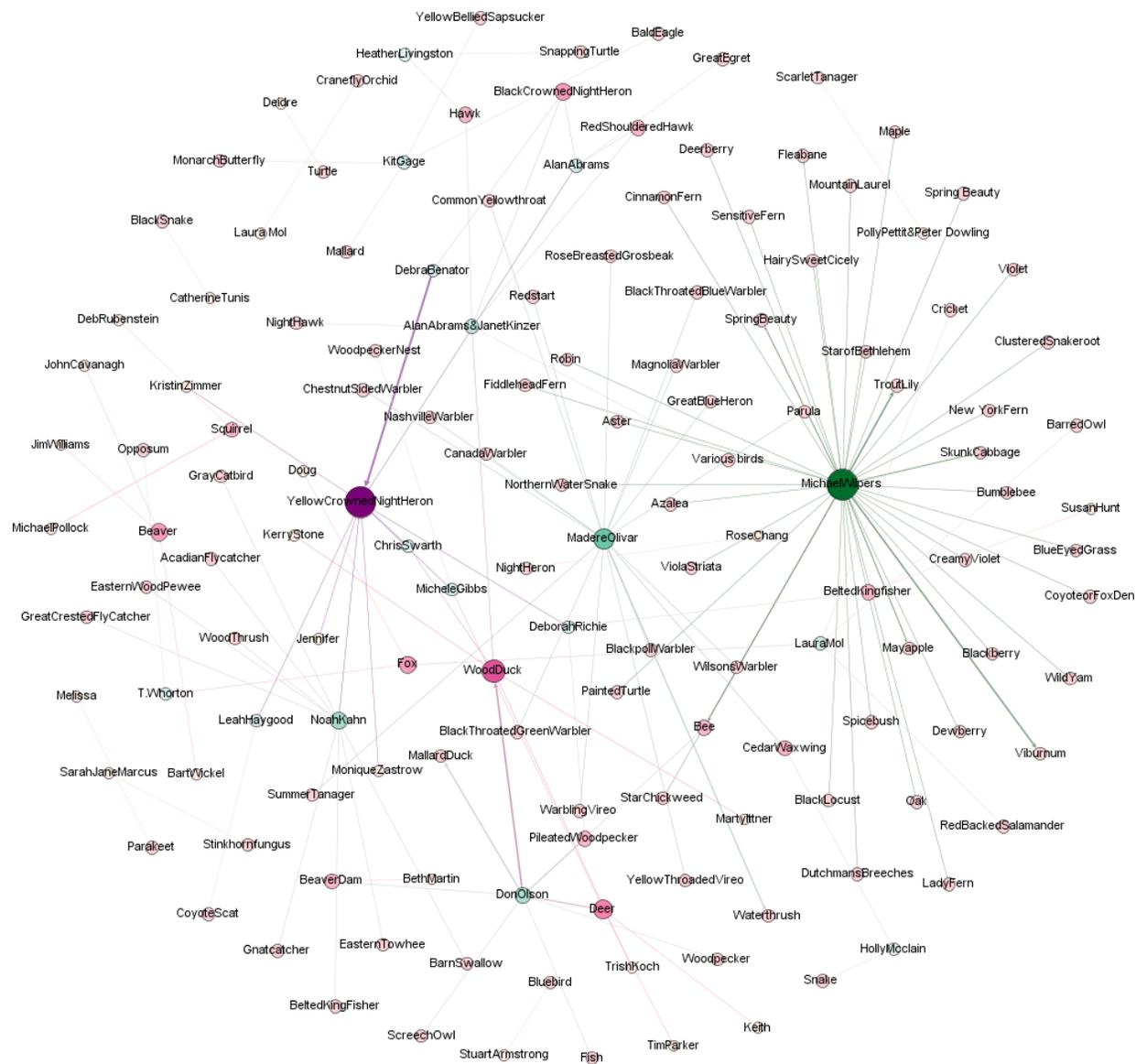
Park staff

1. Can you talk a little about the demographics of park and trail use? What groups are most and least likely to be frequent users of parks and trails? What activities do they like? Are there seasonal patterns?
2. You've been a _____ at _____ for _____ years. During this time, have you seen changes in who spends time in parks, how long they spend, and what they do there? What do you think contributes to that?
3. The parks have great pockets of native plants and wildlife. What do you think the level of interest is among park-goers to observe, whether formally or informally, by writing in the visitor's log, making notes for themselves, or taking pictures?
4. What are some of the most interesting plants and animals you've observed? Are there any rare or delicate species that you would like to protect by not drawing attention to them? Where might you advise people to look if they want to find out more about animals, plants, insects, or birds in our area?
5. What are your impressions of citizen science/public participation in scientific research/ collaborative science projects in the parks? Have you had any firsthand experiences where visitors assist scientists that you can share? Where do you see the value? The challenges?
6. Technology is increasingly important to people yet there is ambivalence about its value in a natural setting. What do you think about its role in helping people get involved in nature? Can you describe any particularly effective or ineffective ways you have seen it used?
7. Turning to your own use of technology related to nature—either in your private or professional life—can you give me some examples of websites, apps, communities, or activities that you find beneficial? What makes them work for you? How could they be even better?
8. Parks and trails often have the dual purpose of encouraging outdoor recreation and protecting habitat. If you were in charge, and resources were limitless, what kinds of changes could you imagine making to realize your vision for the way things should be, both to encourage human use and support plant and animal life (probe on any details gleaned from answers to above questions—lend sensors for collecting data? More camping for city kids? etc.)?
9. Do you have any ideas about what local residents might do in their own homes and backyards that would also help support habitats in the parks?

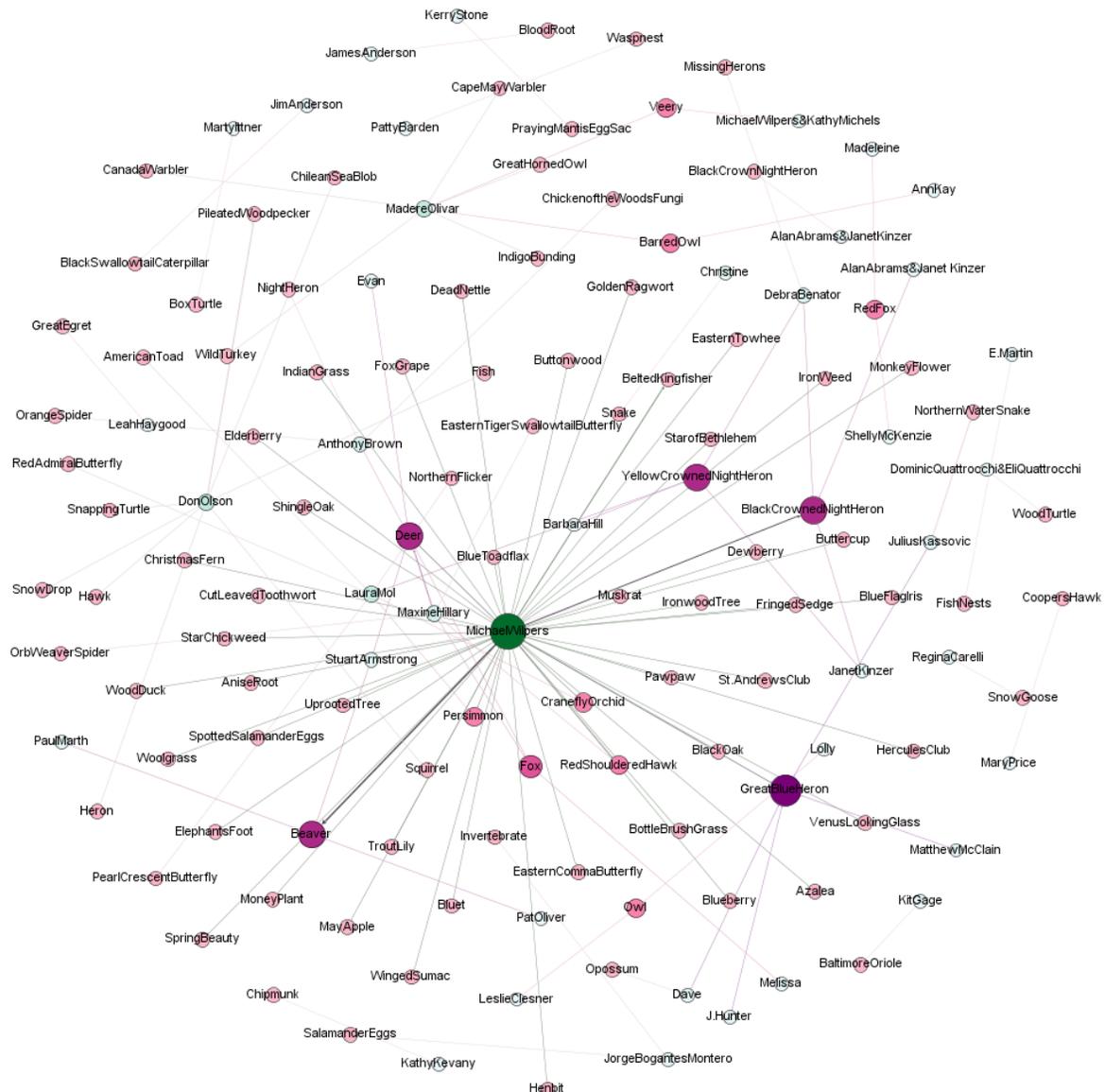
Habitat experts

1. How would you describe the current level of awareness and interest among the people with whom you are in contact on the issue of backyard planting to improve habitats and increase biodiversity? Have there been changes in recent years? If yes, to what do you attribute them?
2. There can sometimes be a knowledge gap between what people want to do (or think they should do) and what they actually do. Have you seen this? What do you think that is about? Are there ways to help people get started? How about sustaining motivation over time?
3. In our area, many people live in apartment houses or rentals and may not be able to make wholesale changes to their outdoor spaces. What would you advise them to do? How about people on very tight budgets? If you could give homeowners one piece of advice, what would it be?
4. People get their plants from lots of places. What do you think the responsibilities of commercial nurseries, mail order catalogs, farmer's markets, and grocery stores/hardware stores are when it comes to educating people about planting to improve habitat?
5. Turning to the role of technology in supporting planting for local habitats and biodiversity, can you give me some examples of websites, apps, communities, or activities that you find beneficial? What makes them work for you? How could they be even better?
6. I'm interested in creating a design prototype that would let people see how their backyards and apartment balconies are individual pieces that link to public parkways to form wildlife corridors. (Explain more.) What are your first reactions to that? Do you have advice, suggestions, and/or ideas about someone else with whom I should talk?

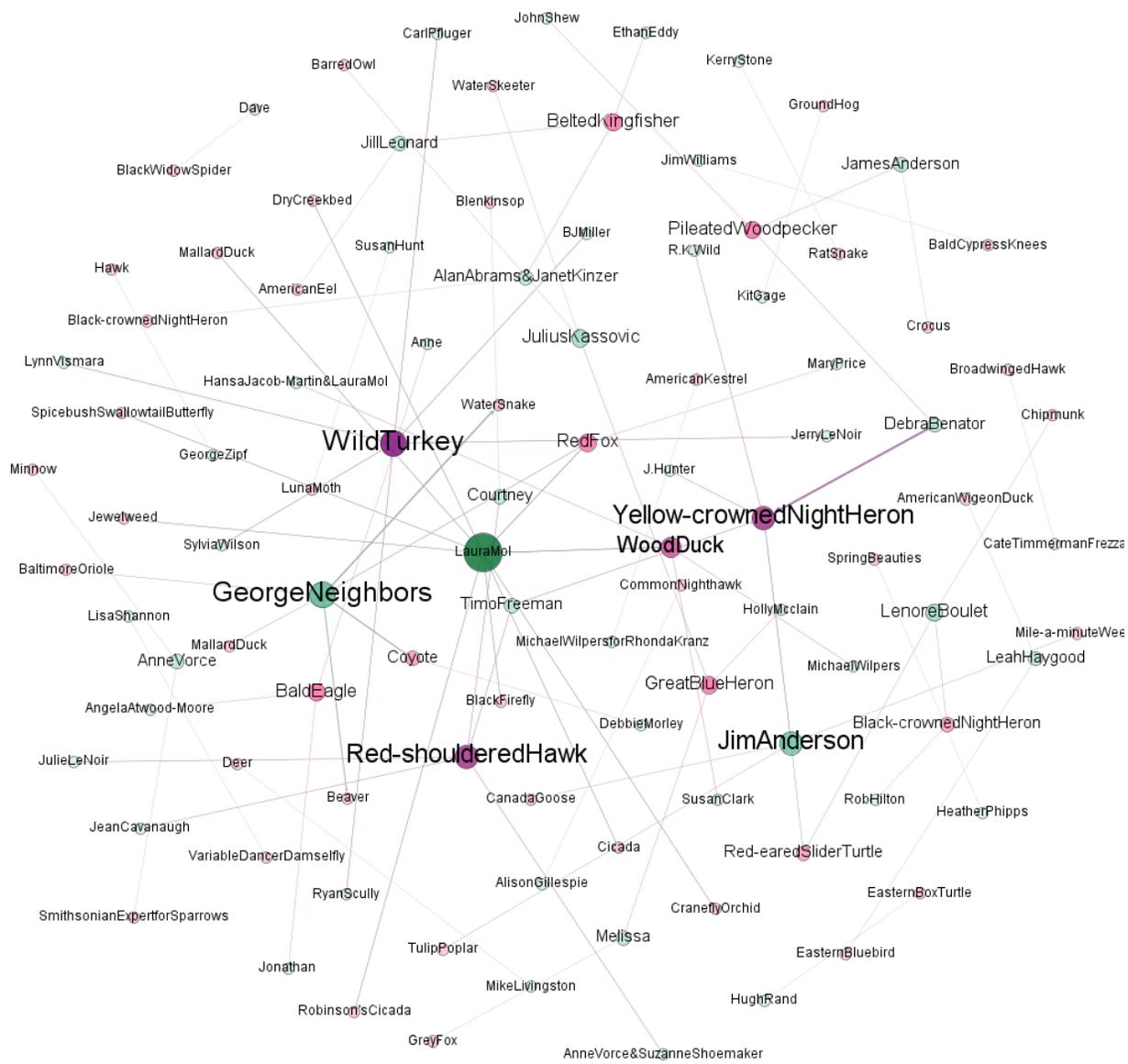
Appendix E: Information Visualizations of Sightings



2011 FOSC Observations



2012 FOSC Observations



2013 FOSC Observations

