iNaturalist: Understanding Biodiversity Through a Digital Medium

by

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A thesis

presented to the University of Waterloo

in fulfillment of the

thesis requirement for the degree of

Master of Arts

in

Public Issues Anthropology

Waterloo, Ontario, Canada, 2018

Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Much of the current excitement about citizen science is due to the innovative use of internet-based media platforms. These are designed to enable data production while seeking to be instructive or even entertaining for its users. The present thesis demonstrates how these two distinct uses can be in a tension, and how users seek to resolve it. It draws on an ethnography of uses of iNaturalist, a digital platform promoted to document biodiversity by BioBlitz Canada, at the Ontario BioBlitz at Rouge National Urban Park in Toronto, and the *rare* Community BioBlitz in Cambridge. Through interactions with the diverse members of these events, I have found that the opinions surrounding new media and citizen science vary significantly and that users adopt specific techniques to circumvent the challenges they experience with a given medium.

Acknowledgements

I would like to thank my supervisor, Götz Hoeppe, for guiding me through my research and helping me understand the data I collected, the faculty of Arts and department of Anthropology for giving me the opportunity to do this research, and my cohort with whom I discussed my project and gave feedback when necessary.

I would also like to thank the members of the BioBlitzes and the organizations involved including the Royal Ontario Museum, Canadian Wildlife Federation, *rare* Charitable Research Reserve, and the Centre for Biodiversity Genomics for taking the time to speak with me and allowing me to attend their meetings.

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How is science understood and how is it communicated? Recently, researchers have found that it is vital to inform the public about science and help them understand it, and to include them in the process of producing knowledge and facts. While the concept of using citizens to contribute to science is nothing new, the internet has enabled citizen science events to increase in number. Citizen science, even if it was not named so, has been prominent in bird studies since at least 1900 with the introduction of the annual Christmas Bird Count by the National Audubon Society. During the twentieth century, individuals began counting a number of other species, monitoring water, and counting stars (Dickinson and Bonney 2012, 4).

As a point of study itself, citizen science began as the efforts of scientists to inform relevant citizens about scientific knowledge that might concern them. Alan Irwin (1995) discussed citizen science in terms of how industry scientists could inform the general public about scientific matters that scientists and, especially, members of the public found to be important. For example, in Britain in the 1980s, a leaflet explaining emergency procedures was given to specific residents that scientists from the nearby factory deemed significant (Irwin 1995, 24–25). Similarly, there was a debate in 1990 about "mad cow disease," where some scientists had differing opinions regarding the risks involved compared to those of the general public (Irwin and Wynne 1996, 2). The focus of "Citizen Science" in the 1990s was more about how science was distributed and interpreted by citizens, but this began to change near the end of the decade with events such as the BioBlitz which started using the general public to acquire data.

Today, citizen science is often defined as "people who have chosen to use their free time to engage in the scientific process" (Dickinson and Bonney 2012, 1). These people can be incredibly diverse, even within the context of a single project studying biodiversity, such as the

BioBlitz. Those involved with the BioBlitz are, therefore, a specific group of people, but biodiversity is a matter that concerns a larger public including small groups of twenty people and large events comprised of hundreds of participants. Biodiversity has become a public issue that requires the attention of social studies. Who gathers biodiversity data, how do they gather it, and how is the public incorporated into the scientific process? To answer these questions, it is important to look at the specific groups involved who attempt to understand biodiversity and communicate knowledge about it to those both within and outside of those groups. Specific groups have specific problems they want resolved and it is, therefore, relevant from an anthropological perspective to identify who these groups are and what they want. Facts are not always obvious and taken at face-value, and they can be interpreted differently by the various social groups involved. As Mark Brown (2009, 139) writes, "people tend to view facts in light of their favored doctrines," which can lead to skepticism. Bringing in the citizen allows the private institution of science to become public. Rather than scientists privately representing knowledge themselves to the public (Brown, 2009, 141), events such as the BioBlitz allow citizens to publicly represent the scientific data being produced. "Citizen Science," however, is not the same thing as "Finished Science." Citizens may produce valuable and reliable data, but this data must be compared and analyzed to produce conclusions, which is frequently done by expert scientists. Citizens, according to John Dewey (Brown 2009, 150), "need to learn to judge when and how expert knowledge might contribute to the resolution of public problems." Issues of conservation and environmental problems facing the wider public can be better understood with the input of the citizen, which can be achieved through proper communication between expert scientists and the general public.

This communication and understanding can only be collectively interpreted through the media used to document biodiversity. It allows everyone to agree on the system used to classify biodiversity and understand the similarities and differences between species, i.e. taxonomy. Media enables biodiversity to be collectively understood by the wider community and makes the knowledge produced durable (Goody 1968, 1; Krämer 2003, 523–524; Latour 1986; Latour 1991; Müller-Wille 2013, 310; Müller-Wille and Charmantier 2012, 743–744; Ziewitz 2016). Media to collect data and media to instruct others about biodiversity are important factors in science and technology studies, but combining these two tasks into one medium can create a tension that the users of that medium must overcome in order to arrive at a collective understanding of biodiversity.

What is a medium? While a medium can be the coaster in between the beer mug and the table on which is rests, the quotidian understanding of "the media" is the way people receive information: the news on television, reading the newspaper, and social media, to name a few. According to John Durham Peters (2015, 2), "Media are the means by which meaning is communicated." Knowledge relating to biodiversity, therefore, is communicated through media. Media are a frequent point of interest when discussing science. As science and technology have progressed, so have the media used to document, instruct, visualize, and communicate. Media have been used to represent the information and raw data that science discovers, and transforms it into useable material for other expert and citizen scientists to progress in the field and in the lab. Raw lab data can be translated into other media: notes become sentences and sentences become paragraphs. This must then be arranged in a way that will properly communicate with the user, who has not experienced the raw data, and it is interpreted by them based on their own knowledge and personal history (Becker 2008, 20–26).

New media, including smartphones and internet-based web applications, introduce a whole new way to connect with others, and not just in the scientific community. Madianou and Miller (2012) analyzed the media used by transnational families to communicate between the United Kingdom and the Philippines. With the introduction of the internet, social media has allowed people around the world, including expert and citizen scientists, to become better connected. The internet, as Triezenberg *et al.* (2012, 216) write, "has changed how people assemble information, how they interact, and the distance over which they can effectively collaborate." How has this affected the communication between different social groups, including expert and citizen scientists who are collecting data and further instructing others?

I have chosen *Public Understanding of Science* (*PUS*) as the academic venue for possible publication. Published by *SAGE Publishing*, which issues a variety of journals encompassing a diverse set of subject matter, *PUS* is the most suited to Public Issues Anthropology and Science and Technology Studies. Authors such as Bonney *et al*. (2016) have published in this journal when discussing citizen science, and this research would sit nicely alongside them. Understanding biodiversity is a form of understanding science, but the incorporation of citizens in the research process moves understanding from the private area of expert scientists, keeping to themselves and representing science to the public when necessary, to a more public area, including a range of people of diverse skill-levels. Citizen science projects such as the BioBlitz seek to help the public understand science and be more involved with contributing to science. With these themes in mind, I believe this academic venue would be a perfect fit for a possible publication.

Chapter 2
iNaturalist: Understanding Biodiversity through a Digital Medium

1. Introduction

Citizen science is becoming an interesting part of scientific research where non-expert citizens engage in the scientific process (Dickinson and Bonney 2012, 1). But how do they contribute to science? What is citizen science? The concept is broad in scope and its meaning has changed over the years. While science has largely been the work of specialists who have dedicated their lives to a particular discipline, there has frequently been a need to include non-specialists in their research. The inclusion of the citizen is nothing new and dates back at least as far as Aristotle, who said, "Each individual may indeed be a worse judge than the experts; but all, when they meet together, are either better than experts or at any rate no worse" (Aristotle 1995 in Brown 2009, 135; Bonney and Dickinson 2012, 19). Therefore, the history of citizen science is long, but the term has become more widely used only in the last two decades.

In the 1990s, citizen science was often equated to democratizing science. Alan Irwin (1995) discussed the ways in which scientists reached out to include citizens in discussions related to risk and environmental threat (Bonney *et al*. 2016, 3). Similarly, Bryan Wynne and Alan Irwin (1996) put together a collection of articles discussing the bridge between science and the general public in situations relating to health, hazards, and the environment, and how citizens know and obtain information on relevant topics. Alternatively, the concept of citizen science can involve the inclusion of citizens in the gathering, submission, and analysis of scientific data (Bonney *et al*. 2016, 3). While the term may not have been used, citizen science has been prominent in bird studies since at least 1900 with the introduction of the annual Christmas Bird Count by the National Audubon Society where bird watchers of varying skill levels count the number of birds they see in a particular area (Dickinson and Bonney 2012, 4).

The media chosen to aid with and perform scientific analysis is crucial to both expert and citizen scientists. In particular, the explosion of the internet and the social web has allowed online citizen science to flourish within a number of applications and websites whose projects are diverse in topic. For example, a popular astrophysics project using citizen science is Galaxy Zoo.[1] With 100,000 participants as of 2008, the general public was able to accurately identify 300,000 galaxies (Lintott *et al.* 2008, 389). Therefore, not only do online platforms allow citizens to inform themselves on scientific matters of interest to them and give their own feedback on those matters, they are also able to contribute reliable data to that field of science.

In citizen science, what difference does the choice of media make? This thesis considers this question and the tension media create between producing reliable data and instructing citizen scientists about a particular science. Specifically, research revolved around the media used in an environmental project known as the BioBlitz. This event brings experts and citizens together at a specific time and location to both produce data to study biodiversity and to educate the public about it. While paper lists have been a commonplace to record biodiversity, new media have been introduced that make use of online citizen science, one being iNaturalist which was used for the BioBlitz Canada 150 events in 2017. What possibilities for action do different online-based media contain that affect expert and citizen scientists' choice of media?

To answer this question, fieldwork took place at the Ontario BioBlitz, which occurred on June 24 and 25 at Rouge National Urban Park in Toronto, as well as the *rare* Community BioBlitz on July 15 and 16 in Cambridge. The former was a so-called Flagship event with approximately 700 participants from around the Greater Toronto Area, while the latter was a smaller event run by the *rare* Charitable Research Reserve. Members of diverse social groups

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[1] All websites are listed under "Website References" at the end of this paper.

participated in these events to understand biodiversity and negotiate the use of the media that are used to do so, including iNaturalist, the central focus of this research.[2]

The website, iNaturalist.ca, was launched in 2015 by the Royal Ontario Museum and Canadian Wildlife Federation as another tool for producing data on biodiversity and instructing citizens scientists about it. It has slowly been gaining popularity in the Ontario BioBlitz and in 2017, BioBlitz Canada, overseeing and funding 35 BioBlitz projects across Canada, made it mandatory to upload all observations to the website, but how do the uses of other media change with the introduction of a new digital medium and how does this affect the knowledge generated? There are multiple social groups including the steering committees and the participants when considering how the use of media is negotiated at an event such as a BioBlitz?

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[2] See *Appendix A – History and Structure of the BioBlitz.*

2. Background

2.1 – Biodiversity

What is biodiversity? Originally conceived as "biological diversity" in 1985 (UNEP 2010), it has been defined simply as "species richness" in textbooks like Krebs' *Ecology* (2001). This was expanded upon in the factsheet, *What is Biodiversity?*, from the United Nations Environment Programme (UNEP) as "the variety of life on Earth, it includes all organisms, species, and populations; the genetic variation among these; and their complex assemblages of communities and ecosystems" (UNEP 2010). With these definitions in mind, how is biodiversity studied? It is frequently quantified by counting the number of species (Krebs 2001, 434), but it is also a matter of instructing and engaging citizen scientists and the general public. Data production through species counting as well as instruction of citizen scientists can be achieved through the use of various media, but sometimes one medium can be used to perform both tasks.

Over the centuries, different media have been used to document the diversity of life on Earth, all of them forms of writing. Writing is a notational medium that visualizes language and thought and is often manipulable and affords cognitive uses (Krämer 2003, 523–524). It can also "be transmitted over space and preserved over time" (Goody 1968, 1; Latour 1986). Some of the first media to represent information about biodiversity were the lists written on paper by Carl Linnaeus (1707–1778). The list "was a handy means to present and preserve knowledge in a concise and structured yet open-minded manner" (Müller-Wille and Charmantier 2012, 743–744). These lists enabled Linnaeus to develop a system of classification, which can only "be accomplished by the collective, empirical work of generations" (Müller-Wille 2013, 314). It is therefore important to write lists in order to develop our knowledge of biodiversity. Indeed, as Müller-Wille (2013, 310) insists, "cultures without writing obviously have no 'system' in the

sense of modern taxonomy."[3]

2.2 – Media Choices and Affordances

For the purposes of this paper, with its focus on a setting that is rich in diverse forms of media, including writing on paper and a web application like iNaturalist, I will follow in Madianou and Miller's (2012, 104) footsteps and "leave behind some of the conventional distinctions between technology, medium, platform and application." While there is much debate over what these terms mean, I will stick with a rather simple definition: "Media are the means by which meaning is communicated" (Peters 2015, 2). How do the participants of the BioBlitz choose between the media available such as paper lists, guidebooks, and internet-based applications including iNaturalist? Furthermore, how are they used to both produce scientific data the experts can use while also instructing citizens about biodiversity? Lists have now taken form though other media, including the digital, but the paper list is still very prominent in biodiversity recording. Whether paper or digital, BioBlitz participants make media choices which can influence the data produced and the way citizens are educated, but these media are different and each allows for a certain set of actions.

In their book *Migration and New Media: Transnational Families and Polymedia* (2012), Mirca Madianou and Daniel Miller discuss how the individuals they studied made a choice among a multitude of media in order to communicate with other family members, a choice that is dependent on the medium's own affordances (Hutchby 2001). For example, voice-based communication such as calls between mobile phones are synchronous and highly interactive. On

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[3] The exact definition of "taxonomy" changes from source to source. For my purposes, taxonomy is "a specific classification scheme that expresses the overall similarity between organisms in a hierarchical fashion" (Rich 1992, 761).

the other hand, text messages do not afford so much interactivity but they are able to be stored so the recipient can view them later (Madianou and Miller 2012, 123). While both media allow the users to communicate with one another, each one contains certain possibilities for action (Hutchby 2001) that affect the user's choice to use it. Some participants may choose a phone call over a text message because they can immediately interact with their loved ones, while others may prefer a text message they can read over and over again.

Ian Hutchby (2001) suggests it is a medium's affordances that need to be considered when a social group is choosing a medium to use. Psychologist J.J. Gibson (1979, 127) argued that affordances of an object are what it offers, provides or furnishes, whether good or bad. In other words, their possibilities for action; they "*constrain the ways that they can be 'written' or 'read'*" (Hutchby 2001, 447). They "may differ from species to species and from context to context" (Hutchby 2001, 447), or even from social group to social group. A bridge, for example, does not offer all the same possible interpretations as an airplane. Meanwhile, written lists, whether paper technologies or digital media, afford preservation and transmission which afford common understanding. Therefore, when attempting to understand biodiversity, the use of a medium, such as iNaturalist, is dependent on its associated affordances and the social groups involved.

2.3 – *Alternative Perspectives: Technological Determinism and Social Constructivism*

Hutchby (2001) argues that affordances stand in between two positions that have been dominant in social studies of technology: technological determinism and social construction of technology. Technological determinism is that a medium will actively cause social relationships to develop (Hutchby 2001, 442). This has been the default position in much of anthropology and

archaeology, especially in discussing past civilizations when speaking of the "stone" or "iron" ages (Wyatt 2008, 167). Hutchby points to Toffler and Poster for discussing the importance that technology has had on social populations. The current "era of electronic mediation" (Hutchby 2001, 442) or "computer age" (Wyatt 2008, 167) is a great influence on our own understanding of ourselves. While media may be made to be used in a specific way which may then change the way people view the world, this view neglects to take into consideration the interpretive accounts of the social groups using a medium.

Opposing this view of technological determinism is social constructivism, where media appear to both the creators and users as *tabulae rasa*, or blank slate (Hutchby 2001, 446), and "explanations for the genesis, acceptance and rejection of knowledge-claims are sought in the domain of the Social World rather than in the Natural World" (Pinch and Bijker 1984, 401). Each technology, whether the bicycle or the camera, contains its own history determined by the social groups who use it (Pinch and Bjiker 1984; Latour 1991). While important, this often fails to notice how certain media are unable to perform certain tasks. For example, there are many similarities between a telephone and a slot machine, but only one of them can be used to speak with someone a great distance away (Hutchby 2001, 446).

While the perspectives of technological determinism and social constructivism each maintain a certain level of validity relating to the interaction between technology and society, studying media use from the perspective of affordances falls in between the extremes of the two. Using Hutchby's (2001) description of affordances, participants' use of media during the BioBlitz can be analyzed based on a medium's possibilities for action that the users find most appealing to produce biodiversity data used by experts, instruct citizens, or both.

2.4 – Remediation

More than one medium is often available to study a phenomenon such as biodiversity. With the introduction of a new medium, remediation becomes possible, where one medium represents another or represents the contents of another. For example, biodiversity was first documented using paper and pencil but after the development of the smartphone, this task can also be done using digital technology. While multiple media may have similar affordances the users of those media must consider why one offers a more appropriate representation than another, depending on the task at hand (Bolter and Grusin 1999, 44). If users find that a digital medium replaces paper lists seamlessly to the point where the medium is "transparent," then it can be interpreted as immediacy, but if users find that it is obvious that they are using a new medium with a number of different options that get in the way of this transparency, then it has achieved hypermediacy (Bolter and Grusin 2000, 23–24, 33–39). The choice of medium is also dependent on a social group's media literacy, defined by Livingstone (2004, in Madianou and Miller 2012, 156) as the "ability to access, analyze, evaluate, and create messages in a variety of forms." The combination of a medium's affordances and the socio-cultural media literacy affects its use for a particular task.

Once a social group has accepted a medium to use for producing data, instructing citizens, or both, the knowledge produced using it can be distributed and accepted. Writing, lists, and internet-based applications have helped the social groups of the biodiversity community make this knowledge durable (Latour 1991; Ziewitz 2016). Therefore, how do the diverse participants of the BioBlitz assess different media to understand biodiversity, and what are the affordances of these media that aid in the durability of biodiversity knowledge? Analyzing a citizen science project such as the Ontario BioBlitz will help to make sense of this.

3. Understanding Biodiversity at a BioBlitz

In this section, I describe my empirical material and interpret it in the context of how members of a BioBlitz understand biodiversity through media. On June 24 and 25, 2017, I attended the Ontario BioBlitz at Rouge National Urban Park in Toronto, Ontario. I had registered for each of the seven sessions that weekend. I also attended the *rare* Community BioBlitz in Cambridge on July 15 and 16, where, in addition to Guided BioBlitzes, I joined the Intensive Insect Survey for a couple hours. Before the Ontario BioBlitz, a survey was distributed to the steering committee and, after the event finished, another was distributed to its participants. Finally, before and after the two events, interviews were conducted with steering committee members and participants from both events.[4] This material can be used to analyze iNaturalist, an internet-based medium used to produce data and instruct participants about biodiversity. I will begin by discussing the social groups involved with the BioBlitzes I attended.

3.1 – Social Groups at the BioBlitz

Who is involved with the BioBlitz? Each social group's motivation for participating can be vastly different, whether to produce hard data for future use, or to instruct themselves so they can effectively contribute to biodiversity research. Members of the Ontario BioBlitz and *rare* Community BioBlitz steering committees, and the participants of the Intensive Surveys and Guided BioBlitzes are important groups which may each react differently to the use of iNaturalist, citizen science, and the BioBlitz itself. Some are more interested in producing data while others are more interested in instructing or learning about biodiversity.

In the survey sent to the participants of the Ontario BioBlitz, a question asked what their

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[4] Listed in *Appendix B*.

motivation was for participating in the BioBlitz. Many noted their desire to produce data and initiate engagement between scientists and the general public, which can lead to instruction and education. One survey participant wrote:

> "The value of citizen science and raising awareness about all of the nature around us, being able to find it, appreciate it and share it with others is valuable for people to desire to help CONSERVE it. Wildlife conservation work is only successful if we focus on the PEOPLE aspect of it."

For some, education, whether of themselves or of others, is enough for them to participate. Others find themselves there because someone else told them to attend, such as their employer or their friend. In an interview with a participant, they said they attended because of their roommate, both of which are in an environment program at their school. They said, "We're roommates so she just kind of dragged me along to do it. I'm glad she did though, it was really fun. I hadn't heard of it other than from her." They went on to say that the experience had influenced them to produce data for biodiversity and potentially continue to use iNaturalist.

I encountered other motivations during the Forest Birds Guided BioBlitz. The session focused on developing citizen science skills and I discovered from the leaders that it was common when birding to desire more eyes and ears to observe birds in the area. The leaders instructed the participants on the different methods for producing data on bird biodiversity,[5] and explained that a BioBlitz is useful for conservation and monitoring population trends. Alternatively, a participant who emigrated from China said that an event such as the BioBlitz is a great way for immigrants to not only understand the new environment they live in, but also to do it as a family and connect with other members of the community. While a BioBlitz can be used to

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[5] This includes collection, banding, and point count. Point counts have two different methodologies: fixed location and area search. Guided BioBlitzes are an area search.

understand biodiversity, it can also be used to make connections and network, but many are still

concerned with data production.

Data entry and consolidating is an important aspect of studying biodiversity. One steering

committee member stated that "...from a data entry perspective, this is my third BioBlitz,

certainly post-event data entry was way down from other years, so that was amazing to have."

With everyone inputting the data themselves using iNaturalist, rather than submitting everything

to one person who must then transfer it all to a spreadsheet, the amount of time to finalize the

species count can be greatly reduced, but some question the quality of the data provided by

citizen scientists and iNaturalist. In the surveys that I distributed to the steering committee and

participants of the Ontario BioBlitz, some of them rated citizen science as being less useful than

others, largely because of the lack of reliability in the data they provide. In some cases, their field

of expertise was a factor in their decision.[6]

A few members the steering committee are also part of specific taxon groups. Some of

those groups work really well with iNaturalist, while others are less inclined to consider it useful.

One steering committee member said,

> "There's a lot of birds, particularly spiders, insects, lichen and fungi that were
> more challenging to use iNaturalist, some from the perspective of: it was time
> consuming or tedious to get good quality photos and it took away from the public
> engagement side; people wanted to spend more time learning about it and less
> time taking well suited photos for ID."

Similarly, another steering committee member said,

> "[W]hen you're hiking for half an hour to an hour to get into a site to set up traps,
> and then you have to hike back out after you set them up, if you slow down to
> take pictures of every insect along the way, it really slows you down...[T]here's

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[6] Entomologists in particular are less inclined to trust citizen science contributions since a photograph is not enough
     to produce reliable data.

only so much time and if you're trying to do both survey collecting and the iNat thing…it's not an efficient use of your time when you're surveying insects."

On the other hand, many agreed that plants, mammals, and reptiles and amphibians are all suitable taxa to document using iNaturalist. Meanwhile, many insects, spiders, lichen, and fungi are much more difficult to identify from a photograph, making iNaturalist unreliable to use on its own.[7]

Across these taxon groups, there are those that completely support the use of iNaturalist as a medium to produce data and others that think it is a waste of time. Since its introduction to the Ontario BioBlitz in 2014, it has slowly been gaining popularity, but there has never ceased to be opposition to its use. Prior to the Ontario BioBlitz, one steering committee member explained:

"Initially, in 2014, the pushback [we] got from the scientific community, specifically the scientists at the ROM, around iNaturalist was significant. They did not want it. They thought it was a gimmick. They didn't think it was appropriate to the research. They didn't think it was encompassing of the way they collect data, and so there's been a huge resistance to iNaturalist, even […] within the ROM, and continues…The uptake in 2014, might have been 5% of our users contributed to some iNaturalist observations. 2015, maybe 10%. 16 maybe 13 [or] 15%, and this year we're really hoping to break that 25 or 50% level of all of our registrants actually downloading and using iNaturalist."

With the structure of the BioBlitz, if scientists do not conceive of iNaturalist being beneficial to understanding biodiversity, they are less likely to instruct citizen scientists about it.

With this information on the BioBlitzes and the social groups involved, how is the use of an internet-based medium such as iNaturalist negotiated among them? By considering the medium's affordances and the social groups negotiating them, we can discuss how members of the BioBlitz events understand biodiversity. In the following, I describe the process of the Forest

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[7] Collection methods are an important part of understanding biodiversity. For a brief description of collection methods and their importance, see *Appendix C*.

Birds Guided BioBlitz at the Ontario BioBlitz and the Intensive Insect Survey at the *rare* Community BioBlitz.

3.2 – A Guided BioBlitz and Intensive Survey

The Forest Birds Guided BioBlitz started at 8:00AM on June 25, 2017. Our group was led by an expert and their assistant. Guidebooks were handed out and the leaders took time explaining how to use them, and then described the pros and cons of the different books and media available. The group was told that some are more advanced, such as *Sibley Birds East* (Sibley 2016), while others are better for novices, such as *Sibley's Birding Basics* (Sibley 2002). Some books may also come with Quick Response codes which can be scanned by a smartphone to open a webpage, or a CD with birdsongs so the observer can become familiar with bird calls before they head out into nature. Internet-based smartphone apps were also mentioned, including iBird Pro (iBird 2012), which one leader said they used. In terms of recording data, while the expert was pointing out the birds they were seeing and hearing, the assistant was making a list on a blank piece of paper. There are printed lists provided by the steering committee to help create a species list for the BioBlitz, but the assistant found that it took too long to find the species being observed in a fillable list, so it was easier for them to write the species names themselves and add it to the list later.

Another major component is the Intensive Survey, which I participated in at the *rare* Community BioBlitz on July 15, 2017. This event was run very similarly to the Ontario BioBlitz. I began by joining the Intensive Insect Survey which consisted of a taxon lead who organized the rest of the group, multiple expert scientists who went off on their own, students who had minimal field experience, and at least one assistant who did not have any formal qualifications. The

participants told me that they were focused on soil samples because there are so many insects in a given area that it is better to focus on one specific level of the forest, and the choice of soil was due to the scientists' own research and funding. They collected surface soil in their filters, whose contents were then put in a plastic bag to take back to the lab to obtain the insects so they could identify them. They also used nets and tweezers and at one point someone smelled a beetle. While iNaturalist was discussed, it was not actually used to document the insects. In general, there was little documentation happening in the field.

The rest of this BioBlitz followed a similar structure as the Ontario BioBlitz, with one key difference: in each Guided BioBlitz, there was a knowledgeable leader, but there was also a *rare* staff member, who was there to help navigate and to log all of the group's findings into iNaturalist. The most notable was during the Plants Guided BioBlitz where the leader would describe a plant to the group, then the *rare* assistant would take a photo, and the leader would input the scientific name. In the next section, I will describe what iNaturalist is and how it is used as a medium for understanding biodiversity at a BioBlitz.

3.3 – Using iNaturalist

iNaturalist is an internet-based digital medium created in 2008 as a Master's final project at the University of California at Berkeley's School of Information (Agrin *et al.* 2008). Since starting as a website, it is now accessible as an app for iPhone and Android phones. To use it, the user must create an account using the website or the app, then they can begin recording observations. On the website, this is done by clicking "Add Observations," where photos or sounds[8] can be uploaded. If desired, there is an option to upload without media. Next the user

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[8] Uploading audio files has been added since the BioBlitz occurred in June.

enters a species name, date, location and description to each of their observations.[9] Finally, they

hit "Submit" and the observation is uploaded to the database. For the app, the user taps the

"Add" button and then selects either "Take Photo," allowing them to take a photo with their

phone,[10] "Choose Image," where the user chooses from photos that are saved on their phone, or

"No Photo." Provided their phone has GPS or Assisted GPS, the location should be recorded

automatically. The user may also suggest an identification, add more photos, add notes or add the

observation to a project of which they are already part.[11]

Among the uses of iNaturalist is its "Data Quality Assessment" which is simplified into

three terms: "Needs ID," "Research Grade," and "Casual Grade." "Needs ID" means that the

observation contains a picture or sound, a date, a location, and it isn't a human. It becomes

"Research Grade" when at least two out of three members of the iNaturalist community agree on

a species-level ID. "Research Grade" observations automatically get uploaded to GBIF: the

Global Biodiversity Information Facility (GBIF 2017). If the observation does not have a photo

or sound, or if the community disagrees with some of the information provided, it becomes

"Casual Grade." This stresses the importance of verifiability of observation as well as

community agreement. Verification is an important aspect of data acquisition and distribution.

One steering committee member commented that photographs and GPS coordinates provide

evidence that prove the observer is telling the truth, regardless of their experience level:

> "Most people now are at a point in time where expertise is not everything and
> most sightings need some sort of proof to go alongside them. A GPS location so
> someone can go back and confirm it, a photo, some DNA so you can barcode it ...
> So our policy at *rare* is, unless we have multiple sightings of a species, we can't

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[9] The date and location may be included in the file's metadata, but this can be altered before uploading the
observation.
[10] The app may ask for permission.
[11] Provided the project creator has done so, the project will automatically aggregate all observations made during the
specific time and place of the BioBlitz.

confirm that it is definitely on the property, so we need either multiple sightings from multiple sources or we need a photo or some other piece of evidence, GPS or DNA."

Researchers need proper evidence when determining if a particular species actually does exist in the area they are analyzing.

One of iNaturalist's biggest advantages for BioBlitz Canada was that it allows for a connection across the country, as described by one steering committee member:

"I almost took a step back and we were thinking how are we going to facilitate BioBlitzes and make a data management system to be able to work properly and share the data across Canada, so that's where we landed, originally thinking what was needed with, the need for iNaturalist. We looked at a few different options...and we just landed on iNaturalist really having all the features and tools that we needed that we thought were essential for such a platform."

One of these features is what it does with "Research Grade" observations. As one steering committee member explained, "All of the data is organized by the ROM for the Ontario BioBlitz, and is sent up to Canadensys, which is the Canadian Natural Heritage Database site, which eventually goes to GBIF, which is the Global Biodiversity Information Facility" (Canadensys 2017). Sending the data to Canadensys is an important step for the Ontario BioBlitz and is being done regardless of the media being used for data collection. In an email from a steering committee member, they mentioned this importance:

"[They are] uploading our blitz data to both iNat and Canadensys, because [they want] to be sure it got to GBIF, and also Canadensys has many more data fields to provide more detail for that data."

This will ensure that all valid observations, even those without a photograph, will be uploaded alongside the "Research Grade" observations from iNaturalist.

3.3.1 – User Experiences

 Before the Ontario BioBlitz began on June 24, 2017, I helped a participant with setting up

the app. All participants were sent an email package containing an attached 6-page PDF

document detailing how to use iNaturalist, including the app and website, and how to take a good

photo. This assumed that the user had already downloaded the app or at least made an account

online. Once I had downloaded the app for the participant, they used the document provided by

the steering committee to make a test observation. A message appeared on the phone that

requested permission to allow the app to use its location, which they were hesitant to do as they

were wary of letting things know where they are. For the sake of simplicity,[12] they allowed the

app to access the phone's location. Once they had tested how to make an observation, they joined

the project and followed the instructions for the Field Guides which have technical issues. While

attempting to use iNaturalist during the Guided BioBlitz, the participant's phone displayed a

messaged asking if the app could access their camera. They selected "No," at which point they

did not know how to take a photo and required assistance to go into the phone's settings and

change the permissions, something they unlikely could have done alone. This demonstrates the

learning curve of media literacy with a new medium when users are unfamiliar with it. The

learning curve for iNaturalist may be more or less steep than other media, depending on the

individual.

 The technical issue mentioned above was with the "Field Guides" created on iNaturalist

for the "BioBlitz Canada 150 – Rouge National Urban Park" project. A few days before the

Ontario BioBlitz began, a post was made on the project page providing links to the species lists

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[12] The user could deny the app access to their location and input the information manually upon making an
  observation.

for taxa in the Rouge Watershed. On the website, this worked fine: users could see the post, click on a taxon that interested them, and view a list of the species on their screen. On the smartphone app, however, the links failed to do anything and it was just a list of general taxa. According to the iNaturalist document mentioned earlier, it explained that users needed to select "Guides" and search for "Rouge," which then gave a list of the available guides created for the project.[13] During my interview with a steering committee member, they seemed rather disgruntled by the medium's separation of projects and guides:

> "That was actually one thing that I didn't really like about the current project on iNat, is I can make all these guides, which is great, but then there's no easy way to associate them with the project, which is what I've made them for; I've made them for this project in the Rouge."

Additionally, all iNaturalist "Guides" are limited to 500 species. Plants, for example, had to be split into three different guides. When attempting to find maple trees within these lists, the participant discussed earlier was unable to do so because trees were split between the three guides. Guides on iNaturalist may be useful in the future, but first they must work out the technical issues.

Another situation arose during the Moths Guided BioBlitz where the leaders briefly mentioned iNaturalist which piqued the interest of one participant. They were then assisted with downloading the app using the WiFi installed for the event, which took around 20 minutes.[14] Once the app had downloaded, the participant was able to upload the photos they had already taken, but they proceeded to select a number of different photos of different moths, meaning that

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[13] While this was decided to have available offline, the steering committee was unsure if they were going to do so because of the amount of bandwidth it takes to offer that option; *rare* did not offer this.
[14] A few participants and steering committee members mentioned in interviews that, while WiFi was installed largely because of iNaturalist, it did not function very well.

their observation would have had multiple species in it, rather than just one as intended. Fortunately, one of the leaders checked on their progress and explained what they were doing wrong. Once they had the proper photos in place, the participant asked for the scientific name of the moth. The leader used the guidebook they had with them to enter the name before they celebrated the participant's first species level ID. The next day, the participant mentioned that there were issues with at least one of their observations where the app wanted to place the location where they were at home rather than back at the park where the photo was taken.

A third situation concerning the use of iNaturalist occurred weeks after the event during my interview with a steering committee member. They were going to show me the current results of a recent BioBlitz when they got distracted and said, "…so much of them, the common names are American and not Canadian." We discovered that they had consulted iNaturalist.org, not iNaturalist.ca. They proceeded to log into the Canadian website and found that the common names had changed. They were grateful to be shown that and felt like they should have known, but no one had told them. Although each of these incidents may appear to be small, it is in such situations that a new medium may be deemed usable, or is rejected.

3.3.2 – Producing Data and Instructing Citizen Scientists

As a medium of data production, adding observations to iNaturalist allows researchers to count the number of species in a given area. The data produced from the BioBlitzes can be seen on the BioBlitz Canada 150 Rouge National Urban Park and the *rare* Community BioBlitz 2017 project pages on the iNaturalist website or the app, respectively. As a medium of instruction and education, iNaturalist allows less experienced naturalists to upload observations without an identification and learn from others what they saw. There are also guides, taxonomic trees, and

species descriptions to help educate the user. As a social medium, users can follow other

iNaturalist users and keep track of what they are observing and identifying, and they can

message each other directly on the website.

It can also be important to make biodiversity fun in order to attract new participants. One

participant said, "As soon as it becomes a game, it really gets 'em going and it does contribute.

And they can get 'Research Grade' and that's exciting too, 'cause I get irritated when I can't get

'Research Grade' on something." Similarly, while comparing it to other smartphone games,

another participant said, "It's a real thing. If you can get that connection to them in a way that

they'll see the value of it, it seems fun and it connects to them ... 'How many sightings do you

have?' 'Have you gotten this yet this year?'" iNaturalist can act as a bridge that leads to further

education.

3.4 – iNaturalist vs. Paper

Whether iNaturalist is accepted as a valid medium for producing biodiversity data and for

instructing the public is based on its uses compared to or alongside other media. One of the

earliest of these is the paper list which, for the Ontario and *rare* BioBlitzes, takes the form of a

spreadsheet. At the Ontario BioBlitz, this is the most common type of data submission.

According to a steering committee member:

> "During the Blitz, most of the information that comes to [us] is actually just
> written out on a page, so people will just go out into the field and then bring back
> this sheet to [us] and I have to transcribe all the information, including all the
> taxonomic information, which they don't always give to [us]."

The Ontario BioBlitz steering committee, after six years of species-list making, has created a

species checklist detailing information they would like the participants to fill out. This includes

the location,[15] the person who observed it, and the person who identified it, as well as any other

details or descriptions. This method of filling out the paper list, however, was not conceived

instantaneously. The lists at the Ontario BioBlitz were negotiated by the groups that use them,

namely between the different taxon leads and the steering committee, as stated by a steering

committee member:

> "The other tweaks are organizing them better for individual taxon needs. For
> birds, for example, a lot of people recognize them by the family grouping that
> they are, and then look for the information based on that, so they would say,
> 'Okay that's a blackbird,' and then they [list] all blackbirds together, they don't
> want it alphabetically by species name, because then the blackbirds would be
> spread all throughout the list, so [we] grouped them that way."

This process continued for the development of the iNaturalist Guides mentioned earlier. The

introduction of a new medium, however, can have consequences on older media like paper. One

steering committee member from the *rare* Community BioBlitz said there was less focus on

properly filling out the paper checklist:

> "I think we focused so much on encouraging iNat that maybe we lost a little focus
> in terms of being very clear about what the handwritten submitted data had to
> include. Whereas in past years where we didn't use iNat, that was the only focus,
> so that information didn't get lost. So this time, because we wanted every
> individual to use iNat and we were really trying to enforce that, I think we maybe
> just lapsed a little bit on making sure that data that wasn't coming in that way was
> vetted and that we knew the details of who saw it and where they saw it as much
> as possible."

The paper checklists may have been missing the observer's name, so there was no way to verify

observations of which the steering committee was unsure. Other media may provide more or less

information than this, sometimes automatically. Additionally, for the Ontario BioBlitz, taxon

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[15] This can be the sector which has a designated set of latitude and longitude coordinates, or it may come from a
device for specific coordinates.

leads collected the paper lists from their respective groups and submitted them to the steering

committee, frequently digitally via email. The original lists are then discarded, having been

remediated onto a digital, durable list.

iNaturalist can be used in much the same way as paper checklists. The user can record an

observation and communicate that information with others including the BioBlitz steering

committee. They both store information for future analysis or remediation, and they are both

mobile enough to be used in the field, but there are some affordances that are superior in one or

the other. The cost of using iNaturalist is higher, requiring a smartphone or computer to use it as

well as an internet connection, while paper is much more easily obtained. On the other hand,

iNaturalist connects the BioBlitz participants to the steering committee as well as a wider range

of users around the world. Meanwhile, the paper lists do not allow direct interaction between two

or more people nor do they persist since much of the data from paper lists is manually

remediated to a digital spreadsheet before the paper itself is discarded. Below is a table

identifying some affordances of iNaturalist and paper checklists, drawing on the format of

Madianou and Miller (2012, 123).

Table 3.1

	Interactivity	Temporality	Storage	Persistence	Replicability	Searchabiltiy	Mobility	Cost	Informational Capacity
iNaturalist	Medium	Asynchronous	Yes (easily accessible)	Yes	Yes (copy&paste)	Yes	Yes	High	High
Paper Lists	Low	More Asynchronous	Yes (but discarded)	No	Yes (manual input)	No	Yes	Low	Medium

3.5 –Alternative Digital Media and Guidebooks

A number of digital media are available for producing data and instructing about

biodiversity. eBird and the Ontario Reptile and Amphibian Atlas were two of the most commonly

discussed with interlocutors from the Ontario and *rare* BioBlitzes. eBird is helpful for data

production because it allows the steering committee to easily add the data to their own records.

As one steering committee member explained:

> "It's really nice for [us] when people use it because then [we] can just get their
> eBird list and copy all the information and then easily put it into our database.
> [We] don't have to go and look up the names that they found on a sheet and then
> do a sort in Excel and get them into a new format to get into the database. [We]
> can literally just copy them."

One of the biggest potential flaws, as one participant mentioned, is misidentification. Flags are

only raised if someone identifies a bird less likely to be observed in that particular area, so less

experienced birders may identify an observation incorrectly and upload it to eBird. Alternatively,

the Ontario Reptile and Amphibian Atlas app was demonstrated to work well as a field guide. It

allows the user to compare an observation to different pictures and sounds that are installed with

the app. A participant described it while showing me the app:

> "So then I just type in and I make a new observation, and in here it actually asks
> you a lot of really detailed information, it's quite specific, and they do want a
> picture, but really, as a citizen scientist and general person, you can feel pretty
> damn confident that you're not an idiot saying it's this when it's that because they
> give you all the data to work with."

This demonstrates the usefulness of the app, but it also shows the relevance of the medium which

it is remediating: the guidebook (Bolter and Grusin 1999).

The guidebook is a useful tool for any naturalist, and there are a great number of them

available, such as *Trees in Canada* by John Laird Farrar (1995) or *Peterson Field Guide to Moths*

of Northeastern North America by David Beadle and Seabrooke Leckie (2012). Rather than

having another person from the community verify or suggest an identification, a guidebook

provides a key so the observer can attempt to identify it themselves. This medium was heavily

used during the Trees Guided BioBlitz at the Ontario BioBlitz where the leaders showed the

participants how to identify a particular tree using a guidebook before the participants were

asked to identify some by themselves. Using a guidebook alongside iNaturalist gives the user the

opportunity to attempt to identify a species and then verify whether their identification was

correct based on others using iNaturalist.

4. Discussion

Does iNaturalist function as both a medium for producing biodiversity data as well as for instructing citizen scientists and the general public? Are there tensions of combining them in one medium? If so, how do participants resolve them?

iNaturalist users have the option of producing data and learning about biodiversity from afar; they do not need to attend a BioBlitz in order to use it. Attending a BioBlitz, however, has the benefit of direct interaction with experts who may be able to instruct better in person. Through this interaction, if participants of the event can collectively produce data and learn about biodiversity with iNaturalist, the medium has a chance of being useful for all social groups involved, but there are other factors to consider, including the other media already in use, and what the different social groups at the BioBlitz want out of the event. Expert scientists may not want to spend the time engaging the public so they can gather the data themselves, and even if they do engage with them, they may be skeptical of data provided by citizen scientists. Citizen scientists and the general public, conversely, are looking to learn about biodiversity and how species are different. This may benefit a goal towards policy and conservation. The steering committee of the BioBlitz then seeks to bring these two ideas together, though even this group is sometimes divided amongst its individuals.

Enabling a form of writing, iNaturalist most certainly allows expert and citizen scientists to alter and use it to determine new information (Krämer 2003, 523–524). It appears to be "a handy means to present and preserve knowledge in a concise and structured yet open-minded manner" (Müller-Wille and Charmantier 2012, 743–744). Furthermore, because iNaturalist can continuously be added to, the hypothetical "natural list" that Linnaeus sought through "the collective, empirical work of generations" (Müller-Wille 2013, 314) may one day be

accomplished, but it must play a larger role if it is to do so. While it is growing in popularity, its uptake is rather slow.

Some have claimed that the acceptance and use of a medium lies completely with the social groups who are using it, making it out to be a blank slate and to do with whatever they want, but Hutchby (2001) provides an argument that suggests it is its affordances, originally conceived by Gibson (1979), that are embedded in the medium which allow and constrain the social groups to act. iNaturalist is not a *tabula rasa*, it was designed for a purpose, written with a code, albeit a malleable one, and used to document biodiversity. While biodiversity may mean different things to different people, in its simplest, quantified form, it is the number of species. iNaturalist provides a way to add a number to the list, but also proof with a photo and location. It can additionally be used as a medium to engage and educate the public, containing vast amounts of information on species all over the world. Finally, it's where BioBlitz Canada funded events have to submit their data, so why are some struggling with this concept?

Since affordances are perceived differently from context to context, they can differ from social group to social group. To the expert scientist group, iNaturalist makes it possible to count biodiversity, and to the citizen science group, it engages them with the scientific community and educates them. In either case, the possibility for action exists regardless of the opinions of the expert or citizen scientists. For the experts, if GBIF is the final goal for the numbers, iNaturalist automatically uploads them there. For the citizen scientists, they can use it to communicate with the scientific community by uploading observations to iNaturalist or connect with scientists using the medium. They may also use it for looking up taxonomic trees or reading about specific species. These qualities exist in iNaturalist whether the social groups of the BioBlitz use them or not (Hutchby 2001).

They are not, however, the only media that generate these affordances. Paper lists also afford research grade data that is uploaded to GBIF, and guidebooks work as an instructional medium that teach its users about specific species and how to tell them apart. The affordances of one medium cannot be considered alone; they must be considered amongst the plurality of other media in the BioBlitz. They may also be used together, such as when a guidebook is used to learn about a species and determine which one is being observed and is then recorded in iNaturalist. Media are frequently used in parallel and are constantly remediating each other (Madianou and Miller 2012; Bolter and Grusin 1999).

The expert scientists largely want a simple checklist. They do not need this new medium to tell them all about a species they have spent a large portion of their lives studying, but they do need one to produce data so that others know about it. To use iNaturalist, they require it to be uncomplicated and user friendly, where they simply check off the species they have seen and maybe add a few details. In other words, they need the simplicity of the paper checklist to be remediated on a screen with no complications, making the digital medium "invisible" (Bolter and Grusin 1999, 21–31). Meanwhile, the citizen scientists need access to multiple resources to learn about biodiversity. They need to observe, suggest ID's, look up taxonomic information, and be able to interact with the scientific community. The remediation of guidebooks, cameras, and webpages hypermediate this process (Bolter and Grusin 1999). Remediation can also affect older media, making them less reliable. In order to emphasize the use of iNaturalist, less was put into the paper list causing some information to be excluded for those checklists. This required a follow up from the steering committee, which in some cases was not possible because the missing information was the observer's name.

5. Conclusion

In this thesis, I have considered how a digital medium is used in a BioBlitz to gather data on biodiversity and instruct citizen scientists about biodiversity at the same time. There is a tension in citizen science events such as the BioBlitz when internet-based digital media, such as iNaturalist, are used to perform these two tasks. The use of iNaturalist at the BioBlitz was negotiated by the social groups involved with the event based on the medium's affordances that allow and constrain it to help participants to understand biodiversity.

I attended two BioBlitz events, the Ontario BioBlitz and *rare* Community BioBlitz, which were very similar to each other and were structured in much the same way. All 35 events across the country, including these two, were required to submit their data to iNaturalist by October 31, 2017. The data produced by the participants of the BioBlitzes is available through the events' project pages on the iNaturalist website which can be useful to both expert and citizen scientists for conservation purposes or for learning about the species in the area where they live. Surveys and interviews demonstrated the various goals of the different social groups at the BioBlitz, namely the steering committee and the various participants composed of expert and citizen scientists.

The two goals of producing data and instructing citizen scientists are desirable to the steering committee and BioBlitz Canada hoped that all BioBlitz events would benefit by requiring them to submit their data to iNaturalist. Some events found this more beneficial than others, and there were even differences between the Ontario BioBlitz and the *rare* Community BioBlitz. What was discovered was that paper and spreadsheets still dominate the data collection area of biodiversity and many expert scientists find it difficult to move away from these media. Furthermore, if the expert scientists of a BioBlitz are not going to use a particular medium, it

becomes much more difficult to get the other groups to use it, too. Many expert scientists at the Ontario BioBlitz did not use iNaturalist and did not advertise it to the Guided BioBlitzes that they led. This could be because they do not believe iNaturalist provides reliable enough data compared to other methods and media. Citizen scientist who want to learn but also want to contribute will not use a medium that expert scientists do not consent to producing reliable data. Expert scientists' opinion of citizen science is also a factor to consider, one which has split viewpoints. If citizen scientists cannot produce reliable data, then it may not matter what media they are given.

There are many factors to consider when analyzing the media used in a BioBlitz and this research has only outlined a few of them. The affordances of the medium, iNaturalist, suggest it could be a great way to instruct citizen scientists and the general public while simultaneously producing research grade biodiversity data, but this can only be the case if the social groups who would use it, actually do.

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Appendix

Appendix A – History and Structure of the BioBlitz

In 1996, the very first BioBlitz, a term coined by Susan Rudy of the U.S. National Parks Service as a shorthand of biodiversity[16] blitz, took place in Kenilworth Aquatic Gardens in Washington D.C. from May 31 to June 1 (Ruch et al. 2010, 1). Two years later, at Walden Pond in Concord, Massachusetts, E.O. Wilson[17] and Peter Alden organized a similar event they called "Biodiversity Day I" which took place on July 4, 1998. The website states, "The fourth of July commemorates the day Thoreau moved into his cabin at Walden Pond" (Walden Biodiversity 2017). This is where Henry David Thoreau wrote his book, *Walden or, Life in the Woods* (2015 [1854]). Currently, the longest running BioBlitz in Canada started in Whistler, B.C. in 2007 and continues annually to this day (Whistler Naturalists 2017).

In the Toronto region, BioBlitzes were first introduced in 2009 by the *Get To Know* program, founded in 1999 by Robert Bateman and Mary Clark (Get To Know 2014), who approached the Toronto Zoo about doing a BioBlitz there.[18] Two years later, while sitting on the shores of Rouge River, they contemplated how to engage 7,000,000 people in the Greater Toronto Area in a study of biodiversity. Planning for the first Ontario BioBlitz then commenced, which was piloted in Rouge Park from June 15 to June 16, 2012.[19] According to the Ontario BioBlitz website, the event was the biggest BioBlitz in Canada with over 225 participants, and they observed more species than any other event in 2012 with more than 1450 species counted.

Across Canada, the BioBlitz is organized through multiple levels. At the top is the Canada BioBlitz steering committee, whose chair is also the chair of the Ontario BioBlitz

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[16] Short for "biological diversity."
[17] E.O. Wilson is credited with mainstreaming the concept of involving citizen scientists (Ontario BioBlitz 2014).
[18] In an email from a steering committee member, I was told the offer was declined due to a lack of robustness.
[19] Interview with steering committee member.

steering committee for 2017. For the event that year, the Canada BioBlitz steering committee

submitted a grant to Heritage Canada and won $1,000,000 to put towards the events held across

the country for Canada 150. If a BioBlitz event wished to receive funding from BioBlitz Canada,

two steering committee members revealed that one of the requirements was that they upload their

results to an iNaturalist project. While BioBlitz Canada allowed each event to plan their own

event how they wish, they set out some guidelines in order to set one up on their page "BioBlitz-

in-a-Box." This page lays out a few of the most important roles: the Taxon Inventory

Coordinators/Scientist co-leaders and Database Coordinator, followed by Taxon Coordinators

("leads"), Taxonomic Specialists, Skilled Naturalists and Student Specialists, Skilled Interpreter

or Nature Hike Leaders, and Novice Naturalists and Nature Enthusiasts.

As the original program behind BioBlitz Canada, the Ontario BioBlitz followed this

structure for their event. In my interview with steering committee B, they described the program

as such:

> "The Ontario BioBlitz program is a horizontally driven partnership between 4
> sometimes as many as 6 organizations depending on where we're doing the
> event...and make sure that we walk through the preparation, development and
> implementation of the program and we meet for about 10 months preceding the
> program."

The 4–6 organizations that form the Ontario BioBlitz program are represented by members of the

steering committee. For the 2017 BioBlitz, the organizations were the Royal Ontario Museum,

Toronto Zoo, Centre for Biodiversity Genomics, Toronto and Region Conservation Authority,

and Parks Canada. This group plans "all aspects of the project including communications,

logistics, food and beverages, budgetary concerns etc." and is formed by approximately 10

people supporting different roles: communications lead, data coordinator, science coordinator,

registration coordinator, food and beverages coordinators, parking coordinator, activity coordinators, and hosts (Ontario BioBlitz 2014, 18). The steering committee made decisions that coordinated the three-tiered event which included the Public Festival, the Guided BioBlitzes, and the Intensive Surveys.

While the Public Festival is open to anyone walking by, the Guided BioBlitzes and the Intensive Surveys require participants to register ahead of time. The Intensive Surveys consisted of experienced and knowledgeable members who have high levels of formal education, less experienced enthusiasts who can learn from experienced experts, and skilled naturalists, who fall somewhere in between those two groups. In a survey distributed to members of the Intensive Surveys, a question was asked about what their motivation was for participating in the Ontario BioBlitz. The most common answers circled around the collection of scientific data, engaging the general public, self-learning, and, in some cases, because their job told them to. The willingness of Intensive Survey participants to engage with the public then affected the Guided BioBlitzes since they were the source of leaders for those sessions, which can sometimes be difficult. As one participant put it:

> "A lot of them aren't focused as much on public interaction. A lot of them are doing intensive fieldwork and that occasionally will lend you to working with the public but it's not really their primary goal or focus. I do have a lot of experience doing that and I've dealt with a lot of people who are in that citizen science spectrum...I'm kind of the hybrid in the middle."

Furthermore, another participant explained:

> "...I'm a generalist and I know the scientists that [blew] me away and I love going out with them but they can't always communicate...I'm not a specialist and because I don't seem intimidating, I get a lot more people trying to communicate with me and asking me questions."

If the steering committee did not get enough response from the Intensive Survey participants

during registration, they would need to cap the number of Guided BioBlitz registrants. A member

of the steering committee explained, "...[W]e had 400 people sign up for Guided Blitzes, and you

want to keep the numbers low. You want to have, maybe, maximum of 20–25 people per thing."

The steering committee, the taxonomic leads, and the remaining members of the Intensive

Survey therefore dictate the information provided to Guided BioBlitz participants and how they

might acquire this information on their own.

While the Ontario BioBlitz was a Flagship event — one of five across Canada — there

were a number of Community events happening across Ontario and the country, as well. *rare*

Charitable Research Reserve is located in Cambridge, Ontario, and has now hosted three

BioBlitzes. In 2017, they followed a similar format to the Ontario BioBlitz program by having a

Public Festival, Guided BioBlitzes, and Intensive Surveys. The event was organized by a slightly

smaller steering committee, representing only two organizations: *rare* and the Centre for

Biodiversity Genomics. They similarly had committee members take on the roles of database

coordinators and scientific coordinators who then organized taxonomic experts for participation

in the Intensive Surveys and leading Guided BioBlitzes, but the leaders of the walks may not be

familiar with the property, so the steering committee arranged to have a *rare* staff member attend

each session to help the leader navigate. Additionally, since the contract with BioBlitz Canada

stated that they were required to submit all their data to iNaturalist, one steering committee

member explained:

> "...that *rare* staff person this year was also responsible for making sure all the
> sightings got into iNaturalist, so it was just a new responsibility, they either had
> their own device or they brought one of *rare*'s iPads with them to try their best to
> make sure that everything that was seen on those Guided Sessions got into iNat,

and I think that was really significant in reducing our data entry requirements post-event because last year, for example, all of those Guided lists, or all those Guided Sessions handed in lists, and those lists had to be entered."

Furthermore, in order to ensure that their staff were prepared for the task, the following situation was described to me by a steering committee member:

"So before the event, most of our staff had never used iNat before, so we had all the staff download iNat, do a little bit of an indoor lesson on how it works, and then we went outside and said, 'Okay, spread out and everyone submit at least three observations on iNat to make sure you know how it works.'"

This contrasted with the Ontario BioBlitz, whose steering committee felt sure that they knew their way around iNaturalist, so they did not feel the need to have a similar type of training day.[20]

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[20] The size of the project may also have been a factor, though this was not discussed. This was expressed by a member of the *rare* steering committee during a meeting before the event on July 5, 2017.

Appendix B – Details on Methods

Surveys
Ontario BioBlitz Steering Committee Survey (8)   - distributed February 2017
Ontario BioBlitz Participant Survey (16)   - distributed June 28, 2017

Significant Email Communication
Steering Committee Member B
Steering Committee Member C
Steering Committee Member G

Interviews
Steering Committee Member A   - February 23, 2017
        - June 15, 2017
Steering Committee Member B   - June 6, 2017
Steering Committee Member C   - July 21, 2017
Steering Committee Member D   - July 21, 2017
Steering Committee Member E   - July 26, 2017
Steering Committee Member F   - July 26, 2017
Participant A   - July 24, 2017
Participant B   - July 25, 2017
Participant C   - July 27, 2017
Participant D   - July 31, 2017
Participant E   - August 3, 2017
Participants F   - August 7, 2017

Ontario BioBlitz Timetable

June 24

Time	Session
Invasive Species	12:30pm–2:00pm
Trees	3:00pm–4:30pm
Reptiles and Amphibians	7:30pm–9:00pm
Moths	9:30pm–11:00pm

June 25

Time	Session
Early Birds	6:00am–7:30am
Forest Birds	8:00am–9:30am
Spiders	10:00am–111:30am

<u>*rare* Community BioBlitz Timetable</u>

July 15

Time	Session
10:30am–12:30pm	Intensive Insect Survey
1:00pm–3:00pm	Fungi
3:30pm–5:30pm	Reptiles and Amphibians
8:30pm–10:30pm	Mammals

July16

Time	Session
Plants	8:00am–10:00am

Appendix C – On Collection Methods

What new media cannot replace when identifying species are methods of collection and dissection. One steering committee member explained that "a malaise trap, which is one of our trapping methods, will collect anywhere from hundreds to thousands of specimens. It's actually a really good way of surveying an area, but I can't see iNaturalist replacing our collecting methods for surveying."[21] Additionally, another steering committee member said, "some species you just can't identify without a dissecting microscope or some lichens you need to test them in a lab with acid to determine how they react — you just can't replace that with a photo." Clearly, some methods cannot be replaced by media; dissection cannot be replaced through iNaturalist.

Other methods include, but are not limited to: filters for soil samples which are then placed in sealed plastic bags; funnels that are left overnight and specimens are ready for collection in the morning; white sheets combined with ultraviolet lights or mercury lights to attract insects, mainly moths; umbrellas and sticks for collecting insects that may fall out of bushes or long grass; aspirators for smaller insects; vials and jars; netting for collecting reptiles and amphibians, butterflies, or bats; plywood left on the ground where snakes may gather; and cage traps for small mammals.

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[21] A malaise trap is a large, tent-like structure designed to trap flying insects. Insects fly into the tent wall and are funnelled into the highest point to be collected.