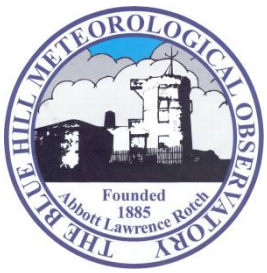

Increasing Citizen Science Participation in the Picture Post Project

An Interactive Qualifying Project

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By

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1. Citizen Science
2. Phenology
3. Climate Change

Abstract

Project Picture Post is part of the Digital Earth Watch network, which monitors the health of vegetation using digital photography. This citizen science endeavor has seen a lack of participation over the past several years. The goal of our project was to identify and implement strategies for increasing participation in citizen science, focusing on Project Picture Post at the Blue Hill Observatory and Science Center. We accomplished this goal through extensive interaction with citizen science experts and potential participants and by testing specifically-designed promotional material. By implementing our recommendations, citizen science programs such as Project Picture Post will be able to increase volunteer participation.

Executive Summary

Over the past two decades, global climate change has become a significant issue that literally shapes the face of the earth. Organizations throughout the world are attempting to monitor how climate change is affecting, and will affect, their immediate location. However, climate change is a slow process, thus these changes are not always obvious. Tracking changes in vegetation is one way to observe the effects of climate change in a specific area, since plants are responsive to changes in temperature, precipitation, and sunlight. By monitoring changes in vegetative growth, the effects of climate change can be measured for a particular location.

In the Boston area, there is a general dearth of information about significant phenological changes in vegetation over time. Data collection methods such as those employed in the Picture Post program can be used to understand how climate change affects local environments. A Picture Post is a post that extends about three feet above the ground with an octagonal mounting station at the top. This acts as a permanent tripod location from which users can take a pseudo-panoramic snapshot of the area by taking pictures from all eight sides of the block and a single picture vertically towards the sky. Despite efforts to collect data using Picture Posts, the amount of data that have been accumulated has been deemed insufficient for useful scientific purposes. The Blue Hill Observatory, one of the most recent organizations to be involved with Picture Post, has been eager to begin collecting data for the study of phenology and climate change. Because the Observatory has limited staff, a constrained budget, and other important tasks to do on-site, citizen scientists are needed to provide the Picture Post data.

The goal of this project was to recommend ways to increase citizen science participation both at Blue Hill and at other locations, focusing on the use of Picture Posts. The project team

wanted to motivate people to collect and submit photographic data via Picture Posts that would provide a scientifically significant set of data suitable for analysis. The group also sought to educate people about citizen science, phenology, climate change, and the relationship between these three areas in an effort to promote scientific literacy to the visitors of the Blue Hills Reservation and encourage them to further participate in citizen science.

To achieve this goal, the research team focused on accomplishing two objectives. The first objective was to successfully incorporate a Picture Post program into the Blue Hill Observatory's current methods of promoting environmental science. Prior to the team's arrival in Boston, the Observatory staff had neither installed a single Picture Post, nor had they developed any material for promoting citizen science to its visitors. As such, the program had to be developed literally from the ground up. The second objective was to devise methods to promote citizen science, through the use of Picture Posts, to the general public in order to help promote scientific literacy within the general population. Many Picture Post sites that are registered with the national Picture Post database evidenced little to no usage. The team wanted to reverse this trend of many Picture Post locations not being utilized, so that data would be collected and people would be engaged in citizen science.

To accomplish the first objective, three Picture Posts were installed at Blue Hill Observatory as a basis for the program. An informational guide was developed for the Observatory's volunteers and tour guides so that they could incorporate the Picture Posts into their various operations. In addition, promotional materials were developed for the Picture Posts at Blue Hill, including two posters, instructional signs that were attached directly to the Picture Posts, an informational brochure, and a Facebook page. The effectiveness of the signs and posters were gauged by observing the reactions of people who passed by them and by randomly

conducting interviews with those who read the material in order to gain specific feedback on the material that had been developed. Additionally, 40 randomly selected visitors to the Blue Hills Reservation were introduced to the Picture Post Project through brief interviews and demonstrations at the Picture Posts. To get qualitative data about their opinions of the program and the materials that were set up, a brief survey was issued to each of the 40 interviewees. Questionnaires were emailed to the people who submitted a picture set to the online database in order to understand what motivated them to use the Picture Posts and to get feedback on the upload process. In addition to personal interviews, school groups that visited the Observatory received a presentation to introduce the students to the Picture Post Project and the concept of citizen science. In summary, after establishing a Picture Post program at the Blue Hill Observatory, its effectiveness was gauged in order to determine its applicability to similar endeavors at other locations.

To accomplish the second objective, the project team acted as citizen scientists and utilized the Picture Posts at Blue Hill throughout the course of the study in order to better understand the technical aspects of Project Picture Post. In doing so, numerous shortcomings with the user interface of the online database were discovered, and ideas were proposed for solving these issues and for improving the website's usability. Also, in addition to using Blue Hill's Picture Posts, other Picture Post sites were visited and analyzed in order to understand the strengths and weaknesses of these locations. These data were used to develop better promotional strategies that could increase overall Picture Post usage. Further, administrators of the Picture Post program were interviewed in order to learn about how the project is developing and where the project could further improve. Two representatives from Project BudBurst, a citizen science project that has enjoyed great success, were interviewed, in order to learn how Project BudBurst

recruits and retains its citizen science volunteers. By accomplishing the second objective, materials and promotional strategies were developed for the Blue Hill Observatory so that they could be utilized by Blue Hill and possibly adapted to the needs of other organizations that host Picture Posts.

By accomplishing these objectives, recommendations were made to the Blue Hill Observatory for promoting the Picture Post Project. Methods were outlined that the Observatory could use to promote the Picture Post Project as a whole while maintaining its own Picture Post program. These methods were designed so that, while they specifically related to the Blue Hill Observatory, other organizations that use Picture Posts could learn from them in order to improve their own programs. Recommendations were also made to the University of New Hampshire for the improvement of the operation and usability of their online Picture Post database. Specific improvements were suggested for the associated website so that it would be easier for users to submit and manage picture sets and so that the website managers could collect feedback on the website while further promoting usage of the Picture Posts. In summary, a fully-functional Picture Post program at the Blue Hill Observatory was developed. Current and future proponents of the Picture Post Project can learn from this program in order to better promote their Picture Posts, thereby collecting more important scientific data and improving the scientific literacy of the general public.

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First and foremost, we would like to thank the staff of the Blue Hill Observatory and Science Center, with special recognition of our liaison, Don McCasland. He and the rest of the staff have been gracious hosts at the Observatory throughout the entirety of our visit and have always helped us to the best of their abilities. Despite his hectic schedule, Mr. McCasland generously devoted much of his limited time to ensure that our project ran smoothly and was highly supportive throughout the duration of the project. We thank you all for your contributions to our project.

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Authorship Page

This report has been a collaborative effort between Timothy Dobosz, Brian Karolicki, and Greg Wheeler. We have worked individually and as a group to conduct research, execute our methods, and compile the report. We have revised each other's work throughout the duration of our project. We have each contributed an equal amount of work to the completion of this report.

Chapter 1: Introduction

The effects of human-induced climate change have been at the forefront of scientific research in recent years. Destructive habits such as mass emissions of carbon dioxide, release of toxic gases, and deforestation have created a gradually warming atmosphere that may have lost the ability to repair itself naturally (Karl and Trenberth, 2003). The average global temperature increase of about 1.5°F since 1880 has resulted in changes in botanical ecosystems (National Aeronautics and Space Administration, 2003). Tracking changes in plant life is essential because plants are regarded as "green canaries" (Measuring Vegetation Health, 2006). This means that, if plants thrive in an area, other organisms are likely to thrive as well. Currently, there is a general dearth of information regarding the changes in vegetation over time. Picture Posts, wooden or plastic in-ground posts that allow camera mounting, can be used by professional or amateur photographers to provide photographic data that records the effects of climate change on plant life. Involving citizens in a Picture Post project promotes meaningful data collection, educates the public about environmental changes, and gives scientists the means to track the effects of climate change on botanical life in a particular location.

Boston, Massachusetts, is one of many cities that are highly susceptible to the consequences of global climate change. To monitor the effects of this global variation, scientific contribution from volunteers is a necessity. According to a report by Jeffrey Cohn (2008), there will never be enough volunteers to complete the amount of citizen science research that needs to be done; the need for citizen scientists is high and expanding. Currently there are more than 200 citizen science projects running in North America. However, this is merely a fraction of citizen science's potential. In order to gain an understanding of how climate change is affecting the

vegetation around Boston, the staff at the Blue Hill Observatory have initiated a project to involve citizen scientists in a Picture Post program designed to gather data around the Observatory. The Blue Hill Observatory (2011) has an extensive history of scientific data collection: it has been making uninterrupted weather observations for 126 years. These observation methods are specialized; trained employees are responsible for this type of data collection. Other methods of data collection, such as Picture Post photography, are not specialized. This data collection method is simple and can be used by anyone who has a digital camera. Organizations that host Picture Posts have been relying on citizen scientists, volunteers who are interested in scientific research, to take pictures at the Picture Post and submit them for data collection. It is critical that the Blue Hill Observatory also begins to receive those data from such sources, since its own employees have other important work to do. This symbiotic relationship between professional and citizen scientists is essential for the success of the Picture Post project.

The Blue Hill Observatory recently started to work with numerous organizations to collect Picture Post data. These organizations have been attempting to motivate citizen scientists to go out in the field and gather data using Picture Posts. However, prior to the involvement of the WPI team, the Observatory had not participated in the Picture Post Project. Specifically, the Blue Hill Observatory did not have a methodology in place to motivate citizen scientists to use Picture Posts. Furthermore, the Observatory had not developed a strategy to educate people about climate change and the importance of monitoring vegetation using Picture Posts.

The primary goal of this project was to create an informational and promotional program to build Picture Post participation at Blue Hill. Organizations that also host Picture Posts can use the Blue Hills promotional program as a model to increase participation in their own programs.

The first objective to accomplish the goal was to incorporate a Picture Post program into the Blue Hill Observatory's programs for promoting environmental science. To reach this objective, three Picture Posts were set up at the Observatory. A brochure was created for distribution, and a guide for volunteers was made to explain and promote Picture Posts during guided tours of the Observatory. This project's second objective was to create methods of promoting Picture Posts to the general public, as opposed to methods that specifically target the attendees of the Blue Hill Observatory's educational programs. Further, post masters and administrators of Picture Post programs were interviewed to learn more about the program. Signs and posters were developed to increase awareness of the project, which can be adapted to use at other Picture Posts. By successfully accomplishing these objectives, the Blue Hill Observatory and other participating organizations were provided recommendations and promotional materials that will assist them in educating the public about climate change and encouraging them to become more involved in efforts to monitor the effects of climate change by using Picture Posts.

Chapter 2: Background

An interesting new method for tracking changes in vegetation, and thus the impact of climate change, is the use of Picture Posts. The Picture Posts act as permanent tripods from which pictures are taken by citizen scientists and analyzed by scientists in order to observe changes in plant life. In this chapter, we will discuss the use of Picture Posts, climate change and its causes, the impact that climate change has on vegetation, and phenology. We will also discuss environmental monitoring, and the importance of citizen science to environmental monitoring. We will additionally discuss citizen science, ongoing citizen science projects, and the positive and negative aspects of each project. We will also present information about the Blue Hill Observatory and Science Center and its involvement with the Picture Post community.

2.1: Climate Change and Vegetation

Throughout the past century, humans have had significant effects on the earth and its atmosphere. Some of the changes that human activity has caused have made a lasting impact that literally shapes the face of the earth and its climate. Today, studying the effects of climate change is the primary concern of botanists, climatologists, and general ecologists. To explain the effects of climate change, we will discuss the causes of climate change and how it affects vegetation growth.

Most scientists agree that the primary cause of climate change is the increase of carbon dioxide and other greenhouse gases in the atmosphere, which have increased exponentially since the start of the Industrial Revolution. According to John H. Douglas (1975, p. 139), since 1910, atmospheric carbon dioxide (CO_2) has been rising by 4% annually due directly to

industrialization. NASA (2011b) reported that the global temperature has risen by 1.5°F since the late 19th century, and this number continues to rise. Temperatures are rising in part because of rising CO_2 levels, which causes a greenhouse effect on the earth, and because chlorofluorocarbons (CFCs) released in the atmosphere destroy the ozone in the stratosphere, which is a portion of the atmosphere that lies about 20 km above the earth's surface (US EPA, 2010). The ozone layer functions to absorb up to 99% of the incoming solar high frequency ultraviolet rays, which are harmful to both flora and fauna (Sparling, 2001). The increased average temperatures and UV light are two factors that are causing climate change and influencing the sustainability of vegetation on Earth.

2.2: Environmental Monitoring

Environmental monitoring is the practice of observing conditions in the environment through observation and data collection. Scientists are interested in studying vegetation because plants are indicators of changing environmental conditions, which may be a result of climate change (MVH, 2008). As seen in Figure 1, plants respond to a variety of external stimuli, implying that plants are a good medium to track climate change in a specific area. Human and natural processes influence conditions in the world whether they are positive or negative. Plants naturally respond rapidly to changes in the environment, making them useful for tracking potentially hazardous contaminants or conditions in their immediate area. According to

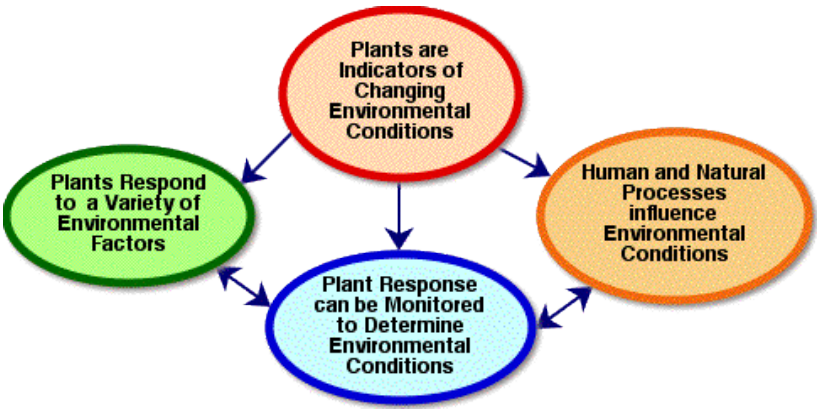

Figure 1: Vegetation Monitoring Concept Map (MVH, 2008, p.1).

Lovett (2007), there is much value in environmental monitoring, as future climate trends may be predicted based on the results of such monitoring, and can provide data to help figure out how to maintain a particular area.

Advances in modern technology have resulted in much more effective and efficient ways of collecting data about the world around us. Digital Earth Watch (DEW), a program formerly funded by NASA, has been collecting data to monitor the earth's surface through the use of satellite imagery and ground-level photographic methods. DEW has become very involved with Project Picture Post, which is a subdivision of DEW. Picture Post is a photographic technique that yields data from near ground level (UNH, 2008).

2.2.1: Picture Post

Project Picture Post began at Concord Academy in 2005. According to Beaudry et al. (2010), environmental observer John Pickle and some like-minded associates devised the Picture Post in an effort to collect a standardized record of visual data of an environment. The first Picture Post was created in April of 2005 for use in Fresh Pond Reservation in Cambridge, MA. The idea has since caught on with many organizations, including community-based environmental groups such as Forest Watch and Friends of Menotomy Rocks Park, academic institutions such as the University of New Hampshire and Concord Academy, and even a few government-affiliated organizations such as the Blue Hill Observatory and NASA (Franco, 2007).

Picture Posts are unique tools for collecting visual data on a given area that are as simple in operation as they are in concept. As described by researchers at the University of New Hampshire (2008), the post is seven or eight feet in length and is generally constructed from wood or plastic. It is typically driven four feet into the ground so that it is unlikely to move or be

displaced. This leaves the top of the post, level, three or four feet above the ground, roughly waist high. The top of the post is designed with an octagonal block that facilitates the proper positioning of a digital camera facing one of the eight compass directions (for an example see Figure 2). As a result, the pictures taken with the camera are standardized: pictures taken from the same position all show the same section of the surrounding environment. The post's user positions his/her camera at each of the eight sides, taking a picture at each position, thus acquiring a panoramic set of pictures that cover all 360° of direction. He/she then takes a ninth picture straight up to get a record of the overhead foliage and/or cloud cover. In this way, a complete visual record of the environment around the Picture Post at a given point in time is obtained. This information can then be passed on to environmental scientists by uploading the digital pictures to a website designed to host pictures taken from such posts. This website, hosted by the University of New Hampshire, allows users to select a Picture Post and submit a set of pictures for the date and time that the pictures were taken. In addition, users are able to register and manage new Picture Posts and access a personal page with lists of posts the user has installed and posts the user has marked as "favorites." By taking pictures on a regular basis (once a week, for instance) and uploading them to the website, casual citizen scientists can collect a large quantity of valuable environmental information with relative ease, an invaluable asset in the hands of an environmental scientist. As Beaudry et al. (2010) titled their EarthZine article; "One Picture Post is Worth A Thousand

Figure 2: Top of a Picture Post with Camera (UNH, 2008, Picture Post: Home).

Pictures." Referring to the saying "a picture is worth a thousand words," Beaudry alludes to the vast amount of data that citizen scientists can collect through the use of Picture Posts.

2.2.2: Usefulness of Picture Posts

Picture Posts are unique in their collection of visual data. Without the use of a permanent stationary camera, a Picture Post lays the foundation for collecting data about an area for months or even years at a time. As long as the post is utilized on a regular basis and nothing happens to the post's position or serviceability, a continual visual record of the area around the post can be acquired with ease. These data provide scientists with a highly valuable cache of information that can be used for a number of environmental applications. As Franco, Sealund, and Tashjian (2007) state, "one can … observe changes in canopy cover, water levels of ponds and lakes, and air conditions" (p. 64). In other words, the visual data collected from Picture Post locations can be used to assist environmental scientists in drawing conclusions that are based on simple observations of the environment. An application that has recently become prominent is the idea of foliage acting as a "green canary." As described by Measuring Vegetation Health (2008), the overall health of vegetation and its patterns of growth and coloration can be utilized as an indicator of an environment's climate and conditions, making vegetation trends a useful, convenient means of monitoring climate change. The advantage offered by Picture Posts is that the data can be collected continually over a period of days, months, and even years, thus allowing environmental scientists to look over a great deal of data from different points in time, an ability that heightens their capacity to draw conclusions about the environment they are observing.

2.2.3: Contributing Organizations in the Boston Area

In their efforts to bring together the abundance of information on vegetation trends and other environmental indicators made accessible by the use of Picture Posts, a number of organizations involved in environmental studies have collaborated to create common websites for hosting the pictures taken at these various locations. One of these websites is hosted by the University of New Hampshire and Digital Earth Watch (previously called Measuring Vegetation Health) (2008). The website's affiliates, mostly academic institutions and state parks and reserves, can be found across New England. Of these professional affiliates, those located around Boston, MA, include Concord Academy, a private high school that witnessed the Picture Post's conception; Friends of Menotomy Rocks Park, an organization that looks after the named public park in Arlington, MA, which features two Picture Posts; and Friends of Fresh Pond Reservation, an organization that looks after the named reservation in Cambridge, MA, which also has two Picture Posts (Beaudry, 2010; FoFPR, 2011; FoMRP, 2011; Franco, 2007). These organizations are in further collaboration with the Boston Museum of Science, the University of California, the Forest Watch, EOS-WEBSTER, the Blue Hill Observatory, and the University of Southern Maine in their efforts to collect practical, pertinent information on their respective environments (MVH, 2008).

2.3 Introduction to Citizen Science

Man's desire to learn and gain understanding about nature and the world around him has been the basis for many of the great scientific discoveries and achievements in modern history. As a result of mankind's quest to understand nature, the need for accurate, quality data has increased. This need for data poses the question: how can these data be collected with only a limited number of scientists and researchers? The answer lies in Citizen Science.

Jerald Schnoor (2007) states that citizen science can be defined as "a program in which a network of volunteers, many of whom have little or no specific scientific training, perform or manage research-related tasks, such as observation, measurement, or computation." Citizen science is generally utilized when the amount of data necessary is too large to be collected by those who would use these data.

2.3.1 History of Citizen Science

Citizen science has been used for the purpose of collecting data for over 100 years. In fact, the longest-running citizen science project that deals with data collection, the Audubon Society's Christmas Bird Count, was established in 1900 by Frank M. Chapman. The Audubon Society states that this project takes place annually from December 14th through January 5th, at various bird count circles, which are locations where citizen scientists gather to collect data for the Christmas Bird Count. Figure 3 shows the locations of bird count circles in the western hemisphere. Each year, tens of thousands of bird enthusiasts meet at various locations to collect data on migratory birds. The collected data are then used to learn about changes in the number of birds in North America. In addition, the data are frequently cited in various articles and journals relating to ornithological observation (p.1). Jerald Schnoor (2007) shows that, since the start of the project, the study has resulted in a better understanding of the migratory patterns and species decline in migratory birds in North America (p. 5923).

Figure 3: Christmas Bird Count Circles in the Western Hemisphere (Audubon, 2011).

One of the more recently initiated citizen science projects that has found remarkable

success is Project BudBurst. Project BudBurst was started in 2007, and is available to people of all ages and abilities. The project's participants across the United States make observations regarding timing of leafing, flowering, and fruiting of plants. The data that people record is then submitted and made freely available online. Also, scientists can analyze these data to learn more about plant responsiveness to changes in climate at local, regional, and national levels (BudBurst, 2011).

2.3.2 Effectiveness of Citizen Science

Arguments about the effectiveness of citizen science arise over the fact that it involves employing members of the public, who may have little or no scientific training, in data-gathering projects. The effectiveness of a citizen science project relies heavily on the quality of the data used and thus is dependent on the individuals who are collecting the data. Since not all of the citizen scientists may have training about proper data gathering procedures, it is difficult to ensure high levels of accuracy and quality for the data collected. While this is a viable concern, it can be easily solved by employing a sufficiently large number of conscientious citizen scientists to counteract those who do not collect the data properly.

There are many advantages to citizen science. For example, by involving the public with data collection, a much larger sample size can be achieved, one that covers a broader area of observation. This is especially useful when the required data need to be gathered on a statewide or even national or international level. Galloway (2006) observed the reliability of citizen science under the case study of the Oregon White Oak Stand Surveys, where a test was conducted using both scientists and school children to see if there was a noticeable difference between the data sets. The project took place during May and July of 2002. It involved having students and

scientists collect data about the different species of white oak trees in Oregon. The study concluded that there were many similarities between the data collected by the children and the data collected by the scientists, thus furthering the argument that data collected by citizen scientists is still scientifically valid. It is also much more cost-effective to use volunteers to collect the data instead of having to pay skilled workers to collect them. To summarize, the effectiveness of a particular citizen science project depends on a multitude of variables including ease of data collection, project design, and ease of data integration.

2.3.3 Benefits of Citizen Science

In addition to serving as an effective means of gathering data, citizen science can also act as a way to get the public interested in the research that makes use of the data they collect. Citizen science can also be used as a means of developing a better understanding of the effects of human interaction with the environment. According to a report by Ottinger (2010) an air monitoring project was proposed because the residents believed that "the manufacturing facility—located merely fifty feet from some of their homes—was unsafe, and that its emissions of toxic air pollutants [were causing] serious illnesses among residents" (p. 245) As a part of the project, the residents of Norco, Louisiana, played a role in acquiring data on the air pollution in their neighborhoods from the late 1990s to 2002. They acquired the data using devices called "buckets", as seen in Figure 4, that measure contaminants in the air. The buckets contained a Tedlar sampling bag to collect air quality samples. The data collected by this study were used to prove that the chemical company was in fact releasing harmful chemicals into the air. In addition, in 1998 one of the

Figure 4: Buckets Used for Measuring Air Pollution (Ottinger, Gwen 2009).

"buckets" recorded high levels of methyl ethyl ketone, which resulted in the discovery of a leak at the plant. This project decisively demonstrates how citizen science can result in obtaining critical data that can be put to productive, substantial use.

2.3.4 Disadvantages of Citizen Science

As stated earlier, perhaps the biggest argument against the validity of citizen science has to do with questions raised regarding the quality and accuracy of the data collected by citizen scientists. Due to the fact that the individuals gathering the data may not know the proper data gathering techniques and proper data handling, citizen science projects could result in data that are skewed or below useful scientific standards. Another problem that arises when incorporating citizen science in data gathering is that there is no guarantee that the data needed for the given project will be collected when needed. This is especially true if the particular project is not publicized well to the public. A good way to correct this problem is to make sure that the project is properly publicized and that the public is aware of the purpose for the project. Another way to lessen the error associated with using citizens to gather data, as stated by Dickinson, Zuckerberg and Bonter (2010) is to use "very large sample sizes [which] will tend to lessen sampling error (that is, increase precision)". Although citizen science may have its flaws, it is usually praised for its ease of incorporation in various data gathering projects and its cost-effectiveness.

2.3.5 Challenges Facing Citizen Science

As the number of citizen science programs increases, the need for proper data management systems does also. Modern technology poses new opportunities for creating better data organization systems. The internet is commonly used to organize data from citizen science projects because it is easy to access and utilize. As stated by Newman (2007) "the advantage of a

flexible, yet controlled, cyber-infrastructure system lies in the ability of users with different levels of permission to easily customize features themselves, while adhering to controlled vocabularies necessary for cross-discipline comparisons and meta-analyses". Furthermore, if the data collected are being organized using the internet, it is important that the website is easy to manage so that changes to improve usability are easy to make. Social networking sites like MySpace or Facebook could also be used in the future to gather data. Their ease of use and widespread use makes them ideal for gathering data such as pictures taken by citizen scientists. As such, technology could present new techniques for better organizing data collected through citizen science using websites or social networking sites.

2.3.6: Motivating the Public to Partake in Citizen Science

One of the fundamental obstacles citizen science faces is motivating the public to partake in citizen science projects: it is often difficult to encourage someone to take time out of their daily life to collect data for someone else without compensation. For this reason, citizen science can sometimes be overlooked as an effective means of data collection. This is a problem because, as Nov, Arazy, and Anderson state, "in times of research budget cuts and increasing cost of doing science, citizen science represents a low-cost way to both strengthen the scientific infrastructure and engage members of the public in science" (2011, p. 68). As such, it is important to promote citizen science as an effective way to collect data and to engage the public in scientific research.

In order to stimulate the public's interest in citizen science, it is important to make participation in the project as convenient for participants as possible. This includes incorporating effective and convenient computer systems with easy to follow instructions, and easy access

tools to collect and manage the data provided by citizen scientists. By making it as easy as possible for the public to partake in citizen science projects, volunteer participation can be increased. Incentive programs could also be used to increase the public's involvement in citizen science. These could involve rewards for posting data frequently. Because of the low cost of citizen science research and its effectiveness, it is important to develop ways of making it easy for the public to partake in citizen science projects in order to increase their participation.

2.4 Phenology

There are many indications that a season is changing. These can include the flowering or deflowering of trees and plants, changes in temperature, and changes in animal migration and breeding patterns. The process of studying changes in vegetation, migratory patterns, and breeding as a result of fluctuations in climate trends is known as phenology.

2.4.1: Effects of Climate Change on Phenology

Phenology has proven to be an invaluable tool in the tracking and recording of climate change over time. This is due mainly to the fact that phenology can be used to track changes in temperature over time. Since plant phenology is greatly affected by changes in climate, it has proven to be a great asset in tracking effects of global climate change on vegetation. It has been found that, as the length of plant activity season increases due to global warming, this increased plant activity has a measurable impact on certain atmospheric levels. For example, according to Peñuelas, as the plant activity season grows, it can lead to "increases [in] biospheric CO_2 uptake and thus decreases [in] the current rise of atmospheric CO_2 concentration and its influence on the greenhouse effect" (2009). Another positive effect of a longer plant activity cycle is a greater release of certain aerosols that help decrease the results of global warming. The aerosols released

by plants during their activity seasons help intercept radiation by diffusing excess light being received by the canopy. Although a longer plant activity season poses some positive consequences, it also has negative consequences. "The extended plant activity also further increases the total annual emission of biogenic volatile organic compounds" (2009) or BVOC. This includes compounds such as ozone. According to Peñuelas, increases in ozone can result in an increase of the greenhouse effects of certain gases such as methane and CO_2. There is a fine line between the positive and negative effects of a longer plant activity season and studying phenology will be a key factor in determining these effects on vegetation health and climate stability.

2.4.2: Benefits of Citizen Science on Phenology

The area of plant phenology has been shown to benefit greatly from the use of citizen science. This is due mainly to the fact that the use of citizen science helps greatly broaden the size and area of collected data. Project Budburst is an excellent example of how citizen science can help in the gathering of large data sets. The project involves employing members of the public to gather data on a particular plant. These data are in the form of pictures taken by the citizen scientist on a daily basis. The data collected are primarily used to determine when the plant begins its budding stage and to observe the growth of the plant from budding to de-leafing. The data gathered from these observations are particularly valuable from a phenological perspective because, by observing when the plant begins its budding stage, scientists can determine how the climate has affected the plant and if there are any variations from previous years. The use of citizen science can prove to be a valuable asset in the advancement of phenological research.

2.5: Blue Hill Observatory

As described on the Blue Hill Observatory's website (2011) and by Conover (1990), the Blue Hill Observatory & Science Center (BHOSC), our sponsor for this project, is the oldest meteorological observatory in continuous operation in the United States. Established 126 years ago, it boasts the longest continuous weather record in North America. Today the facility, shown in Figure 5, continues to collect and distribute climatological data. In addition, the facility seeks to educate the public and future meteorologists about atmospheric science and to further its ability to serve its myriad functions (Blue Hill, 2011; Conover, 1990).

The Blue Hill Observatory receives over 10,000 visitors every year, the majority of these being students or scouts who are participating in the educational programs offered by the facility (McCasland, 2011). Incorporating the Picture Posts into the programs offered by the Observatory will be a large part of reaching out to these potential citizen scientists. The incentive for reaching out to these groups is twofold.

Figure 5: The BHOSC atop the Reservation's Summit (BHOSC, 2011, Observatory Photo Gallery).

First, these groups are being prepared to step forward and take up various scientific activities in the years to come. Getting these groups involved in the Picture Post Project lays a foundation for bringing long-term participants into the project, a critical aspect of the project's usefulness. Second, these are groups who have already expressed an interest in the environment and in actively participating in citizen science programs. As Franco (2007) observed, "The average

[Picture Post] user will be someone who already cares for the environment, someone who is willing to take time out of their own schedule to better the world around them" (p. 19). Thus, the participants of the Blue Hill Observatory's educational programs have already shown a key qualification for being potential Picture Post users.

The Blue Hill Observatory regularly seeks to collaborate with other observatories and institutions involved with climatological study. One such effort that the facility undertook was to join the Picture Post program. The facility collaborates with Digital Earth Watch and the University of New Hampshire in the operation of DEW's online posting site (UNH, 2008; MVH, 2008). The Observatory also collaborates with the Mount Washington Observatory on many occasions, continuing a long-time association that began in the 1930s (Blue Hill, 2011). With a myriad of connections, including other observatories and environmentally-minded citizen organizations, the Blue Hill Observatory stands to be a key contributor to the Picture Post program.

2.6: Summary

Global climate change presents serious problems for the future, problems that will affect both human environments and biological ecosystems. The effects of climate change can already be seen in the world around us. To better understand what effects global climate change will have, we need to be able to study the effects that are already evident. However, the data needed to study these effects are not being collected to any useful degree. The Picture Post Project provides a way to collect these data. For the project to succeed, however, members of the public must be employed to act as citizen scientists and collect the data using the Picture Posts. In this way, data can be collected that can allow environmental scientists to monitor climate change's current effects and draw conclusions about what effects will be seen in the years to come.

Chapter 3: Methodology

Our project dealt with educating the public about climate change and getting them involved in citizen science through personal participation in the Picture Post Project. Specifically, our project group was tasked with determining ways to promote the project to current and potential citizen scientists. The promotional materials and methods that we developed needed to be designed so that they could be used by organizations that host Picture Posts and by citizen science programs in general. To do this, we developed a Picture Post program at the Blue Hills Reservation through collaboration with the staff of the Blue Hill Observatory & Science Center (BHOSC). In doing so, we created an informational and promotional Picture Post program that supporting organizations can learn from in order to improve their own programs. By successfully promoting Picture Posts, these organizations will bring about an increase in the number of people who use them. Increased usage of the posts will lead to a higher degree of general public awareness regarding the issue of climate change and to an increase in the collection of scientifically significant amounts of important environmental data.

In order to achieve this goal, our project focused on two objectives. The first objective was to successfully incorporate a Picture Post program into the Blue Hill Observatory's current methods of promoting environmental science. To do this, we interviewed people from organizations that already promoted Picture Posts and visited sites where Picture Posts had been set up. From these interviews and site visits, we were able to identify ideas and approaches that existing sites use that have proven to be either successful or insufficient. We also generated ideas of our own based on the feedback we received from these interviews and on our observations of the posts' locations. Our project's second objective was to devise methods of promoting Picture

Posts and citizen science to the general public, as opposed to methods that specifically target the attendees of the Blue Hill Observatory's education programs. To accomplish this objective, we developed methods that focus on raising awareness of the usefulness of Picture Posts and of their importance regarding climate change. While a number of these methods naturally fit in with the Observatory's current promotion campaigns for climatology and citizen science, the ideas we developed are applicable outside the Reservation as well. It is our hope that other citizen science organizations, particularly those that use Picture Posts, can use our ideas and methods to improve their programs and thus encourage a greater number of people to participate in citizen science.

3.1: Acting as Citizen Scientists

The Picture Post Project recently initiated at the Blue Hill Observatory is designed to be a citizen science endeavor. In other words, the program involves ordinary people collecting data on the surrounding environment rather than relying on trained observers to collect the data. In this case, the citizen scientists are meant to be casual visitors of the Blue Hills Reservation as well as those attending educational programs at the Observatory. The number of visitors who agree to act as citizen scientists is largely affected by how user-friendly the program is.

To better understand how the Picture Posts will be used by visitors of the Observatory, our group members assumed the roles of citizen scientists while working at Blue Hill. We did this by regularly using the Picture Posts to collect visual data on the surrounding environment and then uploading the pictures onto the online database. By involving ourselves in the process, we were able to discover some usability flaws with the database's online interface and identify ideas both to fix these problems and to improve the website as a whole. This allowed us to make appropriate recommendations to the team that manages the website so that they could update the site and make it more user-friendly.

3.2: Learning from Existing Programs

The Picture Post Project began at Concord Academy in 2005. Since then, numerous environmental and academic organizations have incorporated the project into their own programs. By using the posts themselves, these organizations have had the opportunity to employ various strategies to promote their Picture Posts to potential users. Acquiring feedback from the people who run these programs provided a valuable resource for developing our own methods of promoting the Picture Posts at the Blue Hill Observatory.

The groups and organizations that we focused on collaborating with were the ones that put their Picture Posts to active use, such as Friends of Menotomy Rocks Park, Forest Watch, the Seacoast Science Center, and Friends of Fresh Pond Reservation. Though we couldn't interview representatives from all of these organizations, we were able to get in contact with a good assortment (a sample interview protocol for the program administrators is in Appendix A and a sample interview protocol for the post masters is in Appendix B). We first interviewed Steve Engstrom of the Seacoast Science Center, who manages the Picture Post located there in addition to his tour guide duties. While we were at the Science Center we were also able to interview Annette Schloss, a research scientist at the University of New Hampshire who actively engages in the Picture Post Project, regularly collaborates with Digital Earth Watch, and helps manage the picture-hosting page on UNH's website (Beaudry, 2010). After interviewing Steve Engstrom and Annette Schloss we traveled to the Wells National Estuarine Research Reserve in Maine where we interviewed Suzanne Eder, who is in charge of managing and promoting the four Picture Posts there. Finally, we interviewed Maura Fitzsimmons, a high-school science teacher from Ipswich, MA, who has installed two Picture Posts as a part of her curriculum, via email. In addition to personal interviews with staff members, we visited the actual physical sites of the

installed Picture Posts in order to get a better understanding of where the post was located, how visitors find the post, and what promotional material is placed at the site. We first visited the Picture Post at Crane Beach in Ipswich, MA, that Fitzsimmons had set up and then visited the Picture Post located at the Seacoast Science Center that Engstrom was responsible for. After visiting these posts, we went to the Wells Reserve in Laudholm, ME, to see two of the four Picture Posts that were stationed there. Through these interviews and site visits we were able to gain a better understanding of how these organizations utilize their Picture Posts and how they encourage their patrons to do so as well. We also acquired a better understanding of how the data collected using their posts are used by environmental scientists. By achieving this knowledge we were able to develop promising ideas for promoting the Picture Posts at the Blue Hills Reservation and generate practical information that can be used to promote the Picture Post Project as a whole.

In addition to interviewing Picture Post administrators, we arranged a series of interviews with administrators of Project BudBurst, a citizen science project with notable success. Dennis Ward, an educational technologist, is the lead technologist for Project BudBurst and the lead web developer for the National Ecological Observatory Network (NEON). We also interviewed Sarah Newman, the Citizen Science Coordinator for Project BudBurst and Science Educator for NEON. The purpose of these interviews was to understand the strategies that a successful citizen science program recruits and retains its volunteers, strategies that we were able to apply to our own project. These interviews were conducted via telephone. The interview protocol we followed can be found in Appendix C.

3.3: Promoting the Picture Posts

We categorized the people who visit the Blue Hill Observatory into two groups: those who causally pass the Observatory while they use the reservation grounds (mainly hikers and cyclists) and those who intentionally visit the Observatory to learn from the educational programs they offer. In conducting our project we targeted both groups, using different methods to engage each audience.

3.3.1: Observation and Feedback from Casual Visitors

Many of the hikers and cyclists who visit the Blue Hills Reservation utilize trails with paths that pass by the newly erected eastern and western Picture Posts. Many of these people use the trails regularly, sometimes even daily, which makes them prime candidates for the Picture Post Project, given the frequency of their visits.

To promote the Picture Posts to frequent visitors, we developed instructional signs that we then attached to the eastern and western posts (see Appendix D). We then observed the reactions of the Observatory's casual visitors. Specifically, we gauged the level of interest they had in the Picture Posts as they walked by them. To do this, we designed an observation method and rubric to gauge how well the signs attracted the attention of the aforementioned hikers and cyclists (the observation scale and interview protocol can be found in Appendix E). On each weekday that had clear weather for three weeks, at sometime between 10:00AM and 1:00PM, at least one group member sat near the eastern or western Picture Post for one hour and discretely observed the visitors' interest in the post based on our scale. The interest levels that we observed helped us determine whether or not the promotional signs we had developed had the potential to attract new Picture Post users.

In addition to passively observing the people who passed the Eastern Picture Post, we interviewed randomly selected visitors who took the time to read the sign. People were interviewed on weekdays between 11:00AM and 3:00PM, and on weekends between 10:00AM and 4:00PM when the weather was fair. The interview protocol that we followed can be found in Appendix F. The purpose of the interviews was to further understand why people did or did not use the Picture Post after reading the sign. Also, it was intended to gain specific, open-ended feedback about the attached sign.

In addition to promoting the Picture Posts with informational signs and gauging visitors' interest, we stood next to the Eastern Picture Post and interviewed Reservation visitors. During the interview, we conducted a demonstration of the Picture Post, to show its simplicity (the interview protocol we used can be found in Appendix G). Specifically, we randomly selected and interviewed fifty people who were using the trails near the Eastern Picture Post. On the weekend these interviews were conducted between 10:00AM and 4:00PM, while weekday interviews were conducted between 10:00AM and 12:00PM. The demonstrations and interviews were designed to show the usability and function of the posts while explaining why they are important and how people can use them to become citizen scientists. Immediately following each interview we issued a brief survey to each interviewee that gave us feedback on the quality of the demonstrations, the usability of the Picture Posts, and the visitor's interest in the project (the survey we used can be found in Appendix H). The main goals of the survey were to quantitatively measure the interest that potential post users had in the project, and to gain feedback about the sign we attached. These data helped us design promotional strategies that had the greatest potential to interest new users.

In order to gain a better understanding of how citizen scientists perceived the process of data gathering and submission, follow-up emails were sent to the three people who posted pictures online. The emails consisted of a section thanking the user for posting their pictures, and five brief questions about their experience with Project Picture Post (see Appendix I). By sending these emails, valuable data were collected about the processes that are associated with using a Picture Post. The team was able to get a better idea of how much work is involved at all stages, ranging from the taking of the pictures to the posting of those pictures.

3.3.2: Development of Promotional Media

The Blue Hill Observatory regularly uses displays while conducting their educational programs and to promote their interests. Because the Observatory staff wanted the Picture Posts to become an integral part of their programs, we were able to easily incorporate our promotional materials with the current displays. To promote the Picture Post Project, we developed promotional media that included brochures, posters, and a Facebook page, which functions as a volunteer guide sheet.

The brochure was designed for distribution to the participants in the Observatory's educational programs (the brochure can be found in Appendix J). This brochure gives an overview of citizen science and phenology and how they relate to the Picture Post Project. The brochure was designed primarily to promote the use of the Picture Posts to the families and school groups that attend the Observatory's educational programs because they are the visitors who may potentially be utilizing the Picture Post program.

As a part of the effort to increase the use of Picture Posts at Blue Hill, two presentation posters were designed that function similarly to the brochure by explaining the program and its

importance while educating visitors about citizen science and phenology (the posters can be found in Appendix K). The indoor poster, which targets Observatory visitors attending an educational program, was placed on the third floor of the Observatory because space was available for it and most of the tours go through that area. The outdoor poster was set up on the north side of the kite shed near the eastern Picture Post; this poster is meant to attract the attention of anybody that may walk past the shed. We observed people as they passed the outdoor poster, to study peoples' reactions as they passed. As a means to further test the effectiveness of the outdoor poster, randomly selected people who read the poster were interviewed (this questionnaire can be found in Appendix L). The purpose of the interviews was to determine why, after reading the poster, people were or were not using the Picture Posts.

In addition to promoting the Picture Post Program at the Reservation itself, we made an online Facebook page titled "WPI – Blue Hill Observatory Picture Post Collaboration." The Facebook page has multiple functions that anyone can access, though it primarily promotes the Picture Posts at Blue Hill. The page is also used to receive outside opinions about the promotional materials that we designed to promote the Picture Post Project. The extent of the page's success was measured by a correlation between the number of people who "like" the page and an increase in the number of postings to the online Picture Post database.

3.3.3: Feedback from School Group Visitation

While we were working on our project, we were asked to present the Picture Post Project to two different school groups as a part of their tour of the Blue Hill Observatory. These groups included a group of fifth-grade students from The South Shore Christian Academy and a group of fourth-grade students from Solomon Schechter Day School for Greater Boston. We took the

opportunity to give the groups a brief presentation at the Picture Post and thus receive feedback from a different demographic than that with which we had previously been working. We first presented the groups with a background on Project Picture Post, focusing on its usefulness in observing phenological changes and tracking climate change. We then gave each group a demonstration of how to use a Picture Post. After our presentation to the South Shore group, we invited one of the teachers to take pictures sets using the posts and then post them on the website. When the teacher had finished taking picture sets at both posts, we then asked her to fill out one of our surveys (see Appendix H). We also discussed her reaction to our program and whether she could see Project Picture Post correlating with her curriculum. We did not get the chance to have an in-depth conversation with any of the teachers from Solomon Schechter. We gave these presentations primarily to acquire a better understanding of the reactions of scholastic demographic groups towards the Picture Post Project and thus better develop our program at the Observatory.

3.4: Constructing Picture Post Mounts for the Observatory Tower

One of the tasks presented to our team by Blue Hill Observatory was to develop and build mounts that would turn the Observatory's tower into a functional Picture Post. The mounts had to be strong, durable, visually appealing, and cost-effective. In addition, the Observatory is an historical monument, so altering or damaging the structural integrity and/or appearance of the building to install the mounts was strictly prohibited.

In order to construct the mounts, we first needed to identify a building material that fit the aforementioned requirements. We observed that the tower's railing, which was made of galvanized steel, had good corrosion resistance, was aesthetically pleasing, and was cost-

effective. As a result, we decided to use galvanized steel for the mounts as well so that they would complement the railing and possess the required material properties.

Because Blue Hill Observatory is a non-profit organization, we conducted research online to find hardware suppliers that had charitable-donation programs. Of the companies we found, we decided to approach The Home Depot and Lowe's because they carried what we needed and were large companies with significant donation budgets. In preparation for approaching them for material donations, we created a list of the materials we would need to construct the mounts based on the materials available at each store. We also drafted a form letter with the Blue Hill Observatory letterhead that provided a brief background on Project Picture Post and asked for a donation of the necessary materials (a copy of the letter can be found in Appendix M). Donations for materials were received from the Home Depot stores in Quincy and West Roxbury, and the Lowe's store in Dedham.

Chapter 4: Results & Analysis

Once we had installed the Picture Posts at the Blue Hill Observatory and developed promotional material, we needed to gauge the effectiveness of our program. Because we were developing a program that was to act as an example for other organizations that use Picture Posts, we needed to make sure that the materials we developed attracted the attention of people passing the posts or posters, got people interested in the Picture Post Program and the scientific fields associated with it, and motivated people to use the Picture Posts and become involved in citizen science. In addition to analyzing our own methods, we needed to gauge the effectiveness of other Picture Post programs and determine why they were, or were not, effective, thus allowing us to better develop and refine our own strategies and promotional materials based on what worked well and what seemed less effective. Along with other programs, we also needed to analyze the infrastructure of the Picture Post Project itself so that we could offer recommendations for improving the overall program. Finally, we needed to look over the feedback we got from the program administrators whom we had interviewed and identify any ideas they contributed that we could use as well as any trends in their responses. By conducting this analysis, we would be able to gauge how well our program was achieving our objectives and where it needed improvement. In addition, we would be able to make recommendations for improving other programs and the project as a whole.

4.1: Assessing the Current Program

To better understand what the participants of the Picture Post Project were being asked to do, we regularly participated in the project. In other words, we ourselves used the Picture Posts to collect picture sets that we then uploaded to the online database hosted by the University of

New Hampshire. We generally took pictures using the posts once a day whenever we were at the Observatory and later uploaded the pictures when we had the time to do so. As we used the Picture Posts at Blue Hill and the Picture Post website, many of the strengths and weaknesses of the Picture Post program became apparent.

4.1.1: Strengths of the Picture Post Project

Using the Picture Posts to collect significant ecological data proved to be a simple, time-effective process that took little expertise to perform. Quickly becoming familiar with the process of using the posts, we found that it typically took less than three minutes to go out and take a picture set whenever we were at the Observatory, including the time it took to walk to and from the Picture Posts as well as the time it took to actually take the pictures. In addition, once we were familiar with the website that UNH hosted, uploading the pictures became routine as well, typically taking around four minutes when we were posting a single picture set. Another interesting aspect was that we were collecting the data without any scientific training specific to the Picture Post or otherwise. As such, collecting the data was clearly a simple, effortless procedure.

4.1.2: Weaknesses of the Picture Post Project

There were, however, certain obstacles in the process that we often had to face. First, while taking the pictures was a simple exercise, there was far less motivation to upload the pictures once they were taken, as it was in no way time-bound and would take at least five minutes compared to the minute it took to simply take the pictures. As a result, we often didn't upload the pictures we had taken until our continued involvement with the project reminded us to do so. Also, the process of uploading the pictures was far less intuitive than the process of taking

them: it was only when we had learned a few tricks for using the website's map and obtained the unique URLs for our posts that the process of uploading picture sets became streamlined. Before we learned these procedures, the website's user interface often made it difficult to specify which post had been used to take the pictures, further reducing our motivation to upload our data. In addition, the page management options were often remote from the actual page, making it difficult for us to manage our Picture Posts effectively. To elaborate, in order to select which picture set is used as a guide for orienting new ones, to delete errant submissions, or to see which user had submitted a certain picture set, we had to go to our personal page on the website and select the post in question from the list of Picture Posts we managed: there was no way to get to these options from the post's page itself. In summary, while the posts were simple to use and provided an abundance of phenological data, the process of using the website to upload pictures and to manage picture sets turned out to be more difficult than we had expected.

4.2: Learning from Existing Citizen Science Projects

In order to better develop our Picture Post program for the Blue Hill Observatory, we sought to learn from established, successful citizen science programs. To observe operational Picture Post sites and acquire feedback on the Picture Post Project from project administrators, our project team visited various organizations that used Picture Posts. During our visits we conducted interviews with people who were regularly involved in the Picture Post Project and observed the locations of existing Picture Posts. In addition to our trip, we conducted phone interviews with a number of people who act as administrators for Project BudBurst. By conducting these interviews, we sought to acquire feedback that we could use to develop our own citizen science program as well as generate recommendations for improving the Picture Post Project as a whole. In addition, by observing the sites of the Picture Posts listed above, we were

able to generate ideas regarding what we wanted to do with our own Picture Post program as well as what we wanted to avoid.

4.2.1: Feedback from Program Administrators

During our trip to visit Picture Post sites we were able to meet with three people who were regularly involved in the Picture Post project. These were Steve Engstrom, a tour guide at the Seacoast Science Center; Annette Schloss, a research scientist from the University of New Hampshire; and Suzanne Eder, a program director at the Wells National Estuarine Research Reserve in Maine. We used the interview protocol presented in Appendix A for each of these interviews. Our notes from the interviews can be found in Appendix N.

From our interviews with various program administrators, we were able to acquire a good deal of insight into the strengths and weaknesses of the Picture Post Program as well as the project's significance. For the most part, the interviewees agreed on what these strengths and weaknesses were and what the most significant aspects of the project are. Our interview with Ms. Schloss also brought up a few unique ideas for promoting Picture Posts that we could use to develop our program at the Blue Hill Observatory and our recommendations for the overall Picture Post Project.

Based on our own experiences and discussions with administrators of the Picture Post Project, it is evident that the Picture Post is a fast, easy way to collect significant ecological data that can then be applied to phenology. We knew firsthand that the process of using a Picture Post is fast and simple because we had used Picture Posts ourselves and found that it took less than a minute to physically take a set of pictures. This minute naturally does not include the amount of time it took to reach the Picture Post, but if one is passing by the post in the first place then it

will only take one extra minute to stop and use the Picture Post. In addition, Picture Posts are generally located at nature reserves or by natural landforms, places where passers-by generally have already dedicated a significant amount of time to visiting the area and are likely to have a camera of some sort with them. As such, an individual who is interested in the Picture Post Project who happens to visit the site of a Picture Post may take the time to use the Picture Post as a part of their visit, as demonstrated by those visitors to the Observatory who, after reading our promotional material, voluntarily stopped to use our Picture Posts and then uploaded the pictures they took to UNH's online database. During our interviews, all three administrators agreed that the Picture Post's simplicity was its greatest strength in terms of encouraging potential citizen scientists to participate in the Picture Post Project.

In addition to being easy to collect, the data collected using Picture Posts has strong phenological significance. Phenology, the study of how climate change affects vegetation trends, currently plays a large role in monitoring the effects of climate change. Many citizen science organizations, such as the National Phenology Network and Project BudBurst, focus on collecting data regarding the health and propagation of certain plants along with the timing of various vegetation cycle events in order to provide phenologists with the data they need to monitor these effects. The Picture Post Project, by visually recording the health, expansion, and timing of cycle events, provides an excellent, standardized source of these data. As such, by employing Picture Posts, citizen science organizations can provide scientists with an abundance of significant, high-quality data.

The Picture Post Project currently faces significant challenges in terms of having citizen scientists participate in its data-collection activities. Based on our interviews with program administrators and our own observations, the most significant difficulties are in getting people to

participate in the project. According to the quantitative data we collected by surveying visitors of Blue Hill Observatory, though many people expressed a casual interest in the program, very few of them indicated an interest in actively participating in the program. In addition, based on the number of Picture Posts with few submissions or lengthy periods of no activity, it is apparent that few of the people who came across these Picture Posts bothered to take and submit a set of pictures. In all of our interviews, the administrator we were interviewing expressed the opinion that the small number of people who are actively engaged with Picture Posts did not to provide a sufficient amount of phonological data for scientific studies.

Another problem the Picture Post Project faces involves its infrastructure. As mentioned previously, the current version of the Picture Post website hosted by UNH was not user-friendly. This was supported both by our own observations and by the feedback we got from our interviews with administrators of the Picture Post Project. In addition, the Picture Post Project has little in the way of endorsement from other citizen science and phenological organizations. Though the project was originally funded by NASA, this funding has been discontinued due to budget constraints. Also, while the National Phenology Network (NPN) and Digital Earth Watch (DEW) mention Project Picture Post on their websites, only DEW describes it as a significant phenological tool; NPN simply describes the project as a partner organization. In the meantime, Project BudBurst, though it often works with Project Picture Post, doesn't have a dedicated webpage for the Picture Post Project on their website. This indicates that Project Picture Post has yet to conduct the networking necessary to acquire significant endorsement from other organizations. As such, the Picture Post Project faces significant challenges in terms of receiving endorsement and managing its overall program in addition to getting potential volunteers to participate in its individual programs.

4.2.2: Observations at Picture Post Sites

To gain a better understanding of the process of setting up, managing, and promoting Picture Posts, we travelled to various locations where Picture Posts had been installed. Through observation and analysis at the different sites, we formed conclusions about how different aspects of the Picture Post sites contributed to varying degrees of success of the Picture Post program. The aspects examined by the team included post installation, signage on the post, post location/accessibility, and efforts to promote the Picture Post. Notes of our visits can be found in Appendix O.

The first step to ensuring that a Picture Post collects accurate and useful data is proper installation. This includes proper post height and proper orientation. A Picture Post that is not installed correctly can lead to inaccuracies in the picture sets taken using the post and thus cause inconsistencies with data from other Picture Posts. For instance, when we visited the Picture Post at Crane Beach, we noticed that the post top was not aligned correctly; the north side of the top was actually facing northwest. This can lead to inconsistencies between picture sets taken using this Picture Post and those taken at other posts that were installed correctly. These inconsistencies could result in erroneous observations of variations in the behaviors of the vegetation surrounding the Picture Post. By installing the Picture Post properly, one can establish a sound basis for collecting accurate and effective data using the Picture Post.

While visiting the sites of existing Picture Posts, we made careful observations of the signs that were used to instruct the public on how to use the post. We observed a variety of different styles employed at the different sites. These styles ranged from signs that were too detailed, signs that were not detailed enough, and a lack of signage altogether. We concluded that

there is a fine line between providing too much information or too little information when creating a sign for a Picture Post. The sign at the Crane Beach Picture Post was extremely wordy which could have adverse effects on post usage. This is because the casual citizen who passes the post for the first time might be deterred from reading the sign if it is too long, thus they will not receive the motivation or instruction they need to use the Picture Post. An example of a sign with too much text can be seen in Figure 6.

Figure 6: Signage on Picture Post at Crane Beach

Conversely, a sign that does not provide enough information could affect the quality and accuracy of the picture sets taken as well as the number of picture sets taken. This could easily result from a misinterpretation of how to properly use the Picture Post. For example, when we visited the posts at Wells Reserve, we noticed that it was easy for a first-time post user to use the post incorrectly because of a lack of instruction. Although it is difficult to see, the sign on the post in Figure 7 contains only the link to the Picture Post website and one line of instructions. We determined that this does not provide enough detail to ensure proper use of the Picture Post. The consequences of Picture Post signage that does not contain enough information on how to use the Picture Post properly could include inaccurate picture sets as a result of improper Picture Post operation.

Figure 7: Signage on Picture Post at Wells Reserve

Another factor that strongly affects Picture Post usage is the location and accessibility of the post. For instance, a post that can be easily seen and accessed will tend to have more usage than one that is in an obscure location and is difficult to access. Through our observations, we

hypothesized that, if a Picture Post is not easily seen from nearby areas, it is likely to be overlooked by potential users. The obvious consequence of this would be low Picture Post usage and a low picture set submission rate. The post at Crane Beach is an example of a poorly located Picture Post. We noticed that, because we were familiar with Project Picture Post, we were able to eventually find the post we were searching for. However, a first-time Picture Post user could easily overlook this particular post for a number of reasons. First, the post is in a location that makes the post difficult to spot, both because it is obscured and because it isn't in an area that people are likely to explore (Figure 8). Although not shown in the photo, another problem we noticed was that the Picture Post was in an area that was roped off to prevent too much foot traffic in the surrounding dune area. This could also contribute to low usage of the post due to the impression that it is off limits to the public.

Figure 8: Picture Post Location at Crane Beach

One of the most important factors of increasing Picture Post usage is proper promotion of the Picture Post. Based on the data we collected at Blue Hill, a Picture Post that is well-publicized will generally be used much more frequently than one that is poorly publicized or not publicized at all. Some of the promotional methods that we observed at the different Picture Post sites included brochures about the Picture Post Project, incorporation of the post into tours given by the post's sponsoring organization, and word of mouth by post users and organization employees. Conversely, we found that at Crane Beach there were no promotional methods in place for promoting their Picture Post; the only reason we were able to find the post was because we asked one of the resort employees where it was. However, even with a description of the post's location we still had trouble finding it. Based on this experience, we determined that,

without proper methods of publicizing a Picture Post in place, potential users of the post are likely to either be unaware of the post's presence or be unable to find the post even if they know that it is in the area.

Alternatively, a Picture Post that is publicized properly is much more likely to receive frequent use. When we visited the Wells Reserve, we observed numerous methods of promoting the Picture Posts installed there. The reserve distributed the Picture Post brochure found in Appendix P with a label affixed to it that featured the specific URLs for their pages on the Picture Post website. Another method that was implemented at the reserve involved a digital tour that a visitor to the reservation can access on their iPad; the tour promoted the Picture Post as a point of interest on the reservation. This was an extremely useful tool for promoting the Picture Post because the tour both alerts the visitor when they are near the post and shows where the post is. As demonstrated at the Wells Reserve, a good system for promoting a Picture Post can lead to more frequent post usage and a greater number of submissions for that location as shown by the number of picture sets uploaded on the Picture Post website.

4.2.3: Feedback from BudBurst Representatives

We interviewed Dennis Ward, an educational technologist for BudBurst. He has worked with BudBurst since its beginning and is the head of all web development for the project. After we interviewed Mr. Ward, we interviewed Sarah Newman, who also works with BudBurst. She works to recruit citizen scientists and to engage them in the operations of project BudBurst. Notes from these interviews can be found in Appendix N.

The strengths of Project BudBurst include a strong promotional strategy, which includes a word of mouth campaign, and programs targeted toward academic institutions. The team

learned that the best ways to spread awareness of a citizen science project are through collaboration with other similar projects/organizations, and to promote the project both locally and generally. The two representatives further elaborated by saying that, in order to support a citizen science endeavor, many methods of promotion should be utilized. The representatives from BudBurst have attributed the project's success in part to these strategies.

One of the weaknesses of Project BudBurst is quite similar to Project Picture Post, such that many people who collect data do not submit those data for follow up by researchers. According to the interviewees, the best way to overcome the lack of data submissions is to emphasize the data sharing step of the process. Further, to encourage more data gatherers to share their data to a database, the user interface for contributing data must be as easy and quick as possible.

A specific method to recruit citizen scientists to participate in a project is through word-of-mouth. Throughout the study of this successful citizen science project, we have seen that this strategy has been effective. Our own liaison, Don McCasland had been recruited by word of mouth through a representative from Project BudBurst to collect data. Furthermore, successful citizen science projects such as BudBurst use a regularly issued newsletter to those who have been involved in the project. This strategy attempts to maintain the awareness of people who submitted data, and keep them interested in continuing developments in the project.

4.3: Development of Promotional Material

Our project team was tasked with the development of three Picture Post locations on the grounds of the Blue Hills Reservation. After installing the posts, we created and tested promotional material to determine the effectiveness of what we designed.

4.3.1: Materials for the Blue Hill Observatory

To start the Blue Hill Observatory's Picture Post program, we first needed to install a set of Picture Posts at the Observatory. Our project team first set up two standard, ground based Picture Posts. We then turned the Observatory tower itself into a unique Picture Post by attaching eight camera mounts to the tower's railing. We positioned the mounts inside each crenellation on the Observatory tower that faced all eight cardinal and ordinal directions. We did not attach a camera mount to the southern crenellation due to interference; we designed a unique mount to attach to the parapet near the southern crenellation. Images of these Picture Posts are found in Figures 9-12.

Figure 9: Eastern Picture Post

Figure 10: Western Picture Post

Figure 11: Typical Observatory Tower Camera Mount

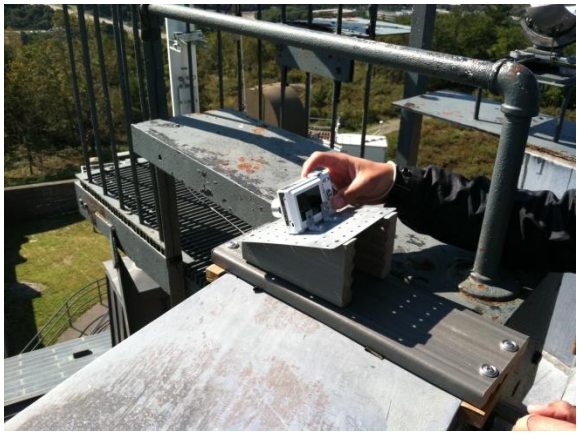

Figure 12 Southern Crenellation Camera Mount

We designed the signs to accomplish multiple goals. The primary purpose of the signs was to provide clear instructions for using the Picture Post to collect data, as there is a specific process for taking picture sets using the Picture Post. Without a set of instructional signs, the Picture Posts look like a strange compass that is mounted to a post, with no apparent intended purpose. A secondary function of the signs was to attract the attention of people passing by, as the posts were inconspicuous without them. We created a colorful sign that contained logos of the organizations that support Picture Post. The University of New Hampshire recommends including the Picture Post logo. We chose to include three additional logos, including the familiar NASA logo, to attract more attention.

To further promote the Picture Posts at Blue Hill, we created two posters to display at the Observatory. One poster was located on the third floor of the observation tower, while the second poster was mounted on the kite shed outside the Observatory. Images of these posters can be seen in Figures 13 and 14 and a detailed image of the indoor/outdoor poster can be found in Appendix K.

Figure 13: Indoor Poster

Figure 14: Outdoor Poster

Posters were designed not only to raise awareness of the Picture Posts at Blue Hill, but also to act as a supplement to guided tours of the Observatory. The main purpose of these posters was to promote the Picture Posts to Observatory visitors. To accomplish this, the posters provided in-depth information about the Picture Post program in order to educate people about the program and motivate them to use Picture Posts. Specifically, the posters included comprehensive information about climate change, phenology, and citizen science. The topic of climate change was chosen because it is a controversial issue that affects everybody. The section about phenology was chosen because Picture Post is a phenological study. People want to learn more about the Picture Post program, to which their data are contributed. Further, the citizen science section was included to raise awareness of citizen science. All three sections were included to encourage people to use the Picture Posts, as they provide a thorough overview of the program and why participation is important.

In addition, we created a brochure about the Picture Post Project to be distributed at the Blue Hill Observatory. Images of this brochure can be found in Appendix J. The brochures were located along the existing wall of brochures inside the Observatory. The brochure was designed to promote citizen science through the use of Picture Posts at the Observatory. The content of the brochure was similar to the content of the posters.

4.3.2: Reactions of Visitors to Promotional Materials

Throughout the course of our observational study, 173 people were studied according to the protocol described in Appendix E. Most of the people whom we observed were either families or hikers. The purpose of these observations was to test the visibility of the eastern Picture Post. The raw data can be found in Appendix Q. In order to facilitate our analysis, we grouped the data

from the two high interest categories and the two medium level interest responses. The graph of the data can be found below in Figure 15.

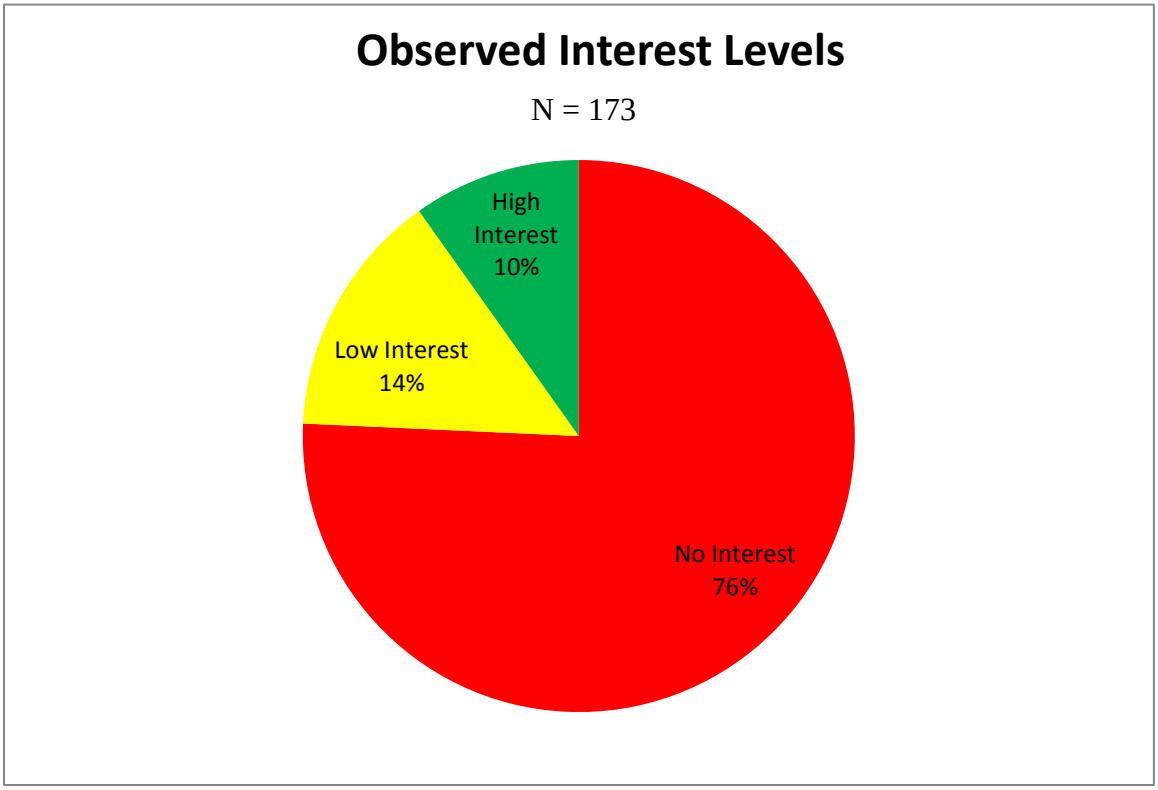

Figure 15: Observed Interest Levels

To supplement the observational study, 40 people, who happened to be 30-50 years of age, were surveyed according to the protocol in Appendix H. The purpose of conducting surveys was to understand what people thought about the Picture Post Project immediately after learning about it. The raw data collected from the survey can be found in Appendix R. A graph of these data can be found below in Figure 16.

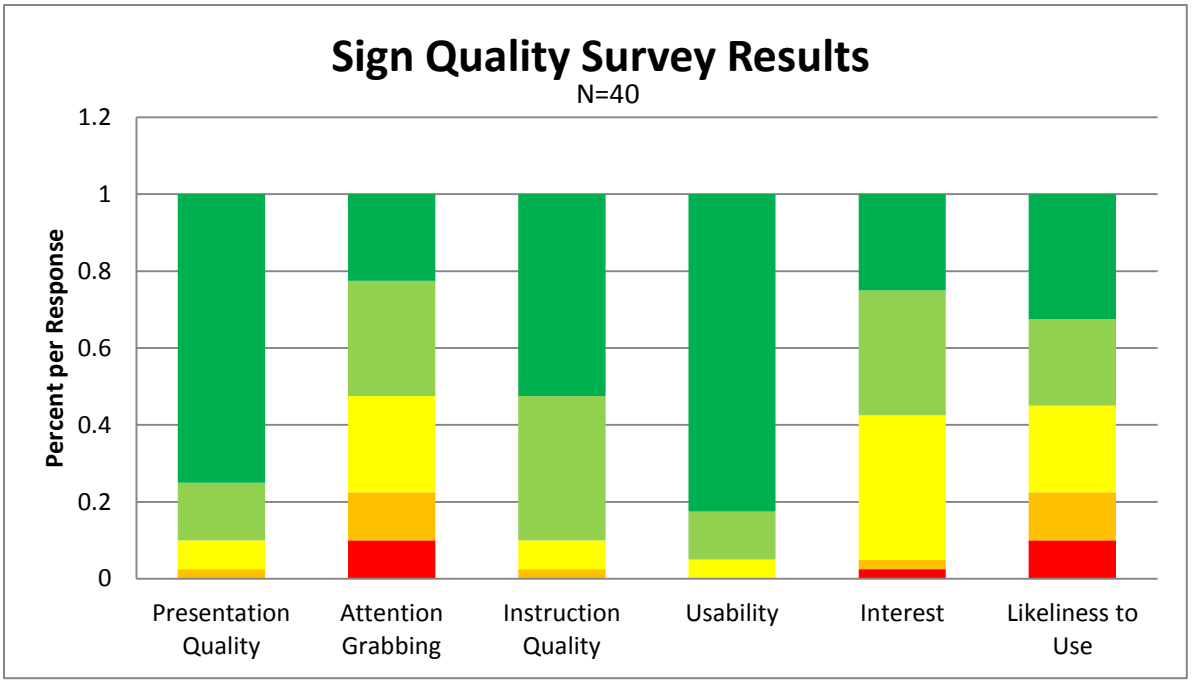

Figure 16: Sign Quality Survey Results

4.3.3: Analysis of Instruction and Appearance of Picture Post

Figure 15 indicates that a large percentage (76%) of people who passed the eastern Picture Post after it was initially installed did not notice the attached signage. It was noted that most of the people who walked from the Observatory to the Red Dot Trail did not notice the Picture Post. This large percentage may be due to position of the initial signage on the Picture Post. Only one sign was initially attached to the Picture Post, facing the walking trail. This sign could be seen easily as one approaches the Observatory from the Red Dot Trail, as seen in Figure 17. However, the sign was quite inconspicuous to the person who hikes on the trail in the opposite direction, as seen in Figure 18.

Figure 17: Approach to the Eastern Picture Post from the to the Observatory

Figure 18: Initial approach to the Eastern Picture Post from the Observatory to the Trail

Despite the initial visibility issues, the sign itself proved to be effective when people noticed it. Of the 42 people who noticed the sign, 17 (40%) of them showed high interest in the project. We determined that the sign was sufficiently effective for our purposes. To elaborate, the data suggests that 40% of the people who noticed the sign became interested in the project, given that they either took the time to read the entire sign or actually used the Picture Post.

The survey results confirmed the observation results, such that the Picture Post sign was not attention grabbing, but was of good quality in content. Numerous people in conversation (including a graphic designer) stated that the sign was far too small to effectively capture the attention of somebody traveling past it. Despite the flaws in the size of the sign, the quality of the instructions received an average rating of 4.4 out of 5, with all but one respondent rating the instructions with a score of 3 or higher.

Furthermore, the interview results further confirm the quality of the sign's instructions. Of the ten people who were interviewed, nine people stated that the sign provided enough detail for him/her to use the Picture Post properly. Only one of the ten people was confused about the instructions, however, upon briefly rereading, that person was able to understand the instructions.

Because the sign's instructions were rated so highly using three different data gathering approaches, we concluded that the instructions were clear enough for our purposes.

To increase the amount of attention that the eastern Picture Post received, we attached a second sign to the post. A view of this second sign can be seen in Figure 19. This 4"x11" sign was mounted such that someone hiking from the Observatory towards the Red Dot Trail could easily see it. Although a formal observation was not conducted, casual observation suggests that more people saw the Picture Post and attached signs.

Figure 19: Approach to the Eastern Picture Post from the Observatory to the Trail with 2nd sign

Because of the relatively high level of attention that the eastern post received and the clarity of the instructions, we concluded that the sign was effective at promoting the Picture Post to potential citizen scientists. We based this conclusion on the fact that the Blue Hill Observatory hosts hundreds of visitors per week, and only needs a minimum of one submitted data set in that time. Because of the vast number of visitors and the low submission requirements, we concluded that, if 40% of people who notice the Picture Post express high interest in the Project, the sign is sufficiently effective for our purposes.

4.3.4: Analysis of Interest in Picture Post Program at Blue Hill

Through our interviews with people who read the Picture Post signs, we also learned why people did not choose to use the Picture Post. Of the ten people who were interviewed after reading the Picture Post sign, only two people had a camera at the time. Both people stated that they did not use the Picture Post because it would be inconvenient for them to do so. Of the eight

people who did not have a camera, two would not have used the Picture Post for the same reason, regardless of carrying a camera or not. However, six people stated that they would have used the Picture Posts if they been equipped with a camera. After reading the sign on the Picture Post, these people were interested in the project and wanted to be involved. By finding that 60% of the sign readers wanted to be involved with the project, we determined that the sign interested people enough to motivate involvement with Picture Post.

The interest in the Picture Post Project, the likeliness to use a post, and the conspicuousness of the sign had an interesting similarity on the graph. The columns in Figure 16 labeled "Attention Grabbing" and "Likeliness to Use" are nearly identical. To determine if the two categories had a relationship, a correlation analysis was performed. The analysis yielded that the correlation constant $r = 0.34$. This constant showed a weak correlation between the two sets of data, and was most likely coincidental.

The columns in Figure 16 labeled "Interest" and "Likeliness to Use" were also quite similar. The analysis for these two responses yielded the correlation constant $r = 0.71$. This constant indicates that the two data sets had a fairly strong correlation. We were able to conclude that the likeliness that one will use the Picture Post increases with a higher level of interest.

4.3.5: Poster Analysis

Despite the small number of interviews with people reading the outdoor poster, the responses from the six interviewees regarding motivation were quite varied. Two of the interviewees had previously been engaged in citizen science through an estuary in Rhode Island. They felt that the poster provided mediocre motivation to use the posts. However, an artist who was interested in time-lapse photography immediately grabbed his camera and searched for the

Picture Post. Another person, who was not interested in photography, was indifferent about being involved.

The people who read the poster, despite inconsistent results regarding motivation to become a citizen scientist at Blue Hill, all found that the content in the poster was interesting. All of the six people stated that they learned something new from reading the posters. One critic did claim that there was too much text in the body of the poster, which made it visually unappealing. However, despite the criticism, we determined that the poster was effective for our purposes. Dennis Ward, the Educational Technologist for Project BudBurst, stated in an interview that the best method to increasing citizen science participation is to promote the project with as many strategies possible (see Appendix N). After only a week, the poster that we developed had already served its purpose, as one poster reader became a citizen scientist by being involved with Picture Post, and everyone who read the poster expanded their scientific literacy.

4.4: Summary

By analyzing our observations and the feedback we got from the interviews we conducted, we were able to identify numerous aspects of the Picture Post Project that we were then able to utilize to achieve our goal and objectives. To elaborate, we were able to identify the program's strengths, such as the post's simplicity and the importance of the data it collects, and the program's weaknesses, such as the posts' low usage rates and the inconveniences presented by the picture-upload process. We were also able to identify numerous methods for promoting citizen science programs such as Project Picture Post. We also discovered how best to design signage for a Picture Post.

By studying the data we acquired through our administrator interviews and through our surveys at the eastern Picture Post, we determined that the best way to encourage potential volunteers for a citizen science project is to educate people about the project. In addition, through our interviews with representatives of successful citizen science programs, we discovered that the proper promotion and publicizing of a citizen science project is a time-tested means of raising awareness about the project and encouraging citizens to participate in the project's activities. In addition, by making the process of collecting and submitting data as simple as possible, citizens will be more likely to initially participate in the project and then continue to contribute. These observations and conclusions allowed us to identify the ideas and practices that would best enable citizen science organizations to increase participation in the Picture Post Project and in citizen science programs in general.

Chapter 5: Conclusion

Throughout the time that we spent as citizen scientists by using Picture Posts and as program advocates using and promoting Project Picture Post, we were able to understand the benefits and limitations of a practical citizen science project as well as weaknesses that exist in a citizen science project. Through our research, we have discovered that although citizen science projects have innate flaws, these flaws can be reduced through various promotional methods and advancements in data submission technology.

By attaining an understanding of how a citizen science project operates, we were able to investigate methods to assist the expansion of Project Picture Post. By analyzing off-site Picture Post locations, we were able to identify strategies to improve promotion to citizen scientists. Furthermore, as Picture Post users, we discovered weaknesses in the usability of the database. To strengthen the Picture Post program, we have provided recommendations to organizations that sponsor Picture Post projects to further increase citizen scientist participation. Through the implementation of our suggestions, we believe that citizen science participation through Project Picture Post will be noticeably increased.

Chapter 6: Recommendations

Based on our study of our observations and the data that we collected, we were able to make recommendations to increase participation in citizen science programs by strengthening Project Picture Post. We formulated specific recommendations for organizations installing Picture Posts, for the Blue Hill Observatory, for other organizations that host Picture Posts, and for the UNH team that manages the Picture Post website. These recommendations can be found below.

6.1: Recommendations for Citizen Science Projects Installing Picture Posts

These recommendations are for citizen science organizations that have decided to install one or more Picture Posts. They focus on where to install the Picture Post and what to mount on it instead of the post's actual installation.

The area surrounding the post should be well-vegetated

When choosing a location for a Picture Post, it is essential that there is an adequate amount and variety of vegetation around the post. A good area may also encompass other phenological and environmental aspects, such as bodies of water or natural landforms. This will ensure that the data collected from the post will be useful in showing specific and informative environmental changes when scientists study the picture sets.

The Picture Post should be easily accessible for a typical person

Picture Posts must not be installed in obscure locations. A good choice is to have the post located on a well-used trail. This will help improve the usage of the Picture Post in that location.

The Picture Post should be visible from a distance

The more noticeable a post is, the more likely it is to be used. It is essential to assure that the Picture Post has adequate contrast with the surrounding area. For example, if the post is surrounded by green vegetation, the color of the post itself should not be green as well. At the same time, the post should not be glaringly obvious: it should not appear garish or become an eyesore.

The attached signs should be easily visible

The sign on the Picture Post should be clearly visible both from a distance and from multiple angles. If it is not possible to create signs for multiple sides, then the sign should be located where it is most likely to be seen. For example, if the post is located on a trail, the sign should be placed so that it faces the trail.

The signage should visually appealing

A sign that is visually appealing will help draw attention to the Picture Post. The sign should appear well-organized and invite the viewer to read it. More attention to the post will promote more frequent usage and more picture set submissions.

The information on the should be sign concise but effective

Only the information that is needed to ensure proper post usage should be included in the signage. Also, when including information about the Picture Post Project, it should be kept brief and to the point. A sign with too much information will deter potential users while a sign with too little information could lead to improper use of the post.

The sign should be designed so that it will last

Materials should be selected that can withstand any weather conditions that the sign is likely to face. This includes laminating any paper signs. The sign should be attached securely to the post. An effective means of securing a laminated sign to the post is by placing it under a washer screwed into the post in order to clamp the sign in place. More durable signs, though more expensive, are likely to last longer and look more professional.

6.2: Recommendations for the Blue Hill Observatory

These recommendations are for the Blue Hill Observatory. They deal with the continuation and further development of the Picture Post program that we developed at the Observatory over the course of our project.

The Picture Posts should be properly maintained

The Picture Posts must be kept in good condition in order to remain functional. Regular replacement cycles for the signs should be developed and followed. Also, regular grounds maintenance should be scheduled to assure ease of access to the posts, i.e. that the paths to the posts do not become obstructed.

The Picture Posts should be incorporated into the Observatory's educational programs

Picture Posts can, and should, be a part of the guided tours of the Observatory. A training program for tour guides and volunteers will assure that these personnel can demonstrate the process of using the Picture Posts. Well-informed guides and volunteers will also assure interesting discussions with visitors attending the tours and/or programs available at the Observatory.

The "WPI – Blue Hill Observatory Picture Post Collaboration" Facebook page should be continually updated

Currency is best maintained by sustaining a regular level of activity on the WPI/Picture Post Facebook page. Uploading new pictures on a semi-regular basis, posting news about events related to the Picture Post Project, and interacting with the page's followers are all important elements of ensuring currency. Keeping interested citizen scientists engaged in the events of the project will encourage them to participate, to stay involved, and possibly to involve others.

A Picture Post page should be added to the Blue Hill Observatory's website

Another means of encouraging participation in the Picture Post program would be to create a page on the Blue Hill Observatory website that relates to the Picture Post program at the Observatory. This would allow for the posting of information about the project and the updating of pictures of, and from, the Picture Posts. Also the inclusion of a link to UNH's Picture Post homepage would promote interest in the program beyond what is being done at Blue Hill.

6.3: Recommendations for Organizations that Host Picture Post

These recommendations are for organizations that manage Picture Posts. They deal with publicizing the Picture Posts to potential users in order to encourage participation in the Picture Post Project.

The Picture Posts should be publicized with a variety of promotional materials

The Picture Post should be promoted with as many types of promotional material as possible. These can include informational brochures and posters as well as signs that publicize

the Picture Post. The more material about the Picture Post Project that is developed and distributed, the more likely it is that participation and awareness will increase.

The Picture Post should be featured on the organization's website

A page dedicated to the Picture Post program should be developed for the hosting organization's website. It should be designed so that people who are looking for more information about the project will be able to learn about Project Picture Post and its associated scientific fields. Links to websites with more information, such as the Picture Post homepage hosted by UNH, will put the Picture Post program in a broader context for web site visitors. In addition, a Facebook page is a great way to attract attention to a citizen science project.

The organization's staff should be educated about the program and citizen science

Staff and volunteers should be encouraged to demonstrate and discuss the Picture Post project as well as answer any questions visitors may have. A staff that is involved in the program will help educate and attract potential citizen scientists, increasing the number of people who are likely to use Picture Posts.

The organization should collaborate with other citizen science programs that conduct similar projects

All organizations that support Project Picture Post should network with other organizations that deal with citizen science so that all parties involved can learn from each other and jointly develop public awareness of each other's programs. By working together, organizations with similar missions can collaboratively identify ways of developing effective

programs and encouraging citizen scientist participation. In this way, sharing data and collaborating effectively can lead to an increase in program awareness and volunteer dedication.

The organization should cooperate with nearby organizations that host Picture Posts

By cooperating with other local organizations that have Picture Posts, each participating organization can learn from one another's programs and publicize each other's Picture Posts. By encouraging participants involved in one program to participate in other programs, involvement in both the Picture Post Project and in citizen science in general can be effectively promoted and developed. In addition, exchanging ideas and feedback can help all organizations involved improve their own programs.

6.4: Recommendations for the UNH Picture Post Homepage

These recommendations deal with improving the Picture Post website hosted by the University of New Hampshire. They focus on making the website easier for volunteers to use, encouraging current supporters to continue to participate, and acquiring feedback from those who use the website.

The website should be user-friendly

It is essential that Picture Post websites make it easier for website users to upload picture sets and manage posts. The post-specification process must be simplified and the user interface must be made more intuitive for both occasional and dedicated users.

Users of the website should be able to provide feedback

Feedback on the website and the Picture Post Project should be encouraged from those who submit pictures to the database. Information about why participants chose to participate in the project and about their experience uploading the pictures will be essential for continuous improvement of the program and the website.

Users of the website should be encouraged to continue to participate in the program

Methods should be developed to encourage people who have submitted picture sets to continue to do so. Participants should be thanked for their contribution, should be allowed to view their personal statistics, and should be recognized for their efforts, such as through the use of a website "leader board".

The database should be mobile-compatible

The current webpage does not support uploads to the database through a mobile device. If the webpage was compatible with a smart-phone, the process of posting pictures would be made far more user-friendly for smart-phone users by allowing them to upload their pictures immediately after taking them.

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Appendix A: Interview Protocol for Administrators

- How did you first hear about the Picture Post project?

- What got you involved in the project?
    - When did you decide to stay with the project? Why?
    - What was different about the project about the project compared to now?
    - How does this project affect your research?
    - What contributed to those changes?
    - How has this project evolved, where is it going in the future and why?

- What percentage of your time do you spend on Picture Post?
    - What are your responsibilities when you work on Picture Post?
    - What part of your duties do you most/least enjoy?

- What do you see as the Picture Post's most significant contribution to DEW?
    - How does Picture Post contribute to the scientific community/Phenology?
    - What do you envision as a future contribution?

- Do you see differences in the demographics of users at different post?
    - What do you feel primarily motivates each demographic to use Picture Posts?

- What are the greatest strengths of the Picture Post Program?
    - What efforts have been taken to capitalize on the strengths?

- What challenges/shortcomings do you feel the project has yet to overcome?
    - What do you think are the major obstacles to increasing participation in the program?

- What do you see as being the best way to expand participation for the Picture Post project?
    - How will this work?

    - Why do you think this hasn't been done yet?
    - What do you think needs to happen in order for it to happen?

- Who does Picture Post collaborate with?
    - Who does Picture Post share its data with?
    - Who uses it?
    - Which organizations/types of organization could collaborate?

Appendix B: Interview Protocol for Post Masters

- How did you first hear about Picture Posts?
- What motivated you to get involved with the Picture Post Project?
- What are your main responsibilities as a Post Master?
    - How much time do you spend on these responsibilities?
    - Are there any other people involved with the promotion of your post?
- Why do you think Picture Post is important?
- What motivated you to put this Picture Post in its current location?
- What type data did you want your Picture Post to collect?
    - What was your vision for the Picture Post?
    - What did you want to learn? Who would use the post?
    - What were the outcomes and challenges that you had to face to realize your vision?
- Are people often traveling near the Picture Post?
- What have you done to promote usage of your Picture Posts?
- What are the most important scientific contributions that the Picture Posts provide?

Appendix C: Interview Protocol for BudBurst Representatives

- How did you first get involved in Project BudBurst?
    - What motivated you to stay involved with the project?
    - What do you see as Project BudBurst's main goal in its efforts?
    - How has the project changed from the beginning of your involvement until now?

- How much of your time do you commit to working on Project BudBurst?
    - What are your responsibilities when you work on the project?
    - How have your responsibilities changed from the beginning of your involvement until now?

- Have you ever heard of Project Picture Post?
    - **If yes**: Have Picture Posts been used in Project BudBurst?
        - What is your opinion about Project Picture Post?
        - Do you promote the Picture Post Project at all?
        - Have you discovered a synergy between your project and Picture Post?
    - **If no**: Would you like an overview about Picture Post, as it may be helpful toward your data collection?
        - Do you think Picture Posts could benefit your purposes?

- How do you recruit citizen scientists to participate in Project BudBurst?
    - How do you maintain their interest and keep their involvement?
    - What percentage of first-time users returns to submit future data to you?

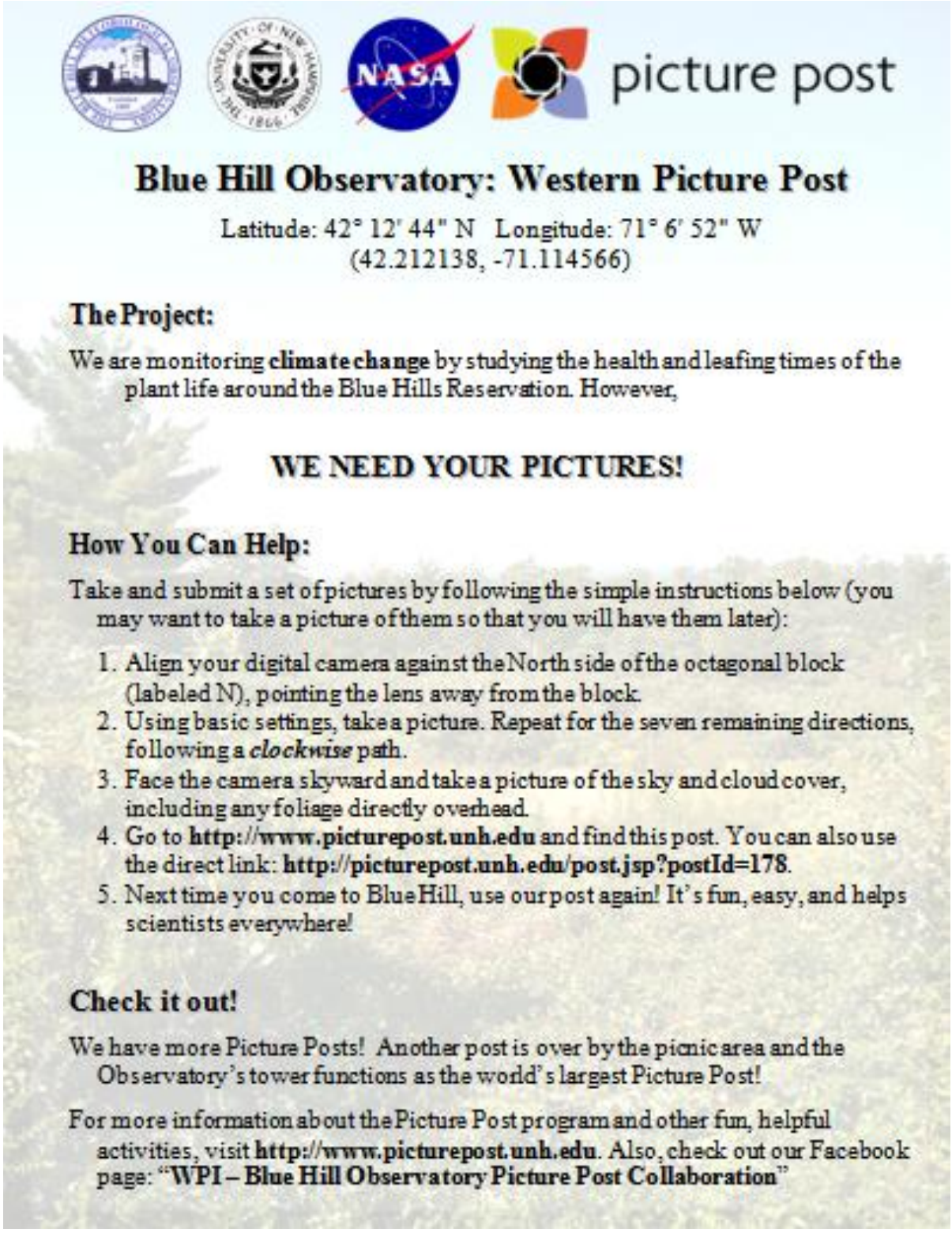
- How do citizen scientists collect data for your use?
    - How is the data used?
    - How is it recorded?
    - Do citizen scientists feel that their data is important?
        - What makes them feel that way?

- What are the strengths of Project BudBurst that make it succeed?
    - What efforts have been taken to capitalize on the project's strengths?
    - What differences do you envision for Project BudBurst in the future?

- What are the weaknesses that Project BudBurst has to overcome?
    - What efforts are being taken to strengthen the weaknesses?
    -

- What do you see as being the best way to expand participation for Project BudBurst?
    - Are these efforts underway now?
    - What do you think needs to happen in order for it to happen?

Appendix D: Sample Picture Post Signs



picture post

Blue Hill Observatory: Western Picture Post

Latitude: 42° 12' 44" N Longitude: 71° 6' 52" W
(42.212138, -71.114566)

The Project:

We are monitoring **climate change** by studying the health and leafing times of the plant life around the Blue Hills Reservation. However,

WE NEED YOUR PICTURES!

How You Can Help:

Take and submit a set of pictures by following the simple instructions below (you may want to take a picture of them so that you will have them later):

1. Align your digital camera against the North side of the octagonal block (labeled N), pointing the lens away from the block.
2. Using basic settings, take a picture. Repeat for the seven remaining directions, following a ***clockwise*** path.
3. Face the camera skyward and take a picture of the sky and cloud cover, including any foliage directly overhead.
4. Go to **http://www.picturepost.unh.edu** and find this post. You can also use the direct link: **http://picturepost.unh.edu/post.jsp?postId=178**.
5. Next time you come to Blue Hill, use our post again! It's fun, easy, and helps scientists everywhere!

Check it out!

We have more Picture Posts! Another post is over by the picnic area and the Observatory's tower functions as the world's largest Picture Post!

For more information about the Picture Post program and other fun, helpful activities, visit **http://www.picturepost.unh.edu**. Also, check out our Facebook page: "**WPI – Blue Hill Observatory Picture Post Collaboration**"

picture post

Blue Hill Observatory

Eastern Picture Post

Latitude: 42.212096
Longitude: -71.113452

The Project:
We are monitoring the effects of **climate change** by observing changes in the plant life around the Observatory. To do this, we need **your** pictures.

Instructions:
1. Place the back of your camera against each side of the block and take a picture, starting with the side marked "N" and going clockwise around the block.
2. Take another picture straight up.
3. Take a picture of these instructions so that you have them later.
4. Go to **picturepost.unh.edu** and upload the pictures you took.

More Information:
http://www.picturepost.unh.edu
Facebook: **WPI – Blue Hill Observatory Picture Post Collaboration**

picture post

Blue Hill Observatory

Eastern Picture Post

Latitude: 42.212096
Longitude: -71.113452

The Project:
We are monitoring the effects of climate change by observing changes in the plant life around the Observatory. To do this, we need your pictures.

Instructions:
1. Place the back of your camera against each side of the block and take a picture, starting with the side marked "N" and going clockwise around the block.
2. Take another picture straight up.
3. Take a picture of these instructions so that you have them later.
4. Go to picturepost.unh.edu and upload the pictures you took.

More Information:
http://www.picturepost.unh.edu
Facebook: WPI – Blue Hill Observatory Picture Post Collaboration

Western Picture Post:



Eastern Picture Post:



Tower Picture Post:



Appendix E: Observation Protocol

While observing, note the gender, approximate age, and transportation medium.

Interest Level Scale:

5. Visitor stopped to read instructions and use the Picture Post.

4. Visitor read the entire sign and left.

3. Visitor stopped to look at the sign and Picture Post for a moment, and left.

2. Visitor glanced at the Picture Post/sign quickly and left.

1. Visitor did not notice the Picture Post or sign.

Appendix F: Interview Protocol for Sign Readers

1. What initially drew your attention to the Picture Post?
2. What motivated you to use the Picture Post?
    a. Will you use it regularly? If so, how often do you think you will use it?

OR Why did you not use the Picture Post?

    a. What would motivate you to use the Picture Post?

3. Are the directions for Picture Post understandable and clear?
4. Did you have any questions after reading the sign?

Appendix G: Interview Protocol for BHO Visitors

- Are you familiar with the Picture Post project?
    - If yes
        - What do you know about it?
        - Where did you hear about it?
        - Have you ever participated?
        - Would you be interested in participating?
    - If no
        - Would you like to learn about it?
- Provide a brief overview of the project
    - Goals
    - Purpose
    - Importance
- Conduct demonstration

Distribute survey (Appendix H)

Appendix H: Picture Post Survey

Picture Post Survey (The target audience was the visitors to the Blue Hill Observatory)

How often do you visit the Blue Hills Reservation? _____

How well did the Picture Post demonstration explain the procedure? (Circle One)

1	2	3	4	5
Poorly		Average		Very Effectively

Is the sign attached to the Picture Post attention grabbing? (Circle One)

1	2	3	4	5
Not at all		Indifferent		Very

Are the instructions on the sign easily understandable? (Circle One)

1	2	3	4	5
Not at all				Very clear

Does a Picture Post seem easy enough for you to use? (Circle One)

1	2	3	4	5
Very difficult				Very easy

What is your interest in the Picture Post Project? (Circle One)

1	2	3	4	5
Not Interested				Very interested

Are you likely to become a Picture Post user?

1	2	3	4	5
Not Likely				Very Likely

Appendix I: Questionnaire for Data Submitters

1. How did you hear about Picture Post?
2. Do you live near the Blue Hills Reservation? (Y/N)
3. Why did you decide to use the post?
4. What made the Picture Post uploading website easy/difficult for you to use?
5. Is Picture Post something you would use again in the future, and why?

Appendix J: Picture Post Brochure

Blue Hill Observatory, A National Historic Landmark

Located at the highest point of the Blue Hills Reservation, the Blue Hill Observatory Science Center is a monument to meteorological study and discovery. Today it continues to study the weather while educating the public about meteorology.

As the Observatory celebrates the past, it also looks to the future. Recently it has installed a set of Picture Posts that visitors can use to help record the ecology of the Reservation.

The Picture Post

The Picture Post is a data-gathering tool that can be used by anyone with a digital camera, even the one on their phone!

Picture Posts are placed in areas that have an abundance of ecological data, i.e. plant life. Panoramic picture sets are taken to record this data so that scientists can track vegetation trends, including changes that indicate Climate Change.

Anyone can participate in the project, even if they don't have any scientific training. So whenever you're out hiking and come across a Picture Post, stop to take a set of pictures and help scientists everywhere preserve the world we live in.

Phenology and Climate Change

Phenology, the study of how animal habits and vegetation trends change in response to fluctuations in climate, is a crucial part of monitoring Climate Change.

By studying how plants and animals react to a changing climate, scientists can in turn observe changes in vegetation trends and animal habits to gauge changes in climate.

By providing scientists with data collected by willing volunteers, the Picture Post Project provides an invaluable resource for Phenology and the study of Climate Change.

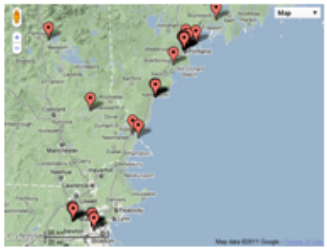
How To Use Picture Posts:

Take and submit a set of pictures by following the simple instructions below:

1. Align your digital camera against the North side of the octagonal block (labeled N), pointing the lens away from the block.
2. Using basic settings, take a picture. Repeat for the seven remaining directions, following a ***clockwise*** path.
3. Face the camera skyward and take a picture of the sky and cloud cover, including any foliage directly overhead.
4. Go to **http://picturepost.unh.edu** and upload your pictures.
5. Next time you visit the post, use it again! It's fun, easy, and helps scientists everywhere!

Images & material provided by:
The University of New Hampshire
The Blue Hill Observatory Science Center
Digital Earth Watch

Picture Posts Across New England



Picture Posts can be found across New England. The nearest ones are located at:

- Blue Hill Observatory
- Fresh Pond Reservation
- Menotomy Rocks Park
- Concord Academy

For more locations and instructions for making your own Picture Post, check out **picturepost.unh.edu**! You can also find us on Facebook!

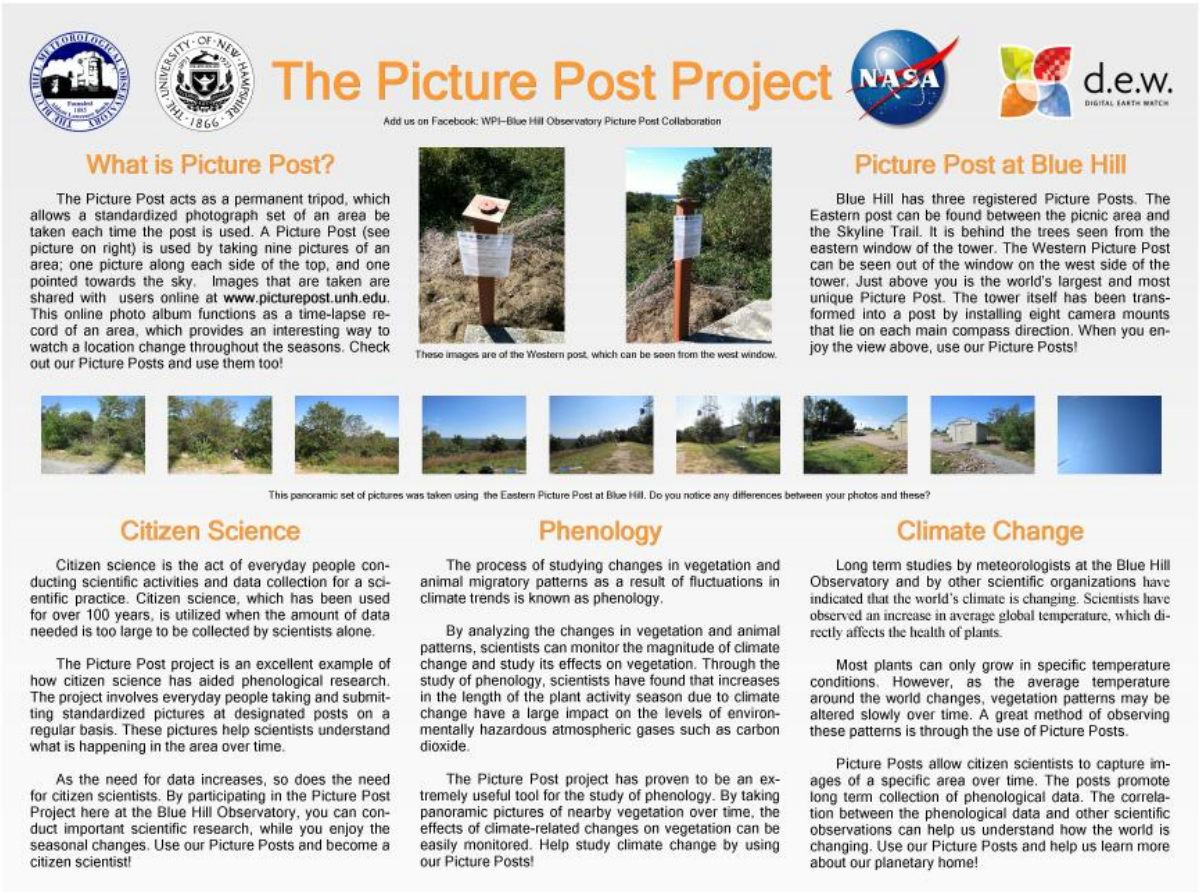
picture post

You Can...
Record Our World
Monitor Climate Change
Make A Difference

How?
By Using Our Picture Posts!

Appendix K: Indoor and Outdoor Posters

Indoor Poster



The Picture Post Project

A simple way to watch and enjoy our world

Add us on Facebook! WPI–Blue Hill Observatory Picture Post Collaboration

These images show the Western Picture Post, only a short walk from this spot.

What is Picture Post?

Picture Post is a citizen science endeavor that uses digital photography to study phenology and climate change. The project, funded by a NASA grant, began at the University of New Hampshire in 2005.

A Picture Post (see picture on left) acts as a permanent tripod, which allows standardized photographs of an area be taken. The Picture Post is used by taking nine pictures of an area; one picture along each side of the top, and one pointed towards the sky.

These photos are shared with other Picture Post users online at www.picturepost.unh.edu. This online photo album functions as a time-lapse record of an area, and provides an interesting way to watch a location change throughout the seasons. Check out our Picture Posts and use them too! (See map on right.)

This image shows the locations of all three Picture Posts at Blue Hill. (Courtesy of www.picturepost.unh.edu)

This panoramic set of pictures was taken using the Eastern Picture Post at Blue Hill. Do you notice any differences between your photos and these?

Climate Change

Long term studies by meteorologists at the Blue Hill Observatory and by other scientific organizations have indicated that the world's climate is changing. Scientists have observed an increase in average global temperature, which directly affects the health of plants.

Most plants can only grow in specific temperature conditions. However, as the average temperature around the world changes, vegetation patterns may be altered slowly over time. A great method of observing these patterns is through the use of Picture Posts.

Picture Posts allow citizen scientists to capture images of a specific area over time. The posts promote long term collection of phenological data. The correlation between the phenological data and other scientific observations can help us understand how the world is changing. Use our Picture Posts and help us learn more about our planetary home!

Citizen Science

Citizen science is the act of everyday people conducting scientific activities and data collection for a scientific practice. Citizen science, which has been used for over 100 years, is utilized when the amount of data needed is too large to be collected by scientists alone.

The Picture Post project is an excellent example of how citizen science has aided phenological research. The project involves everyday people taking and submitting standardized pictures at designated posts on a regular basis. These pictures help scientists understand what is happening in the area over time.

As the need for data increases, so does the need for citizen scientists. By participating in the Picture Post Project here at the Blue Hill Observatory, you can conduct important scientific research, while you enjoy the seasonal changes. Use our Picture Posts and become a citizen scientist!

Phenology

The process of studying changes in vegetation and animal migratory patterns as a result of fluctuations in climate trends is known as phenology.

By analyzing the changes in vegetation and animal patterns, scientists can monitor the magnitude of climate change and study its effects on vegetation. Through the study of phenology, scientists have found that increases in the length of the plant activity season due to climate change have a large impact on the levels of environmentally hazardous atmospheric gases such as carbon dioxide.

The Picture Post project has proven to be an extremely useful tool for the study of phenology. By taking panoramic pictures of nearby vegetation over time, the effects of climate-related changes on vegetation can be easily monitored. Help study climate change by using our Picture Posts!

Picture Post at Blue Hill

As part of a collaborative effort with the BudBurst Project and Digital Earth Watch, the Blue Hill Observatory has installed three Picture Posts for citizen scientists to study phenology and climate change.

The Eastern Picture Post is only a few steps away. The post can be found between the picnic area and the Sky-line Trail. The Western Picture Post is on the opposite side of the Observatory tower. The post can be seen from just off of the trail that runs along the wall outside the Observatory. Refer to the map above to see Picture Post locations.

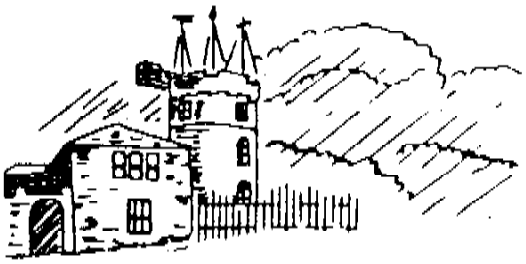
The Observatory tower is the third Picture Post at Blue Hill. This Picture Post is very unusual: its eight separate camera mounts made of galvanized steel hold your camera at all eight main compass directions. In fact, this is the largest Picture Post in the world. Use our Picture Posts and see how our world is changing!

Appendix L: Questionnaire for Poster Readers

- What drew your attention to this poster?
- What did you find most interesting about this poster?
- What did you find least interesting about this poster?
- Was there anything that confused you when you read the poster?
- Have you heard of citizen science before today?
    - What did you know about it?
    - Have you participated in any projects before?
- Does the poster provide sufficient encouragement for you to want to become involved?

Appendix M: Form Letter for Material Donations

Blue Hill Observatory Science Center Incorporated



est.1885

P. O. Box 187
Readville, MA 02137
U S A

Phone: 617-696-0562
FAX: 617-696-0419

September 6, 2011

To whom it may concern,

We are Tim Dobosz, Brian Karolicki, and Greg Wheeler, junior-level students from Worcester Polytechnic Institute who are currently working with the Blue Hill Observatory in Milton, MA. We are working on a project that involves a citizen science program called Picture Post, a project that encourages people to use time-lapse photography from stationary camera mounts to track changes in landscape and phenology over time.

The Blue Hill Observatory is a local non-profit organization that is well-known for its extensive weather record. The organization is seeking to continue its contribution to science in part by expanding the Picture Post Project. As a part of this project we plan to convert the Observatory's tower into the world's largest Picture Post by placing eight camera mounts at the top of the tower. The design of the mounts has to be carefully considered, however, as they must not damage the historic tower.

Our WPI project group and the Blue Hill Observatory are looking for donations of funds and/or materials to construct these mounts, as the project is being conducted by a non-profit

organization. So far we have a design concept in mind, estimated to cost about $150. If you or your organization is interested in donating funds and/or materials we would be very appreciative. In return we would be proud to display your company logo by the mounts you support, as well as make special recognition of your donation in any related media that we distribute to the public. Thank you for your time.

Sincerely,

Tim Dobosz

Brian Karolicki

Greg Wheeler

Appendix N: Interview Notes

Interview with Steve Engstrom

While we were visiting the Picture Post at Seacoast Science center, we were able to speak with Steve Engstrom, who has been designated as the post's manager and typical user. From our interview with him, we learned that Steve makes sure to use the post on a regular basis: he usually takes one picture set each week and never goes more than two weeks without taking a picture set. We also learned that Steve is methodical in his data collection, making sure that he uses the same camera and camera settings each time and always takes the pictures around solar noon. In addition, Steve feels personally responsible for the post even though he wasn't the one who sought to have it installed; he always makes sure that someone knows to take a picture set when he isn't available to do so and he is willing to attend to the post's upkeep if the need arises.

When we talked to Steve about the Picture Post program itself, he was optimistic about its potential. Based on the data he collects from the Picture Post at Seacoast Science Center, he sees the program's strength lying in its ability to track changes over time through the use of simple technology. However, in spite of the program's potential, Steve is the only staff member at the Seacoast Science Center who regularly puts the Picture Post to use. In addition, even though Steve talks about it during his tours, very few others express an interest in using it. As such, Steve sees the project's biggest hurdle as being getting people to actually use the posts.

Interview with Annette Schloss

While we were at Seacoast Science Center we were also able to interview Annette Schloss. When we spoke with Annette, she readily identified the project's strengths as being the posts' simplicity and how people can get involved in the project with very little hassle. However, she was also able to identify some significant weaknesses in the program. According to Annette, while the process of taking a picture set using the posts is simple and hassle-free, uploading the pictures to the online database can often become a hassle itself. In addition, the project faces the difficulty of appearing to be unrelated to the common layperson, as the data it collects is often only useful to scientists, and thus not worthy of their interest or involvement.

In addition to the strengths and weakness of the Picture Post project, Annette indicated what she saw as the Picture Post's most significant contributions. According to Annette, the Picture Post project is the main citizen-science branch of Digital Earth Watch, a significant position given DEW's size and influence. In addition, Annette agreed with Steve Engstrom that the Picture Post's ability to record changes over time made it a highly useful tool for various environmental studies. However, she felt that, rather than data collection, the most important aspect of the Picture Post program is getting citizens involved in citizen science, as the Picture Post itself can be replaced much more easily than the people who use it. Based on these aspects of the program, Annette suggested that strategies for expanding the project involve getting other organizations to endorse or fund the project or to use the data it provides, especially if these organizations are well-known in their field. Her reasoning behind this approach was that if people saw an organization they recognized sponsoring the program, they would feel that the data being collected was being put to use by a legitimate organization and thus that the program would be worthy of their participation. In addition, Annette suggested that efforts to promote the

posts relate the data collected at each post to the lives of the people who live in that area so that the data being collected seems more closely related to the everyday citizen and thus worthy of their contribution.

Interview with Suzanne Eder

Annette told us that she had been inspired to join the Picture Post project when she had seen the Picture Post program hosted by the Wells National Estuarine Research Reserve in Maine. We travelled to the Reserve to examine their program for ourselves. While we were there we spoke with Suzanne Eder, who manages the Picture Posts in addition to coordinating and leading educational programs. Speaking with her, we learned that, while the amount of time she spends using the posts to collect data often varies according to season and circumstance, she typically spends a total of one hour each month using the Picture Posts. We also learned that she often makes the Picture Post a part of her educational programs. For example, the Reserve's education team developed an iPad-based trail tour that featured the Picture Post. When we asked Suzanne which aspects of the Reserve's Picture Post program she saw as being the most important, she indicated the Picture Post's potential contribution to the study of phenology, especially with the various habitats located around the Wells Reserve that could be monitored using the Picture Posts.

Interview with Dennis Ward

During our interview with Dennis, we learned that Project BudBurst is NEON's primary citizen science campaign. As such it is strongly promoted to NEON's volunteers and the visitors of NEON's website. When we inquired about Project BudBurst's collaborative efforts with Project Picture Post, he stated that the collaboration is limited. When we asked about the feasibility of a NEON collaboration with Picture Post, he speculated that one would be possible, but that it would likely be more limited than the one Picture Post has with Project BudBurst.

Dennis has been involved with Project BudBurst since its creation. Through our interview with him, we learned that the goal of the project is to educate the public about the world around them through participation in citizen science, and that the educational experience that people get from the engagement in citizen science is considered more valuable than the data collected. Because Project BudBurst prioritizes education over data, the group prefers an observer who learns a lot but does not submit data over an individual who submits data but learns nothing. We learned that Picture Post and Project BudBurst do collaborate. However, there is little in the way of direct collaboration (i.e. through data-sharing), although an increase in direct collaboration would be extremely beneficial to both projects. The extent of these collaborative efforts can be seen through Project BudBurst's promotion of Picture Post on their website.

Project BudBurst primarily promotes its citizen science through word of mouth, which Dennis claimed works rather well. In addition, Project BudBurst specifically targets its programs towards scholastic groups and academic institutions. Further, Project BudBurst networks with many other projects that sponsor programs similar to their own. Project BudBurst also offers a monthly newsletter for members who wish to subscribe and promotes its events through its group

on Facebook. From our interview with Dennis, we learned that the best way to promote a citizen science project is to employ as many possible avenues of outreach as possible in order to increase awareness and appeal to as many audiences as possible. Furthermore, volunteers who submit data need to feel that their contribution to science is worthwhile.

From our interview with Dennis, we learned that the strengths of Project BudBurst are that it is not location-bound and that it has numerous passionate supporters who submit an abundance of data. We also learned that the weaknesses of Project BudBurst are very similar to the weaknesses of Project Picture Post, such as the fact that many of the people who gather data do not submit it. Dennis speculated that the best way to overcome this lack of submissions is to emphasize the submission part of the process and to make the overall process as simple as possible. Project BudBurst regularly follows this logic, making it clear that the data submitted by volunteers is regularly exported to scientists and is in fact useful to scientific research.

Interview with Sarah Newman

Sarah Newman has worked for and continues to work for organizations that are actively involved with citizen science, such as NEON, Project BudBurst, and the Beaver Creek Reserve in Wisconsin. As the Citizen Science Director at Beaver Creek, Sarah dealt with numerous volunteers on whatever citizen science project was required at the time. At the Reserve, she recruited people through word-of-mouth, which she stated was highly effective. The strong local reputation of the Beaver Creek Reserve worked to her advantage when recruiting new citizen scientists. Additional methods to promote citizen science involvement included newsletters, local publicizing through publications such as newspapers, and collaboration with academic institutions and other local volunteer organizations.

We learned that Sarah was recruited to Project BudBurst through word of mouth and that she has been engaged with the project ever since. She stated that the main goal of Project BudBurst is to educate people about their local environment and vegetation. We learned that, as much as Project BudBurst values the data submitted, the educational value of their programs has higher priority than the raw data does. We learned that Sarah had heard of a fair amount of collaboration between Picture Post and Project BudBurst, but has not yet been directly involved with any such partnership. We also learned that Project BudBurst publicizes its presence through large organizations such as National Geographic. In addition, they are always actively seeking new promotional opportunities through sponsorship with other organizations and partnerships. Sarah stated that such partnerships have been a huge help in promoting Project BudBurst. She also explained that people who submit data to BudBurst feel that their data is important. Sarah stated that this was critical, as people would most likely not submit the data that they had collected if they did not think it would be put to good use.

We learned that the strengths of Project BudBurst include the ease of participating in the program, the project's large base of operations (which is nationwide), the fact that the data being collected is in demand, and the numerous partnerships that Project BudBurst has formed with organizations that have similar goals. The weaknesses of Project BudBurst include the difficulties involved in maintaining the currency of its website and effectively communicating to website users without face-time. In terms of expanding citizen science programs such as Project BudBurst and Picture Post, Sarah emphasized the importance of partnerships and interpersonal relationships. At Beaver Creek, Sarah had noticed that the social aspect of citizen science participation was a key factor in motivating involvement in the program. She had also learned that another good strategy for expanding citizen science projects is to promote the project in as many ways as possible. Ms. Newman also told us that properly using modern technology to make participation simple and quick would increase the desire to participate in the project and to submit data.

Appendix O: Observations from Site Visits

Crane Beach

- Promotional materials
    - There were no promotional methods in place
- Locating the post
    - We were able to locate the post after being told where it was by one of the resort employees.
- Post Location
    - Easy for a first time Picture Post user to overlook
    - Located behind a roped off area
    - Post top was positioned with the north side facing northwest
- Signage on Picture Post
    - Not visually appealing
    - Too much information
    - Poorly mounted

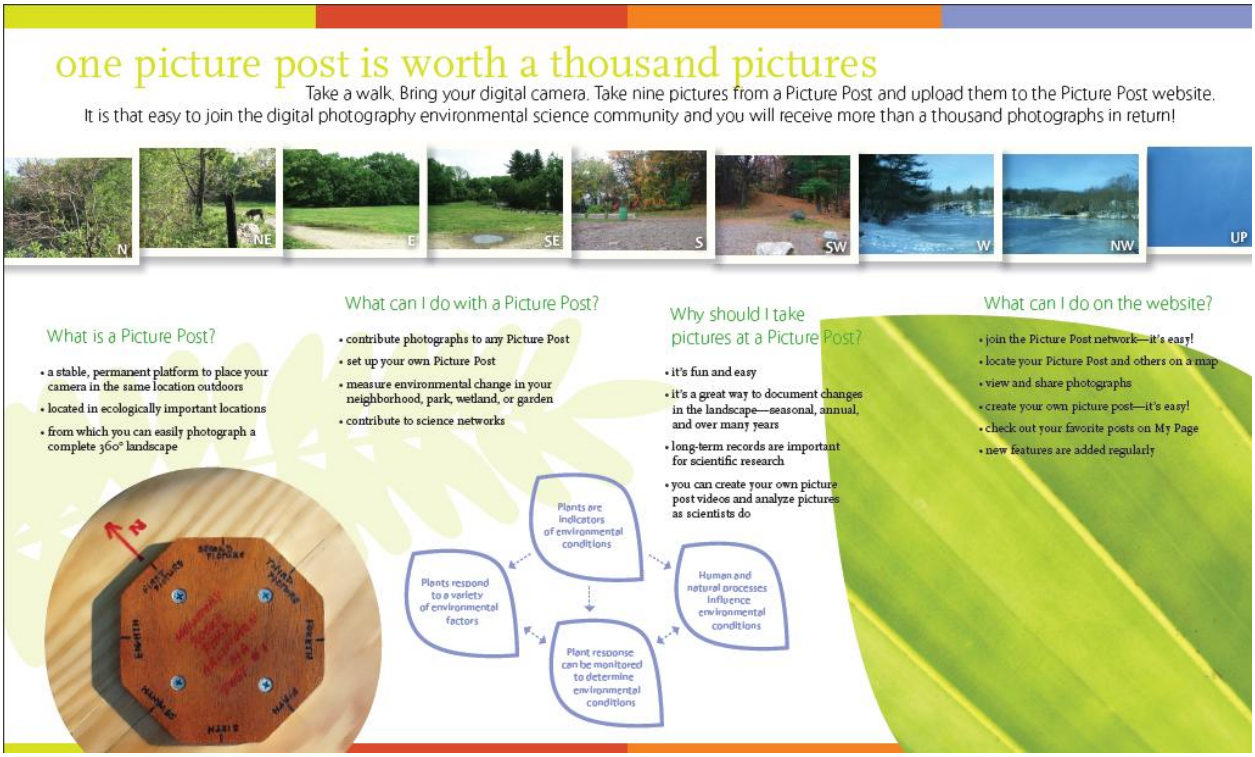
Seacoast Science Center

- Promotional materials
    - There were no promotional methods in place
- Locating the post
    - We were able to locate the post but a first time user could easily overlook it
- Post Location
    - Located in a high traffic area
    - Good vegetation surrounding the post
- Signage on Picture Post
    - None

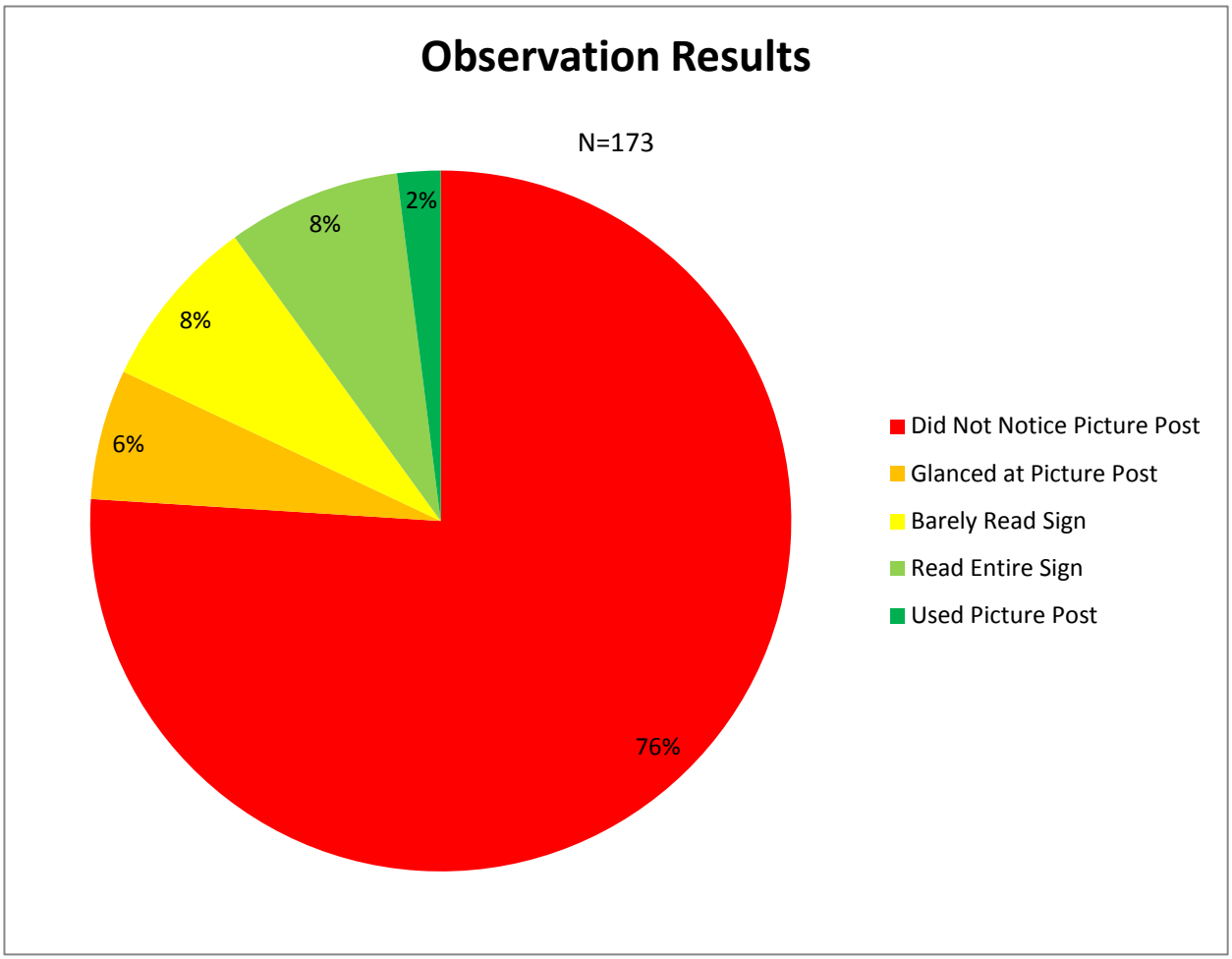
Wells National Estuarine Research Reserve

- Promotional materials
    - Brochures explaining Project Picture Post
    - Picture Post location is included on the Wells Reserve iPad tour
- Locating the post
    - We were able to locate the post after being told where it was by one of the reserve volunteers.
- Post Location
    - Located in an extremely high traffic area
    - Presents an excellent view of the surrounding vegetation
- Signage on Picture Post
    - Not enough information
    - Made from engraved plastic

Appendix P: Brochure at Wells Reserve



Appendix Q: Raw Observation Data



Appendix R: Raw Survey Data

	Quality of Demonstration	Sign: Attention Grabbing	Sign: Directions	Usability of Picture Post	Interest in Project	Likeliness to Use
1	2	1	4	5	3	3
2	3	2	2	4	3	3
3	3	1	4	4	4	4
4	3	3	3	3	1	1
5	4	3	4	5	3	1
6	4	4	5	5	3	2
7	4	4	5	5	3	3
8	4	2	4	5	4	2
9	4	3	4	5	3	4
10	5	4	5	5	3	1
11	5	3	4	5	5	3
12	5	5	4	4	3	3
13	5	4	5	5	5	5
14	5	5	5	5	5	5
15	5	5	5	5	5	5
16	5	5	5	5	5	5
17	5	5	5	5	4	4
18	5	5	5	5	5	5
19	5	3	4	5	4	4
20	5	5	5	5	5	5
21	5	4	5	5	4	4
22	5	1	3	5	4	4
23	5	5	5	5	4	5
24	5	4	4	5	3	4
25	5	4	4	5	4	5
26	5	2	4	4	3	5
27	5	3	4	5	5	5
28	5	4	5	5	3	2
29	5	3	5	5	4	4
30	5	4	5	5	4	5
31	5	4	5	5	5	5
32	5	2	5	5	3	3
33	5	1	3	3	2	1
34	5	3	4	5	4	4
35	5	4	5	5	5	3
36	5	3	5	5	4	5
37	5	2	5	5	3	2

38	5	5	4	5	3	3
39	4	3	4	4	3	2
40	5	4	5	5	4	3