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Fireflies at RPA Natural Area Final Report

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Final Report: Fireflies at RPA Natural Area
ENST 411: Environmental Community Projects
May 8, 2024
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Executive Summary

Our group worked alongside community partners Shaunna Barnhart and Jim Dunn during the Spring 2024 semester to assist with their annual event Fireflies at RPA Natural Area. RPA Natural Area is a local park in South Williamsport, Pennsylvania that was recently acquired by Southside Recreational Authority. Since taking over the park, the organization has begun hosting an event each July to educate the general public about firefly biology and conservation by showing a film and guiding attendees through a firefly tour through the park. Our goals for this project included creating physical educational materials to be used at the park year-round, creating a promotional campaign to bring awareness to the public about both the park and Fireflies at RPA Natural Area, and preparing the event to be scaled up from 50 to roughly 100 attendees. Over the semester, we have created, distributed, and analyzed results from a community survey aiming to better understand current public knowledge on fireflies, produced trail signage and brochures to be printed and used at the park, and designed social media posts and event invitations.

Background

For our ENST411 Environmental Community Project course for the Spring 2024 semester, our group worked with community partners from the Sylvan Dell and Robert Porter Allen (RPA) Natural Area to scale up the annual Fireflies at RPA Natural Area and raise public awareness of firefly ecology. Fireflies contribute to the environment invaluablely. When at a sustainable population level, firefly larvae act as one of our ecosystem's most productive defense systems. Because of their insatiable appetites at this stage of their development, firefly larvae effectively control snail and slug populations which inherently supports vegetative growth. As firefly populations continue to dwindle, environments are left increasingly vulnerable to insects that destroy plant production; without primary producers present, an ecosystem is unable to sustain itself and ultimately diminishes. Therefore, spreading awareness and learning how to rehabilitate firefly populations are paramount practices that the RPA Natural Area is trying to promote through the annual summer event.

The Robert Porter Allen Natural Area was established in 2021 and is a 227-acre piece of land that includes wetlands, farmlands, meadows, and forests just south of Williamsport, PA (see Appendix A). The site is named after Robert Porter Allen, who was a pioneer in both the fields of ornithology and environmentalism and helped bring species such as the roseate spoonbill back from the brink of extinction. There is thousands of years of evidence showing indigenous populations on nearby Canfield Island, but no written documentation was presented at the specific RPA Natural Area until the 1900s. Colonizers created a bathing area called "Goose Island" in the early 1900s which was located on the riverfront in front of the farm area that exists

there today. You can still find images of this beachfront area in historical articles relating to RPA Natural Area, as it was a very popular attraction at the time. RPA Natural Area has historically since been used for recreational activities such as hiking, biking, and bird watching, and plans with the current initiative are to continue this alongside other goals like habitat restoration, connecting trails, and canoeing/kayaking. Currently, the park is owned by the Southside Recreational Authority under the central mission to connect people with nature through recreation and learning (Robert Porter Allen Natural Area Organization, 2023), which is backed up by the Sylvan Dell project that intends to establish an ecological preserve and educational center on the site. This plan encourages outdoor education efforts being made and plans to repurpose the old farm buildings into spots for environmental education workshops. The park has stated future goals involving establishing field research stations for nearby academic institutions besides Bucknell University (such as Lycoming College and Pennsylvania College of Technology).

The RPA Natural Area has the largest intact wetland on the west branch of the Susquehanna River, housing many species of firefly beetles and has many trails open for public use. According to the International Union of Conservation of Nature, 14% of the 2,200 species of fireflies worldwide are on the verge of extinction (Lewis et al., 2021; Pennsylvania Firefly Festival, n.d.). The RPA Natural Area is an Environmental Justice Area classified by the state of Pennsylvania (Department of Environmental Protection, n.d.). The land has historically been used for farming and has legacy oil tanks where oil that was drilled from offsite is stored. Since the organization has begun to convert the farmland into meadows, forests, and wetlands, residents of nearby Williamsport and South Williamsport have had access to an outdoor space previously not open to the public. The natural area improves human and environmental health by connecting visitors to the outdoors and by conserving the land for recreation instead of industrial and commercial farming use.

Fireflies at RPA Natural Area's goal is to engage, educate, and empower residents of the South Williamsport community to conserve firefly habitats and advocate for restoration at the RPA Natural Area. There have been two previous iterations of the Fireflies at RPA event in the past held in 2022 and 2023 which we will be building upon, as well as materials from other events (see Appendix B). The maximum turnout for this event in 2023 was roughly 50 people ranging in age from youth to seniors. The first part of the evening includes a film screening in a dimly-lit barn of *A Midsummer Nocturne* created by the visual artist Diana Lehr. Lehr is known for her multi-disciplinary work that has been exhibited in galleries, alternative spaces, film festivals, and museums in the United States. Following the screening is a talk by Dr. Sarah Lower, an Assistant Professor of Biology from Bucknell University who is a firefly expert on species in Pennsylvania. Her brief talk is about firefly habitats and the conservation of fireflies at the preserve. After the showing, attendees are taken on guided walks through the natural area's trails to see the fireflies out at night and conduct citizen-science reports on firefly populations. Children are provided with arts and crafts projects as the event concludes courtesy of the

Lycoming Arts Foundation. For the summer of 2024, our community partners are hoping to scale the entire event up from 50 people to no greater than 100 attendees.

Relevant People and Conversations

Community Partners

Our community partners were integral in guiding the planning and logistics for Fireflies at RPA Natural Area in July, along with other long-term projects for the site. Professor Shaunna Barnhart is the primary contact as our community partner. In addition to her role in previous years planning Fireflies at RPA, Professor Barnhart works at Bucknell University in the Center for Sustainability and the Environment. She has been a helpful resource, assisting us with site visits and expanding our understanding of the past Firefly events and the potential scope of the project within our timeframe.

In addition to Professor Barnhart, our other community partner, Jim Dunn, is a South Side Recreation Authority Member and Board Member at the RPA Natural Area. He has been a helpful contact for us as we navigate specifics about the site and the RPA Natural Area organization. His primary goal for the project was the creation and upkeep of data collection methods to keep the information from public surveys gauging firefly knowledge and the organization of the event.

Important Contacts

Debi Burch is the president of Lycoming Arts and a chair of Arts in the Neighborhood. She worked with Professor Shaunna Barnhart in 2023 to create the arts and crafts component for children attending Fireflies at RPA Natural Area. We went into our meeting with Burch planning to discuss ideas for the arts and crafts educational aspect this year. She works with children regularly and she has worked with Professor Barnhart in the past, so her knowledge was necessary to create an art component that includes both our research on firefly conservation as well as her gauge on the level of difficulty and creativity for the craft. When we met with her we realized that the component for the arts and crafts aspect of the project was not a priority for our group, and instead, Burch and her colleagues would cover this aspect of the event again this year.

Sarah Lower is an Assistant Professor of Biology at Bucknell University and a firefly expert. She has attended and helped facilitate the Fireflies at RPA Natural Area event in the past, so she was a helpful contact that we reached out to regarding our Firefly educational material. She is an expert in the field and studies these fireflies, so was able to fact-check and look over our research before it was released to the public. Our meeting was very productive with Lower—she referred us to the book “Fireflies, Glow-worms, and Lightning Bugs: Identification and Natural History of the Fireflies of the Eastern and Central United States and Canada,” which covered the light patterns for common fireflies found at the RPA and she shared different threats to fireflies as well as conservation strategies (2017).

Diana Lehr is a visual artist who is known for her paintings, video installations, and work with light. In 2017 a clip from her film, *Midsummer Night's Dream*, went viral on multiple

platforms and was shared across various news outlets, gaining over 100 million views. In addition to *Midsummer Night's Dream*, she created a second documentary titled *A Midsummer Nocturne* which is shown in conjunction with Bucknell University at the event as part of a special collaboration. We reached out to Diana for specifics on the lumens required for projecting such a dark film, and she got back to us with a number that we will rent for this year's event that has higher lumens than last year.

Ibiyinka Alao, or Ibi for short, is an artist who creates multimedia pieces inspired by fireflies and their importance to our ecosystem. Ibi visited Bucknell on March 6th at 7 PM in the ELC Forum to give a talk related to art, education, climate change, and fireflies. We used his talk to gather knowledge to create educational materials. We attended the talk to see how Alao represented nature education through his art. Our takeaways to consider when creating our educational materials are that fireflies and climate change can be discussed together and that we can find a way to teach people about the Fireflies at RPA Natural Area in a joyful and meaningful way. Alao shows passion for educating people about climate change and we want to make sure people find joy in this connection as well. Climate change can be a sensitive topic, but Ibi smoothly educated people of all ages on the subject. As our group was looking forward to coming up with ideas for the craft aspect for children for the event, we wanted to make a similar smooth connection between fireflies and conservation that children and adults would be able to understand and appreciate.

Project Goals

For this event, we worked with our community partners Professor Shaunna Barnhart, who is the Place Studies Program Director at Bucknell University working in the Center for Sustainability & the Environment as well as the organizer of this event, and Jim Dunn, who is a member of the South Side Recreation Authority and an Armstrong Township supervisor. After our initial conversations with our community partners discussing expectations for the semester, we have been working together to implement these ideas into Fireflies at RPA Natural Area held on July 11, 2024, and beyond. Fireflies at RPA Natural Area requested a grant from the DEP (see Appendix C) to help scale up the environmental education component for the programs delivered during the event as well as for creating educational signage and advertising. The funds for the grant would become available on July 1st, 2024. The Southside Recreation Authority and Bucknell University were supposed to hear if they received the grant on April 1st, 2024. As of May 8th, 2024, the group has not heard if they received the DEP grant.

The general goal of this project was to prepare for the scaling up of this year's event and provide comprehensive site-specific educational information for both adults and children. In addition to scaling up the event in July, the RPA Natural Area is looking to do more art and hands-on activities throughout the year beyond the evening event. Working with our community partners, our group has identified four distinct project design components. In order of importance, these categories are community surveys, educational materials, promotion, and general event logistics. These goals have been heavily adjusted as our project has progressed

given we are working with several people each with their own ideas. As such, our project has hinged on our group's flexibility, as seen in our group's timeline (see Appendix D).

The primary component of our project has been the creation, distribution, and analysis of a pre-event survey to better understand the limitations of public knowledge on fireflies and interest in RPA Natural Area and the event. In addition to the pre-event survey, we developed a post-event survey to be released by our community partners following the conclusion of Fireflies at RPA Natural Area on July 11th, 2024. The results of this survey will be used in conjunction with the pre-event survey to assess the impact of the event and can be subsequently used in future DEP grant applications.

A significant portion of our project was dedicated to developing educational materials, both for the event itself and to be used in tandem with the nature trails in the natural area. We have researched different facts about fireflies regarding firefly conservation efforts, habitats, biology, life cycles, seasonality, and other informational tidbits that we used in creating trail signs and pamphlets. The trail signs and pamphlets will hopefully be printed with funds provided by the DEP grant. The goal is to have the pamphlets kept in a box at the front of the nature trail all year round to allow visitors of RPA Natural Area to learn about firefly conservation and habitat restoration as they walk through the park. These pamphlets will also be used on the night of the Fireflies at RPA Natural Area. The trail signs will be posted around the trail with short facts about fireflies which will be used year-round as well. Our educational materials were influenced by the results of the pre-event survey. For example, from the survey, we saw that people did not have much knowledge of conservation strategies, so we made sure to include that in one of our signs.

The promotion for this event mainly focused on increasing public awareness about the RPA Natural Area and the firefly event held there. This was done by posting in Facebook groups and drafting postcard invitations and social media posts to be used by our community partners closer to the event date.

For the event, we had planned to work with Lycoming Arts to put together children's art activities that focus on site-specific firefly conservation in a child-friendly manner. The 2023 Art2Go in collaboration with Lycoming Arts was limited to resources already on hand and was lacking the educational aspects that we are aiming to incorporate into the activities this year. Once we met with Burch we realized this was not one of the big priorities for us and that Lycoming Arts could cover this portion of the event.

Given that this event has been run for two years already, the event logistics was the least pressing of the four categories. The considerations in this category focused on scaling up and improving the event for 2024. Specifically, Shaunna identified current needs including sourcing a reliable projector with specific luminosity for proper visual distinguishment of the fireflies in Diana Lehr's film. In the future, when the RPA has the funds, a goal for them is to build an educational center where they can showcase Lehr's film with proper seating, air conditioning, and flush restrooms.

Literature Review

Firefly Conservation

From our research on the biology, behavioral traits, habitats, and conservation efforts of fireflies, we gained a lot of valuable information that helped us significantly with the development of our educational material. One of the primary aspects we looked for while searching for appropriate sources was the ecological significance of fireflies and why there needs to be increased awareness of how to save them from extinction. We found a great deal about their significance in our literature, such as how fireflies are a global species that consists of over 2000 separate kinds (Xerces Society, 2021) and that fireflies are celebrated around the world as a symbol of natural beauty, being a major cultural icon in Japan especially (Grimberg et al., 2019). The journal and popular science articles we obtained also provided intricate details on firefly biology, namely their life cycle, feeding habits, preferred habitats, and the phenomenon of bioluminescence in which fireflies light up (Xerces Society, 2021). Another part of our research was focused on assessing the major causes of firefly population decline, which concluded that outdoor LED street lights at night disrupt firefly communication, and habitat loss, pesticide use, and water pollution/removal are also responsible (Lewis et al., 2020; Reed et al., 2020). The information we obtained also included a lot of recommendations and guidelines for what the average reader can do to ensure the thriving of local firefly species, and to restore their habitats, including practices such as limiting outdoor lighting and pesticide usage and not cutting lawns, alongside adding bodies of water (Ljmarkson, 2022; Yan et al., 2008). More information specific to firefly species native to the state of Pennsylvania was obtained, which will help give readers a better understanding of what exists within the RPA Natural Area (T. Faust, 2012). When combined and sorted into specific categories, this information aided in the composition of our educational materials for pamphlets and trail signs, alongside helping in the creation of survey questions to see how much the general public knows about fireflies.

Outdoor Education

Another facet of our research that was crucial to the focus of the project was gathering information on outdoor education. More specifically, we looked into past outdoor education events involving fireflies, firefly tourism as a concept, a variety of different art and science educational methods, and the effect that these kinds of outdoor educational events can have on every demographic who attends. The information we obtained on firefly tourism mentioned walks involving information such as distinct firefly species, varying geographies, and local areas that have become the focal parts of firefly tourism, as well as how firefly tourism can have positive impacts on these environments and firefly populations (Lewis et al., 2021; PA Firefly Festival, n.d.). Another couple of sources we covered in this research focused on the importance of science and art education and how incorporating STEAM (science, technology, engineering, and math) into outdoor education can be a great opportunity to involve diverse perspectives and

cultures (PA Firefly Festival, n.d.). Mentioning past examples of science and art-based events, how they were structured, and what types of media were present, as well as how this emphasized areas that are commonly underrepresented in science (Grimberg et al., 2019), this information greatly helped us with structuring our event. Sources that mention more art-based events such as previous musicians and artists who focus primarily on fireflies also gave us insight into how to incorporate different forms of media and the benefits of having such a well-rounded event (Sidik, 2023). This also helped us come up with questions for conversations we had with biology professor Sarah Lower about the media part of the event. In addition to this kind of diversity, information on how to engage children was also imperative to ensure we reached all demographics and opened the event up to a wider audience. Information we found on learning at a young age and methods we can use to effectively communicate with children, as well as the benefits of helping people get attached to ecology and art contributed to our educational material design (Molyneux et al., 2022).

Promotion

Our research on promotion yielded some very interesting results that we used as inspiration as we began to promote and create visual materials for this event. Our research suggested that although social media platforms such as Facebook may have limitations in rural communities (such as South Williamsport) due to a general lack of broadband accessibility, they are generally recognized by local businesses and non-profit organizations as their most effective form of mass communication (Liegel et al., 2021). This was promising for our group as we navigated the best ways to administer our survey and promote this event, as we heavily relied on social media as a distribution method. It allowed us to gain access to a larger network of people while overcoming the barrier of distance between Lewisburg and the Williamsport area. Although social media was used as our primary tool for survey distribution and other promotional tactics, we also promoted our event to individuals who may not be technologically savvy. The study suggests that both direct communication and newspapers are effective ways to reach those who do not have access to social media.

Concerning infographics that we used to promote our firefly event, our research concluded that in rural areas, perceptions of visual data vastly differ from urban areas due to limited access to visualization tools and platforms (Peck et al., 2019). As such, it was found that rural communities in Pennsylvania, like that of South Williamsport and the general Williamsport area, have a strong preference to be represented in the graphics they are viewing, particularly representation of geographic regions. Furthermore, subjects tended to prefer visually appealing and simple infographics. We used this data analysis to ensure that our promotional materials were as effective as possible, leaning into representation and simple, picture-heavy posters.

Community Events

In addition to the methods of outdoor education we used for planning our event, it was also extremely important to delve into how community events are structured and carried out. The information we found covering the logistics of past outdoor firefly community events (like the

one we are planning) underlined how the event progressed over a 1.5-2 hour time frame and focused on the exploration of an area labeled “The Dark Forest” for the viewing of fireflies (PA Firefly Festival, n.d.). We also looked at newspaper sources online surrounding garnering interest for past firefly events, emphasizing their use of the film *A Midsummer Nocturne*, aspects of which we implemented into our advertisements and event plans to attract interest from a wide audience (Northcentral PA Staff, 2023). With this event logistics information, we also researched how to avoid failure of the event and reasons for event failure, having largely to do with reasons such as inadequate promotion, weather, and limited financial resources (Getz, 2002). This aided us in figuring out what to prioritize in our event planning, focusing on gaining public interest and preparing our allocation of the funds we receive. Lastly, we also looked into the benefits of these public community events in rural environments, having the potential to create social connections, community identity, and financial gain in facilitating success in small businesses. These descriptions of benefits emphasize why it is important to consider planning community events like the one we helped with and to also pay attention to whether people from the community will appreciate change (Mair & Duffy, 2018). Having an understanding of the social complexity of holding an event such as ours was key to ensuring the festival ran smoothly and effectively communicated our message on fireflies.

Site Visits

When we began working on this project, we knew we had to visit the Robert Porter Allen Natural Area site and from there decide how we wanted to go about planning the event. We have since visited our site twice, and both times have been extremely helpful in aiding our planning of the event and in figuring out other logistics.

Our first site visit was on Monday, March 4th. It was a warm, sunny day and we arrived at the site around 1:30 PM. We spent about one hour walking around the site and taking notes on different aspects. One thing we realized right away was that it was not as well-maintained and as well-marked with signage and directions as we had assumed (see Appendix E). In addition, we looked online to see if there were any maps posted to make it easy to navigate around and we found nothing. Even the hiking app showing local trails in the area “Alltrails” didn’t have a map of the paths. We relied on the remains of what had been mowed (possibly in the late fall) as our paths and we weren’t sure if the trails we were taking were out-and-backs or loops. Even though this is a year-round site that people can visit, we assume that the most foot traffic would be in the summer months, so when we visited in early March we only saw two other folks, both of whom were walking their dogs. While walking around we generated questions for Professor Barnhart about whether we should focus our work on creating signage just for firefly education, or if our signs should primarily help people navigate the site. The consensus from Professor Barnhart after speaking with Jim was that site navigation should be left to Jim Dunn, and that our work should

focus on firefly signage. In addition, while walking around the site we wondered if since it is used year-round, should we brainstorm multiple trail signs about fireflies for different seasons. This is because different types of habitats for fireflies will be present during different times of the year. We focused on creating only one versatile pamphlet so it can be used during the event, but also at other times of the year when there is not a guided tour. After our initial site visit, we wrote up facts and brainstormed ideas about fireflies, firefly conservation, and firefly habitats at the RPA Natural Area to create online PDFs of signs and pamphlets.

Our second site visit took place on Friday, March 22nd. We arrived on site at 12:30 PM. We met Professor Barnhart who gave us a tour of the grounds—including walking on the path where the guided Firefly tours are taken as well as getting shown around the equipment shed where the film *A Midsummer Nocturne* by Diana Lehr was screened. We were off-site by 1:30 PM. During our walk on the path with Professor Barnhart, we discussed the lack of signage, both educational and directional signage. We talked through some of our ideas about creating signs for bird and bat boxes, warnings for ticks and active trains, and directional maps of the trails. We felt optimistic when looking at the equipment shed as a possibility for the film showing next year. Because the shed gets stuffy and needs to be kept closed for absolute darkness, we thought through some solutions like getting large fans and using bags of ice to circulate the cool air around and staggering documentary showtimes to ensure smaller groups are in the space at one time. Seeing the space for the first time helped us to visualize the set-up of the previous years' Fireflies at RPA Natural Area and how our group could assist in scaling the event up this year. This site visit was integral because we were able to talk about trail sign placement and trail sign posters with Professor Barnhart.

Project Components

Methods

To achieve the results for the event outlined in the project goals, our methodology was structured around four key components: the pre-event community survey, the post-event community survey, the development of educational materials, and general event logistics.

The pre-event survey gauged potential attendees' baseline knowledge of fireflies. This required the creation of a 22-question survey that was approved by the IRB (2324-085). We distributed the survey via physical methods, social media platforms, and community groups.

The post-event community survey was proposed following the event to understand the impact and experience of the event for all participants. Before the event, it will be emailed to the Bucknell IRB chair asking for an addendum to add the post-survey to the survey we've already had approved. It will be distributed by email from an event sign-in sheet in the days following Fireflies at RPA Natural Area in July 2024.

Creation of the educational materials began following feedback from the pre-event community survey along with extensive research on firefly biology, conservation, history, and threats to species. We collaborated with Bucknell Assistant Professor and firefly expert Sarah Lower to ensure our research was factually correct. The materials were distributed digitally to our partners who will use social media to post about the site ahead of the event.

The event planning required logistical considerations. After discussions with our community partners, the 2024 event will be held in the same location as previous years, with the addition of two swamp coolers to increase attendees' comfort while indoors.

Our methodology prioritized two community surveys, the development of educational materials, and overall event logistics.

Pre-Event Community Survey

Development

Before our involvement, Fireflies at RPA provided a more general collection of information that caters to the assumption that people don't know much about fireflies. However, our community partners Jim Dunn and Professor Barnhart hoped to gain a more accurate understanding of what potential guests know coming into the event so that future educational features can be more insightful. Our group developed and distributed a pre-event survey that scoped the average knowledge of fireflies of potential guests coming into this summer's event. Our group applied what we learned from the pre-event surveying to the development of our educational material to ensure we provided a foundation of knowledge on fireflies, as well as the degree to which we expanded on certain topics.

The surveying design that we devised was broken down into two stages: pre-event surveying and post-event surveying. While our group was responsible for the distribution and analysis of the pre-event survey, the post-event survey was only drafted and workshopped so that Professor Barnhart and Jim Dunn had the questions ready after the event. When this time comes, Jim Dunn and Professor Barnhart will submit an addendum to the initial IRB proposal and transfer the drafted questions into a Google Form.

To create our pre-event survey, we drafted 10 questions that revolved around firefly conservation efforts, noticed discrepancies in firefly populations, individual access to the outdoors, and how much exposure individuals have had to fireflies. The final version of the pre-event survey includes 22 questions—5 of which are devoted to collecting demographic information about the respondents and possible future participants. The 17 remaining questions are designed to measure an individual's exposure to fireflies, their current knowledge of the species, and their willingness to partake in firefly activities and expand their learning about fireflies. The finalized survey questions which have been approved by the IRB are located in Appendix E.

In the duration between submitting our survey to the IRB and receiving approval, our group conducted pilot testing to approximate how long it would take an individual to fill the survey out. We reached out to friends, family, and professors who were willing to participate in

our piloting activity which allowed us to produce an estimate that the survey would take an individual 3-5 minutes to complete.

Survey Questions

When we originally approached the drafting process of our pre-event survey, our group was under the impression that we had to keep our work short. We thought that 7-10 questions would be efficient in collecting all of the information we were hoping to receive. However, after receiving the first round of feedback from Professor Wooden and Professor Barnhart, we quickly realized that more questions were necessary. Our group outlined four main topics to ask questions about: 1) demographics, 2) firefly knowledge and exposure, 3) outdoors accessibility, and 4) the Robert Porter Allen Natural Area.

By defining the four categories of question topics, the number of our survey questions expanded from 7 to 22. Rather than solely testing individuals' knowledge of fireflies through test-like questions that would be answered through multiple choice, our group found it beneficial to use our pre-event survey as an opportunity to figure out possibilities for why firefly knowledge varies among the South Williamsport community. Presenting questions about how often an individual spends time outdoors, whether or not they can easily access the natural environment, and if they are curious to learn more about fireflies allows our group to understand how we can more effectively contribute to this summer's event.

Another component of curating the survey process was deciding how we wanted participants to answer our questions. While we originally believed multiple choice answers would produce the best results in terms of when we would later analyze our collected data, Professor Barnhart recommended that we incorporate Likert-scale response formatting into our survey so that answers could better reflect the participant's intention. Unlike our original format that limited participants to using multiple choice answers, incorporating the Likert scale and fill-in-the-blank response formatting allows our survey to collect more personalized and articulate answers.

Distribution

Our survey proposal was accepted by Bucknell's IRB board on March 21st, 2024. We then progressed to the next step: distributing our survey to the local South Williamsport community. To optimize the results of the pre-event survey, participants should be from a variety of demographics, varying in age, gender, and ethnicity. This was accomplished by creating several different distribution routes, including physical posters which were handed out to local businesses and Facebook posts in various Facebook groups, all of which enabled the survey to be seen by as many different cohorts as possible.

Following our second site visit on March 22, 2024, our group visited the James V. Brown Library in downtown Williamsport, where we dropped off 20 printed copies of the survey, as well as two copies of our poster which include a QR code and link address leading to the online survey (see Appendix E). Subsequently, we walked through downtown Williamsport and

dropped off the remaining eight posters to other local businesses. Businesses were chosen based on two main factors: their suspected foot traffic, and whether they were advertising other posters. We believed that businesses with more suspected visitors would increase the total number of people who would see our poster and take the survey. Similarly, it was thought that businesses that were actively promoting other posters would be targeted by audiences who were actively looking for events to partake in. With these variables in mind, we distributed posters to Alabaster Coffee Roaster & Tea Company, Crown Fried Chicken, Gustonian Gifts, Lycoming Arts, Lycoming County Visitors Center, The Otto Bookstore, and The Tria Prima Tea Company.

We joined several Facebook groups that we believed would target audiences in the general Williamsport area, and posted a digital version of our poster along with a caption reading,

“Hi everyone! I am a student at Bucknell University and am working with a local Williamsport park to gather information on public interest and knowledge on fireflies. We are looking for residents of the Williamsport area to take our brief survey to help us as we plan an upcoming event, and would greatly appreciate your participation. The survey can be found at <https://bit.ly/fireflysurvey2024> or using the QR code in our poster. Thank you!”

This post was sent out to a total of eight different Facebook groups, including Central PA Public Events in a Community Near You!, First Friday - Williamsport, Lewisburg, Williamsport, Danville, PA, etc.- Buy, Sell, Recruit, Promote, Lycoming County News Events Community, Montgomery, PA News & Views, South Williamsport, PA News & Views, Williamsport Happenings and Events, and Williamsport, PA News & Views. The QR code for the survey also was posted in the Lycoming Arts newsletter, published in April 2024. An additional Facebook post was made on the Robert Porter Allen Natural Area Facebook page after contacting the page admins, Katie Caputo and Chris Kuriga.

Survey Results and Data Analysis

In the 25 days, from March 22nd to April 15th, where our surveying was conducted, our group was able to receive 87 responses. It is imperative to note that despite achieving 87 individual responses, the data from our demographic questions has illustrated that our results can not be used to represent a general population; more than 75% of the total participants identified as a white female over the age of 35. Due to these results, our data is skewed and can only be significant in representing one, specific group of individuals who are a part of the South Williamsport community.

All of these responses were from the digital Google Form, none were from the copies we left at the James V. Brown Memorial Library. We presume that copies left at the library were lost after multiple calls with library staff. This process brought us invaluable information that will help the Robert Porter Allen Natural Area expand its influence and impact on the South Williamsport community. In this section, we will be presenting relationships and trends that have been identified through our analysis. To gain insight into all of our findings and results, please

refer to Appendix G which presents a detailed description and presentation of all our collected data.

The key points our survey responses demonstrated are that there is a shared interest in increasing outdoor exposure among the participants, the majority of participants are curious to learn more about fireflies, there has been a noted decline in firefly populations within the South Williamsport area, and there is an overall desire to attend this summer's firefly walk. One section of our survey was devoted to asking participants about their exposure to the outdoors. When asked "Currently, how satisfied are you with the amount of time you spend outdoors?", 66.6% of 87 participants were not satisfied with their outdoor exposure. We then compared the data from this question to the data from the question "How many hours per week do you currently spend outdoors?". 60.9% of the 87 participants expressed that they spend 5 hours or less outdoors per week. To figure out potential reasons as to why participants were not spending a satisfactory amount of time outdoors, we then investigated qualitative data received from our short answer, follow-up question which asked participants to describe any limitations that they might face in accessing outdoor spaces. 45 participants decided to answer this question. A trend that we identified in this analysis was that busy schedules, work obligations, and financial pressures were the most prevalent restrictions individuals faced. Undesirable weather conditions as well as health concerns/physical disabilities/old age were two other leading factors as to why individuals are not getting outside as much as they would like.

The next section of our survey focused on the Robert Porter Allen Natural Area. We learned that 77% of the 87 participants had not heard of and/or had been to the RPA Natural Area prior to taking our survey. We then conducted a more thorough analysis of the data from this question, coupled with the qualitative data collected from a follow up question, "Where did you hear about the Robert Porter Allen Natural Area?". In doing so, we learned that the majority of the 23% participants who had been to and had heard of RPA Natural Area prior to taking our survey learned about the organization through friends and family, or through social media (specifically facebook). This insight is very valuable for our community partners as it distinguishes two proven modes of promotion and advertising. If RPA Natural Area intends on expanding their event in upcoming years, utilizing social media platforms and relying on local "word of mouth" are two tried and true methods to get the word out.

The following section of questions assessed participants' knowledge and exposure to fireflies. What was interesting to learn from the collected data was that around 87% of the 87 participants answered the first two test-like multiple choice questions correctly. These two questions quizzed participants on what the leading causes to firefly populations were, and what the chemical reaction that allows fireflies to produce light is called. Where responses deviated was in the final test-like question, which asked participants "What habitat do fireflies generally inhabit?". Only 40.2% of participants answered this question correctly. We then compared the results from these three questions to the following question that asked participants to rate their knowledge on various aspects of fireflies. We presented five topics (general firefly biology, why fireflies light up, variety of firefly species, suitable firefly habitats, threats to firefly populations,

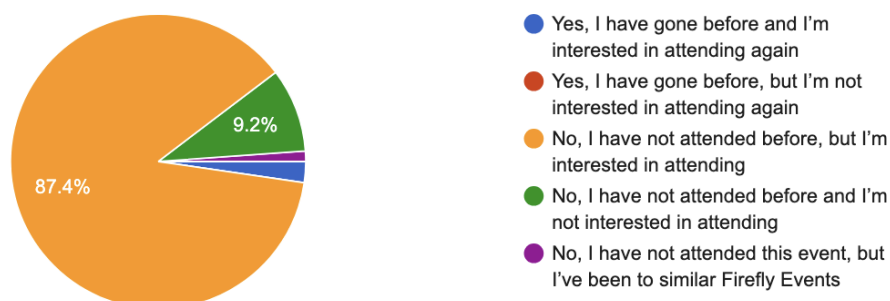
and firefly conservation strategies) and offered a likert scale for participants to express their assessments through. What was incredibly insightful from this data analysis was that despite the fact the majority of participants answered the test-like questions correctly, there was an overwhelming response that individuals believed their knowledge was lacking in every aspect of firefly knowledge. Specifically, the greatest number of participants expressed that their knowledge was poor in the topic of “variety of firefly species” and “firefly conservation strategies”. This finding was not only incremental to developing our educational material, but also serves as an outline for volunteers and leaders of this summer’s firefly event who are able to cater more elements of the event to this sensed lack of knowledge.

The final section of our survey asked participants about their interest in attending RPA Natural Area’s firefly event this summer. While noting the initial takeaways that were illustrated from the raw data collected from each question, our analysis of this section was focused on identifying trends between why participants felt the way they did about this summer’s firefly event and their knowledge and exposure to fireflies.

Have you attended and/or are you interested in attending a Firefly Event at the Robert Porter Allen Natural Area in July 2024?



87 responses



Following the firefly-focused section, our group asked participants "Have you attended and/or are you interested in attending a Firefly Event at the Robert Porter Allen Natural Area in July 2024?". Out of 87 responses, **87.4%** of participants (**76 out of 87 respondents**) said “No, I have not attended before, but I’m interested in attending”. **9.2%** of participants (**8 out of 87 respondents**) said “No, I have not attended before and I’m not interested in attending. **2.3%** of participants (**2 out of 87 respondents**) said “Yes, I have gone before and I’m interested in attending again”, and **1.1%** of participants (**1 out of 87 respondents**) said “No, I have not attended this event, but I’ve been to similar Firefly Events”. Our group then presented an optional, short answer follow-up question that stated “Please provide more information about why you are interested or not interested in attending. This may help future planning efforts.” To analyze the qualitative data that was collected from this section, our group formulated categories that represented similar answers. These categories include “I want to learn more about fireflies and firefly conservation!”, “It’s a great event for my children!”, “I want a new experience!”, “I

want to do my part in bettering the environment”, “Seems interesting and fun!”, “It’s a great opportunity to spend time outside!”.

Out of the 87 responses to the previous multiple-choice question, 63 of these individuals chose to elaborate on the follow-up question. Of the 63 individuals who responded to the short answer, 27 participants said that they were interested in attending this summer’s event because they want to learn more about fireflies and firefly conservation. 11 participants said that they were interested in attending this summer’s event because they thought it would be a great event for their children to go to. 4 participants said that they were interested in attending this summer’s event because they think it would be a great new experience. 4 participants said that they were interested in attending this summer’s firefly event because they want to do their part in bettering the environment. 7 participants said that they were interested in attending this summer’s firefly event because they thought it sounded interesting and fun. And lastly, 2 participants said that they were interested in attending this summer’s firefly event because they thought it would be a great opportunity to spend time outdoors.

In addition to the participants who expressed interest in attending this year's firefly walk, 8 individuals said that they were not planning to attend. These participants all provided explanations in the follow-up question as to why they were not interested in attending. 4 of the respondents said that they did not have time to go, 3 explained that they have limited mobility that prevents them from participating in the summer event, and 1 individual said that the event was too far away.

Further analysis into these initial findings showed that the majority of individuals who expressed interest in going to this summer’s firefly event to learn about conservation efforts had noticed a decline in firefly populations. One of our key questions that guided our entire analysis process was “who knows what, and why/how?”. Out of the 68 individuals who noticed a decline in firefly populations, 55% (38 out of 68) of them were white women over the age of 35 who had lived in their town for 10+ years. These same individuals expressed a desire to attend this summer’s firefly event to learn about conservation efforts that they could apply to their own backyards. A common answer that arose in the follow up question that asked participants why they were or were not interested in attending this summer’s firefly event was, “I enjoy viewing fireflies in my field, so I would be interested and willing to learn and develop ways to attract them to my property and help them thrive”.

While we were not able to pull statistically significant data from our survey that supported the conclusions of which people know what about fireflies, and why due to the skewed demographic identity of the survey participants, we were able to pull invaluable insight from our data that will help the RPA Natural Area expand and improve their annual firefly event. We know that there are individuals apart of or in proximity to South Williamsport who are looking for opportunities to spend more time outdoors. We know that there are individuals who have noticed firefly populations decline in their local areas. We know that the majority of these individuals who noticed a decline are interested in learning and helping to rehabilitate firefly populations. We know that the majority of the 87 participants who took our survey possess a basic and

introductory knowledge of fireflies, but feel generally knowledgeable about various topics concerning the species: specifically about firefly speciation and firefly conservation strategies. And lastly, we are able to take away from our data that the majority of our survey participants are interested in attending this summer's firefly event in hopes of learning conservation strategies, and or to bring their children.

Post-Event Community Survey

Development

In discussing our plans to survey the South Williamsport public with our community partners Professor Barnhart and Jim Dunn, we decided that a post-community survey would also be extremely beneficial to the RPA Natural Area. This survey seemed like a necessary step, because not only would it help to determine the effectiveness of the event in improving the attendees' general knowledge of fireflies' biology and conservation, but it would also give them an idea of how much people enjoyed the event and would give them public feedback on improvement for the next years to come. This could greatly aid the natural area in applying for future grants from the DEP, as it could underline the true importance and effectiveness of having this annual event, making a good case for why it is worth investing the time and money. As mentioned above, before creating the actual Google Form survey, Professor Barnhart and Jim Dunn will have to submit an addendum to the IRB proposal, and this segment of the project will be done after the semester is over and our part is finished.

Survey Questions

When beginning to draft the questions, like the pre-event survey, we wanted to keep this questionnaire relatively short and straightforward to encourage participants to take the time and to give the board of RPA Natural Area the data they need to further improve the firefly event. Creating the questions in a group meeting and brainstorming session, we modeled many of the post-event questions after the pre-event questions to accurately depict changes and trends in responses between the two surveys. The questions include mostly short answer responses this time, to get constructive and diverse feedback on how the event went. The questions involved asking about aspects of our project efforts, such as the promotional side, as well as asking about the information given at the actual event (including what was beneficial, engaging, not necessary, should have been included, etc.). In rating how effective the promotion of the event was, as well as the effectiveness of the outdoor education at the event, we sought to put these responses to a numerical scale for better analysis, so we used the Likert scale formats that Professor Barnhart suggested we use for the pre-event survey. These sections were included with a few other short response questions, asking the participants about aspects such as information they had hoped to learn and memorable moments at the event, also asking a Likert scale question on rating firefly knowledge after the event and how the participant came to hear about the event. This will lastly be followed by a section that gives the participant free rein to share additional comments or feedback if they feel that it is necessary. With many short-response answers as well as Likert

scale-based questions, we hope to give the event participants the freedom to create personalized and specific answers that will serve as an excellent basis for the next year.

Distribution

The distribution of the post-event survey has been discussed, with two primary ideas on the table currently. The first is simply sending out a link to the Google Form following the event and collecting responses just like the pre-event survey, while the second involves splitting the survey into two sections, with one being immediately after the event for the in-person participants and one being released online a week after the event. This second option's main objective is to get impressions while the event is fresh in the participants' minds, and then afterward once they had time to think about their experience (especially what was memorable and stuck in their minds even a week after the event). As far as getting this survey out to the participants after they have left the in-person event, Professor Barnhart and Jim Dunn could gather the contact information of all attendees on a sign-in sheet once they arrive, and then use these email addresses and/or phone numbers to send out the post-event surveys.

Educational Materials

As responses from the survey started coming through, we noted how the participants rated their knowledge of the various aspects of fireflies. These categories were general biology, why fireflies light up, species variety, suitable habitats, threats to fireflies, and firefly conservation strategies. We found that the majority of respondents rated their knowledge of fireflies as poor regarding the general firefly biology, variety of species, and firefly conservation strategies. Because the respondents self-reported their firefly knowledge as poor, we decided to write our educational material so that it was understandable and accessible to the general public. This meant using easy-to-digest graphics with ample images, and less scientific jargon that may be confusing to those who are not familiar with science concepts.

In conjunction with research based on our survey questions, we compiled information on the history of the RPA Natural Area, firefly species in the South Williamsport area, firefly habitats, life cycles, extinction threats, and what the average person can do to help. Additionally, as a group we met with Sarah Lower, Bucknell's firefly specialist, to help guide our research and better understand how to relate the signage to the firefly talk and tours.

Once all the research was complete, we created bullets and paragraphs of information in a document formatted for the educational materials. We decided to use slightly different wording on the trail brochures versus the trail signs. The trail signs were designed to be easily accessible and understandable to a general public audience that has little to no scientific knowledge. We had three different ideas for trail signs. Our first trail sign will possibly be placed at the entrance to the natural area and it covers general information about the natural area, providing a trail map and the importance of learning about fireflies. The second sign will be placed a little bit further into the natural area and discuss firefly biology with an emphasis on four firefly species common at the RPA natural area. Our last trail sign will be placed towards the beginning of the trail. It

provides the threats to fireflies and how you can help protect fireflies. These three signs will be spread out in the natural area. The trail brochure includes similar information but is slightly less in-depth due to the size limitation of the brochure. We drew images of fireflies and other icons that are pictured on both the trail signs and the trail pamphlet. In addition, the brochures and signs were sent to Professor Barnhart and Professor Lower for review before they were finalized. Rather than devoting our time and resources to creating physical signage, our group produced digital copies in formats that can easily be printed out when the grant money becomes available.

Promotion

One key finding from our pre-event survey indicated that a large percentage of the community had not heard of the RPA Natural Area, and fewer had heard of the event itself. The vast majority of these people, however, stated they would be interested in attending the event after having heard about it through our survey. This general lack of awareness emphasizes how critical promotion is, as the limited turnout from previous years does not equate to low community interest. Scaling up the event, then, would heavily rely upon an updated system of advertisement.

Our first step in promoting the event then, although unintended, was the survey poster we distributed physically and virtually (see Appendix H). As aforementioned, many of our survey respondents had not heard of the park before taking the survey, but being prompted to take the survey through posters hung around downtown Williamsport or posts in community Facebook groups created awareness.

In addition to utilizing the survey poster as a method of promotion, our group also updated materials used during past iterations of the event. In previous years, the Southside Recreational Authority sent out a limited number of invitations to key community members (see Appendix B), though after reviewing the invitation our group concluded that it was not an effective advertising tool. The invitation was printed on standard copy paper with limited visuals and excessive text making it difficult to digest and retain the important information. Our group decided to update this invitation, to make it more visually appealing and easier to read. We decided to create a postcard invitation, taking inspiration from other local event postcards (see Appendix B). The front of the postcard utilizes several photos from the RPA Natural Area taken by Michael Kinney and stills from Diana Lehr's film in a classic retro style in a callback to the park's history as a community gathering space (see Appendix H). The back of the postcard includes relevant information like date, time, and location, as well as a brief description of the event. This postcard can be sent to the same key individuals the invitations were sent to in previous years, as well as other past attendees and community members.

Following the same design concept as the postcard, our group also created a draft social media post with the key information about the event to be posted on platforms such as Facebook by our community partners as it gets closer to the event (see Appendix H). These social media posts will be vital in drawing a larger attendance to Fireflies at RPA Natural Area, as we believe the majority of our survey responses came from the Facebook group posts.

General Event Logistics

During preliminary conversations with our community partners, it was brought to our attention that the planned scaling-up of the event for this year would require significant changes to previous operations. Most notably, we were asked to develop an alternative indoor location for the screen filming, as the equipment shed used in the past had capacity limitations and was not properly ventilated for the summer months, making the space extremely hot and uncomfortable for visitors.

However, after speaking with our community partners about time and resource limitations, we settled on keeping the event in the same indoor location as it had been in previous years. The 2024 expected visitor turnout will not be as large as they initially had hoped because of factors including the equipment shed capacity, volunteer ability, and funding. Instead of a different film viewing space, to make the previous location more comfortable we decided to purchase two swamp coolers which work with water and ice to reduce air temperature in a large facility. The coolers were purchased using funds approved for our project by the Environmental Studies and Sciences Department at Bucknell. On the day of the event itself, our community partners will purchase bags of ice to place in the swamp coolers to cool the building down.

In addition to the facility, our community partners expressed a need for a high-luminosity projector to showcase the firefly film. The requirements are above 10,000 lumens. Our group researched local rentals for a projector of this capability and found a facility an hour and a half away that rents many different types of projectors. The funds for the projector will be purchased using either a program partners' budget or the DEP grant.

With the event having already been developed and run for two years before our involvement, our impact in this category was limited. Besides the indoor location, modifications for viewer comfort, and the projector rental, no other event logistic considerations were needed for our project.

Future Work

Given that our involvement in this project has concluded before the event happens, the majority of our work is planning logistics and events that occur after we leave. The work that we didn't have time to get to during our semester falls into three categories. The categories include the post-event survey, physical site upgrades, and an increase in the social media and online presence of the Robert Porter Allen Natural Area.

The post-event survey is the most important piece of unfinished work that our group will be handing off to our community partners. Fireflies at RPA Natural Area will take place on Thursday, July 11th, 2024, so hopefully our partners will be able to administer a short survey to event guests as they exit. Before the event is held, our community partners will send out an email to the chair of the Bucknell IRB board to approve our post-event survey with similar

demographic questions as our pre-event survey. The work on this survey is complete and we've shared it with our community partner, so the only work needed on their end is to distribute the survey and then analyze the results once they come in. Understandably, these are the more labor-intensive aspects of creating a survey so analyzing the data might take more time.

In regards to the future work needed on the site, our group noted many upgrades and considerations to improve the natural area that could not be completed during our semester. The first aspect we thought could be improved was the location of where the Firefly documentary was shown during the event. In the past, the documentary was shown in an old barn that had been repainted white on one wall and windows covered to reduce light infiltration into the building. Before our site walk, we heard from our community partner Professor Barnhart that there was talk about making a building that acts as an educational and community space shared between the natural area and another park in South Williamsport. This building would be an ideal place in the future to show the firefly film as the event gets scaled up. Unfortunately, the building has not been created but we suggest making a room large enough to hold about 50 people as well as the possibility of building a projector into the building plans. Along with the building, we think making the entrance to the site more welcoming will attract more visitors. Considerations could be adding permeable pavement to make the entry more accessible while still reducing the risk of run-off into the river. In addition to the permeable pavement, adding benches, drinking water fountains, trash cans, portable restrooms, dog bags, welcome signs, and trail maps for visitors to the site would make the entire area more accessible. Our group understands these additions all cost money, but to become a more welcoming trail for all people, they could be beneficial. Our last physical addition to the site we have considered are extra signs warning people of the active train tracks, common ticks in the area, and signs marking the location of bird and bat boxes throughout the path of the walking tour.

The final future work that could be done for the natural area is updating the online presence. The Robert Porter Allen Natural Area recently created a user-friendly website that includes helpful information about the site, but the only way to get to the site is through a link on their Facebook Page. Listing the website so that it can be found by a Google Search will be a beneficial step in creating an accessible natural area. Along with that, the trail map of the RPA Natural Area is not posted on any hiking websites or the general Facebook page. This can cause first-time visitors to be unsure of how to get around and what the conditions are of the trail. Posting the trail map online and on a website like Alltrails or TrailLink would be another important way to ensure the accessibility of the site. The RPA Natural Area Facebook Page could post more images of the site at all seasons and tell people about the current conditions of the natural area. Overall increasing the online and social media presence would be helpful.

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Appendices

Appendix A. Site Map

Figure 1: Architecture Plans for Robert Porter Allen Natural Area (Brian S. Auman)



Appendix B. Reference Materials

Figure 1: Children’s Informational Firefly Pamphlet, used during the 2022 event

Shortcuts
by Jeff Harris

Shedding Some Light On
Fireflies

This cartoon is a fly-by-night operation.

Light created by a firefly is called "bioluminescent" light. Bioluminescent light is light that is created by a biological process in a living organism. Nearly all of the energy in a firefly's light is given off as light. In contrast, a normal light bulb only uses about 10 percent of its energy to produce light while the rest is given off mainly as heat.

Light Source

A firefly has special cells called "photocytes" located in its abdomen. The photocytes store two chemicals called "luciferin" and "luciferase." A firefly's light is created by the chemical reaction that results when these two chemicals are mixed with oxygen, magnesium and a special compound called "ATP!"

Look On The Bright Side

Fireflies use their flashing lights to attract and identify mates.

Not all species of fireflies can give off light.

The larvae and eggs of most fireflies give off light.

Fireflies are not flies. They are beetles.

The females of many species of fireflies do not have wings.

You Glow Girl!

Can you spot all six differences between these two scenes?

Word Search

Can you find the hidden words? Search carefully because some words are backward or diagonal.

LUCIFERASE FLIES HEAT
LUCIFERIN FIRE ATP
SIGNAL NIGHT FLY
BEETLE LIGHT MILK
FLASH GLOW BOB
WINGS COLD LURE
TRAVEL NROADS
OFLYSLUGGERUN
SLIUARTDLOCIF
PIPRROBAOBREE
SEATEENSWEETH
USHRFQMWPEMSO
BTHGINMITTAEH
TOSSCACHXLRAP
MOBYUSQPEITS
THGILOOBRATS

Female fireflies usually wait on the ground or in bushes until a male flashes the right signal. When she spots a male with the correct light signal, she then flashes her light to guide the male to her location.

Fireflies are found on every continent except Antarctica.

Some female fireflies use their light to lure unsuspecting male fireflies of other species to eat them.

How is a firefly like a car? They both have headlights.

Firefly larvae may live for as long as two years, but most adult fireflies live for less than 30 days.

There are more than 2,000 different species of fireflies. Each species has a specific pattern of light signals.

What do you call a book on fireflies? Light reading.

What do you say to a grumpy firefly? Lighten up.

Ready, set, glow!

How do baby fireflies learn math? With flash cards.

This edition of Shortcuts is sponsored by The Flash.

for more information on fireflies, check out these books: "Fireflies" by Cori Meister (Checkerboard Books) or "Fireflies (Early Bird Nature Books)" by Sally M. Walker (Lerner Publications). www.shortcutscomic.com Distributed by NEA, Inc. © Jeff Harris 2020 8/22

Figure 2: 2022 Fireflies at RPA Natural Area Poster



We are excited to present a unique and exciting collaboration at the intersection of art, science, nature and the land at the Robert Porter Allen Natural Area, in conjunction with Bucknell University, and visual artist Diana Lehr.

Lehr captures the remarkable, ephemeral and intricate world of fireflies in her groundbreaking video, *A Midsummer Nocturne*. She invites the viewer, via an immersive experience, to enter a world that has become invisible in many ways.

Viewers will enter a darkened barn on the preserve, where the video will be played, bearing witness to the often unnoticed world of these magical creatures.

Outside the barn, biologist, professor and firefly expert Sarah Lower of Bucknell University, will discuss, in an informal conversation, a plan for creating an optimal environment for fireflies to flourish at the Robert Porter Allen Natural Area. Along with a couple of her students, Sarah will lead a walking tour of the firefly habitat.

This special opportunity to connect with art, nature and science outside the walls of a museum, will celebrate the temporal lifespan of these winged, bioluminescent insects, whose numbers are rapidly dwindling. Underlying the power of nature, revealed in *A Midsummer Nocturne*, is a call for attention towards conservation and sustainability.

**A special thank you to artist Diana Lehr, and musician Wayne Higgins,
for debuting *A Midsummer Nocturne* at Robert Porter Allen Natural
Area and Sylvan Dell Environmental Center.**

**The Robert Porter Allen Natural Area and Sylvan Dell Environmental
Center is a growing community asset made possible by support from
and partnerships with:**

Owner / Operator - South Side Recreation Authority

Municipal Partners - Armstrong Township, Duboistown Borough,
South Williamsport Borough

Funding Partners -

PennVEST
PA Department of Conservation and Natural Resources
Lycoming County - Act 13 Funding
North American Wetland Conservation Act Funding

Project Partners -

Lycoming County Commissioners
Lycoming Arts
Lycoming Audubon Society
Lycoming County Conservation District
Lycoming County Planning and Community Development
Bucknell University / Center for Sustainability & the Environment
Pennsylvania Game Commission
U.S. Fish and Wildlife
Ducks Unlimited
Susquehanna Greenway Partnership
Keystone 10 Million Trees Partnership

Community Partners -

Eizabeth Kymble, Elyse Schopfer, Tracey Tillett, Elizabeth Marcello

**This evening's event is made possible by the volunteer work of the
following Event Planning Partners:**

Diana Lehr, Video Artist
Sarah Lower, Bucknell Biology Professor
Brian Auman, Landscape Architect at BSA/LA
Jim Dunn, South Side Recreation Authority
Amie Penfield, South Side Recreation Authority
Shaunna Barnhart, Bucknell Center for Sustainability & the Environment
Debi Burch, Lycoming Arts
Judy Olinsky, Lycoming Arts
Sandy Hill, Lycoming Arts - Public ARTWORKS
Cheryl McGinnis, Arts Curator

Figure 3A: Milton Planted in Place Exhibit Postcard

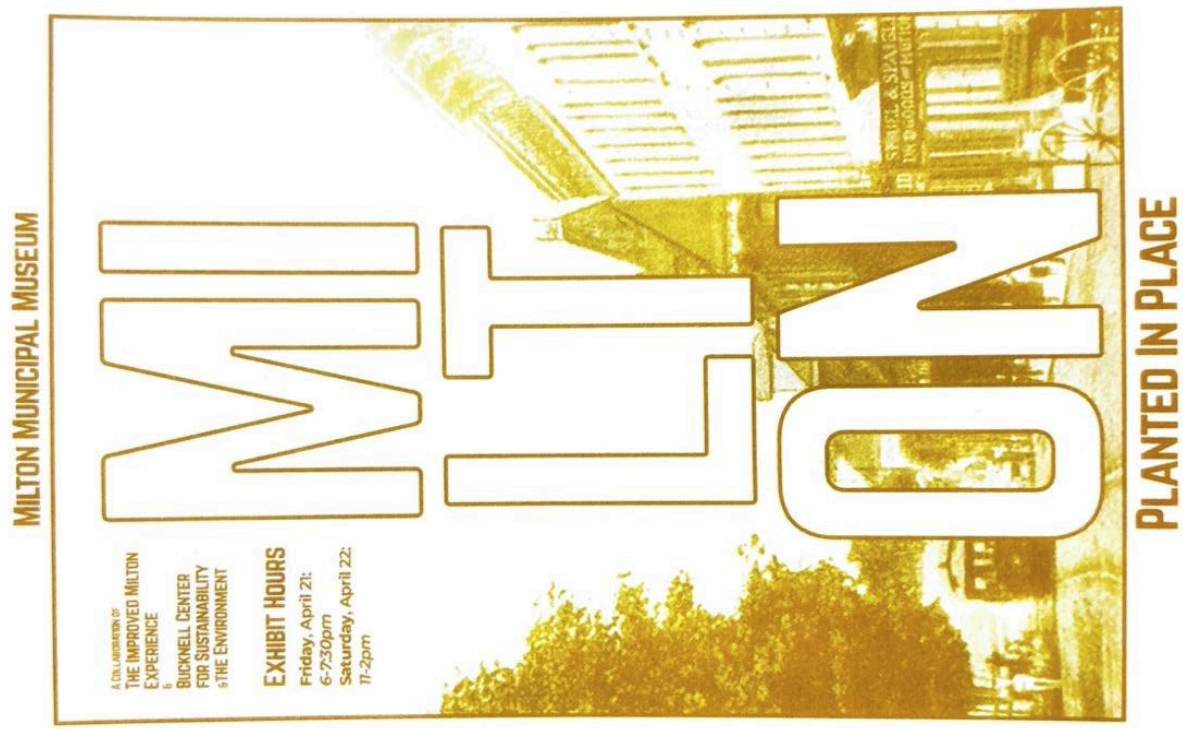


Figure 3B: Emil Kubek Project Postcard



The Emil Kubek Project is a scholarly resource that tells the stories of Slavic & Eastern European communities in Pennsylvania's Coal Region.

The project is named in honor of Father Emil Kubek (1857-1940), a Carpatho-Rusyn immigrant who wrote the first Rusyn-language novel *Marko Šoltys* (1923) in Mahanoy City, Pennsylvania.

kubekproject.wordpress.com

The Kubek Project website includes:

- A blog about the Slavic immigrant experience
- A virtual tour of the Slavic neighborhoods of Mahanoy City, Pennsylvania
- Translations of Emil Kubek's poetry and prose about the Carpatho-Rusyns of the Coal Region

For more information, contact:

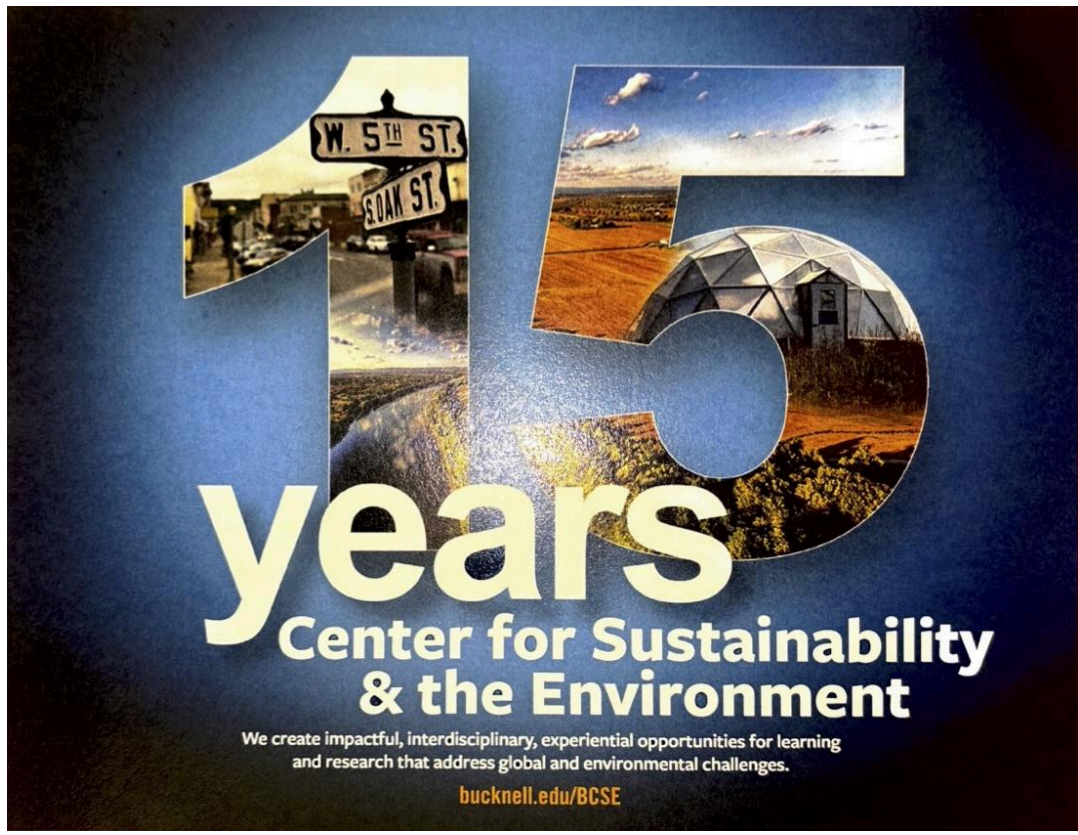
Professor Nick Kupensky
nkupensk@bucknell.edu | (203) 214-0325

Bucknell
UNIVERSITY

Sponsored by the Coal Region Field Station and
the Bucknell Center for Sustainability and the Environment

Nick Kupensky leads a walking tour of the Slavic neighborhoods of Mahanoy City.

Figure 3C: Center for Sustainability and the Environment 15 Year Anniversary Postcard



APRIL

FRI. 17 8th ANNUAL SUSTAINABILITY SYMPOSIUM: "Addressing Climate Change through the Arts, Research, and Community Action"
 > Noon-9 pm, locations vary

TUES. 21 COAL REGION FIELD STATION 5th YEAR CELEBRATION LUNCHEON
 > 11:30 am-1pm, HMH Great Room

SEPTEMBER

THURS. 10 BCSE: A RETROSPECTIVE Celebration of 15 Years
 Join Faculty and Staff for casual conversation about the creation of the Center and 15 years of great work
 > Noon-12:50 pm, HMH Great Room

BCSE TOURS
 To start at 835 Fraternity Road and covering additional on-campus locations
 > 1-4 pm

ALUMNI PANEL
 Hear from graduates who have worked closely with the Center and how it impacted their lives and careers
 > 4-5 pm, HMH Great Room

BBQ CELEBRATION
 Food and Fun
 > 5-7 pm, Science Quad

OCTOBER

WED. 7 OPEN HOUSE
 Learn how you can become more involved with the BCSE
 > 3-5 pm, 835 Fraternity Road

NOVEMBER

FRI. 6 15th ANNUAL RIVER SYMPOSIUM
SAT. 7 > Elaine Langone Center

Figure 4A: Photo from *A Midsummer Nocturne* (Diana Lehr)



Figure 4B: Photo from *A Midsummer Nocturne* (Diana Lehr)



Figure 4C: Photo from *A Midsummer Nocturne* (Diana Lehr)



Figure 4D: Photo from *A Midsummer Nocturne* (Diana Lehr)



Figure 4E: Photo from 2022 event (Michael Kinney)



Figure 4E: Photo from 2022 event (Michael Kinney)



Appendix C. DEP Grant Application

Project Proposal
Fireflies at Sylvan Dell: Art, Science, Nature, and the Land
A collaboration of Bucknell University, Robert Porter Allen Natural Area,
& Lycoming Arts

I. A complete description of the project, including the environmental education programs and activities that will be delivered during the period July 1, 2024–June 30, 2025.

This project centers on raising awareness about the importance and plight of fireflies. Globally, there are more than 2,000 species of fireflies. Pennsylvania is home to 30 species of firefly beetles. According to the Xerces Society for Invertebrate Conservation, fireflies populations are at risk due to a range of factors such as light pollution, habitat loss, and droughts, which are exacerbated by climate change. The International Union of Conservation of Nature estimates that of the 2,000 firefly species globally, at least 14% are threatened. Public education on the threats to firefly populations and how the public can participate in their conservation is an important tactic to protect the species. Through a collaboration with the Robert Porter Allen Natural Area, Bucknell University, visual artist Diana Lehr, and Lycoming Arts, this project will raise public awareness of firefly ecology and how the public can be involved in their conservation.

The Robert Porter Allen Natural Area (RPANA), established in 2021, is a 227 acre parcel being restored from farmland to meadow, wetland, and forest. It is home to the largest in-tact wetland on the west branch of the Susquehanna River. Located just south of Williamsport, an environmental justice community, RPANA has trails open to the public for recreation. Since 2018, Bucknell University through its Center for Sustainability & the Environment (BCSE) has been partnering with what is now the RPANA, also referred to as Sylvan Dell, based on shared values with regard to community sustainability, engaged learning, and civic commitment. The activities supported by this arrangement are mutually supportive of the missions of the two groups. The evolving collaboration between BCSE and Sylvan Dell seeks to create opportunities for Bucknell faculty, students, and staff to collaborate with community partners to support the growth and development of a park and nature center. Our collaboration aims to provide quality educational and research opportunities, while serving the needs of Sylvan Dell, the RPANA authority and the community.

The proposed series of firefly education events fits well within this partnership. To date, we have hosted two annual firefly events (in 2022 and 2023) with visual artist Diana Lehr and biologist Sarah Lower. It is a unique and exciting collaboration at the intersection of art, science, nature and the land hosted at the Robert Porter Allen Natural Area. Lehr captures the remarkable, ephemeral and intricate world of fireflies in her inspirational video, *A Midsummer Nocturne*. She invites the viewer, via an immersive experience, to enter a world that is often unnoticed.

Viewers enter a darkened barn on the preserve where biologist, professor and firefly expert Sarah Lower of Bucknell University, discusses, in an informal conversation, a plan for creating an optimal environment for fireflies to flourish at the Sylvan Dell preserve. After Dr. Lower's talk, *A Midsummer Nocturne* is screened. This inspiring video allows the audience to bear witness to the increasingly overlooked world of these magical creatures.

1

Afterwards Dr. Lower and student research volunteers lead a walking tour of the firefly habitat and collect citizen science data on the firefly population that is reported to Mass Audubon Citizen Science project to collect firefly population data through their Firefly Watch program. The event is a special opportunity to connect with art, nature and science outside the walls of a museum and celebrates the temporal lifespan of these winged, bioluminescent insects, whose numbers are rapidly dwindling. Underlying the power of nature, revealed in *A Midsummer Nocturne*, is a call for attention towards conservation and sustainability.

In 2023, we expanded the program offerings and included Art2Go firefly kids craft that were provided by Lycoming Arts. We also had volunteer assistance from Americorps Seniors who were on site to help with logistics, parking, and crowd control.

For this DEP EE grant, we will build on this program outlined above and fund 5 public engagements across three categories:

1. The Firefly Event Walk and Talk. We will host it for the third year, but add more hands on art for kids with the Art2Go program and intentionally try to reach a broader audience for the event. For the first two years, we intentionally tried to keep it small to test out the event idea and structure to slowly build capacity towards a larger annual event. We will collect firefly observation data using citizen science and report it to the Firefly Watch program of Mass Audubon. As a new addition, we will have take-home materials available on how individuals can make or conserve firefly habitat.
2. We will add in three additional opportunities for hands-on science education through art for children in partnership with Lycoming Arts. This will include art workshops later in the summer 2024 and in late spring 2025 with Lycoming Arts. Additionally, we will table at a First Friday event in Williamsport to distribute information on fireflies and Art2Go kits to reach more people. Williamsport's First Friday is a monthly event hosted by Lycoming Arts with the summer sessions held outdoors in downtown Williamsport. This event draws hundreds of participants each first Friday in the summer months.
3. We will also create interpretive nature trail signs on fireflies to be unveiled in June 2025 at a public event.

Our goal is to both expand firefly conservation awareness through the events and to create legacy education materials, such as interpretative signs, bookmarks, and magnets, that will continue to educate the public after the conclusion of the grant year. We will also leverage existing educational information from organizations that focus on firefly conservation, such as the Pennsylvania Firefly Festival.

2. The name of the Applying Organization and the Title of the project. Bucknell University.

Fireflies at Sylvan Dell: Art, Science, Nature, and the Land

3. The credentials of the applying organization specific to implementing the project. Include an example of past successes delivering similar projects.

Bucknell University has both staff and institutional capacity to implement and manage the

project. The project is being applied for through Bucknell's Center for Sustainability & the

2

Environment (BCSE), which is currently partnering with organizations in Shamokin on a series of Resiliency Workshops funded through DEP EE. Since 2005, the BCSE through its three signature programs (Place Studies, Sustainable Technology, and Watershed Sciences and Engineering) has engaged in teaching, research, and outreach related to key sustainability and environment concerns and priorities in central Pennsylvania. This includes grant-funded initiatives. The Center manages a network of 18 collaborative field sites for teaching and research, one of which is the Robert Porter Allen Natural Area at Sylvan Dell. The Place Studies program is the main program managing the proposed project for the grant. The program director has extensive experience working with collaborations of faculty, students, and community partners on public facing projects, such as the recent *Milton: Planted in Place* exhibit and event which brought together history and ecology into one public exhibit with the involvement of over 70 students and two non-profit partners. Opening weekend brought in more than 160 members of the public.

4. The credentials of the key people, including the Project Leader, supporting staff, and partners, who will be implementing the project. Include subcontractors, if known (see Subcontractors, page 19). Include an example of past successes delivering similar projects.

1. **Project Leader: Shaunna Barnhart, PhD**, Place Studies Program Director, Bucknell Center for Sustainability & the Environment. As Place Studies Program Director since 2015, Dr. Barnhart works with a number of collaborative networks on projects that address areas such as: Climate and environmental action, Community revitalization, Environmental justice and community planning, Human dimensions of renewable energy systems, and Place-making and sustainability. As part of this, she manages relationships and research with three field sites, including the Robert Porter Allen Natural Area. Collaborative projects include faculty, students, staff and Bucknell as well as non profits, K-12 schools, libraries, and local, state, and federal governments and agencies.
2. **Partners: Robert Porter Allen Natural Area** - Every year, Robert Porter Allen Natural Area hosts several public outreach events that reach at least 50 people. These events include firefly education nights, natural resource inventories for moths and plants, Ten Million Tree Partnership plantings, Audubon Field Trips, and E-bird surveys. These events bring awareness to the ongoing restoration of 50 acres of wetland habitat in the park. Funding was secured through the only Standard NAWCA Grant ever awarded in Pennsylvania, in a partnership with Ducks Unlimited, PA. Game Commission and Western Pa Conservancy.
3. **Partners: Lycoming Arts** - Founded in 1960, Lycoming Arts believes that by connecting our community through partnerships and shared vision Arts thrive, the collective quality of life prospers and a place is created where people passionately want to live. Lycoming Arts is a founding member of Williamsport First Friday, a monthly event that has continued to grow and now brings in nearly 100 vendors in the summer months drawing hundreds of attendees. The event showcases artists and includes an Art2Go program for kids.
4. **Partners: Sarah Lower, PhD** - Dr. Lower is a biologist and internationally known firefly expert. She is a Director of the Pennsylvania Firefly Festival, a 501c3 non-profit focused

on public firefly education. She works to further firefly education for the general public and make scholarship, awareness, and conservation on firefly beetles accessible and public facing.

3

- 5. Partners: Diana Lehr** - Diana Lehr is a visual artist. She is a multi disciplinary artist who is known for her paintings, video installations and work with light. Lehr's work has been exhibited in galleries, alternative spaces, film festivals and museums across the US. In 2017 a clip from her video, *Midsummer Night's Dream*, went viral on multiple platforms - it was aired/posted around the world by media outlets such as ABC News, The Telegraph UK, The Australian, Biogua TV, and others, garnering upwards of 100 million views. In July 2022 her video, *A Midsummer Nocturne*, was exhibited in conjunction with Bucknell University as part of a special collaboration with Lehr.

5. EE Grant Program priorities: Describe the Climate Change and/or Water environmental education content that will be delivered. Include activities and anticipated outcomes. Note: If engaging Environmental Justice audience(s), be sure to complete question 3 on the application Addendum, specifying the city/town and zip code for each EJ area location.

Climate Change: Firefly populations are threatened by a range of risks, one of which is climate change. The primary risk from climate change is the threat of drought and changing precipitation patterns. Fireflies prefer moist soils for laying eggs. Firefly larvae can spend up to two years in the soil, thus their lifecycle can be greatly disrupted by drought that impacts soil moisture. One way to mitigate against this is to provide water features or to create more natural habitat with plants that help to retain soil moisture (rather than a manicured lawn, for example). Activities will include the walk and talk and the kids art workshops that bring this science to life through discussion and art activities. An anticipated outcome is that participants will understand how climate change impacts a familiar species and what they can do to support firefly conservation that counters this climate change induced risk.

Environmental Justice Area: The Robert Porter Allen Natural Area, at 1724 Sylvan Dell Road in South Williamsport, is in an Environmental Justice Area. The target audience is an environmental justice community - both Williamsport and South Williamsport are classified as such by the state. The natural area is home to the largest in-tact wetland (even in its reduced state) on the West Branch of the Susquehanna. By restoring this area to meadow, forest, and expanding the wetland, residents of Williamsport have ready access to a nearby natural area with long term visions of connecting it to the existing network of trails and riverwalks in the area to increase its accessibility from the City. As an EJ area impacted by the legacy of industrial land use, (indeed, there is a carve out in the natural area with legacy oil storage tanks for the region which is not part of the natural area authority) access to natural areas - and converting land use back to natural areas - has positive impact for both human and environmental health. By connecting climate change to local ecology and its impact on a beloved species, this program will demonstrate the importance of conserving and expanding firefly habitat and provide education and tools for residents to have an active role in these issues. By having children's programs that teach science through art at First Friday and at the in-city studio, we will also

reach residents in the city raising awareness about the plight of fireflies and what individuals can do to support their conservation.

6. Specify the Grant track:

Mini grant, up to \$5,000

4

7. Explain the project audience(s) and your strategy to ensure their participation. Include information such as established relationships that the applying organization or its partners have with the audience(s). Consider both Primary and Secondary audiences. Primary audience(s) are people who will be reached directly by the project. Secondary audience(s) are people who will be reached indirectly by the project.

The project is designed to engage the general public - adults and children - in firefly conservation. Partnerships between the Robert Porter Allen Natural Area, Bucknell University, Visual Artist Diana Lehr, and Lycoming Arts have resulted in two annual firefly events to date. These events demonstrate that there is public interest in fireflies and people are willing to come out late on a summer evening to experience firefly-inspired art and participate in a firefly walk. Lycoming Arts is a well-respected community organization, having a presence in Williamsport since 1960. Their communications reach thousands of area residents, as do their Williamsport First Friday events. This grant will allow us to expand the offerings of the annual Firefly event, add in additional outreach to youth through summer art workshops and Art2Go at Williamsport First Friday, and create permanent interpretive signage about fireflies at the site.

The primary audience will be those who attend the July 2024 firefly walk, the children's art workshops in summer 2024 and late spring 2025, those who interact with our table at a First Friday Event, and the signage unveiling in June 2025. The secondary audience will be the families and friends of the children who participate in the art workshops and the users of the Robert Porter Allen Natural Area trails who read the interpretive signage on fireflies. Additional secondary audiences will be those who read about the event and its goals in local newspapers and social media as well as friends and families of attendees who will be encouraged to share their knowledge.

8. The type of project (Formal PreK-12/Higher Education curriculum and/or Non-Formal education).

Non-Formal education

9. The audience behavior change(s) and project assessment:

The project will result in two audience behavior changes. First, an increased awareness about the threats to fireflies and more knowledge on their biology and habitats. Second, demonstrating a willingness to take action to further firefly conservation, such as through committing to reduce light pollution and protect or enhance firefly habitat.

• Describe the assessment tool/strategy that will be developed to measure the audience's behavior change(s).

During the biologist's presentation, audience members will be asked to show hands at various

points in response to questions about firefly biology and habitat. Printed materials with things people can do to help fireflies will be provided to attendees. Attendees will be asked which of the measures they are willing to commit to in their own practices. For the children's art workshops, short presentations will be given and the children asked pre- and post- questions on their firefly knowledge.

5

10. A plan to present the project to an external entity (not the project audience) at a conference, meeting or other appropriate event. General Grants present at regional or statewide events. Mini Grants may present at local venues.

We will identify local conference opportunities for project partners to attend and share the project outcomes. This could be at Bucknell's annual Sustainability Symposium, the Middle States conference of the American Association of Geographers, or perhaps with the Sustainable PA annual conference. The goal will be to ensure a broad reach that can include municipal, general, and academic audiences.

11. Use of technology social media, web-based applications, and/or other appropriate technological tools and resources.

Social media will be used to advertise the events.

12. A plan to sustain the project after grant funds end.

Our partnership has hosted two Firefly Events as a pilot, first in 2022 with about 30 attendees as invitation-only, and again in 2023 with about 45 attendees open to the public. These events were more modest in scope with the showing of *A Midsummer Nocture* followed by a firefly walk. In 2023, we added in Art2Go kits for kids with Lycoming Arts. This grant will allow us to expand programming. After the grant, partnerships with Robert Porter Allen Natural Area and Bucknell University will continue as we maintain a "field station" relationship. This relationship allows classes and researchers to access the Natural Area for research and scholarship, but also ensures that we continue to find creative collaborations that further public engagement. The Bucknell Center for Sustainability & Environment manages a network of 18 different field sites, and thus has experience in prolonged and deep place-based collaborations. With this history, we will continue collaborations to ensure that firefly education continues at the site.

Additionally, this grant will allow all partners - Robert Porter Allen Natural Area, Bucknell's Center for Sustainability & the Environment, and Lycoming Arts to deepen their collaborations. Plans are already in discussion for how the science and art outreach for kids can continue with Lycoming Arts with additional and different workshops and activities planned for 2025 and beyond. This grant will allow us to pilot some different types of interactive sessions in different venues (on-site, at Williamsport First Friday, and in-studio) that will inform how the science and art outreach can progress going forward.

Appendix D. Timeline

Sylvan Dell Group Timeline

March 4th through 8th

- Finalize survey pre-event survey questions
- Submit IRB proposal
- Final Project Design Report due
- Site walkthrough
- Ibiyinka Alao Firefly Lunch Firefly Talk

Key:
Research
Educational Materials
Promotion
Event Logistics
Course

SPRING BREAK

March 18th through 22nd

- Finalize poster design for physical survey distribution
- Print and distribute both poster design and physical survey to library
- Contact local library for survey distribution
- Site visit with Shaunna
- Draft Interim Report due
- Interim report presentation
- Release pre-event survey to the community
- Reach out to facebook groups for survey distribution

March 25th through 29th

- Contact local newspaper for survey distribution
- Final Interim Report due
- Reach out to Debi Birch regarding arts and crafts activity
- Reach out to Sarah Lower regarding educational materials
- Meet with Sarah Lower regarding educational materials

April 1st through 5th

- Discuss/plan other event logistics
- Complete rough draft of trail signs and trail pamphlet (PDF)
- Meet with Debi Birch regarding arts and crafts activity

April 8th through 12th

- Send PDF of trail pamphlet/ trail signs to Shaunna Barnhart before meeting
- Draft post-event survey questions
- Draft the postcard invitation
- Finalize event logistics

April 15th through 19th

- Finalize postcard invitation
- Finalize trail signs and trail pamphlet (PDF)
- Send PDF of trail pamphlet/ trail signs to Sarah Lower before meeting
- Do research on projector types
- Reach out to secure a projector for the event
- DEP grant decision released
- Get results from pre-event survey from the community
- Go to the Williamsport library to pick up the survey
- Finalize post-event survey to release
- Create draft post-event survey social media posts and posters
- Final Project Report Draft Due Friday April 19th 5 PM
- Draft Final Presentation April 19th 1 PM

April 22nd through 26th

- Post trail signs and trail pamphlet to RPANA website
- Compile our survey results in a database for future research/groups
- Finalize post-event survey social media posts and posters for publishing after the event
- Final Presentation Shared by April 26th 10 AM
- Final Presentation on April 26th 1 PM

During Exam Week

- Final Project Report Due by May 8th

END OF SEMESTER

Appendix E. Site Visit

Figure 1A: Photo of Bifurcated Path (from site visit on 03/04/2024)



Figure 1B: Photo of Sign (from site visit on 03/04/2024)



Figure 2A: Photo of Indoor Event Location (from site visit on 03/22/2024)



Figure 2B: Photo of Overhang at Event Location (from site visit on 03/22/2024)



Figure 2C: Photo of Unspecified Species of Bird Box (from site visit on 03/22/2024)



Figure 2B: Photo of Unlabeled Bat Box (from site visit on 03/22/2024)



Appendix F. Survey Material

Figure 1: Pre-Event Survey

3/3/24, 8:43 PM

Firefly Survey

Firefly Survey

You are invited to participate in a research study to gather information about public knowledge of fireflies. The data collected will be presented to the Robert Porter Allen Natural Area organization to help develop educational materials and events focused on firefly conservation.

Please answer these questions independently. Please refrain from using outside sources to answer the survey questions. This survey will take approximately 10 minutes to complete. There are no risks anticipated for participating in this study. All responses will be kept anonymous. Your name and identifying information are not asked or collected in this survey, and no identifying information will be disclosed in any reports or publications resulting from this study. Only researchers involved in this project will see the data, which are anonymized.

Participation in this survey is entirely voluntary, and you may choose to withdraw from the survey at any time without penalty. If you decide to withdraw, simply close the survey window and your responses will not be recorded.

This survey is being implemented by Bucknell students Olivia Bush, Sofia Gordon, Sydney Shea, and Nick Wiebke. If you have any questions or concerns about this study, you may contact the Principal Investigator, Sydney Shea, by email at sms072@bucknell.edu or Prof. Amanda Wooden at aw021@bucknell.edu. General questions or concerns about the rights of human subjects of research may be directed to the chair of the Institutional Review Board at Bucknell: Eric Kennedy, at 570-577-2013 or irbchair@bucknell.edu. This study was approved by the Bucknell University IRB on _____, Proposal # _____

* Indicates required question

1. By clicking 'Agree' below, I affirm that I am 18 years of age or older

Mark only one oval.

Agree

Disagree

Firefly Survey

3/3/24, 8:43 PM

Firefly Survey

2. As a child, how frequently did you spend time outdoors? *

Mark only one oval.

- Never
- Rarely
- Occasionally
- A moderate amount
- A great deal

3. How many hours per week do you currently spend outdoors? *

Mark only one oval.

- Less than 1 hour
- 1 to 3 hours
- 3 to 5 hours
- 5 or more hours

4. Currently, are you satisfied with the amount of time you spend outdoors? *

Mark only one oval.

- Very dissatisfied
- Dissatisfied
- Unsure
- Satisfied
- Very satisfied

3/3/24, 8:43 PM

Firefly Survey

5. Rate your access to outdoor spaces/outdoor recreation sites. *

Mark only one oval.

- Poor access
- Fair access
- Good access
- Very good access
- Excellent access

6. Have you heard of or been to the Robert Porter Allen Natural Area? *

Mark only one oval.

- Yes, I have heard of it and have been
- Yes, I have heard of it, but have not been
- No, I have not heard of it and have not been

7. When you were a child, did you catch fireflies? *

Mark only one oval.

- Yes
- No

3/3/24, 8:43 PM

Firefly Survey

8. What are the leading causes of the decline in firefly populations? *

Mark only one oval.

- Habitat loss
- Water pollution
- Pesticide use
- Light Pollution
- All of the above
- None of the above

9. What is the name of the chemical reaction that allows fireflies to produce light? *

Mark only one oval.

- Bioluminescence
- Glowing
- Switching
- Luciferin

10. What habitat do fireflies generally inhabit? *

Mark only one oval.

- Grassy areas
- Treelines
- The ground
- Both A and B are correct
- All of the above

3/3/24, 8:43 PM

Firefly Survey

11. How would you rate your knowledge of the following aspects of fireflies? *

Mark only one oval per row.

	Poor	Fair	Good	Very good	Excellent
General firefly biology	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Why fireflies light up	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Variety of firefly species	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Suitable firefly habitats	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Threats to firefly populations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

12. Have you noticed a change in the firefly population in your local area? *

Mark only one oval.

- Yes, I have noticed an increase in firefly populations
- Yes, I have noticed a decrease in firefly populations
- No, I have not noticed a change in firefly populations

13. Have you attended and/or are you interested in attending a Firefly Event at the Robert Porter Allen Natural Area in July? *

Mark only one oval.

- Yes, I have gone before and I'm interested in attending again
- Yes, I have gone before, but I'm not interested in attending again
- No, I have not attended before, but I'm interested in attending
- No, I have not attended before and I'm not interested in attending
- No, I have not attended this event, but I've been to similar Firefly Events

Demographic Questions

14. What town you currently live in?

15. How long have you lived in the Williamsport area?

Mark only one oval.

- 0-5 years
- 6-10 years
- 11-15 years
- 15+ years
- I do not live in the Williamsport area

16. What is your age?

3/3/24, 8:43 PM

Firefly Survey

17. What is your race?

Mark only one oval.

- White
- Black or African American
- Hispanic or Latino
- Asian
- Native American or Alaska Native
- Native Hawaiian or Pacific Islander
- Other: _____

18. What is your gender identity?

Mark only one oval.

- Male
- Female
- Non-binary
- Other: _____

This content is neither created nor endorsed by Google.

Google Forms

Figure 2: Likert-Type Scale Response Anchors (Vagias 2006)

Likert-Type Scale Response Anchors

Citation:

Vagias, Wade M. (2006). *Likert-type scale response anchors*. Clemson International Institute for Tourism & Research Development, Department of Parks, Recreation and Tourism Management. Clemson University.

Level of Acceptability

- 1 – Totally unacceptable
- 2 – Unacceptable
- 3 – Slightly unacceptable
- 4 – Neutral
- 5 – Slightly acceptable
- 6 – Acceptable
- 7 – Perfectly Acceptable

Level of Appropriateness

- 1 – Absolutely inappropriate
- 2 – Inappropriate
- 3 – Slightly inappropriate
- 4 – Neutral
- 5 – Slightly appropriate
- 6 – Appropriate
- 7 – Absolutely appropriate

Level of Importance

- 1 – Not at all important
- 2 – Low importance
- 3 – Slightly important
- 4 – Neutral
- 5 – Moderately important
- 6 – Very important
- 7 – Extremely important

Level of Agreement

- 1 – Strongly disagree
- 2 – Disagree
- 3 – Somewhat disagree
- 4 – Neither agree or disagree
- 5 – Somewhat agree
- 6 – Agree
- 7 – Strongly agree

Knowledge of Action

- 1 – Never true
- 2 – Rarely true
- 3 – Sometimes but infrequently true
- 4 – Neutral
- 5 – Sometimes true
- 6 – Usually true
- 7 – Always true

Reflect Me?

- 1 – Very untrue of me
- 2 – Untrue of me
- 3 – Somewhat untrue of me
- 4 – Neutral
- 5 – Somewhat true of me
- 6 – True of me
- 7 – Very true of me

My beliefs

- 1 – Very untrue of what I believe
- 2 – Untrue of what I believe
- 3 – Somewhat untrue of what I believe
- 4 – Neutral
- 5 – Somewhat true of what I believe
- 6 – True of what I believe
- 7 – Very true of what I believe

Priority:

- 1 – Not a priority
- 2 – Low priority
- 3 – Somewhat priority
- 4 – Neutral
- 5 – Moderate Priority
- 6 – High priority
- 7 – Essential priority

Level of Concern

- 1 – not at all concerned
- 2 – Slightly concerned
- 3 – Somewhat concerned
- 4 – Moderately concerned
- 5 – Extremely concerned

Priority Level

- 1 – Not a priority
- 2 – Low priority
- 3 – Medium priority
- 4 – High priority
- 5 – Essential

Level of Problem

- 1 – Not at all a problem
- 2 – Minor problem
- 3 – Moderate problem
- 4 – Serious problem

Affect on X

- 1 – No affect
- 2 – Minor affect
- 3 – Neutral
- 4 – Moderate affect
- 5 – Major affect

Level of Consideration

- 1 – Would not consider
- 2 – Might or might not consider
- 3 – Definitely consider

Level of Support/Opposition

- 1 – Strongly oppose
- 2 – Somewhat oppose
- 3 – neutral
- 4 – Somewhat favor
- 5 – Strongly favor

Level of Probability

- 1 – Not probable
- 2 – Somewhat improbable
- 3 – Neutral
- 4 – Somewhat probable
- 5 – Very probable

Level of Agreement

- 1 – Strongly disagree
- 2 – Disagree
- 3 – Neither agree or disagree
- 4 – Agree
- 5 – Strongly agree

Level of Desirability

- 1 – Very undesirable
- 2 – Undesirable
- 3 – neutral
- 4 – Desirable
- 5 – Very desirable

Level of Participation

- 1 – No, and not considered
- 2 – No, but considered
- 3 – Yes

Frequency – 5 point

- 1 – Never
- 2 – Rarely
- 3 – Sometimes
- 4 – Often
- 5 – Always

Frequency

- 1 – Never
- 2 – Rarely
- 3 – Occasionally
- 4 – A moderate amount
- 5 – A great deal

Frequency of Use

- 1 – Never
- 2 – Almost never
- 3 – Occasionally/Sometimes
- 4 – Almost every time
- 5 – Every time

Frequency – 7 point

- 1 – Never
- 2 – Rarely, in less than 10% of the chances when I could have
- 3 – Occasionally, in about 30% of the chances when I could have
- 4 – Sometimes, in about 50% of the chances when I could have
- 5 – Frequently, in about 70% of the chances when I could have
- 6 – Usually, in about 90% of the chances I could have.
- 7 – Every time

Amount of Use

- 1 – Never use
- 2 – Almost never
- 3 – Occasionally/Sometimes
- 4 – Almost every time
- 5 – Frequently use

Level of Familiarity

- 1 – not at all familiar
- 2 – Slightly familiar
- 3 – Somewhat familiar
- 4 – Moderately familiar
- 5 – Extremely familiar

Level of Awareness

- 1 – not at all aware
- 2 – Slightly aware
- 3 – Somewhat aware
- 4 – Moderately aware
- 5 – Extremely aware

Level of Difficulty

- 1 – Very difficult
- 2 – Difficult
- 3 – Neutral
- 4 – Easy
- 5 – Very easy

Likelihood

- 1 – Extremely unlikely
- 2 – unlikely
- 3 – Neutral
- 4 – likely
- 5 – Extremely likely

Level of Detraction

- 1 – detracted very little
- 2 –
- 3 – Neutral
- 4 –
- 5 – Detracted very much

Good / Bad

- 1 – Very negative
- 2 –
- 3 – Neutral
- 4 –
- 5 – Very positive

Barriers

- 1 – Not a barrier
- 2 – Somewhat of a barrier
- 3 – Moderate barrier
- 4 – Extreme barrier

Level of Satisfaction – 5 point

- 1 – Very dissatisfied
- 2 – dissatisfied
- 3 – unsure
- 4 – satisfied
- 5 – Very satisfied

Level of Satisfaction – 5 point

- 1 – Not at all satisfied
- 2 – slightly satisfied
- 3 – moderately satisfied
- 4 – Very satisfied
- 5 – Extremely satisfied

Level of Satisfaction – 7 point

- 1 – Completely dissatisfied
- 2 – Mostly dissatisfied
- 3 – Somewhat dissatisfied
- 4 – neither satisfied or dissatisfied
- 5 – Somewhat satisfied
- 6 – Mostly satisfied
- 7 – Completely satisfied

Level of Quality – 5 point

- 1 – Poor
- 2 – Fair
- 3 – Good
- 4 – Very good
- 5 – Excellent

Comparison of Two Products

- 1 – much worse
- 2 – somewhat worse
- 3 – about the same
- 4 – somewhat better
- 5 – much better

Level of Responsibility

- 1 – Not at all responsible
- 2 – somewhat responsible
- 3 – mostly responsible
- 4 – completely responsible

Level of Influence

- 1 – not at all influential
- 2 – slightly influential
- 3 – somewhat influential
- 4 – very influential
- 5 – extremely influential

Figure 3A: Bucknell IRB Proposal Submission

1

IRB Project Proposal Summary

Tracking Number: 2324-085
Principal Investigator: Sydney Shea
Co-PI(s): Olivia Bush, Sofia Gordon, Nick Wiebke
Research Assistants or Other Project Personnel: Shaunna Barnhart
PI Status: Student
Submitted By: sms072
Submit Time: 3/1/2024 at 13:31
Title: Sylvan Dell Firefly Pre-Event Survey
Sponsor: aw021
Department: Environmental Studies and Sciences
Address: 701 Moore Avenue, C7471
Phone: 6095290623
Email: sms072@bucknell.edu
Review Type: EXEMPT

Answers To Part I:

- 1) The research WILL NOT involve prisoners, individuals with impaired decision-making capacity, or economically or educationally disadvantaged persons.
- 2) The research WILL NOT involve subjects under the age of 18.
- 3) The research WILL NOT involve collection of information regarding sensitive aspects of the subjects' lives.
- 4) The research WILL NOT be recorded by the investigator in such a manner that the identity of the subjects can readily be ascertained either directly or through identifiers linked to the subjects.
- 5) The research WILL NOT involve either deception or incomplete disclosure of the purpose, methods, or other relevant aspects of the research.
- 6) The procedures of this research present no more than minimal risk to the subject (where minimal risk means that the probability and magnitude of harm or discomfort anticipated in the proposed research are no greater than those ordinarily encountered in daily life or during the performance of routine physical/psychological examinations or tests).

Answers To Part II:

1) Please describe in some detail the purpose of the proposed study (including, as appropriate, information about the research question and relevant hypothesis or, if the research is exploratory, what the researchers hope to learn).

We are students for ENST411 partnering with the Southside Recreation Authority and the Robert Porter Allen Natural Area. This is an exploratory survey with the purpose of gaining a better understanding of public knowledge on Fireflies in the Williamsport area, as well as understanding the impact the Sylvan Dell Firefly event may have on improving public knowledge and/or awareness of the Robert Porter Allen Natural Area.

2) Describe the proposed subject sample. If subjects under the age of 18 will participate in your research, indicate the expected age range of the samples. If your research involves a category of subjects that is vulnerable to coercion or undue influence, such as children, prisoners, individuals with impaired decision-making capacity, or economically or educationally disadvantaged persons, you must indicate clearly why the use of these subjects is scientifically necessary.

The proposed subject sample is any person aged 18 or older who lives in Williamsport and South Williamsport.

3) How will subjects be recruited and selected?

Subjects will be recruited using convenience sampling via local Facebook groups, posters around South Williamsport with QR codes, and local newspaper advertisements linking to the survey.

Describe fully the following:

4a) all research methods and procedures that will be employed in this study.

To conduct our study, we will be reaching out to varying Facebook groups who represent the South Williamsport community. We will also be putting up posters around South Williamsport where individuals can access the survey form via QR-codes. The surveys themselves will be collected through Google Forms. Additionally, we will be purchasing newspaper advertisement slots to showcase our survey in order to reach an older demographic of potential subjects. Our goal is to receive 100 completed surveys.

The survey itself will be composed of 17 questions, 5 of which collect demographic information regarding age, gender identity, race, township, and how long an individual has resided in the Williamsport area. The purpose of collecting such information is to gain an understanding of who knows what about fireflies and if there is a certain demographic that is more informed about the species from others.

The remaining 12 questions are dedicated to measuring the knowledge that individuals possess regarding fireflies, and identifying a general interest in advancing one's education on fireflies. We have devoted 3 multiple choice questions to scope the general level of knowledge individuals possess about fireflies. Each question ranges in specificity and difficulty. The first question asks for an introductory understanding of fireflies while the second question requires a little bit more knowledge to answer correctly. The third question is what we believe requires the greatest knowledge on fireflies. With that said, each of these questions ask for knowledge on broad topics. There is no scientific language or specificity about niche qualities about firefly species. The questions measure how much knowledge individuals have from paying attention to the species.

At the end of our survey period, we will begin the data analysis process. Based on the fact our survey questions produce nominal and ordinal data, we will be conducting one sample t-tests to analyze our data. Furthermore, we will then conduct correlation tests if applicable.

4b) approximately how much time each subject is expected to devote to the research.

Each subject will spend approximately 10 minutes completing this survey. We will pilot the survey prior to distribution for confirmation.

4c) how data will be collected and recorded (With or without identifiers? What instruments, materials, or equipment will be used? Will audio or videotapes be employed in data collection?). In the final step of this form, please append electronic copies of all written instruments and/or describe any apparatus with which subjects will be in direct contact.

This survey will be collected and recorded using Google Forms without any identifying information.

4d) methods for obtaining and documenting informed consent of subjects (or assent in the case of minors; for minors, please also indicate how the consent of parents or legal guardians will be obtained). In the final step of this form, append electronic copies of all materials used to obtain informed consent or assent. See resources on the IRB website and §6 of the IRB Policies & Procedures Manual for requirements and best practices for seeking subjects' informed consent.

Consent will be obtained and documented using a consent form which will be placed at the beginning of our survey

4e) any use of deception in the proposed study and justification for its use.

There is no deception used in this study.

4f) methods for preserving confidentiality (including plans for storing/disposing of audio- or visual-recordings and other data records at the conclusion of the research); see §7 of the IRB Policies & Procedures Manual for requirements.

Our survey will not collect names, email addresses, addresses, or any other identifying information.

5) Indicate any benefits that are expected to accrue to subjects as a result of their participation in the research. In the event that subjects will be paid, describe all payment arrangements, including how much subjects will be paid should they choose to withdraw from the study prior to completion of the research.

Subjects will not accrue any benefits for their participation.

6) Describe any pre-existing relationships between researcher and subjects — such as teacher–student, superintendent–principal–teacher, employer–employee — that might impact subjects' ability to participate in the research voluntarily. How will any potential for coercion be mitigated by the researchers?

There are no suspected pre-existing relationships between the researchers and subjects.

Answers To Part I (continued):

- 7) WILL NOT be conducted in established or commonly accepted educational settings and will involve normal educational practices (e.g., research on regular and special education instructional strategies, research on instructional techniques, curricula, or classroom management methods).
- 8) WILL involve survey or interview procedures, observation of public behavior (including visual or auditory recording), or educational tests (e.g., cognitive, diagnostic, aptitude, or achievement tests).
- 9) WILL NOT involve benign behavioral interventions in conjunction with the collection of information from an adult subject through verbal or written responses (including data entry) or audiovisual recording if the subject prospectively agrees to the intervention and information collection.
- 10) WILL NOT involve already existing identifiable private information that has been collected or will be collected solely for non-research purposes. This information may include documents, records, or biological specimens (including pathological or diagnostic specimens)
- 11) WILL NOT be designed to study, evaluate, improve, or otherwise examine public benefit or service programs, including procedures for obtaining benefits or services under those programs, possible changes in or alternatives to those programs or procedures, or possible changes in methods or levels of payment for benefits or services under those programs where such research is conducted or supported by a Federal department or agency, or otherwise subject to the approval of department or agency heads (or the approval of the heads of bureaus or other subordinate agencies that have been delegated authority to conduct the research and demonstration projects).
- 12) WILL NOT involve taste and food quality evaluation and consumer acceptance studies.
- 13) WILL NOT involve secondary analysis for which broad consent is required.

Figure 3B: IRB Approval

3/21/24, 7:57 PM Bucknell University Mail - IRB Research Project Approved: 2324-085

 **Mail** Sydney Shea <sms072@bucknell.edu>

IRB Research Project Approved: 2324-085

eric.kennedy@bucknell.edu <eric.kennedy@bucknell.edu> Thu, Mar 21, 2024 at 6:16 AM
 To: sms072@bucknell.edu
 Cc: aw021@bucknell.edu




IRB #: 2324-085
 Title: Sylvan Dell Firefly Pre-Event Survey
 Level of Review: EXEMPT

Dear Sydney Shea,

The IRB has reviewed the above referenced proposal and determined that it is exempt from further review under 45 CFR 46.104(d)(2).

Please keep in mind that any protocol modifications/deviations must be approved by the IRB prior to implementation, unless they reduce risk to participants. Minor modifications (e.g., changes to the subject pool, recruitment strategies, adding researchers, non-substantive changes to materials) can usually be made via email. Substantive changes to the protocol should be changed via the renewal feature of the IRB's online submission system. Otherwise, the IRB's approval of this proposal does not expire.

Good luck with your project.

Sincerely,

Eric Kennedy
 Associate Professor of Biomedical Engineering and IRB Chair
 tel. 570-577-2013 | IRB Website: <http://my.bucknell.edu/irb.html>

Figure 4: Proposed Post-Event Survey Questions

Post-Event Survey Questions

1. How did you hear about the Firefly Event at Robert Porter Allen Natural Area?
 - a. Short answer
2. How would you rate the effectiveness of communication and promotion of the event?
 - a. Likert scale
 - i. (Poor - Excellent)
3. Did you find the Robert Porter Allen Firefly event to be informative?
 - a. Yes
 - b. No
4. If so, what element of the event did you find most informative, beneficial, and engaging?
 - a. Short answer
5. If not, what element of the event did you find least informative and or unnecessary?
 - a. Short answer
6. Did you learn any new information about fireflies?
 - a. Likert scale
 - i. No, I did not learn any new information
 - ii. Yes, but I don't remember specific details
 - iii. Yes, I learned a few new facts
 - iv. Yes, I learned a lot!
7. Is there something that you hoped to learn more about on the trail walk that was not discussed?
 - a. Short answer
8. Please list one or two memorable firefly facts that you've learned from the event.
 - a. Short answer
9. What did you enjoy the most from the Robert Porter Allen Firefly Event?
 - a. Short answer
10. Were there aspects of the event that you believe can be improved? If so, what?
 - a. Short answer
11. How would you rate your knowledge of fireflies now?
 - a. Likert scale
12. How did you hear about this survey?
 - a. Social Media (Facebook, Instagram, etc.)
 - b. Local flyers
 - c. A friend/family member
13. Please share any additional comments or feedback you have about your experience at the Firefly event.
 - a. Short answer

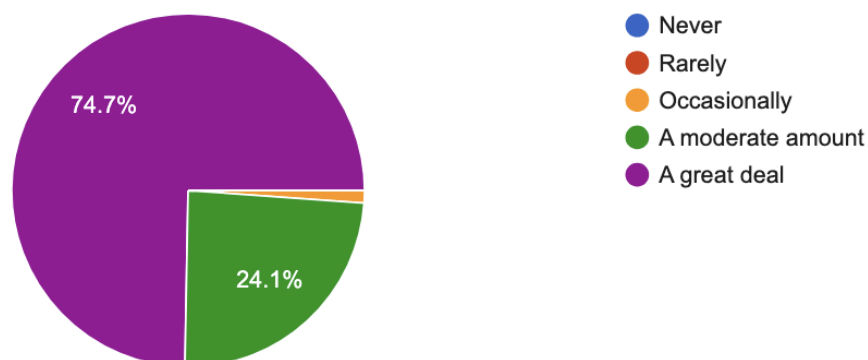
Appendix G. Pre-Event Survey Results

Discussion and Description of Survey Results (both quantitative and qualitative data):

Results from questions concerning outdoor exposure:

As a child, how frequently did you spend time outdoors?

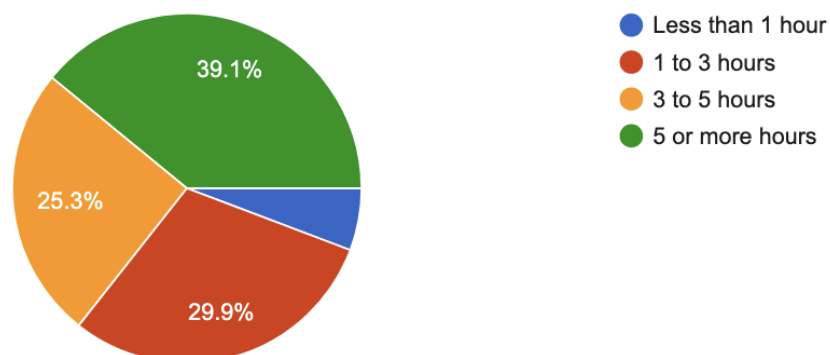
87 responses



The first question of our survey asked participants “As a child, how frequently did you spend time outdoors?”. Out of 87 responses, **74.7%** (65 respondents) expressed “a great deal”, **24.1%** (21 respondents) expressed “a moderate amount”, and **1.1%** (1 respondent) said “occasionally”. Out of 87 responses, there was no individual who said they rarely or never spent time outdoors as a child.

How many hours per week do you currently spend outdoors?

87 responses

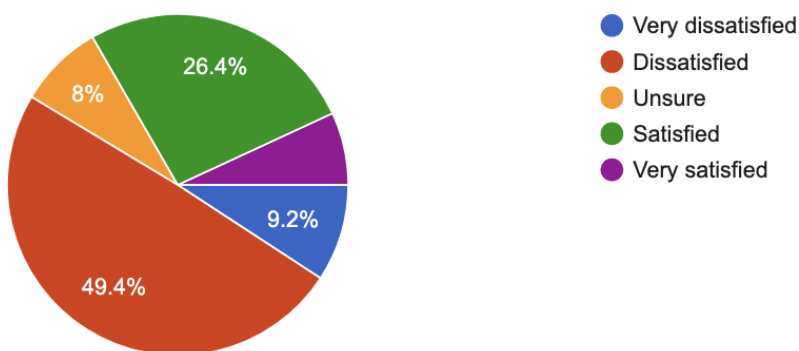


The second question of our survey asked for an average of how many hours per week does an individual spend outdoors at this point in their lives. **39%** of participants (**34 out of the**

87 respondents) said they spend 5 or more hours outdoors per week. **25.3%** of participants (**22 out of the 87 respondents**) said they spend 3 to 5 hours outdoors per week. **29.9%** of participants (**26 out of the 87 respondents**) said that they spend 1-3 hours outdoors per week. **5.7%** of respondents (**5 out of 87 respondents**) said they spend less than 1 hour outdoors per week.

Currently, how satisfied are you with the amount of time you spend outdoors?

87 responses



We then asked how satisfied participants were with the amount of time they were spending outdoors. **9.2%** of participants (**8 out of 87 respondents**) expressed that they were very dissatisfied. **49.4%** of participants (**43 out of 87 respondents**) expressed that they were dissatisfied. **8%** of participants (**7 out of 87 respondents**) said that they were unsure how they felt. **26.4%** of participants (**23 out of 87 respondents**) expressed that they were satisfied, and **6.9%** of participants (**6 out of 87 respondents**) expressed that they were very satisfied.

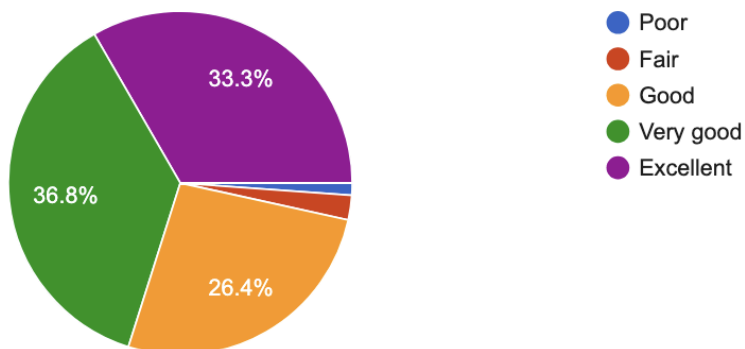
This question was followed by a short answer question that asked participants to explain why they are satisfied or dissatisfied with the amount of time they spend outdoors. Out of the 87 participants who responded to the previous question, 69 of these participants chose to elaborate. To measure the qualitative data that we collected from the short answer questions, we created categories that represented answers with similar reasoning. To interpret the data for the question “Please elaborate on your satisfaction or dissatisfaction with your outdoor time”, we distinguished reasoning by: Work/Busy Schedule, Natural Elements (weather, bugs, etc.), Physical Health Concern, Old Age, and Financial Strain.

For those who expressed that they were very dissatisfied with the amount of time they spent outdoors: 1 individual explained that they could not spend time outdoors because they were not in a financially secure position where they would be able to allocate time to leisure. 1 individual explained that personal health issues prevent them from spending time outside. 4 individuals explained that their schedule, work, or school obligations did not permit them to spend as much time as they would like outdoors. Lastly, 1 individual explained that they are very deterred by poor weather conditions. Out of the 8 participants who responded “very dissatisfied” from the pre multiple choice questions, 7 of them provided explanations as to why.

For those who expressed that they were dissatisfied with the amount of time they spent outdoors: 10 explained that their busy schedule, work, or school obligations prevented them from spending as much time outdoors as they'd like. 15 individuals explained that undesirable weather conditions deterred them from being outdoors as much as they'd like. 5 individuals explained that varying health concerns imposed on their ability to be outdoors. And lastly, 1 individual explained that their old age has put a strain on their ability to spend as much time outdoors. Out of the 43 participants who responded with “dissatisfied” from the previous multiple choice question, 31 of these individuals provided further explanation as to why they were dissatisfied with the amount of time they spend outdoors every week.

Rate your access to outdoor spaces/outdoor recreation sites.

87 responses



Following the questions that ask about one's satisfaction or dissatisfaction with the amount of time they spend outdoors, we then presented a multiple choice question that asks participants to rate their access to outdoor spaces/outdoor recreation sites. Out of 87 responses, **33.3%** of the participants (**29 out of 87 respondents**) said “excellent”, **36.8%** of participants (**32 out of 87 respondents**) said “very good”, **26.4%** of the participants (**23 out of 87 respondents**) said “good”, **2.3%** of the participants (**2 out of 87 respondents**) said “fair”, and **1.1%** of participants (**1 out of 87 respondents**) said “poor”.

This multiple choice question was then followed by an optional short answer question that asks individuals to describe any limitations that an individual faces in accessing outdoor spaces. Out of the 87 participants who answered the preceding question, 45 of them decided to elaborate on their limitations. Following the same methodology of analyzing the data from the previous short answer question, our group created categories that represented answers with similar reasoning. To interpret the data for the question “Please describe any limitations you face in accessing outdoor spaces”, we distinguished reasonings by: Work/Busy Schedule, Natural Elements (weather, bugs, etc.), Physical Health Concern, Old Age, and Location (individuals live inconveniently far from natural areas).

For those who described their access to the outdoors as “very good”: 3 individuals explained that their work/busy schedules have limited their access to the outdoors, 4 individuals explained that their old age limits their access to many natural areas and walking paths, 1 individual explained that their inconvenient and far away location limits their access to the outdoors, 2 individuals expressed that actual nature trails are difficult to physically read, 2 individuals explained that weather conditions limit their access to outdoor spaces, and 1 individual explained that personal health issues limit their access to the outdoors. Out of the 32 participants who responded “very good” to the question “rate your access to outdoor spaces/recreation sites”, 13 of them decided to elaborate on their limitations.

For those who described their access to the outdoors as “good”: 3 individuals explained that their inconvenient and far away locations limit their access to natural areas, 5 individuals explained that their work/busy schedules limited their access to natural areas, 3 individuals explained that personal health implications and physical disabilities impose limitations on their access to outdoor spaces, 1 individual explained that a mental health diagnoses limits their access to outdoor areas, 2 individuals explained that undesirable weather limits their access to natural areas, and 1 individual was not sure what natural areas are available to the public because they are new to their neighborhood. Out of the 23 participants who answered “good” to the question “rate your access to outdoor spaces/recreation sites”, 15 of them decided to elaborate on their limitations

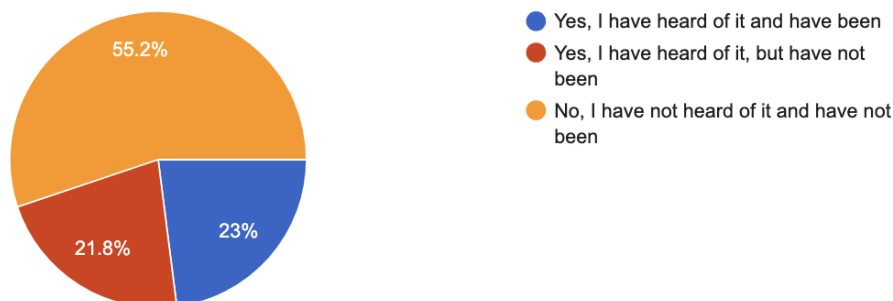
For the 2 individuals who rated their access to the outdoors as “fair” in the preceding multiple choice question, only one of them chose to share their limitations. This individual identified themselves as a 38 year old, white, non-binary person who has been living in Montgomery, PA for 15+ years. They explained that they have a chronic illness and live in a toxic neighborhood where their kids aren’t safe. Additionally, the one individual who described their access to the outdoors as “poor” did not choose to elaborate on their limitations.

Results from questions concerning the Robert Porter Allen Natural Area

Have you heard of or been to the Robert Porter Allen Natural Area in South Williamsport, PA?



87 responses

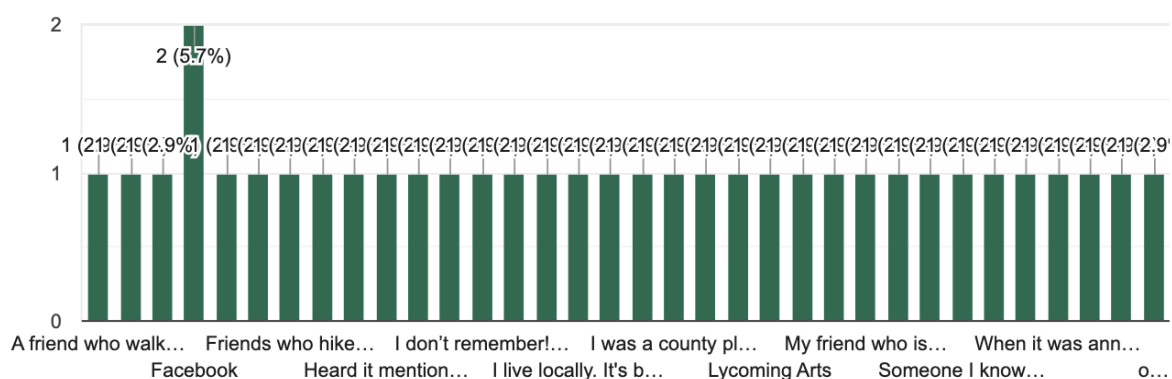


The next questions that we presented in our survey asked for personal knowledge and experiences regarding the Robert Porter Allen Natural Area. We introduced this question topic by asking “Have you heard of or been to the Robert Porter Allen Natural Area in South Williamsport, PA?”, providing a multiple choice response format. Out of 87 participant responses, **55.2%** of these individuals (**48 out of 87 respondents**) chose “No, I have not heard of it and have not been”, **23%** of the individuals (**20 out of the 87 respondents**) chose “Yes, I have heard of it and have been, and **21.8%** of the individuals (**19 out of the 87 respondents**) chose “Yes, I have heard of it, but have not been”.

Where did you hear about the Robert Porter Allen Natural Area?



35 responses



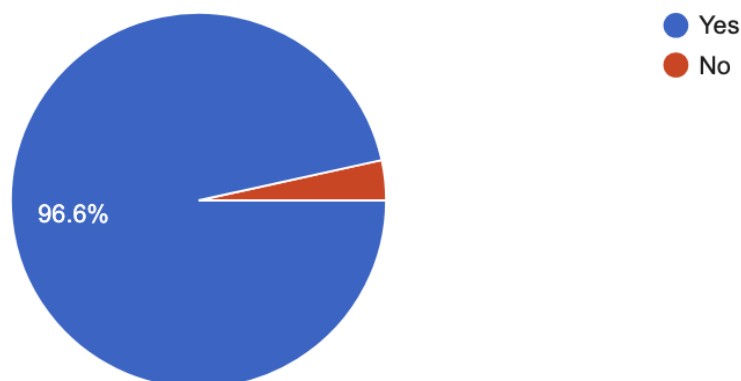
We then asked a follow up, optional short answer question asking “Where did you hear about the Robert Porter Allen Natural Area?”. 35 of the 87 participants who answered the preceding question chose to respond to this follow up question. Our group followed the same methodology of analyzing qualitative data from the previous two short answer questions. To interpret the data for the question “Where did you hear about the Robert Porter Allen Natural Area?”, we distinguished answers by: Friends/Family, Lycoming Art Events, Girl Scout, Social Media (Facebook), Newspaper, Living Locally, Google Search.

Out of the 35 respondents, 9 individuals said they heard about the RPA Natural Area through family and friends, 8 individuals said they heard about the organization through Lycoming Arts, 2 individuals said they heard about the organization through Girl Scouts, 6 individuals said they heard about the organization through social media, 3 individuals said they heard about the organization through the newspaper, 5 individuals said they heard about the organization just by living locally, and 2 individuals said they heard about the organization through googling it.

Results from questions concerning fireflies

When you were a child, did you catch fireflies?

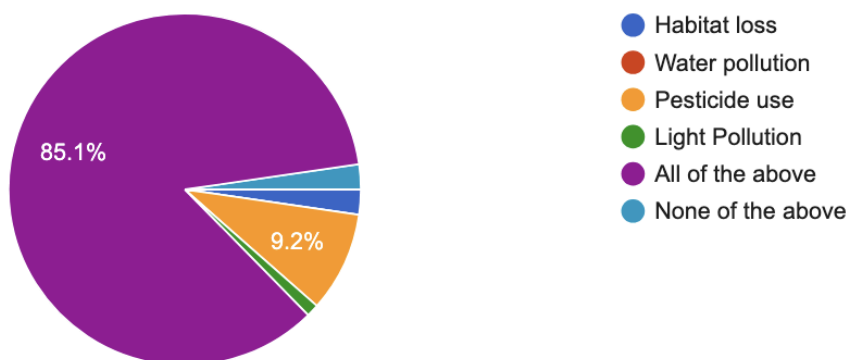
87 responses



To introduce a line of questions about fireflies, firefly knowledge, and potential interest in firefly conservation efforts, our group presented a multiple-choice question that asks “When you were a child, did you catch fireflies?” Out of 87 responses, **96.6%** of participants (**84 out of 87 respondents**) replied “yes”, while **3.4%** of the participants (**2 out of 87 respondents**) replied “no”.

What are the leading causes of the decline in firefly populations?

87 responses

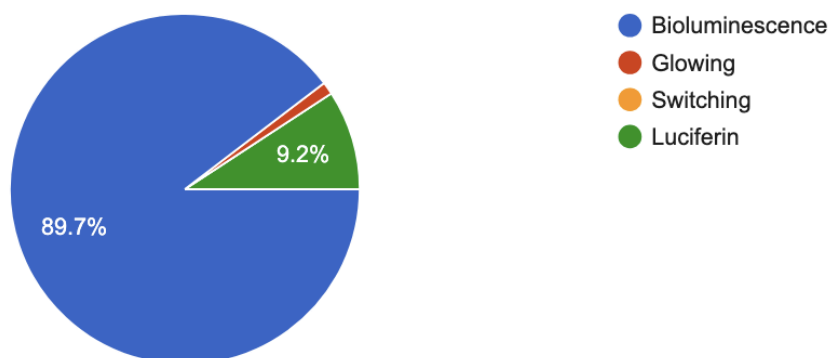


We then asked a series of test-like questions that tested participants' general knowledge of fireflies. The first of these questions was “What are the leading causes of the decline in firefly populations?”. Out of 87 total responses, **85.1%** of the participants (**74 out of 87 respondents**) chose the correct answer, which is “All of the Above”. **9.2%** of the participants (**8 out of the 87**

respondents) chose “Pesticide Use”, **2.3%** of the participants (**2 out of the 87 respondents**) chose “Habitat Loss”, **2.3%** of the participants (**2 out of the 87 respondents**) chose “None of the Above”, and **1.1%** of the participants (**1 out of the 87 respondents**) chose “Light Pollution”.

What is the name of the chemical reaction that allows fireflies to produce light?

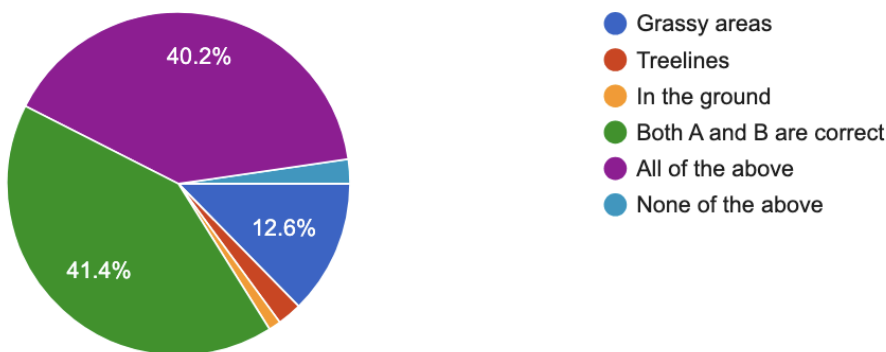
87 responses



The next question asked participants “What is the name of the chemical reaction that allows fireflies to produce light?”. Out of 87 responses, **89.7%** of the participants (**78 out of 87 respondents**) chose the correct answer, which is “bioluminescence”. **9.2%** of the participants (**8 out of 87 respondents**) chose “Luciferin”, and **1.1%** of participants (**1 out of 87**) chose “glowing”.

What habitat do fireflies generally inhabit?

87 responses



We then presented the question “What habitat do fireflies generally inhabit?”. Out of 87 responses, **40.2%** of participants (**35 out of 87 respondents**) provided the correct answer, which is “All of the Above”. **41.2%** of the participants (**36 out of 87 respondents**) chose “Both A and B are Correct”, **12.6%** of the participants (**11 out of 87 respondents**) chose “grassy areas”,

2.3% of the participants (**2 out of the 87 respondents**) chose “treelines”, **2.3%** of the participants (**2 out of the 87 respondents**) chose “None of the Above”, and **1.1%** of the participants (**1 out of the 87 respondents**) chose “In the Ground”.

For the following question, our group provided participants with a Likert scale to represent their answers to the question “How would you rate your knowledge of the following aspects of the fireflies?”

How would you rate your knowledge of the following aspects of fireflies?



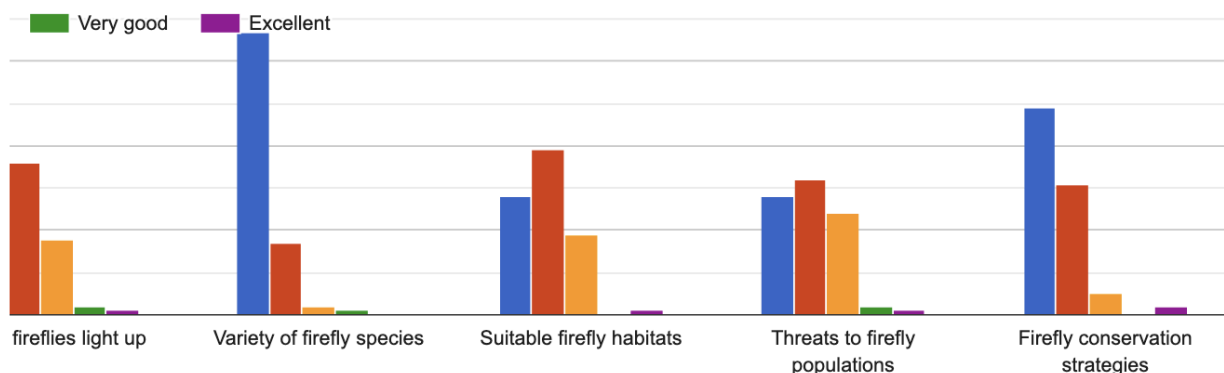
For the topic “General Firefly Biology”, 40 individuals rated their knowledge as “Poor”, 35 individuals rated their knowledge as “Fair”, 9 individuals rated their knowledge as “Good”, 2 individuals rated their knowledge as “Very Good”, and 1 individual rated their knowledge as “Excellent”.

For the topic “Why Fireflies Light Up”, 30 individuals rated their knowledge as “Poor”, 36 individuals rated their knowledge as “Fair”, 18 individuals rated their knowledge as “Good”, and 2 individuals rated their knowledge as “Very Good”, and 1 individual rated their knowledge as “Excellent”.

For the topic “Variety of Firefly Species”, 67 individuals rated their knowledge as “Poor”, 18 individuals rated their knowledge as “Fair”, 2 individuals rated their knowledge as “Good”, and 1 individual rated their knowledge as “Very Good”.

For the topic “Suitable Firefly Habitats”, 28 individuals rated their knowledge as “Poor”, 39 individuals rated their knowledge as “Fair”, 19 individuals rated their knowledge as “Good”, and 1 individual rated their knowledge as “Excellent”.

How would you rate your knowledge of the following aspects of fireflies?



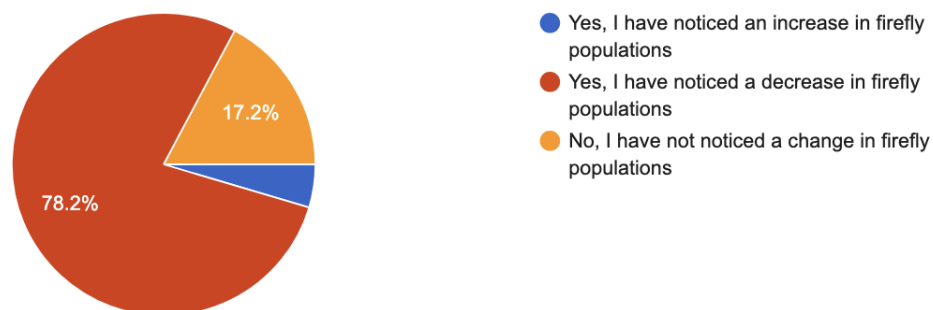
For the topic “Threats to Firefly Populations”, 28 individuals rated their knowledge as “Poor”, 32 individuals rated their knowledge as “Fair”, 24 individuals rated their knowledge as “Good”, 2 individuals rated their knowledge as “Very Good”, and 1 individual rated their knowledge as “Excellent”.

For the topic “Firefly Conservation Strategies”, 49 individuals rated their knowledge as “Poor”, 31 individuals rated their knowledge as “Fair”, 5 individuals rated their knowledge as “Good”, and 2 individuals rated their knowledge as “Excellent”.

Have you noticed a change in the firefly population in your local area?



87 responses



Following the series of test-like questions, we then presented a multiple-choice question that asked “Have you noticed a change in the firefly population in your local area?”. Out of 87 responses, **78.2%** of participants (**68 out of 87 respondents**) said “Yes, I have noticed a decrease in firefly populations. **17.2%** of participants (**15 out of 87 respondents**) said “No, I have not noticed a change in firefly populations”, and **4.6%** of participants (**4 out of 87 respondents**) said, “Yes, I have noticed an increase in firefly populations”.

In a follow-up question, we then asked participants to share more information regarding the change in firefly populations that they have noticed. Unlike our previous approach to these

short answer questions, we found that highlighting a couple of responses that reflected overall themes from the 57 responses that we received would be the most productive and insightful method for utilizing this data.

Some individuals who responded to the prior multiple choice question with “Yes, I have noticed a decline in firefly populations” stated that:

- “They seem to show up later and be a lot less abundant. When i was a kid you (i was catching fireflies btwn 1985 & 1994) could almost just wave your hand in the air in the early summer and be assured to catch several. In my kid's childhood (they are 18, so probably 2010-2018), they were out there, but it was more of a big deal to catch them. Honestly i thought it was bc we moved farther north. :/”
- “Specifically it was when fracking happened near my old house, then moving into town, light pollution and round up applications around homes. I live in a tree filled park area and the decline is very noticeable over years”
- “We live in Duboistown, I would say that when we moved here 20+ years ago, every summer our lawn would glow with fireflies. Within the last 5 years, there are less and less. In fact, last summer there were hardly any but that might have been due to the Gypsy Moth infestation we have experienced in the last 2 years.”
- “Growing up here 60 years ago the air was thick with them. Tragically I only see a few at any one time now.”
- “When we moved here 16 years ago, the fireflies were in great abundance. We have the perfect setting for them, wetlands, creek, forest. In the last few years I would say the firefly population is about half of what it was.”
- “Used to catch jar upon jar of them as a child. They were EVERYWHERE. Now I’d be shocked if the population was even 1/10th what it was 30-40 years ago. Even in the past 5-10 years it seems there’s been a decline.”

Two individuals who responded to the question “Have you noticed a change in the firefly population in your local area?” with “Yes, I have noticed an increase in firefly populations” provided particularly insightful information, stating:

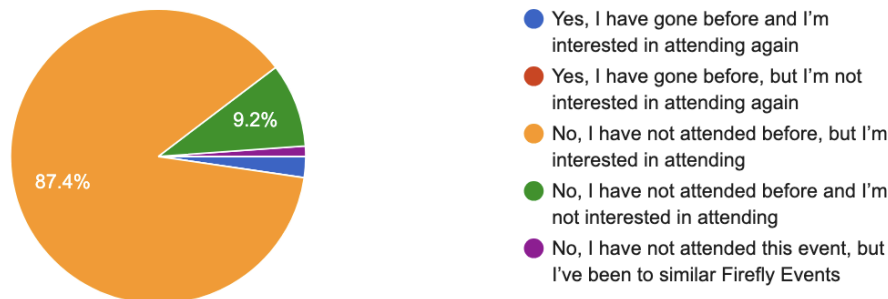
- “As my garden grows, so does the firefly population. When we first bought our house, we had to cut down all of the trees on our property (diseased) and have since replanted. Every year we seem to have more and more fireflies. “
- “I have almost 40 acres. Chemical-free could be certified as organic for 14 years. Fields are mowed once or biannually yearly. The fireflies are back. Not as the 1990s. The chemical farmer next to me with bordering fields have fireflies. the stands of milkweed pods are growing and not mowed.”

Results from questions regarding this summer’s event:

Have you attended and/or are you interested in attending a Firefly Event at the Robert Porter Allen Natural Area in July 2024?



87 responses



Following the firefly-focused section, our group asked participants "Have you attended and/or are you interested in attending a Firefly Event at the Robert Porter Allen Natural Area in July 2024?". Out of 87 responses, **87.4%** of participants (**76 out of 87 respondents**) said "No, I have not attended before, but I'm interested in attending". **9.2%** of participants (**8 out of 87 respondents**) said "No, I have not attended before and I'm not interested in attending. **2.3%** of participants (**2 out of 87 respondents**) said "Yes, I have gone before and I'm interested in attending again", and **1.1%** of participants (**1 out of 87 respondents**) said "No, I have not attended this event, but I've been to similar Firefly Events". Our group then presented an optional, short answer follow-up question that stated "Please provide more information about why you are interested or not interested in attending. This may help future planning efforts." To analyze the qualitative data that was collected from this section, our group formulated categories that represented similar answers. These categories include "I want to learn more about fireflies and firefly conservation!", "It's a great event for my children!", "I want a new experience!", "I want to do my part in bettering the environment", "Seems interesting and fun!", "It's a great opportunity to spend time outside!".

Out of the 87 responses to the previous multiple-choice question, 63 of these individuals chose to elaborate on the follow-up question. Of the 63 individuals who responded to the short answer, 27 participants said that they were interested in attending this summer's event because they want to learn more about fireflies and firefly conservation. 11 participants said that they were interested in attending this summer's event because they thought it would be a great event for their children to go to. 4 participants said that they were interested in attending this summer's event because they think it would be a great new experience. 4 participants said that they were interested in attending this summer's firefly event because they want to do their part in bettering the environment. 7 participants said that they were interested in attending this summer's firefly event because they thought it sounded interesting and fun. And lastly, 2 participants said that

they were interested in attending this summer's firefly event because they thought it would be a great opportunity to spend time outdoors.

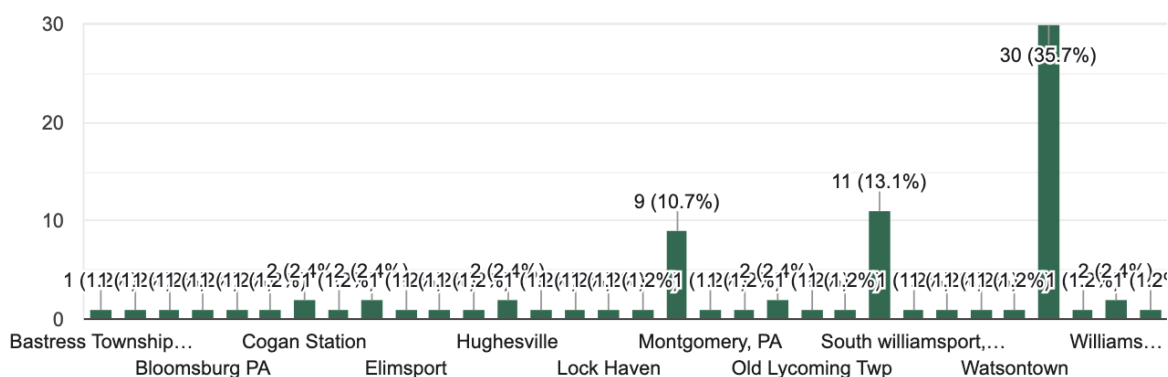
In addition to the participants who expressed interest in attending this year's firefly walk, 8 individuals said that they were not planning to attend. These participants all provided explanations in the follow-up question as to why they were not interested in attending. 4 of the respondents said that they did not have time to go, 3 explained that they have limited mobility that prevents them from participating in the summer event, and 1 individual said that the event was too far away.

Demographic Results:

What town do you currently live in?

 Copy

84 responses

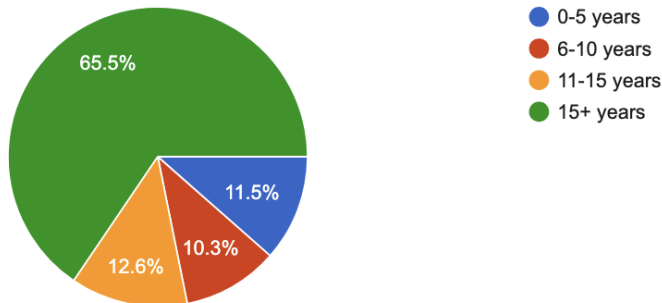


The last section of our survey consisted of 5 questions that assessed the demographic identity of each participant. All of the demographic questions were optional. For the question that asked participants “What town do you currently live in?”, 84 individuals answered. **38** participants said they live in **Williamsport, PA**. **12** participants said they live in **South Williamsport, PA**. **10** participants said they live in **Montgomery, PA**. **3** individuals said they live in **Hughesville, PA**. **3** participants said they live in **Cogan House Township**. **3** participants said they live in **Duboistown, PA**. **2** individuals said they live in **Bloomsburg, PA**. **2** individuals said they live in **Nisbet, PA**. **2** participants said they live in **Jersey Shore** (did not specify the state). **1** participant said they live in **Bear, DE**. **1** individual said they live in **Elimspport, PA**. **1** individual said they live in **Lock Haven, PA**. **1** individual said they live in **Loyal Sock, PA**. **1** individual said they live in **Montoursville, PA**. **1** individual said they live in **Old Lycoming Twp**. **1** individual said they live in **Picture Rocks, PA**. **1** individual said they live in **Trout Run, PA**. **1** individual said they live in **Watson town, PA**.

How long have you lived in your current town or nearby?



87 responses

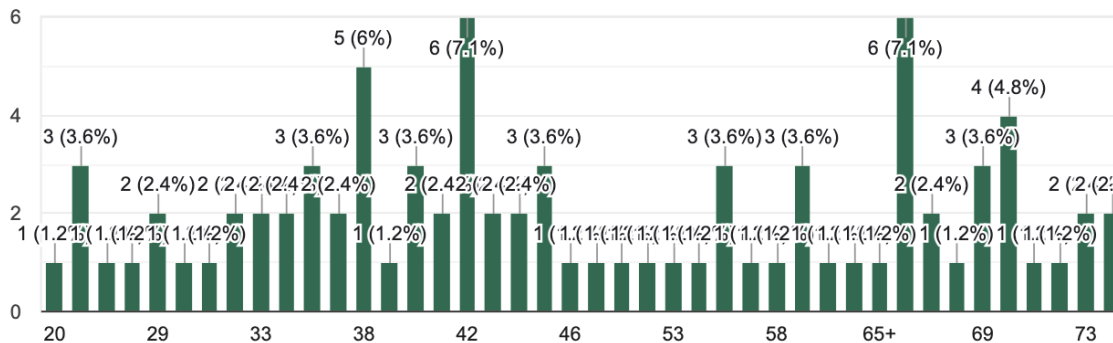


Out of 87 participants who responded to the question: “How long have you lived in your current town or nearby?”, **65.5%** (57 out of 87 individuals) said “15+ years”, **12.6%** (11 out of 87 individuals) said “11-15 years”, **11.5%** (10 out of 87 individuals) said “0-5 years”, and **10.3%** (9 out of 87 individuals) said “6-10 years”.

What is your age?



84 responses

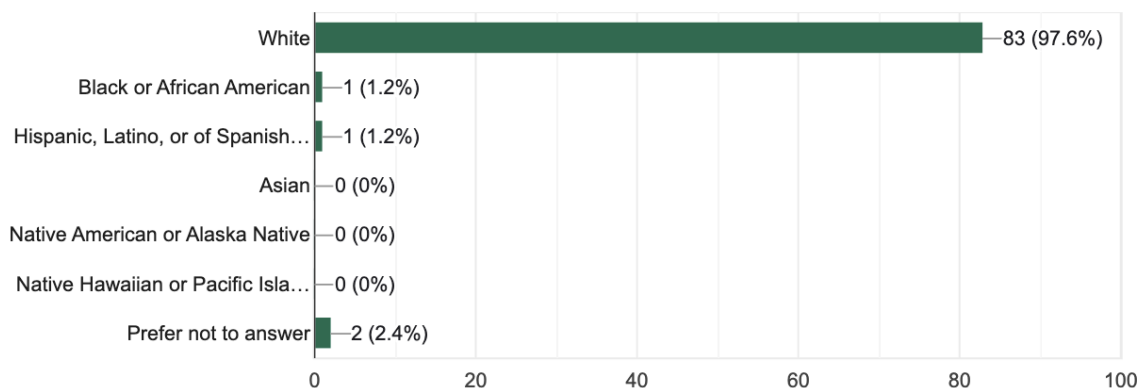


The following question asked individuals to disclose their age, if willing. 84 participants responded. **8 of the 84** individuals were between the ages of 20-30 years old. **21 of the 84** individuals were between the ages of 30-40 years old. **19 of the 84** individuals were between the ages of 40-50. **10 of the 84** individuals were between the ages of 50-60. **23 of the 84** individuals were 60+ years old.

How would you describe your racial identity?



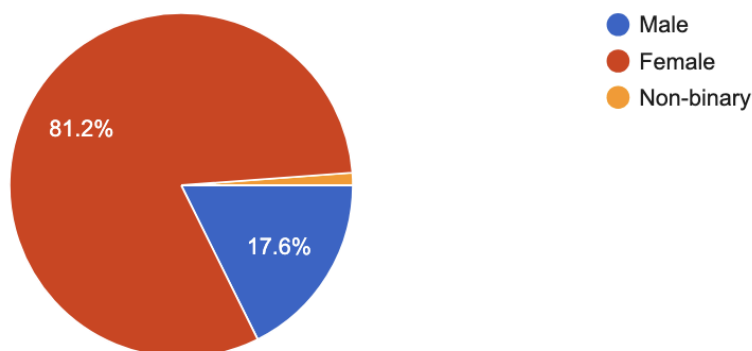
85 responses



We then presented the question “How would you describe your racial identity?”. 85 participants chose to respond. Out of the 85 participants, **97.6%** (83 out of 85 individuals) identify as **White**. 1 participant identified themselves as Black or African American, and 1 participant identified with the category of Hispanic, Latino, or of Spanish origin. Lastly, 2 individuals chose the “prefer not to answer” option of this multiple-choice question.

What is your gender identity?

85 responses



The last question of our demographic section, and the survey as a whole, asked participants about their gender identity. 85 participants responded to this question. **81.2%** (69 out of 85 individuals) identified as **female**. **17.6%** (15 out of 85 individuals) identified as **male**. Lastly, **1.2%** (1 out of 85 individuals) identified as **non-binary**.

Appendix H. Design Elements

Figure 1: Facebook Post With Survey Information

Sydney Shea · Just now · 🌐

Hi everyone! I am a student at Bucknell University and am working with a local Williamsport park to gather information on public interest and knowledge on fireflies. We are looking for residents of the Williamsport area to take our brief survey to help us as we plan an upcoming event, and would greatly appreciate your participation. The survey can be found at <https://bit.ly/fireflysurvey2024> or using the QR code in our poster. Thank you!

SCAN HERE
OR VISIT
[BIT.LY/FIREFLYSURVEY2024](https://bit.ly/fireflysurvey2024)

Like Comment Share

Write a public comment...

Figure 2: Postcard Invite



Attendees experience a film screening of A Midsummer Nocturne, a movie shining light on the beautiful lives of fireflies. Visitors will also engage in a tour guided by an area biologist where they will learn about fireflies and contribute to citizen-science reports on firefly populations.



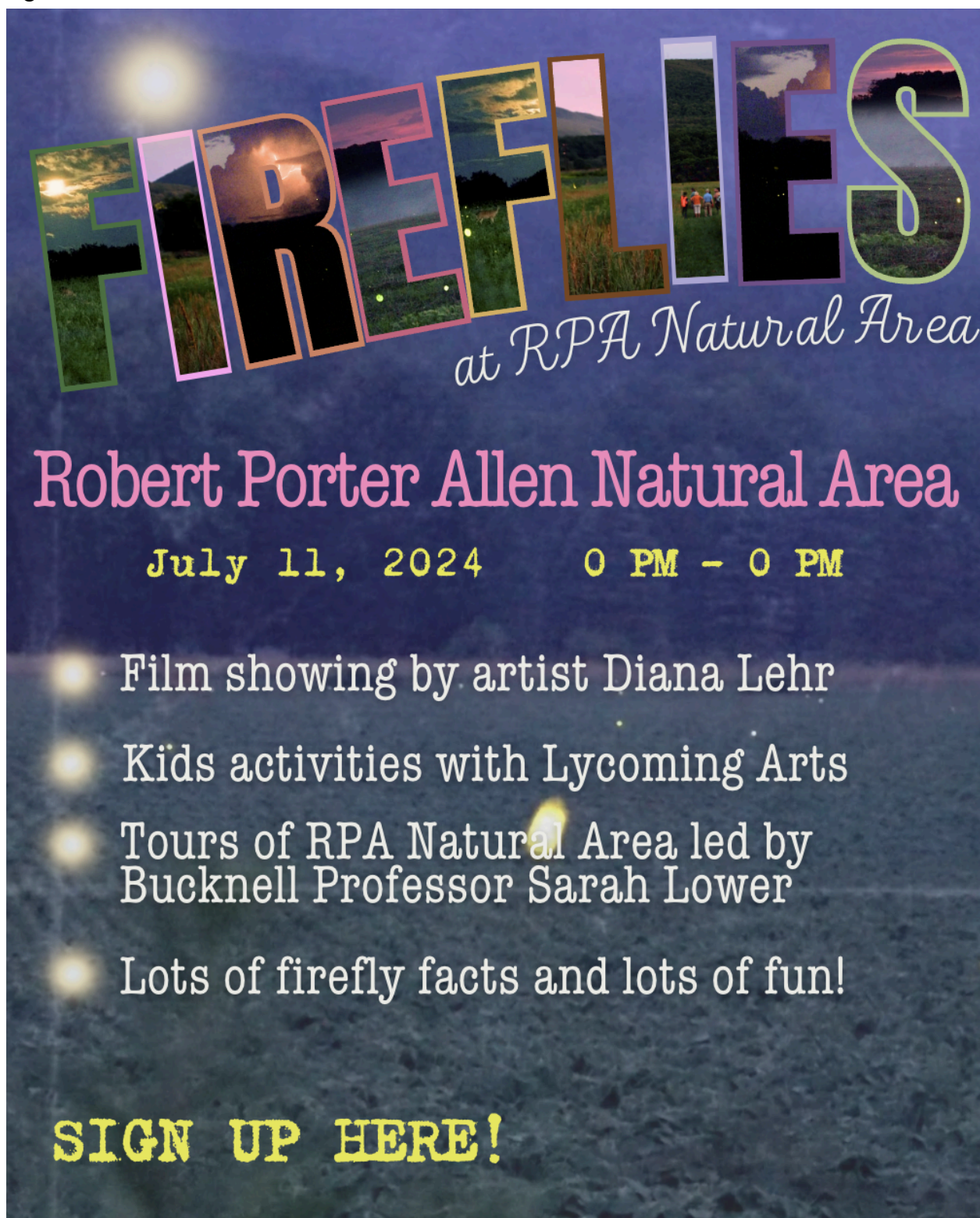
This event is a collaboration between RPA Natural Area, Bucknell University, Lycoming Arts, and visual artist Diana Lehr. For a full list of partners visit www.rpanaturalarea.org

1722 Sylvan Dell Rd, Armstrong Township, PA 17702

POST CARD



Figure 3: Draft Social Media Post



FIREFLIES
at RPA Natural Area

Robert Porter Allen Natural Area

July 11, 2024 0 PM – 0 PM

- Film showing by artist Diana Lehr
- Kids activities with Lycoming Arts
- Tours of RPA Natural Area led by Bucknell Professor Sarah Lower
- Lots of firefly facts and lots of fun!

SIGN UP HERE!

Figure 4: Firefly Trail Brochure

Seasonal Life Cycle of Fireflies

Summer: Fireflies use flashes or pheromones to find mates and females lay 100 eggs! Firefly larvae hatch about 3-4 weeks later and begin catching prey using their toxins to survive.

Autumn: Firefly larvae continue to grow and mature. This stage will last for about one season to multiple years depending on the species.

Winter: During colder months adult fireflies hibernate in the bases of trees or underground, and larvae live in the soil as they continue to find food and grow.

Spring: Most larvae become pupae and develop into adults approximately 10 days to several weeks later.



How You Can Help the Natural Area

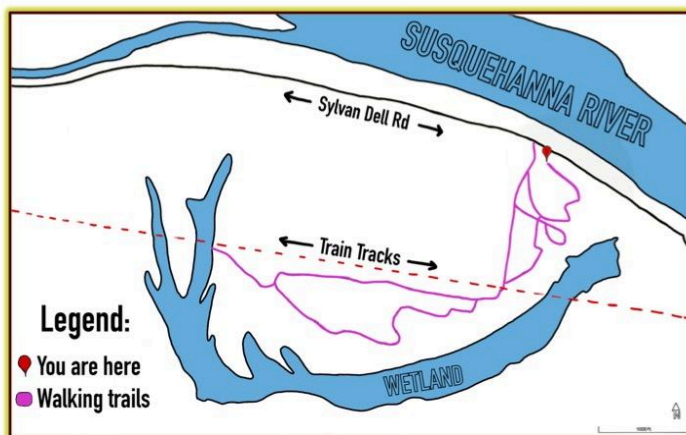
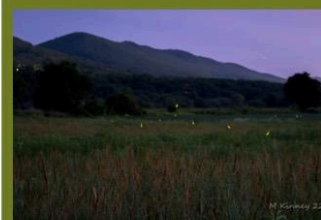
- ◆ Use limited artificial light at night.
- ◆ Naturally fertilize crops that fireflies use for pollination.
- ◆ Make the ground cover denser in your backyard using logs and leaf litter.
- ◆ Improve ground cover by avoid cutting grass or raking leaves.
- ◆ Talk to your neighbors and local government officials about the benefits and importance of fireflies!

Thank you so much for your support! If you are interested in learning more about the Natural Area, please scan the QR code below to like us on Facebook and check out our website: rpanaturalarea.org



ROBERT PORTER ALLEN NATURAL AREA

TRAIL BROCHURE



Sylvan Dell Trail

Welcome to the Robert Porter Allen Natural Area (RPA) at Sylvan Dell! The RPA was established in 2021 and it is a 227-acre parcel of land that is home to the largest intact wetland on the west branch of the Susquehanna River. The RPA hosts an annual firefly event in July to educate and inform locals and friends about firefly conservation in the natural area. This pamphlet provides a bit of background information of fireflies at the site. Enjoy the trails open for public recreation!

Safety & Rules

- ◆ The trail is open to human foot traffic and dogs on a leash.
- ◆ The natural area is open from dawn to dusk.
- ◆ Please always stay on the mowed areas.
- ◆ Please do not take anything from the natural area or leave anything behind.
- ◆ *All guests use the trail at their own risk.*

Fast Facts about Fireflies:

- ◆ Fireflies are not even flies, they are a type of beetle that start out as larva, then become pupa before finally emerging as an adult!
- ◆ Fireflies' light is used to both warn off predators and communicate with other fireflies during mating season, which is in the late spring.
- ◆ Ground fireflies' favorite habitats are those with humid, wet environments usually with small bodies of water and dense covering of grasses and leaves.
- ◆ Fireflies can be in the larval state for up to two full years!



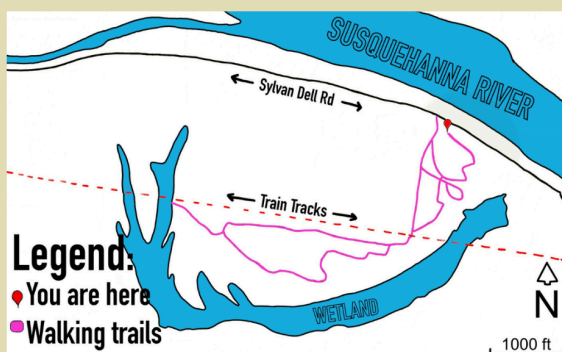
Figure 5a: Firefly Nature Trail Sign- Fireflies at RPA Natural Area

FIREFLIES AT RPA NATURAL AREA

If you were asked about what fireflies are, you'd probably imagine a warm late spring or early summer evening in your yard watching them glow and flash through the night, and catching them to watch as they light up. But have you ever thought about why fireflies can even create light on their own? Or why you only see them during warmer seasons? Believe it or not, fireflies have over 2,000 different species across every continent except for Antarctica. People have always been amazed by the way fireflies make light, so fireflies inspire cultural celebrations and events like firefly festivals in the US and around the world. Fireflies are also excellent pollinators, allowing for the growth of plants that feed other animals.



ROBERT
PORTER
ALLEN
NATURAL AREA



History of RPA Natural Area

- RPA Natural Area is named after Robert Porter Allen, who was a pioneer in ornithology (the study of birds) and environmentalism
- Back in the early 1900s, the land was used as a bathing beach called "Goose Island" where people would gather to swim, canoe, bike, and bird watch
- Southside Recreational Authority, the owner of the land, aims to connect people with nature through recreation and learning by restoring the land to its natural glory


Why is it Important to Learn About Fireflies?

Fireflies are vital contributors to ecosystems across the world. Firefly larvae are insatiable predators who feed on slugs, snails, and earthworms. Their appetite plays an essential role in maintaining the delicate balance of ecosystems around the world, including ours at Sylvan Dell! A decline in firefly populations translates to the imbalance of our healthy environments, which affects everyone and everything present!




Figure 5b: Firefly Nature Trail Sign- Firefly Biology


FIREFLY BIOLOGY




Firefly Eggs



Firefly Larva



Firefly Pupa




Adult Firefly

Seasonal Life Cycle

SPRING


During the spring, larvae go through metamorphosis and turn into pupae, an intermediate stage of firefly development. After a few weeks, the pupae emerge as adults!



SUMMER

FALL

In the fall baby fireflies, or larvae, grow up and mature. This process can be as quick as one season, or as long as multiple years. The fireflies you see this year may be the parents of the ones two years from now!



WINTER

Like bears, adult fireflies hibernate during the winter months. They find shelter in the bases of trees or underground. Larvae don't hibernate, and instead use the winter to find food and grow.

Did You Know?
You can identify firefly species by their light patterns! Using the chart below, try to see if you can tell which type of firefly is near you.

Pennsylvania Firefly Species






<p>Common Eastern Firefly <i>Photinus pyralis</i></p>  <p>9-19mm</p>	<p>Photuris Genus <i>Photuris</i></p>  <p>8-20mm</p>	<p>Pale Firefly <i>Photinus scintillans</i></p>  <p>6,5-8,5mm</p>	<p>Little Gray Firefly <i>Photinus marginellus</i></p>  <p>6-9mm</p>	<p>Winter Firefly <i>Photinus cornuscus</i></p>  <p>9-18mm</p>
<p>Light pattern</p> <p>✓ 1s 2s 3s 4s 5s 6s 7s ✓</p>	<p>Variable Light Patterns</p> <p>1s 2s 3s 4s 5s 6s 7s</p>	<p>1s 2s 3s 4s 5s 6s 7s</p>	<p>1s 2s 3s 4s 5s 6s 7s</p>	<p>Unlighted Firefly</p>

Figure 5a: Firefly Nature Trail Sign- Protecting Fireflies



PROTECTING FIREFLIES



Threats to Fireflies

Even though we benefit greatly from the presence of fireflies outdoors (and we love looking at them!) firefly populations are at risk of extinction because we don't properly care for them or their environment.

Ways We Hurt Fireflies

- The use of streetlights and other bright lights at nighttime can make it hard for fireflies to see their glows, which makes it hard for them to communicate and find mates 
- Clear-cutting tall grasses and polluting bodies of water destroys firefly habitats 
- Pesticides are toxic to fireflies, and overusing them can kill fireflies 
- Introducing new plants and animals to an environment they don't belong in, also known as invasive species (like red fire ants), can deplete resources or add a new predator 
- Rising global temperatures make the environment too hot and dry for fireflies to live 

How You Can Help

While firefly populations are hurting because of our actions, there is still a lot of hope! There are many easy steps we can take to make sure our local areas are good environments for fireflies to live.

Ways We Can Help Fireflies

- Use as little artificial light as possible at night time. If street lighting is necessary, advocate for colored lights that some fireflies can handle, like amber 
- Use natural fertilizers for crops and plant native plants that fireflies can use to perch on
- If you choose to catch fireflies in jars, be sure to release them shortly after and don't poke holes in the top of the jars. This can actually dry the fireflies out 
- Avoid raking leaves or cutting your grass too short 
- Talk to your family, friends, and local government officials about the importance of fireflies and how we can all work together to save them!