University of North Carolina Asheville
Journal of Undergraduate Research
Asheville, North Carolina
December 2022

Lights Out! Reducing Anthropogenic Bird Mortality in Asheville, NC

Andrea Carver
Interdisciplinary Studies
The University of North Carolina at Asheville
One University Heights
Asheville, North Carolina 28804 USA

Faculty Advisor: Dr. Andrew Laughlin

Abstract

Anthropogenic light pollution has had a negative effect on migratory bird populations and is the cause of approximately one billion bird deaths a year in the United States. Light pollution disrupts migration by attracting birds towards urban areas, which can result in fatal window collisions. Not only does artificial light at night have a negative effect on migratory birds, it also disrupts other aspects of biodiversity and human health. The National Audubon Society created an initiative that tackles this problem -- the Lights Out Program. This nationwide program provides a framework in which local organizations can work with building owners, managers, and occupants to turn off their lights at night to reduce light pollution. I researched the ongoing actions of other cities participating in the Lights Out program to document barriers and strategies that have been successful elsewhere. To gauge level of compliance in downtown Asheville, NC, baseline data was collected on light pollution across targeted buildings and compared with the data collected from the surveys completed after outreach and education efforts. The data collection involved taking an inventory of buildings to measure how each structure ranked in compliance with the Lights Out Initiative, which includes the state of the interior and exterior lights. The building occupants, owners, and managers were contacted about this initiative and encouraged to comply with this program along with installing bird-friendly and energy-smart technology such as motion sensors, timers, or detectors and closing blinds at night. There was an overall decrease in light pollution within the survey area after the community outreach and education efforts took place. This paper also summarizes research that focuses on financial incentives from third parties in terms of retrofitting buildings to install motion sensors or energy efficient technology.

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1.0 Introduction

Bird populations have decreased by 3 billion birds or 30 percent in the past five decades due to anthropogenic activity.[1] Habitat loss, feral cats, and collisions with artificial structures, including vehicles, power lines, and windows are the main causes of this decline. Collisions with windows are the second most common cause of direct bird mortality. Light pollution, which disrupts migration and attracts birds toward urban areas, has a negative effect on migratory bird populations and contributes to approximately one billion bird deaths a year in the United States[2]. Light pollution or Artificial Light at Night (ALAN) also disrupts bird's circadian rhythms and reproductive activity. Not only does ALAN have a negative effect on migratory birds, it also disrupts other aspects of biodiversity and human health[3].

Artificial Light at Night (ALAN) has altered wildlife mating behavior and migration patterns, and is one of the main culprits of bird-window collisions and ultimately, fatalities. ALAN is the greatest in urban areas, which comprises about 0.5% of the world's land surface[4]. This figure is increasing along with the rate of development and urbanization. About 80%[5] of North American migratory birds make their journey at night; by addressing light pollution as a main factor, we can decrease the threats associated with light pollution. Because of the amount of data readily available that exposes the negative effects of light pollution, utilization of data to integrate mitigation on local and global scales is now possible.

To address the challenges to conservation and mitigation efforts, pointing out specific considerations when designing conservation action plans is imperative. Efficient light pollution monitoring practices provide a comprehensive outline of what areas would be most effective in reducing ALAN. Findings indicate that there have been advances in data access and machine learning to capture new and rich details in characterizing bird movements in relation to activity from humans and urban development[6]. Assessments and applications that are focused on bird migration patterns provide the data necessary to guide conservation actions to identify locations where ALAN-reducing programs may be most effective. BirdCast is an example of a radar- based bird migration dashboard and application, which provides insight to bird movement patterns.

Assessing different methods or models used to classify buildings as "least likely" to "most likely" to cause avian mortality is useful in determining which buildings should be targeted. Buildings were isolated to three classifications in one research model. Windowless warehouses in urban deserts are at one end of the scale, while multi-story buildings with mirror-like glass on lushly vegetated grounds are on the other end of the scale. The relevance of this methodology is crucial in estimating the functionality of different landscapes and to establish possible improvement methods. In conjunction with this data, it was established that working directly with business owners, residents and pushing legislation that promotes sustainable systems to conserve biodiversity is directly correlated to reducing bird mortality[7].

There are multiple factors that cause window collisions induced by light pollution. Tree cover percentage, amount of glass on buildings, location of building, architectural factors, amount of vegetation all play into the likelihood of window strikes. Mitigation activities in Chicago, Houston, San Francisco, Philadelphia, and Toronto have been on-going. These mitigation activities include creating social media accounts, creating a website, hosting events related to Lights Out! in their cities, and more. During discussions with Lights Out! team members located in other cities, there were several conclusions made on what direction and certain methods should be used in community outreach efforts. Overall, it is established that bird-window collisions is one of the largest contributors to anthropogenic bird fatalities, and that equal focus must be placed upon mitigation within residential areas and homes as well as commercial and taller buildings[8], which is why social media is an effective form of communication; due to the ability to reach a broader audience.

In conjunction with mitigation efforts, citizen monitoring and radar data are both imperative in providing accurate models of migratory and movement predictions. During peak migration, birds passing over Asheville reach nearly 50,000 birds per kilometer per hour[9]. Digital databases, applications, and tools such as e-Bird provide observational data regarding migratory movement and provide documentation of bird distribution, abundance, habitat use, migration, and trends. Wide use of data tools and applications such as e-Bird can engage and educate communities along with recasting methods of mitigation. Having the capability to understand migratory patterns based on weather systems and seasons is useful in developing efficient mitigation strategies. Information on atmospheric conditions can provide insight on how meteorological drivers can influence migratory movement. Overall, citizen science and radar data are central to detecting animal activity and the scope of anthropogenic influences. Rapid growth and development without the integration of documented impacts on ecosystem degradation, habitat and biodiversity loss

seeks to continue the on-going threats to Planet Earth, not just the avian population. Long-term investments in data sourcing and localizing research will benefit and help fight ongoing threats.

The Lights Out! Initiative stems from a program that was first started in Toronto under the name FLAP (Fatal Light Awareness Program) and was adopted by the National Audubon Society in 1999. The goal of the program is to address light pollution and bird mortality and to incorporate a multi-faceted approach to migratory bird conservation.

Asheville was listed among the top 125 cities that produce light pollution that disrupts birds' migration patterns during the spring and fall migration season. Two UNC Asheville alumni started the Coalition for a Bird Friendly Asheville, which is a group that advocates for the protection of birds through the implementation of measures that will support their safety, namely, bird-safe window treatments and a lights-out commitment during migration months. The group launched the Lights Out! Asheville program and in February of 2022, Asheville Mayor Esther Mannheimer signed a proclamation which encourages all buildings and residences to turn off lights from 11:00pm until 6:00am from March through May and from August through October every year, to reduce light pollution. By reducing light pollution between these times, fatal bird-window collisions can be reduced.

In this study, I took an interdisciplinary approach to understanding the scope of light pollution in Asheville, NC, the effectiveness of various communication methods in advocacy work, and researched overall effects that light pollution has on migratory birds based off scientific literature and previous studies. My research questions were: 1) What methods were used by other cities to implement their Lights Out! initiative? 2) What is the current scope of light pollution in downtown Asheville, NC, during migration seasons? 3) How successful is community education and outreach in reducing Artificial Light at Night in my survey area in downtown Asheville, NC? I measured light pollution within a chosen survey area (figure 1) before and after outreach efforts, which included 106 businesses in downtown Asheville.

Figure 1. Map of Survey Area

2.0 Methods

The purpose of this study was to begin to implement the Lights Out! initiative signed by Mayor Manheimer in March 2022, and to measure the effectiveness of outreach measures in reducing ALAN in downtown Asheville, NC. The methods involve interviewing representatives from other Lights Out! initiatives cities, measuring light pollution in my survey area in downtown Asheville, NC, and performing outreach and education efforts to building managers within the study area.

2.1 Lights Out! in other cities

I interviewed representatives from four cities that have implemented their Lights Out! initiatives: Chicago, IL; San Francisco, CA; Houston, TX; and Philadelphia, PA. During each interview, I asked the representatives what methods of outreach they found to be most effective, how many volunteers and organizers they had within their team and what barriers they encountered in their work. These questions were mainly answered via phone or video call.

2.2 Study area and surveys

The location of the study area is Asheville, NC with a population of approximately 90,000 residents. Asheville is located between two migratory pathways, the Mississippi Flyway and the Atlantic Flyway, and provides a protected migration corridor for many forms of wildlife[10]. Asheville is also located at the junction of the Swannanoa and French Broad rivers and is situated at 2,200 feet above sea level. The study site for the light pollution surveys in downtown Asheville, NC consisted of four streets that ran parallel to each other and approximately 160 meters on each street (Figure 1). A large concentration of businesses and activity were located within these parameters and this area also contained high levels of light pollution. I surveyed 106 businesses located in downtown Asheville on Haywood Street, Rankin Avenue, Lexington Avenue, and Broadway Street, and noted the condition of interior and exterior lighting. The surveys were conducted from 11:00pm until 1:00am due to most of these businesses being closed during these hours. Four surveys were conducted during the pre- education and outreach period and four were conducted after the community and outreach took place. I created a point system with a scale of 0 to 2 and this was applied to the 106 businesses within the initial surveys. One point each was given if the interior lights were on and if the exterior lights were on and not down shielded. The scale's points referred to whether these selected businesses were or were not compliant with the 3-point Lights Out! index. The initial data regarding light pollution varied but was averaged to determine if ultimately the business/ structure was producing interior and exterior light pollution. I attempted to extract the structure location, business name, and contact information using the Go Local Asheville directory website[11] and Google Maps. I included buildings on both sides of the road in the survey

I conducted two sets of surveys, on random days of the week and one set from May to June 2022, and the other set in September 2022. The sets consisted of 4 surveys each: totaling 8 surveys by the project's end. The documented answers were averaged out to quantify one final index result. Between the surveys, I conducted outreach and education to the building managers and tenants. The purpose of the initial surveys was to gauge baseline levels of light pollution, and the post-outreach surveys were conducted to gauge the level of effectiveness of outreach and education efforts. The surveys are mentioned in the timeline (figure 2 and 3) and the timeline also illustrates the combined efforts of the program from October 2020 to November 2022.

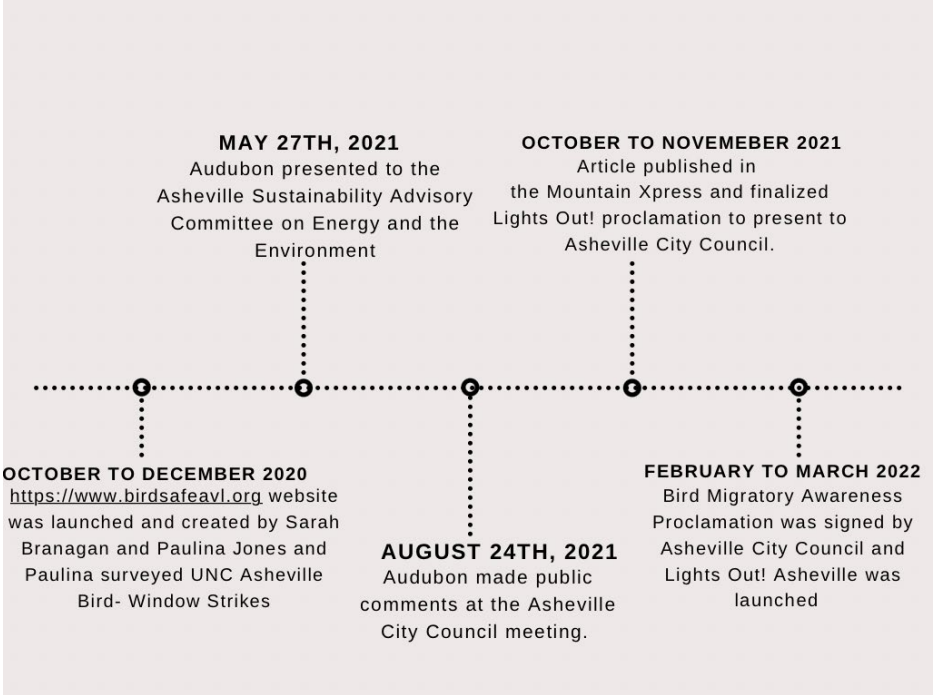

Figure 2. Timeline representing the program efforts from October 2020 to March 2022.

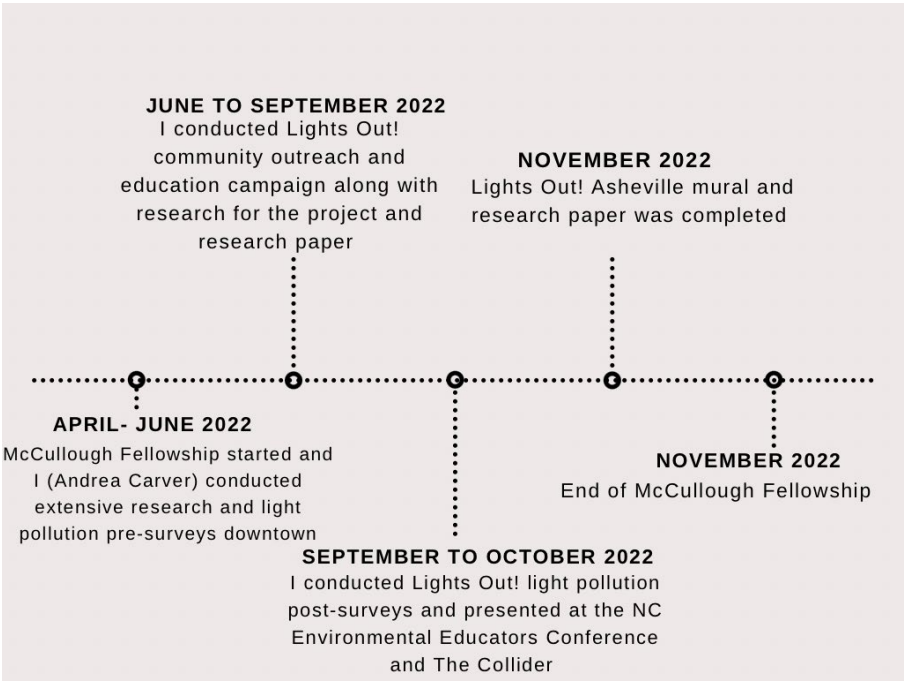

Figure 3. Timeline representing the program efforts from April 2022 to November 2022.

2.3 Outreach efforts

The outreach consisted of providing information on managing the state of interior and exterior lights to the businesses that were included in the light pollution survey and the effect that light pollution has on the avian population. The outreach took place before conducting a post-outreach survey and information regarding the Lights Out! Initiative and pledge form and the proclamation signed by Asheville Mayor Esther Manheimer during the months of July, August, and September was provided via email, phone calls, and in-person communications. Coalition for a Bird Friendly Asheville created a website in 2021 which includes a Lights Out! pledge form that gives businesses the ability to pledge their dedication to following the Lights Out! guidelines. These guidelines included turning off exterior decorative lighting, extinguishing pot and flood-lights, reducing atrium lighting wherever possible, turning off interior lighting especially on higher stories, substituting task and area lighting for workers staying late, pulling window coverings down, installing down-shield exterior lighting to eliminate horizontal glare and all light directed upward, installing automatic motion sensors and controls wherever possible, converting to new lighting to assess quality and quantity of light needed, avoiding over-lighting with newer technology. The overall goal of the Lights Out! pledge and proclamation is to provide a set of guidelines to increase bird safety and light pollution awareness. After the initial email and phone call in which I provided a brief description and goals of the initiative, I approached each business in person and communicated the purpose of the Lights Out! Asheville program and provided them with a Lights Out! brochure and attempted to extract the manager or building owner's name but was relatively unsuccessful in obtaining these names due to the individual being unaware of that information or not wanting to share that information with me. Another essential part of the outreach efforts included creating an Instagram account and campaign for Lights Out! Asheville and messaging the businesses via direct message on Instagram along with sharing the Lights Out! message to a broader audience.

2.4 Post- Outreach Surveys

The post-outreach survey replicated the initial survey using the 3-point scale and was performed to gauge the level of compliance after communication of the Lights Out! initiative and receiving the Asheville City proclamation and Lights Out! pledge via email. All 106 businesses were then surveyed again in September to assess compliance after this information had been provided. Four surveys were conducted and the results were averaged in the pre-outreach surveys.

3.0 Results

3.1 Lights Out in Other Cities

The cities of San Francisco, Philadelphia, Houston and Chicago have all adopted a Lights Out! Initiative. Chicago was the first city in America that adopted the program and the most successful in terms of community participants. Lights Out! San Francisco was spearheaded by Nate Tyler in 2007 in which he created the website http://lightsoutsf.org/. Nate and I had several phone and FaceTime discussions regarding how the Lights Out! San Francisco initiative was successful and what barriers the Lights Out! San Francisco organizer encountered. I also had several zoom meetings with organizers from other cities and the information extracted was very similar between each initiative. The information included that publicity and press was a key factor to an initiative's success and the more volunteers working on outreach was another important factor. The barriers were like the one's I have encountered: low rate of community and government compliance. During each zoom meeting, we hypothesized ways in which Lights Out! initiatives could be more successful. Lights Out! San Francisco, along with Lights Out! Philadelphia, and Lights Out! Houston all had Instagram accounts, so curating an Instagram page for Lights Out! Asheville was the next step. The Lights Out! organizers from other cities also suggested that reaching out to local organizations for partnership was very successful in terms of increasing publicity. Per this advice, I reached out to many local organizations in hopes to partner with them. Asheville Green Built Alliance, Blue Horizon's project and Waste Reduction Partners were more than willing to participate and become a partner and spread awareness about

the program. Each organization has continued to share information about the program on social media and in newsletters.

3.2 Asheville Night Lighting Survey Results

I surveyed key streets in downtown Asheville in order to gauge light pollution. In the initial pre-outreach surveys, one point was applied if the interior lights were on and one point for exterior lights that are not down shielded and a zero if both exterior and interior lights were off. The scale's points referred to whether these selected businesses were or were not compliant within the 3-point Lights Out guideline matrix. Figure 2 refers to the results of pre and post survey results and the state of light pollution from interior and exterior lighting. Blue represents pre- outreach survey results and red represents post- outreach survey results. There was a 142% increase in buildings that received a level 0 rating, which means both interior and exterior lights were off (18 businesses were documented with their interior and exterior lights off and in the pre- outreach survey, 42 businesses were documented to have their lights off). There was an approximately 26% decrease in the number of businesses that received a level 1 rating (38 being documented with just exterior or interior lights on in the first survey and 28 in the post-outreach survey). Level 2 received a 28% decrease, which translates to 50 buildings with both interior and exterior lights on in the pre-outreach survey and 36 being on in the post-outreach survey. This results in fewer businesses overall producing decreased levels of light pollution, which means the outreach efforts were successful. There was a pledge form attached to emails, communicated in person, and a link to the pledge form was provided on the Lights Out! Asheville Instagram account. The success rate was only 5.6% but is not representative of the overall success in the outreach efforts. The levels of light pollution did decrease between pre-outreach and post-outreach surveys. As shown in Figure 4, there was a decrease in overall light pollution between the 106 businesses after the outreach and education efforts.

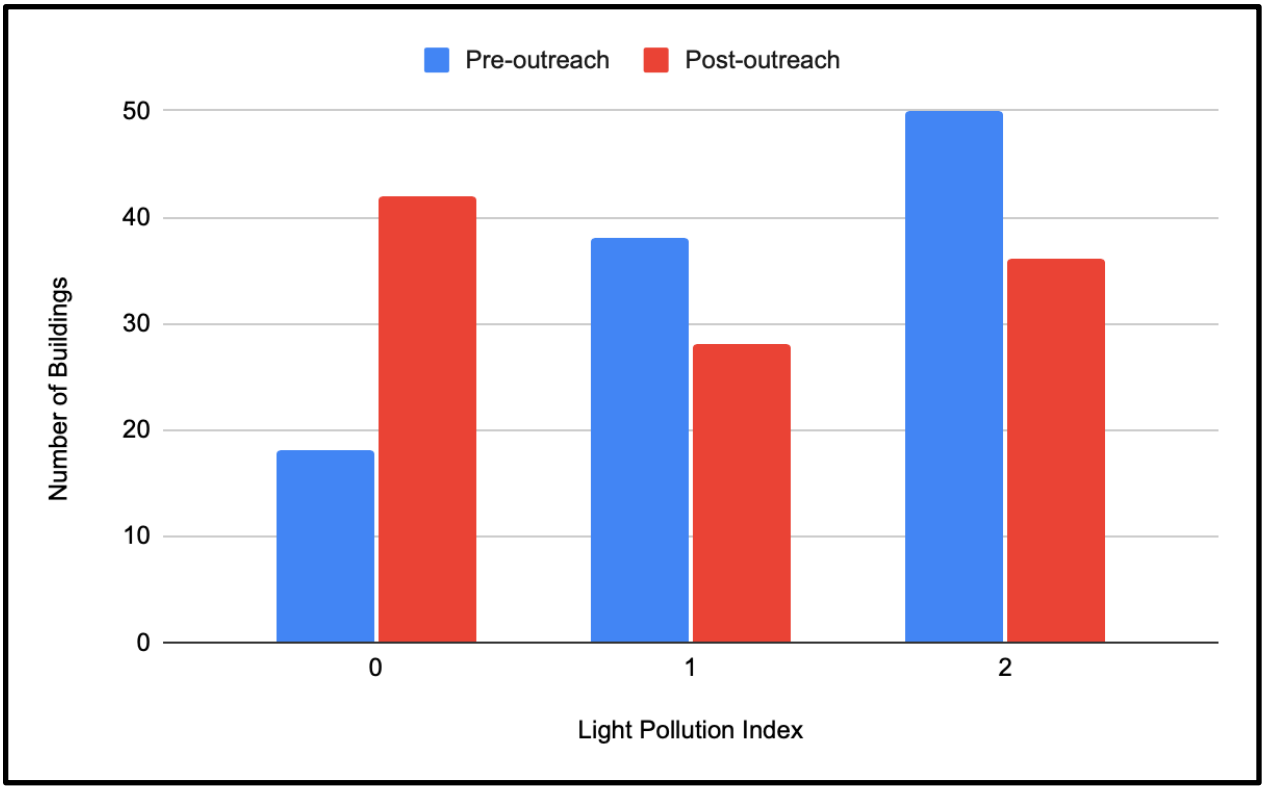

Figure 4. Pre- and post-outreach light pollution survey results. Businesses earned a "0" if both interior and exterior lights were turned off, a "1" if either interior or exterior lights were on, and a "2" if both interior and exterior lights were on.

3.3 Education Campaign Results

Out of the 106 businesses contacted, 6 businesses signed the Lights Out! pledge form, which is a 5.6% success rate. I created an Instagram account @lightsoutasheville in July 2022 to provide community members and businesses with outreach and engagement tools, and the pledge form link was provided in the bio area of the Instagram Account "LightsOut! Asheville". My first Instagram post (Figure 5) was on July 11, 2022 and acquired 24 likes and 5 shares from various accounts.

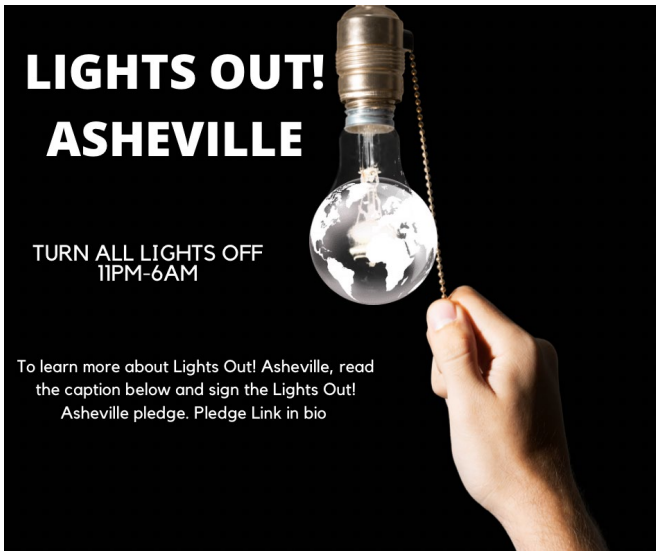

Figure 5. Lights Out! Asheville Instagram Post

My second post (Figure 6) acquired 21 likes and 5 shares from other various accounts. Each image had approximately a one paragraph write-up within the post going into detail about the program and how to engage and participate with Lights Out Asheville. The social media posts will continue and are created using the program Canva and other methods of content production.

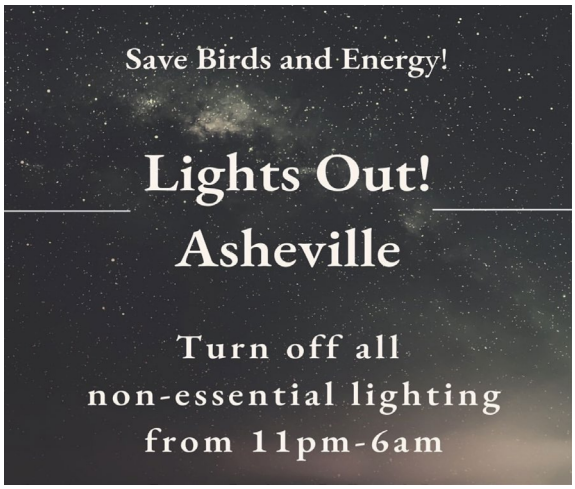

Figure 6. Lights Out! Asheville Instagram post

In addition to curating an Instagram account, I designed a Lights Out! Asheville mural and the mural was completed on October 29th, 2022 (figure 7). I had previously reached out to a supporter of the Lights Out! Asheville program and building owner and inquired about using one of their walls for the mural and they agreed. I contacted Irot; an Indigenous artist from Albuquerque, New Mexico, who was visiting Asheville. They agreed to help with the mural and completed the bird and lettering in one day after I buffered (painted) the blue wall. The mural will be a great addition and tool to bring awareness to the Lights Out! Asheville program by providing a platform for discussions about bird and energy conservation.

Figure 7. Lights Out! Asheville mural. The artist that painted the bird and the wording— they use the alias “Irot”.

5.0 Discussion

The objective of this section is to discuss the project's successes in terms of getting businesses to turn their lights off and how the project could be improved in the future, while comparing my research results to initiatives in other cities. I found social media and in-person contact to be the most effective by means of communication due to the level of response. Direct messaging via Instagram was more effective than emailing because of a higher response rate. If night surveys are conducted again, an instrument that accurately measures location of light pollution and a more accurate tool to gauge the level of light pollution instead of gauging light pollution manually by determining the state of interior and exterior lighting would be useful.

There are a growing number of ways for businesses to reduce their light pollution footprint other than just turning their lights out manually. Eliminating light pollution by transitioning to more energy efficient lighting practices is a viable option. Bird- safe lighting practices include sustainable, energy efficient light retrofitting; such as motion sensors and transitioning to other certain bird-safety guidelines in buildings. Installing smart meters to efficiently gauge energy usage and problematic areas has the potential to decrease energy usage. One solution for reducing light pollution is retrofitting and incorporating efficient lighting technology into new and current construction. Some funding for commercial lighting efficiency retrofits stems from the 179D Federal Tax Deduction for Commercial Buildings and Energy-Efficiency[12]. This enables building owners to claim a tax deduction for installing qualifying systems in buildings. LED lighting qualifies building owners for the 179 D deduction which is up to $0.60 per fixture. Upgrading to energy-efficient lighting can reduce energy usage by up to 30% and Duke Energy offers a lighting efficiency rebate program for commercial buildings known as "SmartSavings"[13]. Another suggestion is within each business or organization, a lighting compliance officer in each building to turn lights off could be appointed. In order to emulate this, strategic planning within city government, private and public organizations is required.

Determining the most accessible methods of communication and pledge signing success rate is useful in determining the level of success relating to outreach but conducting post- outreach and pre-outreach surveys is a better way to gauge the level of success for gauging a decrease in levels of light pollution and overall initiative success. The validity of the study design conducted could be assessed and possibly improved for future data collection methods. The consistency in communication could also be documented in a more efficient manner. Philadelphia, Houston, San Francisco, and Chicago have all had successful Lights Out! campaigns and communicating with the leaders of these organizations is a good way to brainstorm ideas and mimic their successful implementation methods. Continuously engaging with these individuals will only result in a more proficient standard of success. By integrating my findings into the recommendations, the results suggest that continuous outreach is imperative and necessary in order to be successful in increasing the rate of bird safety guideline compliance and level of success. The City of Asheville needs to link with and promote these savings and figure out enforcement of the proclamation or new policy/rules. One of my final conclusions is that consistent communication methods and reminders via social media is the most effective route for the initiative's success.

6.0 Conclusion

The main conclusions that have been made by conducting this research is that sharing the Lights Out! messaging and building guidelines with tenants, employees and businesses via flyers, newsletters, and social media is necessary for methods of communication for successful community education and outreach. It can also be concluded that by emulating successful Lights Out! campaigns from other cities, utilizing social media and organizing more volunteers for outreach efforts would make the initiative more effective. Communication via social media has the potential to reach out to various and a broader audience and population and provides an initial discussion or communication platform. The primary reason social media works so effectively is the element of accessibility. Along with social media, in- person communication is necessary and is one of the most impactful ways to communicate. Within the context of eliminating artificial light at night (ALAN) and improving energy efficiency, installing motion sensors in rooms is the most cost effective and efficient action to take.

Acknowledgements

I want to acknowledge the Anikituwagi (Cherokee Peoples and original stewards of the land) and Togiyasdi; (where they race) the space we refer to as Asheville. The colonization of Northern America has caused irreversible environmental damage and stress to the natural resources. I want to thank the Blue Ridge Audubon Chapter, UNC Asheville McCullough Institute, Dr. Alison Ormsby, Dr. Andrew Laughlin, Paulina Jones, and Danielle Lenaway for their guidance and patience in this project and for working so hard and always being willing to answer any questions or concerns. I want to acknowledge Jared Wheatly, who started the Indigenous Walls Project, the artist Irot (pictured in figure 6), and David Moritz for their assistance with the Lights Out! Asheville mural.

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