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Advisors: Chloe Cerwinka and Joseph Durrance  
Project: Bird Collisions Mitigation and Tracking  
Stakeholders: FRES

### **Abstract**

The student Eco-Reps Bird Strikes team collaborated with Chloe Cerwinka, a landscape planner within Facilities and Real Estate Services (FRES) and Joseph Durrance, an IT staff member at the Perelman School of Medicine.

Primarily, the team worked to identify and analyze various bird strike hotspots, develop an educational campaign (for both mitigation and tracking), devise a hotline for the public and Penn housekeeping to notify the team of any bird strikes, and draft a building clause that included bird-safety guidelines. Analyses were conducted of iNaturalist data, on-foot canvassing of locations by student Eco-Reps, and the species/count of the birds collected during the year.

Recommendations, such as continuing the implementation of hotlines and communication with housekeeping and the larger Penn community are presented for future projects related to study and mitigation of bird strikes. These recommendations also include the evaluation of the hotline procedure, mitigation efforts at Lauder College House, and the planned educational campaign that was unable to be implemented due to the spread of the novel coronavirus (COVID-19) in the spring of 2020.

Some challenges the team faced included the complexity of the factors involved in bird strikes, the time needed to establish relationships, and the slowness of Penn's decal installation process. Specifically, there are a multitude of factors that cause bird strikes to occur, so it is quite difficult to pinpoint methods that have definitive efficacy in mitigating them. This creates difficulty for facilitating Penn's buy-in of installations of decals or film on buildings since the efficacy isn't confirmed and the mitigation methods are often expensive. Additionally, it was time consuming to facilitate the communication of several community partners who would all be involved in the tracking and mitigation process while also developing education campaign plans and collecting birds. So, now that communications are in place it is recommended that they be consciously maintained through workshops and regular meetings. Penn's decal installation timeline was also quite tedious, and there are many potential causes of this since Penn is a large organization, but it essentially delayed the student Eco-Rep's analysis of the mitigation, which would have been vital to understanding how Penn can further mitigate bird strikes.

Ultimately, the team determined that the most effective course of action for this complex issue of bird strikes is to enforce a standardized procedure for considering bird safety *before* a building is constructed. This measure is a proactive way of mitigating bird strikes and has been proven to be longer lasting than decals or film that only last for 10 to 15 years. So, we strongly recommend that future Eco-Reps teams and/or FRES pursue the finalization of this clause.

## **Project Overview**

It is estimated that up to 1 billion birds die per year due to collisions with windows in the US.<sup>1</sup> Many of these birds provide essential ecological services, such as reducing pests, pollinating flowers, and dispersing seeds.<sup>2</sup> The loss of birds can be observed at the University of Pennsylvania as birds impact glass windows throughout campus. The goal of this project was to diagnose the severity of the problem and reduce the number of birds killed on campus by mitigating hotspots at existing buildings, creating bird-friendly design guidelines for new buildings, and increasing awareness of the issue. Work on this project occurred primarily with the University of Pennsylvania Facilities and Real Estate Services team, a significant point-of-contact that further provided the contact information of various stakeholders such as building managers, housekeeping staff, and other Penn affiliates.

### *Project Goals*

In the Fall 2019 semester, the project started with the exploration of a variety of data collection, focusing on walking daily routes to look for and collect bird corpses. An effort was also made to get in touch with all relevant stakeholders in hopes of building a campus wide network of individuals who would be able to continually contribute to data collection efforts after the 2019-2020 school year. In the Spring 2020 semester the focus of the project shifted towards implementing a campus engagement campaign, monitoring existing mitigation methods, and continuing campus bird strike collection.

### *Project Approach and Methodology*

During the fall semester, the project began by analyzing previously collected data from the iNaturalist Penn Bird Strikes (<https://www.inaturalist.org/projects/penn-bird-strikes>) project first created by Joe Durrance in April 2015. The sidewalks surrounding the Perelman Center for Political Science and Economics, the sidewalks surrounding the Annenberg Public Policy Center, and the inner courtyard of Lauder College House were identified as the three locations with the most existing bird strikes. As such, these areas were chosen for consistent documentation and collection of bird strikes. On Mondays, Wednesdays, and Fridays, these locations were checked at around 8:30 AM, and on Tuesdays and Thursdays these locations were checked at around 10:30 AM.

The procedure for a discovered bird strike is as follows. If a bird strike was found, a number of details were recorded both on paper and through iNaturalist. The time and date the bird was found, the GPS coordinates, a description of the location of the bird, the species of the bird (if known), and the unique iNaturalist ID number were all recorded on a sheet of paper placed inside a zip-top plastic bag. An observation was also uploaded to the iNaturalist page with all the same details, as well as multiple images of the bird strike from different angles. The corpse of the bird was then placed inside the plastic bag with the paper identification details. Collected birds were stored temporarily in a freezer on the second floor of Hayden Hall until they could be delivered and donated to the Drexel Museum of Natural Sciences.

Exploration of a more precise measuring tool of bird-window collisions was also considered and explored. After learning about the work of Dr. Carr Everbach from Swarthmore College (Appendix 4.3) regarding a novel vibration detecting and continuous video recording system for sensing the precise

<sup>1</sup> <https://pdfs.semanticscholar.org/57ee/ca0d1a8f715947b7e7fa8b9c36d67e71a7b3.pdf>

<sup>2</sup> <https://doi.org/10.1007/s10336-015-1229-y>

location and time of impact for birds, an attempt was made to connect with him and apply his work on Penn's campus. The goal was to mount some sort of vibration sensor and camera system on windows that would detect bird-window collisions and save a video recording of the impact in a data efficient manner. This would allow for increased precision in determining where windows are especially problematic. After communicating with Dr. Carr Everbach, it was determined that his solution system was not yet ready for implementation, as it was still in the early process of prototyping. This method of bird strike detection merits future exploration when implementation is possible.

In a direct attempt to mitigate bird strikes at Lauder College House, Keith Russel of Audubon Pennsylvania was consulted in order to suggest strategies that might be implementable. At the time, there were already plans to install "dot-pattern" styled window decals on the lower level windows of Lauder College House. These dot-pattern styled window decals enable birds to see windows, thereby decreasing the frequency of bird strikes.<sup>3</sup> However, after noticing feathers still clinging to the glass of the upper hallway windows (Appendix 7), he suggested the installation of some sort of covering, screen, or window art on these windows. In a somewhat premature effort, a recruitment blurb was sent out through the Weitzman School of Design listserv, and a large number of students expressed interest in designing window art for this project. However, it was determined that additional details would need to be determined prior to moving forward with this effort, including but not limited to the possibility of faculty buy-in and the requisite program structure, so progress was put on indefinite pause.

While the daily search routes resulted in the collection of 19 birds throughout the fall semester, the search capacity of two student Eco-Reps for the entirety of Penn's campus is limited. As such, an effort was made to connect with the university housekeeping staff, university groundskeeping staff, and other building managers or caretakers.

In terms of building managers and caretakers, Ellen Iwamoto, Nicole Tomlinson, and Ed Deegan, were contacted, all of whom had already been in contact with FRES and the Penn Bird Strikes project (Appendix 4.6). These individuals were surveyed how frequently, where, and how they were collecting birds. They were also encouraged to notify the Penn Bird Strikes team through a bird strike collection hotline email ([upennbirdstrikes@gmail.com](mailto:upennbirdstrikes@gmail.com)). Not only does this provide a centralized location for all necessary collections, but it also enables the account to be shared and passed on to subsequent Eco-Reps who inherit this project.

In terms of housekeepers, contact was initiated through two Eco-Reps working on the 2019-2020 Housekeeping Sustainability Training project: Marina Dauer and Catherine Chen (Appendix 4.8). Seeing as this project group was already aimed at engaging with housekeepers for the purpose of sustainability training, it was a natural decision to also add bird-strike protocols. The housekeepers were provided with a specific protocol for collecting the birds (Appendix 1).

During the spring semester, several goals were hindered due to the novel coronavirus leading to the rest of the semester being completed remotely. However, the intended methodologies to achieve the goals are explained below.

<sup>3</sup> <https://abcbirds.org/get-involved/bird-smart-glass/>

Two campus engagement campaigns were planned for Fridays in late March and early April. The campus engagement campaigns entailed the development of informational fliers (Figure 1), a physical display, and other incentives. The flier included an overview of the steps for prevention and tracking of bird strikes on campus, and the back of the flier included specific steps for notifying the Penn Bird Strikes team about the bird strike, as well as an image explaining the 2 x 4 rule for window decals that details the minimally effective dimensions of bird-friendly window decals (Appendices 2 and 6). The method of campus engagement specifically included tabling outside Lauder College House, which was chosen because of the high frequency of bird strikes there, as well as another location on Locust Walk to draw in general campus awareness. At the table, there would be a physical display which included a mirror with the intent of showing passerbyers what the last thing these birds see before dying. Additionally, free donuts would be offered to students who downloaded the iNaturalist application to their phones. In order to incentivize use of iNaturalist, a giveaway raffle was planned. Students would be eligible for the raffle upon adding a bird observation to the Penn Bird Strikes Project.



Figure 1: Informational flier for campus engagement campaign

Existing mitigation methods continued to be monitored, such as the planned installation of dot pattern window decals on Lauder College House (Appendix 5). While installation had not yet occurred before campus closure, efforts would have been made to measure their effectiveness by monitoring the Penn Bird Strikes hotline and iNaturalist to see how the number of bird strikes compares to previously when there were no decals on the glass walls of the Lauder College House courtyard.

In order to further mitigate the frequency of bird-window collisions, work was also done to draft a building clause, which includes specifications for how to make a building safer for birds. This building clause was intended for the use of FRES to ensure that future on-campus infrastructure would be developed with bird safety in mind. Not only would this contribute to the long-term sustainability of the campus, but implementing bird-friendly glass during the construction phase typically lasts much longer

than the 10 to 15 year lifespan of mitigation methods like decal or film. A draft of this building clause is included in Appendix 3, which still must be approved by the University of Pennsylvania’s Architect before its utilization by designers.

Another important part of the spring 2020 semester would have been to explore the implementation of the Penn Bird Strikes hotline. In the fall it was communicated with housekeeping and building managers to set up a protocol for housekeeping staff to notify the Penn Bird Strikes team through email whenever the dead bird was found. Some success with the campaign was observed with a few emails at the beginning of the spring semester where housekeeping managers notified us of a bird strike and left a wet floor sign nearby. However, the spring migration would have been a key time to determine the effectiveness of the campaign and to see if additional manpower from the Penn Bird Strikes team was required to assist in the collection of birds. During this time it would have also been possible to more accurately measure how many bird strikes were occurring on campus and more accurately determine bird strike hotspot locations.

### Research Findings

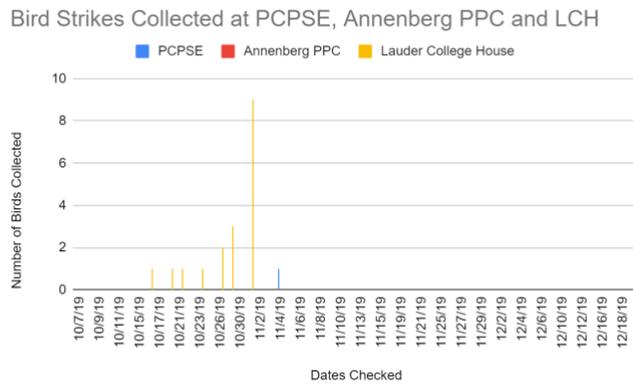


Figure 2: Frequency of Bird Strikes at Various Locations as collected by Eco-Reps

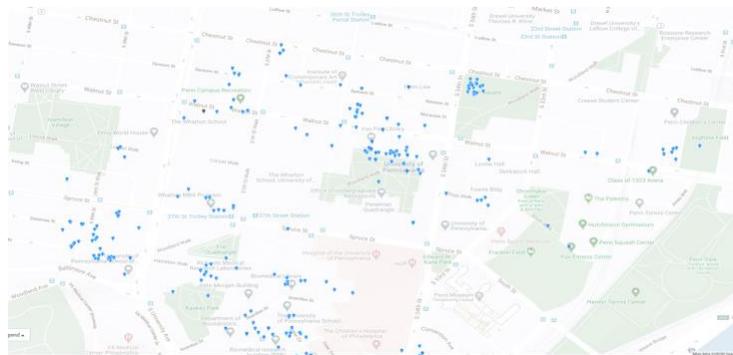


Figure 3: iNaturalist Map of Bird Strikes on Penn’s Campus as of 04/11/2020



Figure 4: Bird Species Identification and Count

Prior to delivery to the Drexel Museum of Natural Sciences, the collected bird strikes from the fall semester were laid out for species identification and final counts (Figure 4). In total, the following birds were recorded through iNaturalist during the student Fall 2019 semester from 09/09/2019 to 11/03/2019, sorted by decreasing frequency (Figure 5).

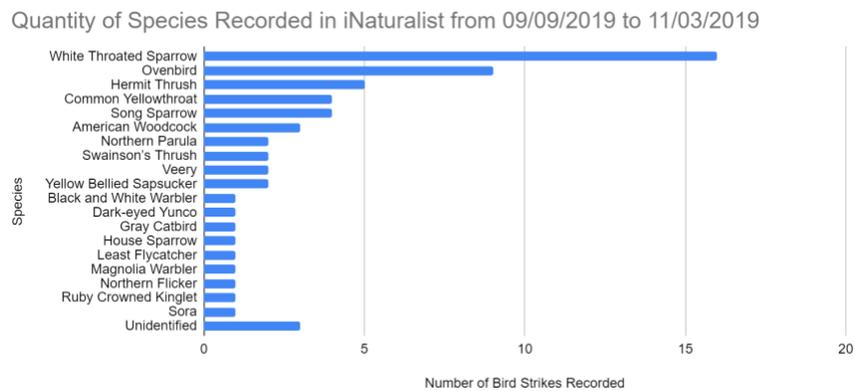


Figure 5: Bird Strikes Recorded on Penn Bird Strikes iNaturalist Page from 09/09/2019 to 11/03/2019

## Results and Evaluation

### Results

Most days there were no bird strikes found (Figure 2). However, a few key details should be noted. First, the collection was not continuous. Observations only occurred on weekdays and not during any holidays. Second, the collections only occurred between 8:30 and 10:30 AM. Most bird strikes occur at night, and groundskeepers are often cleaning up campus much earlier, at around 6-7 AM. As such, many bird strikes were likely discarded before observation. Circumventing this issue may prove to be a challenging effort moving forward.

Even with these limitations in mind, three important conclusions can be drawn from this data. First, the collections all occurred within a relatively small window of time, from mid October to early November. This coincides with the bird's fall migrations. Thus, in order to maximize the efficacy of any mitigation strategy, the strategy should be implemented before fall or spring migrations. Second, when bird strikes do occur, they can occur in large numbers upwards of nine birds at a time. When coupled with the fact that observations were somewhat discontinuous, the actual number of birds dying may be significantly more than what has been recorded. Third, the Annenberg Center for Public Policy and PCPSE may not be as active for bird strikes as initially predicted. Instead, as shown in Figure 3, Van Pelt library may be a building of greater concern. However, bird strikes from the large glass windows of Van Pelt are not accessible to the public for collection since they fall onto an inaccessible ledge extending from the

building.

### *Future Opportunities*

There are several ways that this project can be expanded in the future. First, the awareness campaign can be expanded in the form of regular tabling on Locust to increase student awareness and participation in the bird strike collection and general advocacy. Along with student awareness, in the future general PR opportunities should be pursued, such as adding the Penn Bird Strikes efforts to newsletters like the American Bird Conservancy's Glass Collisions newsletter. In addition to these in-person communication efforts, information about bird collisions and bird-friendly efforts should be added to Penn Sustainability's website.

The Penn Bird Strikes team can also work to analyze the efficacy of the installed decals at Lauder College House. This would include a qualitative analysis through speaking to housekeeping teams and Penn affiliates to understand differences in the experiences with seeing bird strikes during their shifts as well as a quantitative analysis by comparing changes in iNaturalist statistics. Furthermore, resumption of contact with students and professors of the school of design may prove to be fruitful for the design and installation of bird-friendly window art on the upper level windows of this building.

Additionally, work should be done to implement the draft building clause (Appendix 3) into FRES building standards so that future Penn facilities and buildings will be developed with bird safety in mind.

There also is an opportunity to collaborate with Dr. Carr Everbach from Swarthmore College to implement his vibration sensor and camera system on a few buildings on campus (Appendix 4.3). It is recommended that future teams correspond with him to continue the Penn Bird Strike team's relationship with him. This will ease the transition from when his research team has completed their product to when the Bird Strikes team is looking to install his system at certain locations on campus.

Collaborations with housekeeping teams/projects and building managers should be continued. The success of the tracking of bird strikes on campus is contingent on the housekeeping team's awareness and buy-in to the hotline. The initial success with Penn Housekeeping's sharing of bird strike sightings shows that it is vital that future teams maintain the education campaigns and collaborations with housekeeping management to ensure knowledge of the Penn Bird Strikes hotline and collection protocol that has been put in place. Additionally, as the hotline initiative continues, the team could explore further adaptations to the protocol through communicating with the housekeeping teams to understand any challenges or problems they are experiencing with the existing protocol. With the building managers specifically, the Penn Bird Strikes Team should aim to collaborate with them in order to facilitate the mitigation of one hotspot location each year. This will also require partnerships with interested Penn affiliates who would be willing to share the mitigation costs.

### **Conclusion**

Because bird strikes can continue to be expected, this project has potential to be continued and implemented as a continuous Eco-Rep initiative through the Office of Sustainability. The 2019-2020 project primarily laid the groundwork for a scalable project with three focus areas: (1) mitigating hotspots at existing buildings, (2) drafting bird-friendly design guidelines for future buildings, and (3) increasing

awareness of the issue. In the future, key objectives should be to continue to monitor bird strikes across campus through expanding the network of individuals involved with the project, and to continue to mitigate bird-strike hotspots across campus with a goal of one building per year being feasible.

## **Appendix**

### *Appendix 1: Housekeeping Staff Protocol for Bird Collection*

Please follow the following protocol until the end of this school year, but not during student holidays:

1. If you find a bird, please don't collect it.
2. Place a wet floor sign over the bird.
3. Immediately email [upennbirdstrikes@gmail.com](mailto:upennbirdstrikes@gmail.com) saying that you found a bird.
4. Describe the location of the bird as detailed as possible so that a student Eco-Rep/a member of the bird strikes team can find it and collect it.
5. If you can't send an email immediately, also note the time that you found the bird.

### *Appendix 2: Instructions for Hotline Usage on Backside of Flier*

1. Open up the iNaturalist app on your phone, and join the Penn Bird Strikes page.
2. Tap the observe button at the bottom of your screen.
3. Take a photo, and then add additional photos from multiple angles.
4. Under the notes section, detail the location of the bird in as much detail as possible.
5. Adjust the GPS coordinates to your precise location.
6. Add the submission to the Penn Bird Strike project.
7. Using an inverted Ziploc bag over your hand, pick up the bird.
8. On a slip of paper, write the species (if known), location (latitude/longitude from iNaturalist), and date/time of the find, the iNaturalist observation number and also put this in the bag.
9. Bring the bird to the freezer in Hayden Hall. It's in front of the graduate administration office, and it's covered with a bright tablecloth-you can't miss it.

If you don't feel comfortable doing this, we're also trying to promote our bird pickup hotline, [upennbirdstrikes@gmail.com](mailto:upennbirdstrikes@gmail.com). Just send an email to that address with the location, and one of us will try to pick it up. We'd also be happy to send you the login details if you want to help with collections.

### *Appendix 3: Building Clause (Draft)*

#### **BIRD-FRIENDLY DESIGN DRAFT GUIDELINES**

##### **Intent:**

Evaluate the opportunity to incorporate design strategies that reduce bird collisions with new buildings and where large areas of exterior glazing are replaced in renovated buildings.

##### **Exterior Glazing Guidelines:**

Develop a building façade strategy using bird-friendly material to make the building visible to birds by mitigating reflective and transparent conditions. Bird-friendly material should have a threat factor of 25 or less, as defined by the American Bird Conservancy.

Investigate the opportunity to include these guidelines in the design response:

- 2 x 4 rule: When trying to mitigate large glazed surfaces, uninterrupted horizontal spaces of reflective or transparent surfaces should be two or fewer inches. Uninterrupted vertical spaces of reflective or transparent surfaces should be four or fewer inches.
- Consider glazing with an ultraviolet (UV) pattern that meets the 2x4 rule and has a threat factor of 25 or less, as defined by the American Bird Conservancy.

- Consider screens, grilles, shutters, and/or exterior shades to interrupt reflective or transparent surfaces.
- Consider adding patterns to glazing: Interrupt reflective or transparent surfaces utilizing a visible pattern that responds to the 2 x 4 rule. Visible patterns can include lines, dots, etc. using etched or fritted glass.
- Carefully consider narrow spaces or glazed bridges that create the perception of fly- through conditions, ie. glass passageways with parallel glazing 17' or less apart that create an illusion of a void or reflective condition.
- Carefully review plantings near glazing for bird habitat and/or potential collision.

Interior Lighting Guidelines:

Minimize excess light emitted through windows at night, and where possible control interior lighting to automatically shut off at night.

Exterior Lighting Guidelines:

Shield all exterior fixtures such that the installed fixture does not directly emit any light at a vertical angle greater than 90 degrees.

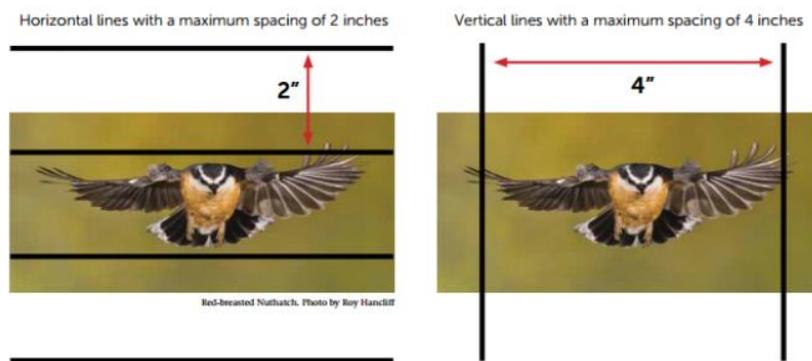
*Appendix 4: Key Stakeholders and Useful Contacts*

1. Project Partners:
  - a. Chloe Cerwinka - [chloec@upenn.edu](mailto:chloec@upenn.edu)
  - b. Joe Durrance - [durrance@penmedicine.upenn.edu](mailto:durrance@penmedicine.upenn.edu)
2. Pennsylvania Audubon:
  - a. Keith Russell - [krussell@audubon.org](mailto:krussell@audubon.org)
3. Swarthmore Contact for Vibration Sensing:
  - a. Carr Everbach - [ceverba1@swarthmore.edu](mailto:ceverba1@swarthmore.edu)
4. Penn Director of Housekeeping:
  - a. Wendy Sparks - [wsparks@upenn.edu](mailto:wsparks@upenn.edu)
5. Operations Manager of Housekeeping:
  - a. Joseph Gaither - [gaither@upenn.edu](mailto:gaither@upenn.edu)
6. Special Projects Manager at Lauder College House:
  - a. Stephen Mauer - [stmauer@upenn.edu](mailto:stmauer@upenn.edu)
7. Bird Strike Monitors:
  - a. PCPSE: Nicole Tomlinson - [nicolet@upenn.edu](mailto:nicolet@upenn.edu)
  - b. Annenberg Center for Public Policy: Ellen Iwamoto - [ellen.iwamoto@appc.upenn.edu](mailto:ellen.iwamoto@appc.upenn.edu)
  - c. Fisher Fine Arts Library/Meyerson Hall/Van Pelt Library area:
  - d. Ed Deegan - [edeegan@pobox.upenn.edu](mailto:edeegan@pobox.upenn.edu)
8. Bird Strike Monitoring Project at Temple University:
  - a. Kathleen Salisbury - [kathleen.salisbury@temple.edu](mailto:kathleen.salisbury@temple.edu)
9. Eco-Reps working on Housekeeper Training Project:
  - a. Marina Dauer - [mdauer@sas.upenn.edu](mailto:mdauer@sas.upenn.edu)
  - b. Catherine Chen - [catchen@wharton.upenn.edu](mailto:catchen@wharton.upenn.edu)

*Appendix 5: Example Dot Grid Window Decal, Image Courtesy of Convenience Group Inc.*



*Appendix 6: Visual Representation of 2x4 Rule, Image Courtesy of American Bird Conservancy*



*Appendix 7: Clinging Feather, Evidence of Bird Strike on Western Hallway Windows of Lauder College House*

