

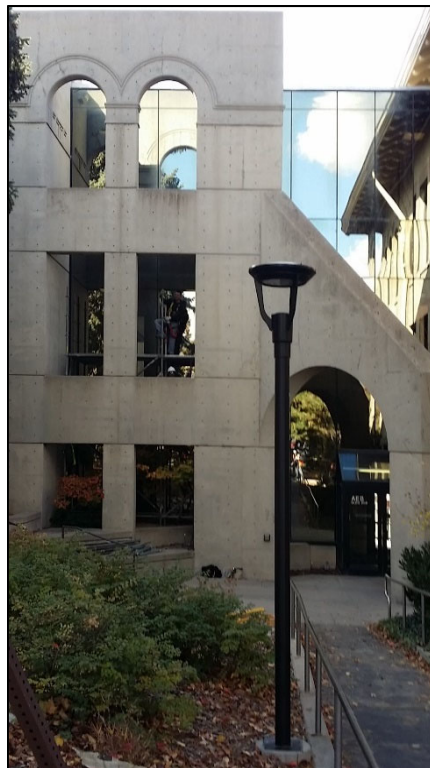
Bird-window Collision Study Manual
Techniques and Practices for Bird-window Collision Studies

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Our discovery: Pear trees + mirrored/reflective windows = Dead Cedar Waxwings



*Our solution:
Pear trees
+ mirrored/reflective windows
+ Feather Friendly®
= 71% fewer bird strikes!*



Your solution? We encourage more bird strike studies. We have written this guide to make it easier for you to do a bird strike study for classes, research, clubs, or service organizations.

- Barbara Brown & the bird strike team

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Introduction

We have developed this manual to encourage other universities or institutions to engage in bird window collision studies preparatory to mitigating bird deaths from window collisions. Over 250 universities or colleges have green or sustainability funds to improve their campuses, but few bird window collision prevention projects are listed on the Association for the Advancement of Sustainability in Higher Education site (AASHE, 2019). We believe that many disciplines offer courses or independent study opportunities that could include bird-window collision counts and mitigation efforts.

We have benefitted from other studies that advise on best practices and methodologies for window collision studies and we try to address why alternative methods might be chosen for your specific study (Hager & Cosentino, 2014; Loss, Loss, Will, & Marra, 2014). Our belief is that it is especially important for universities to mitigate the worst windows for birds on campus. Research shows that between 365 and 988 million North American birds die annually from window strikes, removing 2% to 9% of the yearly bird population (Loss, Will, Loss, & Marra, 2014). “Birds behave as if windows are invisible” (Klem, 2009). Unless you conduct systematic observations, it is easy to overlook the extent of the problem. If we can identify and mitigate the worst buildings, many birds will be saved.

Collision studies are often initiated because people hear birds striking windows or see dead or stunned birds. At the University of Utah, we discovered two buildings were responsible for many Cedar Waxwing fatalities in winter because buildings with reflective windows were near the fruiting pear trees that provided their winter food. Our casual observations led to more systematic documentation of the problem, applying for a “green fund” grant to protect the worst windows, and a follow-up evaluation (Brown, Kusakabe, Antonopoulos, Siddoway, & Thompson, 2019). We have been surprised at how often people fail to “see” bird carcasses. We describe the steps needed to conduct the systematic observations and documentation of collisions in order to determine if problems exist and, if so, how to use the data to propose funding of mitigation of the worst windows.

We cover all the details you would need to conduct a study that might be publishable, although many studies would simply need to document where problems occur in order to write a persuasive proposal. Here you find answers to your questions:

- What supplies and technology are needed?
- How do you get started checking for collisions?
- How to train observers?
- How do you store the data?
- How do you write a grant proposal?
- How do you publish an intervention or risk factor study?

Supplies and technology

Briefly, our procedures involve scheduled observations for bird carcasses under target building windows, with photos documenting each building uploaded to a cloud server, and photos of bird carcasses uploaded to an iNaturalist project, then summarizing the data.

1. Supplies

- Photographing device (smartphone, camera, etc.)
- Plastic bags (gallon size, ties or Ziplock, for double bagging bird carcasses)
- Gloves (nitrile, to avoid latex allergies)
- Bird carcass label and explanation cards to carry (examples below)

Finder name: _____

Species (if known): _____

Date: _____

Building details: Name, side (N/S/E/W), near what end or under what window:

UNIVERSITY OF UTAH

BIRD - WINDOW COLLISION PROJECT

We are doing systematic searches of campus building exteriors
for evidence of bird strikes.

Learn more:
https://fcs.utah.edu/research/bird_project

Report a dead bird:
Email: UUBirdStrike@gmail.com
Text or Call: (385) 200-0813

Figure 1: Carcass collection label & explanation card examples

2. Recommended Applications/Programs

- Box for uploading building photos (or other cloud storage network, be sure it is free or low-cost)
- iNaturalist for uploading bird carcass photos (set up a project page that specifies your location; see <https://www.inaturalist.org/projects>)
- SPSS, if you want to do statistical analyses (or other statistical packages like R or Stata)

Advanced planning, permissions, & schedules

1. Spread the word.

You may want to alert the grounds staff so that they can report dead birds to you. You may want to alert staff in the buildings that you are observing. The institution may require some formal permission. Local customs will vary. We find that a good way to spread the word about the study is to offer explanations when people look curious about our activity; explanatory cards (pictured above) can help.

2. Get permission to conduct research, if applicable.

If you anticipate you want to publish findings as research in a peer-reviewed journal, you will need to get permission from a research review committee, such as an Institutional Review Board.

3. Plan for stunned birds.

Before beginning study, find a person or organization that will be able to take in injured birds in case that a wounded bird is found during the study. Have a box with air holes that can be used to place the injured bird until it may be delivered for recovery.

4. Plan what to do with bird carcasses.

An ornithologist on campus had the needed permits to take our carcasses and either use them for research, prepare them for museum display or dispose of them. You cannot possess or own a carcass otherwise. You may need to find federal (see <https://www.fws.gov/pacific/migratorybirds/permits/salvage.html>) or state requirements that regulate your situation (Hager & Cosentino, 2014).

5. Choose the season(s).

Many studies report higher bird fatalities during fall or spring migration, especially fall (Borden, Lockhart, Jones, & Lyons, 2010; Hager et al., 2013; Kahle, Flannery, & Dumbacher, 2016; Loss, Will, & Marra, 2015; Schneider, Barton, Zirkle, Greene, & Newman, 2018). However, we found our problem to be in winter and others have found many strikes occur in summer (Hager & Craig, 2014). If you are choosing to conduct a study because birds are known to hit particular windows, you may want to pick the season when they hit windows most frequently.

6. Choose the two to three days per week (minimum) to observe.

For accuracy, it is best to complete systematic observations at least 2-3 non-contiguous days a week. Carcasses usually remain in their original position in this time frame; longer intervals between observations risk scavengers removing the carcasses (Hager, Cosentino, & McKay, 2012; Hager & Craig, 2014; Kummer et al., 2016; Riding & Loss, 2018).

7. Decide if you want a consistent time of day for building checks.

Many birds struck during the afternoon in our winter study, but some studies collect morning data to retrieve migrants who hit buildings overnight (Nichols, Homayoun, Eckles, & Blair, 2018). You may need to collect data when labor is available, but try to make sure ground crews do not remove birds.

8. Anticipate schedule problems.

Team safety is important. Check weather to anticipate problems such as snowstorms; alter your schedule as needed to fulfill your weekly quota. Plan for holidays or illness.

If your schedule is not met, record the inconsistency. Determine if the miss will be a single incident or if schedule needs to be changed in order to better accommodate the week's quota of daily checks.

9. Clean-up day before the regular schedule.

To compare buildings, you want to look for bird strikes in about the same week. To make sure each systematic observation phase starts fresh, clean up all the old carcasses around all the target buildings before your scheduled study. We upload these observations to iNaturalist but do not count them in the building comparison data analysis.

Building selection, route, and risk factor documentation

1. Which buildings should be chosen for data collection?

Importance: If your goal is to identify hot spots and risk factors, it is important to sample both “bad” and “good” buildings. Past research shows that the bad buildings have lots of glass or very reflective or mirrored windows, especially near sources of food or habitat, such as trees or food sources (Borden, Lockhart et al. 2010, Schneider, Barton et al. 2018, Brown, Kusakabe et al. 2019). You also want to target some good buildings with few risk factors, with less glass or away from habitats. It is good to select a range of buildings along the bad to good continuum.

If you have any buildings designed specially to prevent bird strikes, through any of the bird safety glass features noted on the American Bird Conservancy web site, it can be useful to include those because there are few field tests of how well mitigation such as fritted glass or bird deterrent film works in practice.

A large data set helps reveal safe and unsafe buildings. For example, systematic observations of buildings with and without windows having anti-reflective treatments allows you to estimate the true effectiveness or dangerousness of windows in a particular setting.

Variation: To strengthen estimates of how many birds are killed in window collisions, Loss et al. recommend that buildings be randomly sampled (Loss, Loss, et al., 2014). Researchers also may want to combine collection of data on suspected hot spots with random selection, making sure to note which observations derive from randomly or nonrandomly chosen buildings.

2. Document the number of buildings and the facades being studied

Importance: This is necessary to create a consistent study protocol. Every participant in the research should know where checks are being conducted. Building names, locations, and the extent of façade checking should be recorded and maintained throughout the study.

In some instances, the research assistant (RA) will circle a building, in other cases, just part of a building may be included in the study. Part of a building may be excluded because it is difficult to access due to hilly conditions or fencing that prevent easy access.

3. Detail information about each building’s risk and protective features

Importance: Recording the features of buildings in the study creates a database of the unique risk or protective features of the buildings. Because multiple buildings are being studied, it is important to document what characteristics may make a building more or less dangerous for birds.

Some characteristics that may be noted are the areas of glass faces, the types of glass (reflective or anti-reflective), surrounding vegetation types (fruiting trees, foliage height and density, etc), building stories, and façade orientations. Campus planners can provide information such as window areas and sizes of facades of buildings.

Training research assistants, conducting systematic observations

1. Training research assistants

Have a trainer walk along with new research assistants to familiarize them with the route and search practices. We have placed carcasses along routes to get RAs used to the task and to check for their reliability. Practice taking photos, uploading them, and editing the uploaded photo name with the initials of the research assistant. Get used to how far out from the building to search; we use 3 meters and a tape measure for training. Depending on the complexity of the route, it may be useful to provide maps annotated with the route. Encourage RAs in training to look through past collections of dead bird photos on iNaturalist projects, so they can become aware of how carcasses can blend into the ground cover or other surface of the ground.

While research assistants are in training, it is useful to have data collected by a trained person, just in case new research assistant proves unreliable. Also, it may be important to figure out how best to assign research assistants. One of our buildings had a preschool in it, so we made sure that only female research assistants walked by those windows.

2. Systematic observations

- Walk along determined study path next to building, observing up to 3 m. away
- Avoid stepping on vegetative landscaping (e.g. bushes and flowers). Instead weave around vegetation.
- Examine inside, behind, and underneath bushes and trees that may hide carcasses (when accessible).
- Search windows for strike marks- When examining buildings, check for (new) strike marks on glass facades because this may indicate that a bird has fallen in the area. See examples below.



Figure 2: Examples of window strike. Photos by Lia Hunter

3. Opposite direction checks: Alternate clockwise and counter-clockwise search paths across days.

Going one way around a building gives one perspective and going the opposite direction gives a different perspective that can enhance detection of carcasses (Hager & Cosentino, 2014). Shadows, vegetation orientation, and other obstructions can alter bird counts. Checking in opposing directions can alleviate some of these errors. To minimize the influence of a limited perspective, go clockwise on Tuesday, but counter-clockwise on Thursday, for example. A variation used by Hager is that one person circles each building twice, in opposite directions, each time a building is surveyed.

Take photos of buildings and bird strikes

1. Take a photo of each building checked and upload it to storage

Importance: Recording each building check, even those without found birds, confirms that the check was completed. We advise taking a picture that has enough detail that we can recognize the building. These photos can be useful for later presentations, especially when you take good pictures of reflections in windows or proximity of fruit trees to buildings, for example.

We uploaded photos from the cell phone to a Box cloud storage shared directory (screen shot examples are provided below). When photos are given default names that include the day, hour, and minute of the photo, this allows easy tracking of the time of each observation. Editing the photo name to contain initials of the RA allows for a record of who completed the search. For example: "20191112_111611_LH.jpg" indicates that a photo was taken November 12, 2019 at 11:16 am by RA with initials LH. Sometimes research assistants could not provide default file names in the preferred format, so we did not use them as data collectors.

In many cases, conditions may be too bright to upload photos of buildings or birds from the field, if it is difficult to see the cell phone screen. Arrange for a way to upload all photos soon after they are taken. Some research assistants go indoors immediately after data collection to upload, while others upload after they get home. Adopt a system that is convenient but reliable for your team. During one season, we found it useful to assign a team member to check on uploads weekly and send out reminders to any team member who neglected to upload the week's data.

2. What is a bird strike or collision?

We found this definition useful: A strike is counted as any stunned bird, fatality, or feather pile (>12 feathers within a square foot or 0.09 m²) found under walls with windows and extending approximately 3 m (about 10 feet) from the designated building.

This definition excludes birds found under walls that have no windows; for example, on the northeast corner of one building there was a pine tree in front of a wall and predators would perch in the tree and eat birds, discarding the carcass on the ground below. Although the bird might have struck a window and been removed by the predator to the pine tree, we could not verify that possibility, so we counted these carcasses and uploaded photos to iNaturalist but did not include them in our analysis of window strikes. Make sure these exceptions are explained on the iNaturalist notes.

3. Take photos and notes of any bird species and locations and upload to iNaturalist

To identify species, you may need close-up shots of the bird's front, back, and side markings. Before moving the carcass, because we want to know what windows are problematic, we take a picture of the bird and the building façade surrounding the strike. To get the close-up shots that can identify the bird, once the context shots are finished, you may need to move carcass to better position with gloves or using the plastic bags as a glove.

We upload these photos to iNaturalist to organize and share the collected data. We upload the best close-up of a bird first, which can help other iNaturalist users to identify the bird, then any other pictures of the bird that might help with identification, then the surrounding building context pictures are uploaded last. If we don't know the species we ask bird experts on campus to weigh in; iNaturalist users can also verify identifications. Occasionally there carcasses or feather piles that cannot be identified, so we just list them as unknown.

All iNaturalist entries allow you to upload photos, the bird's location on a map, and bird species or guess of species, and notes. Our project added custom questions about whether the bird was dead or alive and about the building name and side. If you can identify which windows were hit, that would be optimal. You may be able to raise only enough money to mitigate the worst windows; we did not cover the first floor, given that we saw most marks or strikes (smudges, outlines of birds, feathers stuck on glass) on the second and third floor windows.

We also upload photos of dead birds to a Dead Bird folder on our Box account. This is helpful as a backup and to document when both RAs saw the same dead bird on a reliability check (see details below).

4. Collect any bird carcass to place in your designated location.

Use plastic bag to collect bird carcass (if Ziplock, turn inside out to use bag as glove). Seal or tie bag. Fill out a carcass tag (see Figure 1). Put the bagged bird and carcass tag in a second bag, making sure written information is visible from the outside of the bag.

We give the carcasses to our biology department personnel who can use bird carcasses for research, display, or disposal, with proper salvage permits.

5. When you find a stunned bird.

Try to take a picture, but do not stress the bird by too close an approach. The bird may just need a few minutes to fly away. If not, have a box with air holes available to all research assistants in a known and accessible location in case it is needed. This box can be used to keep the bird warm while transporting to the designated rehabilitation outlet for recovery.

6. Record collisions found outside of scheduled checks separate from main study

Importance: This can help identify other hotspots while keeping the original study accurate. If they occur outside of the scheduled observations and at different buildings, they may indicate a problem area to include in future systematic observations. In practice, this means at the end of your project you will have an iNaturalist file that may include a) bird strikes at your target buildings during scheduled days, b) bird strikes at target buildings on unscheduled days, and c) bird strikes elsewhere.

If a dead bird is found outside one of your target buildings but not on a scheduled data collection day, you can leave the carcass there and see if it still exists to be counted during the next data collection day. If a stunned bird is found outside a target building but not on a scheduled data

collection day, you can take a picture and upload it to iNaturalist, but do not count it as a scheduled observation.

Conduct reliability assessments

1. Implement reliability checks

Importance: Assigning at least two RAs to check the same buildings at the same time for at least a portion of observations can demonstrate how often two research assistants agree on the presence or absence of birds. Past research has found that an RA might be as low as 70% likely to find a bird on only one pass (Hager et al., 2013). Technically, good research achieves high inter-rater reliability. Inter-rater reliability statistics yield values of 0 to 1, with higher scores showing more agreement. Statistical analysis of inter-rater data, using SPSS software, is provided in the appendix. If you are trying to publish the study, this is very important.

2. How to maintain independent checks when 2 RAs check a route together

It is important to note that one RA should not inform another of a bird carcass until after the building has been completely checked by both RAs. When you find a dead bird during a reliability check with 2 RAs:

- a) Take a quick photo of the bird as so it is not obvious to the other RA that a carcass was found.
- b) Finish building check procedure as normal, taking the regular overall building photo.
- c) Meet with other RA once finished and discuss findings, returning to the carcass or carcasses and comparing any quick photos to prove whether both RAs saw each bird or not.
- d) If only one RA noticed the bird and took the initial quick photo, that RA should then take more careful photos to document and upload to Box and iNaturalist. The context photo is uploaded to the building folder on Box and all carcass photos are uploaded to a Dead Bird file on Box.
- e) If both RAs saw the bird initially, make sure both upload photos with RA initials to Box. However, only one RA should upload the photos to iNaturalist.
- f) Alert the project manager in an email if there were dead birds found during a reliability check, including which RA saw or did not see which carcass, so that the project manager can enter the data into a special reliability data file.

Upload Building and Bird Data to Box and iNaturalist

Below is a guide of how to set up suggested applications on a smartphone.

Note: When you find a bird, building pictures go in both Building folder (in Box) and the Dead Bird folder (in Box)

Box (version 5.3.4)

Box is a free online storage system that allows users to share and store data such as photos and files.

Set up:

1. Search for “Box” in your app store and download the app.
2. Create an account or sign in with existing account.
3. Tap the red “+” on the bottom corner and select “new folder”. See *Figure 3*.
4. Add name to folder (e.g. Bird Project).
*You can add folders within this folder with names of buildings in the study and a dead bird file.
5. Enter the email addresses of each person you would like to have access to the folder. Use a comma between each email address. Select the “permission” down arrow and tap the editor option to allow users to add/edit folder (Box.com, 2020).

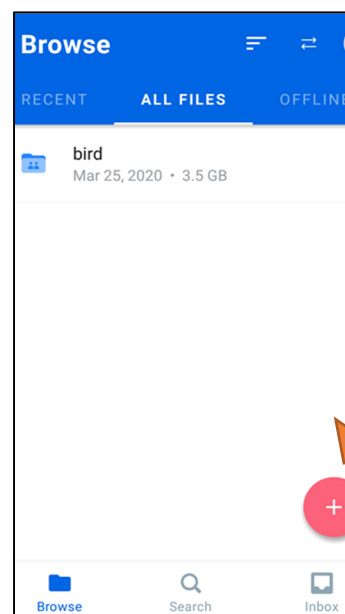


Figure 3: Box screenshot

See the Box support site for more information:

<https://support.box.com/hc/en-us>

Uploading photos:

1. In phone’s photo gallery, select the image you would like to upload to Box.
2. Tap the sharing icon and pick Box as the sharing location.
3. You should then be led to the Box app where you may select the correct folder.
4. Upload the photo.
5. Edit the photo name with your initials at the end. Go into the photo, tap the more options icon, then select “rename”. Adding initials will help identify who took the image.

iNaturalist (version 1.17.16)

This application allows users to organize and publicize bird observations.

Joining a Project:

1. Download “iNaturalist” from your app store.
2. Create an account.
3. Once directed into your account page, go to projects tab.
It can be found in the “more options” icon at the top left-hand corner.
4. In the search bar, type in the name of project you want to join.
(e.g. University of Utah Bird Window Collision Project. See *Figure 4*.)
5. Select the project. You will be prompted to the project’s homepage.
6. Tap the join button.

See iNaturalist help site for more information: <https://www.inaturalist.org/pages/help>

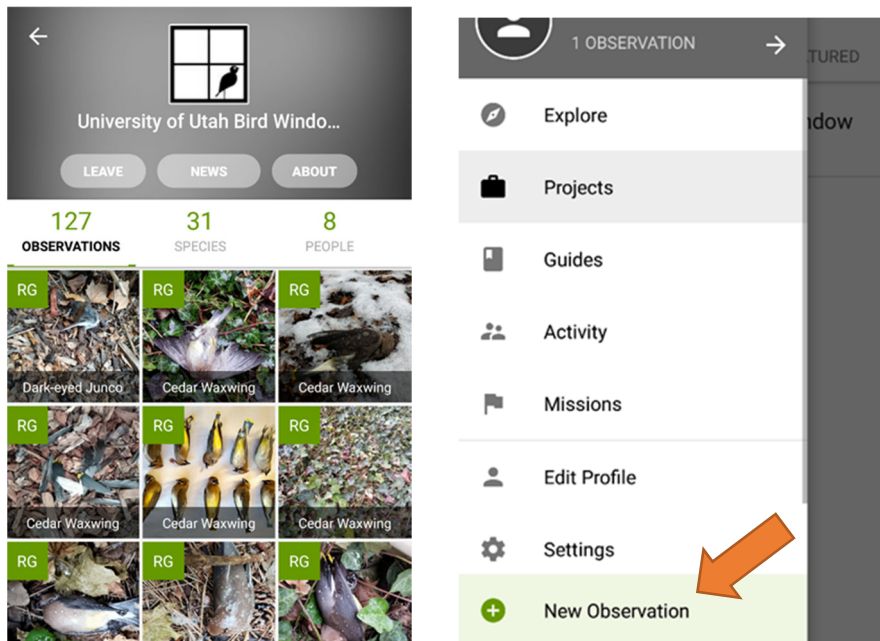


Figure 4: Left - Screenshot of U of U project. Right- More options side bar in iNaturalist

Adding an

observation

1. Go to “New Observation” (green “+”).
It can be found under the “more options” icon at the bottom of the side bar. See *Figure 4*.
2. Tap the “Choose Image” option. Select photo from gallery.
3. You will be directed to a form in which you can fill out details about the observation.
 - a) Add other photos (building, context photos, etc.)
 - b) Add bird identification (species) if applicable
 - c) Add specific location of sighting.

Tap location field and zoom to where the observation was found. Place marker specifically in location then save.

- d) Fill out bird condition and other notes as needed.
- e) Tap the "Add Project(s)" field and select project to submit to.
- f) Tap the check mark when finished.
- g) Go to your project's homepage to verify the observation was submitted properly.

Conduct Data Analyses

If you are a student group trying to understand whether bird strikes are a problem on your campus, you may simply want to tally strikes across buildings. If areas have lots of strikes, you may want to use these data to apply for funds from a campus green fund for mitigation.

If you want to publish your findings, more sophisticated analyses will be needed. In a supplemental Excel file (Appendix1_Brown2019PeerJ_DataExample.xlsx), three types of analyses are illustrated, using SPSS software (IBM, 2017). All three were published in our earlier study (Brown et al., 2019) and the data and syntax (i.e., commands) appropriate to an SPSS analysis are provided on three separate tabs. Please note that these studies involve repeated observations of the same buildings over time, so you need a data analysis technique that accounts for the repeated nature of the data collection, instead of treating them as independent observations. We used Generalized Estimating Equations, but other techniques may be suitable as well, such as mixed models. The examples cover three types of data analysis:

1. Reliability test- How to demonstrate that two Research Assistants have strong agreement on their observations.
2. Intervention evaluation. How to show that bird strikes went down from one year to the next after installing bird protection (Feather Friendly, in this case). The design is a pretest-posttest design with untreated comparison group.
3. Risk factor evaluation. How to tell if things like pear tree proximity, bird-friendly windows, or mirrored windows relate to the odds of a building having a bird strike.

Apply for Mitigation Funding

Universities often have some source of “green funds” for projects related to sustainability. In fact, over 250 universities or colleges have green or sustainability funds to improve their campuses, but few bird-window collision prevention projects are listed on the Association for the Advancement of Sustainability in Higher Education site (AASHE, 2019). These include projects at William and Mary (Weber, 2016), University of Pennsylvania (Durrance, 2015), and Temple University (Elmhurst & Grady, 2017), with various mitigation methods tested. Sometimes art classes design etchings or paintings on the window exteriors so that birds can see that the windows are a solid surface and sometimes commercial window film is applied.

In our case it was not really possible to consider an art project as mitigation because the approach to the windows was tricky. A company was hired to building a scaffold over a stepped planting structure to access the upper two stories of the building.

Appendix 2 (Appendix2_Brown2018GreenFundsProposalExample.pdf) contains the text of the proposal that funded the first \$10,000 round for applying Feather Friendly® mitigation. Please note that we ordered a different product from the do-it-yourself product referenced in the proposal. The company makes coverings in big sheets that are applied to the whole window surface. Then the backing is removed and small white dots are left on the window exterior, which are visible to birds. As noted in our publication, we covered a small part of a mirrored window wall and it reduced bird strikes from 7 to 2, across two consecutive winters, with no change in the rest of the uncovered windows, at 8 each winter.

If you want to consider other solutions, you can consult the directory at the American Bird Conservancy web site (<https://abcbirds.org/program/glass-collisions/bird-friendly-window-solutions/>). These solutions have been experimentally tested in flight tunnels. More studies of these solutions on actual buildings are needed, so we encourage you to publish your findings to help save birds.

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