Investigating Bird-Building Collisions at the University of British Columbia's Vancouver Campus

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Table of Contents

ABSTRACT

Human-wildlife conflict is an inevitable issue that can be observed in almost every sector of living in the Anthropocene. Bird-building collisions, which cause the deaths of 25 million birds annually in Canada, are a prime example (Machtans et al., 2013). These collisions occur due to avian vision not perceiving glass as a direct barrier. Specifically, the fact that windows are highly reflective, and are often in close proximity to tall vegetation and nearby attractants such as bird feeders cause many birds with high flight speeds to be unable to avoid impact in time. This study investigated the number of collisions occurring at the Buchanan Blocks (A-E) on the University of British Columbia's Vancouver Campus in an 8-week study, as well as looked at how retrofitting with the use of FeatherFriendly® markers affected these findings. An 80% decrease in collision evidence was found between 2021 and 2024, with two facades being retrofitted during 2022 and 2023, suggesting that the use of these stickers should be continued at Buchanan, specifically as a cost-effective solution for existing windows. Finally, education is a crucial aspect of management that leads to continued support towards human-wildlife coexistence.

INTRODUCTION

In Canada, an estimated 25 million birds fall victim to window collisions each year (Machtans et al., 2013). In fact, glass is associated with being one of the most destructive anthropogenic sources of bird mortality (Rossler et al., 2015). Following a collision, approximately 55% have been shown to be immediately fatal due to intracranial hemorrhage (Klem, 1990). With that being said, this number is likely greater considering those who survive the initial impact, but go on to succumb to their injuries, such as due to a physical injury that prevents the bird from partaking in natural activities including searching for food or avoiding predation. Regardless, avian prevalence has thus been experiencing a decline of 29% since the 1970s (Rosenberg et al., 2019). Several individual and environmental factors may be at play when considering this decline from a bird-building collision perspective.

On an individual level, avian vision is not particularly adapted to view glass as an obstacle. Birds are more perceptive to movement, specifically that in their surroundings, not directly in front of them as their eyes are situated towards the sides of their heads (Rossler et al., 2015). Because they do not see the reflective glass as an imminent barrier, and due to their high flight speeds, they often do not have enough time to change the course of their flight before colliding with these surfaces. Moreover, habituation to an environment and species characteristics play a role in collision risk. For example, De Groot et al. (2021) found that the Varied Thrush, a low-forest dweller, had the highest vulnerability for collisions, while the American Crow, an urbanized city dweller, had the lowest. This suggests that species not as familiar with a specific environment may be more at risk of colliding with buildings. Ocampo-Peñuela et al. (2016) support this by stating that those who regularly fly low and precisely through small spaces, such as thrushes are more vulnerable. As the University of British Columbia (UBC) is located on the Pacific Flyway, a busy migratory route, many birds passing by may be unaccustomed to the abundance of glass-heavy buildings through which they must navigate along their journeys.

As for environmental risk factors, the most significant is the amount of glass on a building, which is positively correlated with the number of collisions (Zulian et al., 2023). When there are large areas of glass, reflections can be deceiving and birds may mistake them for open air. In fact, Klem et al. (2009) found that the risk of window strikes was reduced by 69% when there was less space in between facades (ie. less space from one face of a facade to the face of another). Additionally, vegetation in proximity to facades contributes to collision risk. Klem et al. (2009) described that for each 10% increase in tree height came a 30% additional collision risk. This could be due to the fact that the vegetation reflects onto the glass and further resembles an open area. A final consideration in the realm of this study is the presence of attractants. Attractants consist of anything that may compel a bird to visit an area. Vegetation is a great attractant, as it can serve as a resource for not only nesting, hiding, and perching, but also nutrition. Likewise, bird feeders are common attractants that may increase the risk of a collision with a nearby building. Machtans et al. (2013) studied the level of mortalities arising from varying building types and found that in Canada, houses caused 90% of mortalities, likely due to the great amounts of vegetation and feeders that attract birds close to the windows.

It is important to mention the influence of migration season on collision risk, though it is not a substantial consideration in this paper. Studies have shown that the most vulnerable species are those that are migrating between breeding grounds (Loss et al., 2019). De Groot et al. (2021) also noted that the fall migration season possessed the highest collisions, though winter and spring also were significant.

With all that being said, bird collisions are a prime example of a human-wildlife conflict. We will inevitably exist in the same spaces, and in this case, the construction of new buildings cannot be prevented. Landscapes in the Anthropocene are constantly being urbanized. As a result, not only are birds losing their natural habitat for new buildings to be constructed, but these obstacles then contribute to millions of their deaths. Thus, this study highlights the importance of mitigation strategies to prevent these collisions and promote an environment of coexistence for wildlife and humans.

This study focuses on the Buchanan buildings (Blocks A-E) on the University of British Columbia's Vancouver Campus. This set of buildings has data beginning in 2021 which can be compared to the 2024 findings. Two of the building facades had been retrofitted with FeatherFriendly® markers prior to the 2024 study period. These elements allow for a general comparison of findings throughout the years, and to compare to the literature on the efficacy of such markers in decreasing the number of collision events.

Considering the literature, we hypothesized that there would be a greater number of collisions on facades that are highly reflective, and in close proximity to tall vegetation. Moreover, we believed that the number of collisions on previously retrofitted facades would decrease in regard to past data. In the grand scheme of things, we wanted to continue collecting collision data for Buchanan Building Management in order to encourage further action into becoming bird-friendly.

METHODS AND MATERIALS

Study Procedure

In order to determine the number of collisions occurring and compare them to previously retrofitted facades, this study consisted of eight weeks of data collection which were not consecutive. The study period began on January 31st, 2024 and was completed on March 29th, 2024. Three days were surveyed each week, with the exception of twice during the week following reading break (February 19th to 25th, 2024). Prior to beginning surveying initially, and following reading week, a day was spent cleaning any prior evidence that had occurred outside of the study period that was insignificant to our data (hence, only two days of data collection following reading break). A note was made in a shared file with the three surveyors for evidence that was inaccessible due to height, in order to prevent the repeated recording of the same piece of evidence. As mentioned, three surveyors total participated throughout the study period. Two people surveyed each session, for a total of two weekly surveys per person.

To assess for collision events on monitoring days, the two members began at the front doors of Buchanan A (facade 31), just off of Main Mall (see Figure 1). The two surveyed in opposite directions around the entirety of the facades, allowing for proper visibility of evidence from different angles. The area within 2m of the windows was searched, including within vegetation or other obstacles to the best of the surveyor's ability.

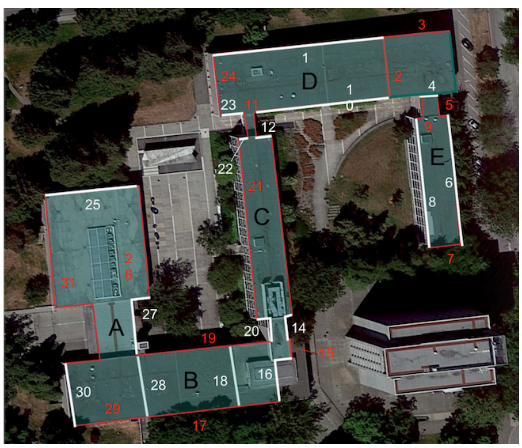

Figure 1 Map of the 31 Buchanan Facades monitored throughout the 8 weeks of surveying.

EpiCollect

Once both surveyors had completed the monitoring of all 31 facades without speaking, the pair returned, together, to locations where evidence was found. There, the evidence was discussed, and recorded in the EpiCollect app under the *UBC Buchanan Building Bird Collisions Project.* The EpiCollect app asked a series of questions in the following order: initials of the surveyors present, the date of the survey, the building survey start time, weather condition at the start of the survey, if collision evidence was found, and if the answer was no, the building survey end time, and any other additional notes. If the answer was yes, the location with latitude, longitude, and accuracy, as well as the facade where it was found, the initials of the observer who found the evidence, and what type of evidence was recorded, where more specific questions describing the evidence were asked, and images were collected.

Returning to elaborate on the possible weather conditions, the options included clear or a few clouds, partially cloudy or variable sky, cloudy or overcast, fog, drizzle, rain, snow, or showers. As for evidence categories, a carcass included the body of any bird, where it could be further separated into complete, scavenged or partial. A feather pile had to include at least 10 distinct feathers all being located within a 1m diameter circle area, and a feather smear consisted of a feather being stuck to the glass.

When evidence was found, it was cleaned and removed. Feather piles and carcasses were to be collected in a bag and labelled with the building code (ie. BUCHC) facade number, time of day and date, and if possible, species, before being brought to the freezer in Macmillan 208. If a live bird was found, a photo would need to be taken, followed by containment in a paper bag or box with airflow to be kept in a dark and quiet area, where our instructor, TA, or community partner would transport to Wildlife Rescue Association to be assessed.

Materials

While in the field, surveyors wore high-visibility vests to establish an official presence while in such close proximity to personal offices and classrooms. In each supply bag (at least one being brought to each monitoring session), were sanitizer spray, gloves, napkins, smaller bags, and sharpie. The past 3 years of Buchanan data from other APBI 490D/CONS 495 cohorts (2021-2023) was also used, which was organized with the new 2024 data within one cohesive document by our community partner from Environment and Climate Change Canada.

Carcass Persistence and Surveyor Efficiency Trials

Two additional trials were conducted. The first, testing carcass persistence. Two carcasses, one Varied Thrush, and one Rufus Hummingbird, were placed randomly along Buchanan facades on March 12th, 2024. The Thrush was left in the middle of a pathway, but within an hour was already moved to the dirt patch alongside facade 10. The hummingbird was left on a metal framework where it camouflaged beside facade 1 (see Figure 1). The two carcasses were monitored at 12pm and 5pm on the 12th and 13th, only at 5pm on the 14th, and then during regular monitoring afterwards to determine their persistence in the presence of natural scavengers and elements.

The second trial was surveyor efficiency. On the 8th week of monitoring, a carcass was placed randomly by our community partner with the location undisclosed to the two surveyors that day. The two proceeded to conduct their survey as normal in order to determine their efficacy in finding carcasses that often camouflage to their natural environments. All carcasses involved in deliberate trials were previously frozen, thawed, and had a clipped back hallux in order to distinguish them from carcasses that were natural victims of a building collision.

RESULTS

Following the 8 weeks of data collection, 10 probable collision events were found. A collision event was only certain if a natural carcass was found, which did not occur during this study period. With that being said, 2021 showed 49 events, 2022 showed 33, and 2023 showed 18, making 2024 the year of the lowest number of collision events found with an 80% decrease since 2021 (see Figure 2).

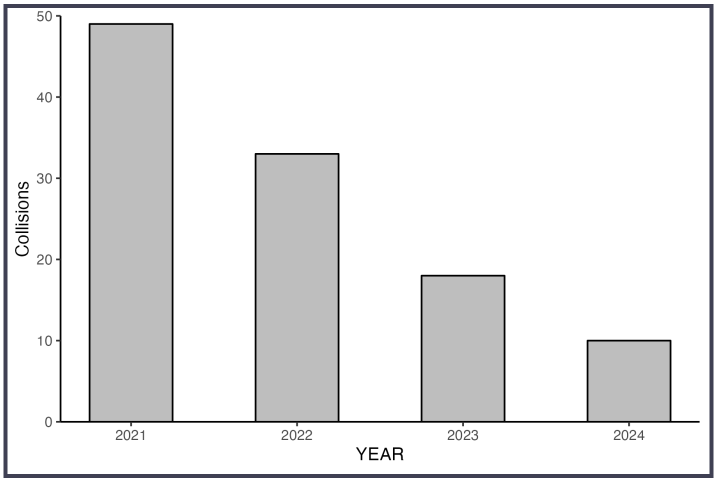

Figure 2 Total number of collisions found on all 31 Buchanan facades from 2021-2024.

Specifically, 3 “problem” facades were identified, each having shown a consistent number of collision events throughout the years. Two facades (26 and 27) are a part of Buchanan block A, while facade 21 is a part of block C (see Figure 3).

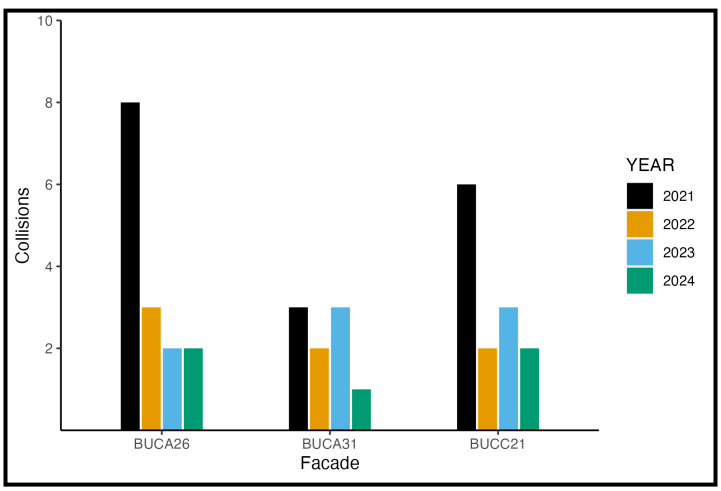

Figure 3 Summary of the findings on 3 prominent facades: 26, 31 and 21.

With that being said, it must be considered that the findings of 2021 and 2022 included a higher number of general observations. For each survey, 31 observations are made for each facade. This was then categorized into *yes or no* for evidence found. In 2021 and 2022, there a significantly higher number of observations made (970 and 995, respectively) compared to 2023 and 2024 (619 and 682 respectively), indicating a greater number of surveys completed (see Figure 4).

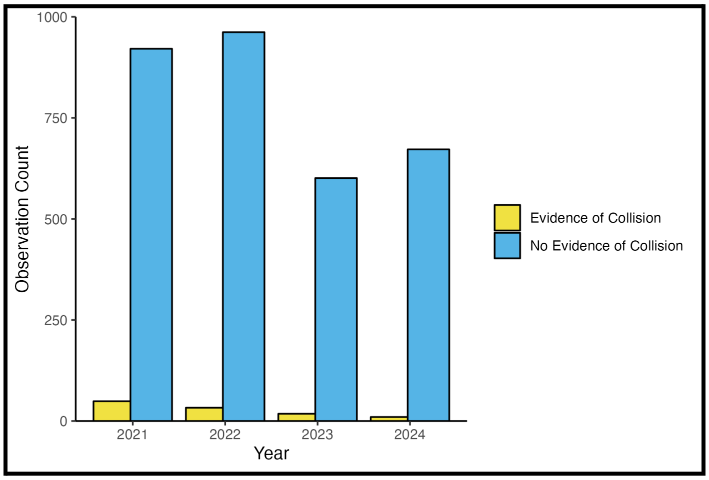

Figure 4 Observation Trends (2021-2024). Yellow indicates the instances where evidence of a collision was found, in comparison to the blue where no evidence was found.

Finally, considering the effect of retrofitting on collision events, facades 27 and 25 had been retrofitted with FeatherFriendly® markers, which consist of small, white dotted stickers being placed approximately 5cm apart, prior to the 2024 survey period which allowed for the results of this retrofitting to be shown. Facade 27 was retrofitted in 2022, where an immediate decrease from over 10 collisions to less than 1 was found. Facade 25 was retrofitted in 2023, which previously had an average of 5 collision events recorded per study period. After being equipped with FeatherFriendly® stickers, the average dropped to an average of less than 1 collision within 2 years.

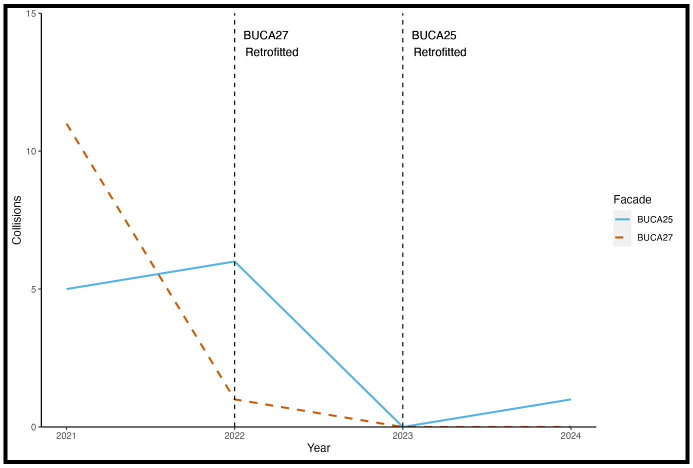

Figure 5 Results of the two retrofitted facades from 2021-2024 including when they were retrofitted. (facades 25 and 27).

Carcass Persistence and Surveyor Efficiency Trials

As for the carcass persistence trial, the varied thrush was moved off the path into the adjacent vegetation within one hour, and within 48 hours, was completely removed. The hummingbird remained on the metal grate until at least the end of March, which marked the completion of our study period. The surveyor efficiency trial, which only tested 2 out of 3 of the participants in the study, resulted in 1 out of 2 surveyors finding the carcass.

DISCUSSION

General Review

The results demonstrate that collisions are indeed occurring at UBC, and suggest that retrofitting with the use of FeatherFriendly® markers decreases the number of these events. In fact, an outside study demonstrated that these stickers decreased collisions by 71% (Brown et al., 2021). As UBC is home to many buildings where replacing windows with other bird-friendly additions such as UV films or ceramic frits can be extremely costly, these stickers are an efficient and relatively cost-effective strategy to employ on existing windows.

A risk factor for bird-building collisions is the proximity of tall vegetation, as supported by Zulian et al. (2023). This is consistent with our findings, as facades 21, and 31 were either directly facing or in close proximity to tall trees and bushes. Conversely, facade 26 faced out into the courtyard of Buchanan, which was not significantly close to any vegetation (ie. within 2m), but was highly reflective, as well as just outside of the cafe in the building, where scraps and trash may be a source of food, or an attractant, for wildlife.

As for the carcass persistence trial, the Varied Thrush was likely removed from the path by a human passerby as this occurred in the early afternoon, where scavengers are less numerous. Once in the bush, it disappeared within 48 hours. This is consistent with Smallwood (2010) who noted that most bird carcasses are removed within three days. As our survey methods consisted of three searches per week, there were often gaps in between of over 48 hours, even reaching up to 96 hours. With this in mind, it can be assumed that the mortality rates resulting in immediate death may be higher than we found, with scavengers removing evidence before it could be collected.

Smallwood (2010) also found an increase in mean days to remove a carcass with an increase in trial length. They suggested that the longer a carcass sits, the longer it has time to decompose and is no longer seen as a viable food source for scavengers (Smallwood, 2010). This may explain why the hummingbird remained until the end of our survey period. Initially, it may have been difficult to visualize as it camouflaged onto the metal grates. On top of that, it is a small species, and the metal grates are an unnatural substrate that may have been difficult for scavengers to access due to the small holes and texture.

In a natural situation, a bird hits a window and falls to the ground, not only creating several sounds that may attract predators but also often a display of movement and feathers due to the impact. Smallwood (2010) noted that the wounds sustained due to impact also may create odours, further attracting scavengers. In terms of carcass disposition, Kerns et al. (2005) found that fresh carcasses were removed more rapidly than those that were frozen, possibly due to odour or tissue state. The carcasses in our trial were previously frozen, thawed, and placed by a human on the ground, meaning no sound or natural movement was made. This may contribute to the length of time elapsed before the Thrush was scavenged, or why the hummingbird persisted until the end of our study.

Considering searcher efficiency, our trial found that 1 out of 2 or 50% of our observers found the carcass, suggesting that half of all carcasses may have been missed throughout our trial. With that being said, one observer was not tested, and the trial was only conducted once, which does not provide for a substantial sample size. Despite this, searcher efficiency may be a more reliable method of testing the lack of finding carcasses. Barrientos et al. (2018) found that experience did *not* affect searcher efficiency rates, which is applicable in the case of APBI 490D/CONS495 as one sole training session occurred at a different building.

Limitations

Similar to any study, there were certain limitations throughout the term. First, several buildings within Buchanan block were made up of up to four levels. As some feather smears were as small as half a centimetre, it was difficult to confidently conclude whether a piece of evidence was from a feather smear, or simply a seed, cotton, or a stick, especially from such a distance. Due to this, our study focused on the lower facades (ie. the first two levels). Likewise, facade 25, which had been previously retrofitted, was along a tall ledge, making it difficult to examine. With this in mind, collision events were likely higher, as we could not account for evidence higher than the second story.

Furthermore, as we were a group of three surveyors, we attended Buchanan three times a week, except following reading break, compared to three or four times weekly in previous years of Buchanan research (see Figure 4). This may have impacted our findings; as mentioned, from our carcass persistence trial, one carcass was removed within 48 hours, and our surveys may have had breaks of 24-96 hours in between them. Should we have had one more participant and been able to survey four times weekly, there may have been less time in between and an increased likelihood of finding a carcass prior to it being removed by scavengers.

Moreover, throughout the eight weeks, there was construction occurring surrounding Buchanan Block E. It was loud and disruptive to the environment with heavy machinery. Because of this, normal residents of the vegetation in this area that may have been present during previous study periods may have been deterred, leading to a lower number of possible collisions. Furthermore, for several weeks, the construction resulted in large tree branches restricting our access to facade 6, meaning we were unable to be as close to the facade, as usual, to survey for evidence. A final, minor consideration is that facade 29 was retrofitted during reading break, meaning any findings were void as the facade had been altered in the middle of our study period.

Future Research Suggestions

As this was a time and resource-limited study, there is space for further research. First, conducting year-round trials throughout the summer and fall terms would allow for a greater and more cohesive understanding of the collisions that occur on the UBC campus, rather than 8 weeks. Additionally, longer and more frequent carcass persistence and searcher efficiency trials may be helpful to further understand the finding of carcasses or the lack thereof. To elaborate, a carcass persistence trial where a sound similar to what is made naturally when a bird hits a window is reproduced, or a more fresh carcass is left rather than one that is frozen and thawed, may allow for different results. Moreover, a higher number of searcher efficiency trials involving all observers would create a greater sample size and provide more detailed results in how this may affect findings throughout the study period.

Another possible area for research in terms of Buchanan is the use of art on facades as a mitigation strategy. As it is costly to replace windows, this is a great alternative to test at these buildings. In fact, Zyśk-Gorczyńska et al. (2020) found that for example, in the presence of graffiti, less bird carcasses were found surrounding local bus stops than those without graffiti.

Management Suggestions

We found that on two facades, the FeatherFriendly® markers were effective in decreasing collision events. Another local study found that they are in fact 95% effective (De Groot et al., 2022). Therefore, it is suggested that management continue to retrofit facades, specifically ones that cause consistent collisions (such as facades 21, 26, and 31), whether that be with the stickers already in use, or perhaps adding murals that allow birds to better visualize the barrier that is a window. Additionally, as many facades are adjacent to vegetation that grows in height and can create deceiving reflections on the windows, keeping it well maintained is another suggestion to consider. Finally, continuing to partake in studies such as this will allow for a continued collaborative environment to mitigate this issue. Providing staff and faculty with this information and awareness may be useful to foster an incentive for working towards human-wildlife coexistence at Buchanan.

CONCLUSION

In conclusion, the collision of birds with buildings is an ongoing human-wildlife conflict that occurs globally, contributing to the death of millions of birds annually. Because risk factors include highly reflective surfaces, as well as the proximity to vegetation and attractants, education should continue to be provided for this issue which may encourage citizens to make changes at their residences. As mentioned, the majority of collisions occur at residential homes (Machtans et al., 2013). Research should continue to address limitations outlined in this study, and in the instance of new buildings, bird-friendly policies should be strictly enforced. We hope that UBC continues to engage in and share these studies. With more people understanding why collisions occur and how they can be prevented, we are one step closer towards the goal of human-wildlife coexistence.

REFERENCES

Barrientos, R., Martins, R.C., Ascensão, F., D'Amico, M., Moreira, F., Borda-de-Água, L. (2018). A review of searcher efficiency and carcass persistence in infrastructure-driven mortality assessment studies. *Biological Conservation, 222*: 146-153. https://doi.org/10.1016/j.biocon.2018.04.014

Brown, B.B., Santos, S., Ocampo-Peñuela, N. (2021). Bird-window collisions: Mitigation efficacy and risk factors across two years. *PeerJ, 9*:e11867. http://doi.org/10.7717/peerj.11867

De Groot, K.L., Porter, A.N., Norris, A.R., Huang, A.C., Joy, R. (2021). Year-round monitoring at a Pacific coastal campus reveals similar winter and spring collision mortality and high vulnerability of the Varied Thrush. *Ornithological Applications, 123*(3), 1-15. https://doi.org/10.1093/ornithapp/duab027

De Groot, K.L., Wilson, A.G., McKibbin, R., Hudson, S.A., Dohms, K.M., Norris, A.R., Huang, A.C., Whitehorne, I.B.J., Fort, K.T., Roy, C., Bourque, J., Wilson, S. (2022). Bird protection treatments reduce bird-window collision risk at low-rise buildings within a Pacific coastal protected area. *PeerJ*: PMC8953498. doi: 10.7717/peerj.13142.

Kerns, J., Erickson, W.P., Arnett, E.B. (2005). Bat and bird fatality at wind energy facilities in Pennsylvania and West Virginia. *Relationships between bats and wind turbines in Pennsylvania and West Virginia: an assessment of fatality search protocols, patterns of fatality, and behavioral interactions with wind turbines*. (pp. 24-95). The Bats and Wind Energy Cooperative, Bat Conservation International, Austin, Tax.

Klem, D.J., Farmer, C., Delacretaz, N., Gelb, Y. (2009). Architectural and Landscape Risk Factors Associated with Bird-glass Collisions in an Urban Environment. *The Wilson Journal of Ornithology, 121*, 126-134. https://doi.org/10.1676/08-068.1

Klem, D.K. (1990). Collisions between Birds and Windows: Mortality and Prevention. *Journal of Field Ornithology, 61*(1): 120-128. http://www.jstor.org/stable/4513512.

Loss, S.R., Lao, S., Eckles, J.W., Anderson, A.W., Blair, R.B., Turner, R.J. (2019). Factors influencing bird-building collisions in the downtown area of a major North American city. *PLoS ONE, 14*(11): e0224164. https://doi.org/10.1371/journal.pone.0224164

Machtans, C.S., Wedeles, C.H.R., Bayne, E.M. (2013). A First Estimate for Canada of the Number of Birds Killed by Colliding with Building Windows. *Avian Conservation & Ecology, 8*(2):6. http://dx.doi.org/10.5751/ACE-00568-080206

Ocampo-Peñuela, N., Winton, R.S., Wu, C.J., Zambello, E., Wittig, T.W., Cagle, N.L. (2016). Patterns of bird-window collisions inform mitigation on a university campus. *PeerJ, 4*:e1652. 10.7717/peerj.1652

Rosenberg, K.V., Dokter, A.M., Blancher, P.J., Sauer, J.R., Smith, A.C., Smith, P.A., Stanton, J.C., Panjabi, A., Helft, L., Parr, M., Marra, P.M. (2019). Decline of the North American avifauna. *Science, 366*(6461): 120-124. 10.1126/science.aaw1313

Rössler, M., Nemeth, E., Bruckner, A. (2015). Glass pane markings to prevent bird-window collisions: less can be more. *Biologia, 70*, 535-541. https://doi.org/10.1515/biolog-2015-0057.

Smallwood, K.S. (2010). Estimating Wind Turbine-Caused Bird Mortality. *The Journal of Wildlife Management, 71*(8): 2781-2791. https://doi.org/10.2193/2007-006

Zulian, V., Norris, A.R., Cockle, K.L., Porter, A.N., Do, L.G., De Groot, K.L. (2023). Seasonal variation in drivers of bird-window collisions on the west coast of British Columbia, Canada. *Avian Conservation & Ecology, 18*(2):15. https://doi.org/10.5751/ACE-02482-180215

Zyśk-Gorczyńska, E., Skórka, Piotr., Żmihorsi, M. (2020). Graffiti saves birds: A year-round pattern of bird collisions with glass bus shelters. *Landscape and Urban Planning, 193*, 1-7. https://doi.org/10.1016/j.landurbplan.2019.103680.