Bird-Window Collision: A Problem at UBC Buildings (Phase 1)

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University of British Columbia

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Bird-Window Collision: A Problem at UBC Buildings

Final Report

In partnership with:

UBC SEEDS Program
UBC Sustainability and Engineering
UBC Building Operations
Environment Canada

April 12, 2015
An Environmental Science 400 Project

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Abstract

Collision with building windows is one of the main causes of direct human-related bird deaths in North America, particularly during migration seasons. Vancouver has the highest densities of wintering birds of any Canadian city, so occupants on the University of British Columbia campus were interested in finding out whether or not bird collisions are a significant problem. As a result, for a period of eight months, four Environmental Sciences students, partnering up with The UBC SEEDS program, UBC Sustainability and Engineering, UBC Building Operations and Environment Canada, compiled and analyzed bird-collision data on the UBC Vancouver campus. The project mainly focuses on the problem of bird-building collisions and the severity of the situation. Ten buildings were chosen for their have high percentage of glass cover and are suspected to be the most problematic on campus. The number of bird collisions at each selected building were then recorded and examined for patterns. Since this study is one of the first bird-window collision studies on UBC, the results will help to inform future UBC bird-friendly building guidelines and future studies.

Executive Summary

This paper analyses and summarizes the results of a eight month study on UBC birds and their collisions with campus windows. We surveyed windows for collision evidence, and made use of reported strikes (citizen science). Birds hit windows because they don't know the window is there, either because it is transparent or because they see a reflection of outside. Our main method of analysis was the use of Poisson Regression models, which found a weak positive correlation between large areas of window glass and collisions. Buildings away from the centre of the University typically had higher collision rates. In the end, we found evidence for 60 collisions over our ten buildings, and the Museum of Anthropology, Earth Sciences Building and Beaty Biodiversity Museum were the most problematic. We recommend the use of mitigation measures currently available on the market such as window screens, wind curtains or decals to indicate the presence of windows to birds on current buildings at UBC. Future building planning should include visual markers or obstacles such as decorative grilles or sunshades on large windows, or tilt the window so that they provide a view of the ground.

Introduction

Studies have stated that bird-window collision ("strike") cases on buildings have been escalating around the world and are results of birds not identifying windows in buildings, bus shelters, glass walkways, and glass partitions as barriers (Machtans et al., 2013). Birds may fly into windows, corner windows, glass walkways, glass partitions, and glassed lobbies when they see the reflection of clouds, sky or trees in the clear properties of glass (Klem, 2014). The reflection gives a mistaken impression to birds that they are flying into open air and it allows habitat or sky to be seen on the other side, creating the appearance of a clear passage.

Birds hitting windows is a ubiquitous problem; it is rare to find someone who hasn't heard of or witnessed a bird colliding with a window. The University of British Columbia Vancouver campus is no exception. The UBC SEEDS program, along with UBC Campus and Community Planning, UBC Building Operations and Environment Canada decided that it was appropriate to gather information on the bird-building collision situation on the UBC Vancouver campus. In the eight-month time period, the organizations worked closely with four environmental sciences students on this research project.

25 million birds are estimated to be killed annually in collisions with buildings in Canada (Machtans et al. 2013). Though the number is enormous, most of the data that had been collected were from Eastern North America, especially from cities with very high densities of birds during the migratory period, and not many documents have been established on the issue in areas west of the Rocky Mountains. However, from online peer-reviewed articles on the topic, it is found that windows in human residential and commercial structures are one of the main causes of bird deaths worldwide (Klem, 2014). It is difficult to exactly state the risk for each bird species. Some birds may be more likely to encounter bird strikes, but study findings can disagree. In a study by Hager et al.(2014), it was found that bird-window collisions were highest in the least abundant species, such as red-eyed vireo, and lowest in species with high abundance values, for example the chipping sparrow (Hager & Craig, 2014). Another study found adults and immatures equally likely to suffer a strike, but that the species with the majority of collisions would change depending on the season (Klem 1989). In disagreement with Hager et al., they cited unpublished data from Graber and Graber that showed it was birds with highest densities that had the highest number of strikes (Klem 1989). To limit harm to the bird community at UBC, it is necessary to be aware of the impacts that our building structures have on the local bird community so that informed decisions can be made. Our project was built on previous work and can hopefully help shed light for future proposals.

The statistics collected for this project would be supplied for future reference and used for establishing bird-friendly guidelines and policy. The guidelines and policy can be taken into consideration when planning the layout and materials for a new building. This is particularly important as the University is continually investing in new and upgraded infrastructure,

including the Engineering Student Centre to be completed in late 2015, Orchard Commons and the New Aquatic Centre, both to be completed by 2016 (Infrastructure Development, 2014).

From all the data collection and analysis, the following two questions that had been proposed at the start of the project have also been answered:
1) What are the collision rates at selected buildings on the UBC Vancouver campus during the winter months?
2) If there is a bird strike problem, defined as five or more birds hitting a building in our time frame, what recommendations and suggestions can be proposed to minimize the negative effects?

Methods

1) DATA COLLECTION – "BIRD SURVEY"

i. Time Period: Total of 27 searched days between November - February

Data collection took place from November 18, 2014 through February 26, 2015. Excluding the holidays, winter and reading breaks, we collected the data for three consecutive days per week for a four month period.

ii. Location of study: UBC Vancouver

The ten buildings we have selected for our study are shown below in Figure 1., and the names of the buildings are listed 1. through 10. The first group looked at the first five buildings listed, the second group the next five buildings, respectively.

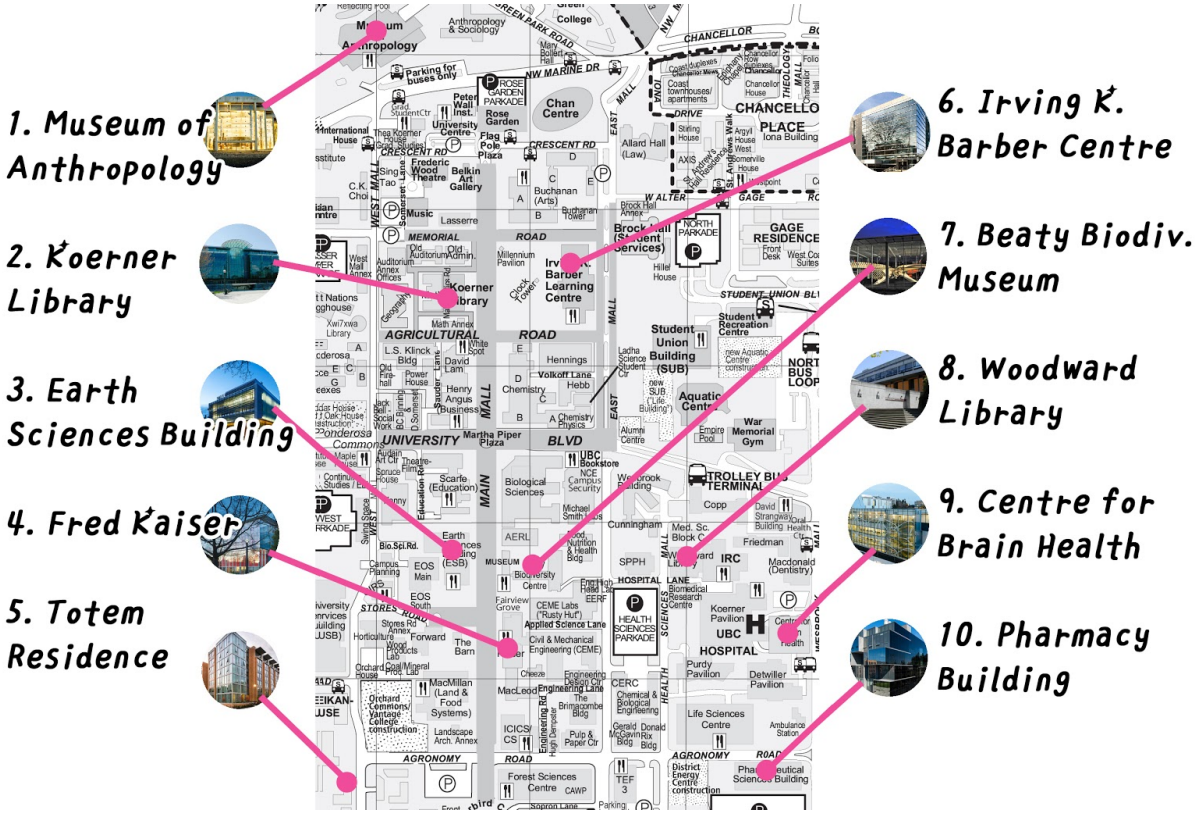
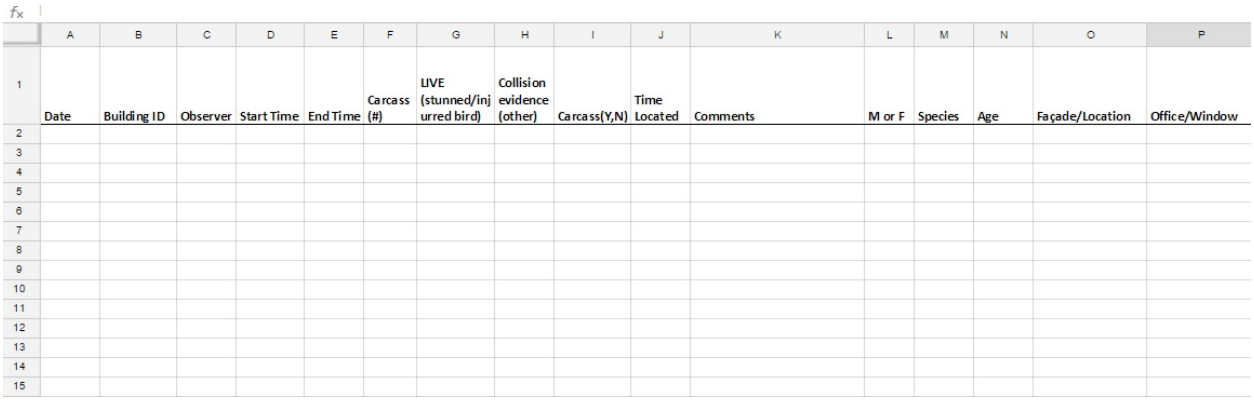


Figure 1. The ten selected buildings on UBC Vancouver Campus and their locations on the map of UBC. These buildings are known for having a relatively high percentage of glass cover on the exterior and were chosen under approval of our community partners.

1. Museum of Anthropology
2. Koerner Library
3. Earth Sciences Building (ESB)
4. Fred Kaiser
5. Totem Residence (həm'ləsəm' House)
6. Irving K. Barber Learning Centre
7. Beaty Biodiversity Centre
8. Woodward Library
9. Centre for Brain Health
10. Pharmaceutical Sciences Building

iii. Tools



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	Date	Building ID	Observer	Start Time	End Time	Carcass (#)	LIVE (stunned/injurred bird)	Collision evidence (other)	Carcass(Y,N)	Time Located	Comments	M or F	Species	Age	Façade/Location	Office/Window
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Figure 2a. The data collection sheet used throughout the study consisted of 16 columns of various information such as the date, building ID, %glazing, distance from building to nearby vegetation.

We used the above chart to record data collected. The information we have collected as a part of our data set includes the date, building ID, observer, start time, end time, number of carcasses found, the state of the bird when spotted, comments, % glazing, distance from building to nearby vegetation as shown above in the chart. Other equipment we have used includes binoculars, clipboard, pen and/or pencil, and sanitary gloves to handle carcass and any other signs of bird collisions such as smears, feathers stuck on windows, and smudges.

Figure 2b. Sample photo of bird collision evidence. Carcass (left) was found on Nov 18, 2014 by the S facade of Totem Residence while the small feathers stuck on windows (right) were found on Nov 25 by the same location.

ii. General methodology of "Bird Survey"

- Two teams of two each were assigned five of the ten buildings.
- Each building was divided into four different facades (N, S, E, W).
- For each building, two observers went around the building in opposite directions, observing windows and any other exterior surfaces for any signs of bird collision evidence and filled in the above chart for later reference and analysis. Splitting up was important to provide a different angle, allowing one member to catch something their partner missed.
- The data was then later uploaded on Google Doc into a combined data set.

2) DATA COLLECTION – Citizen Science

Figure 3. The digital version of the poster created to fulfill citizen science portion of our project. The posters were either printed and put up around the buildings or digitally displayed on the screens in various buildings.

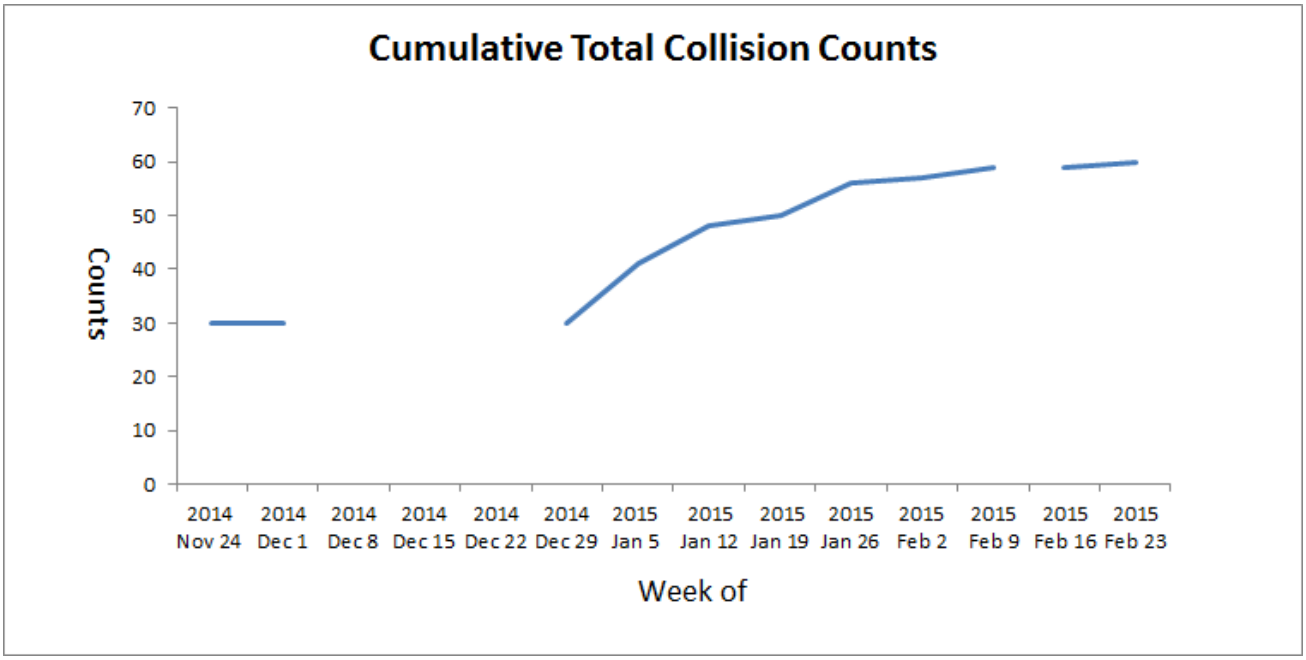
We have also incorporated Citizen Science into our study in which we set up a Gmail account for our group (bird.strikes.ubc@gmail.com) to encourage the public (though restricted to people on UBC Vancouver campus) to send us an email should they witness a bird collision. We put up posters around the buildings we were surveying, and also put up some digital advertisements. For the entire study period, we received two emails from the public and also received notifications regarding carcasses being spotted from our representatives from Environment Canada and UBC Building Operations.

3) DATA ANALYSIS

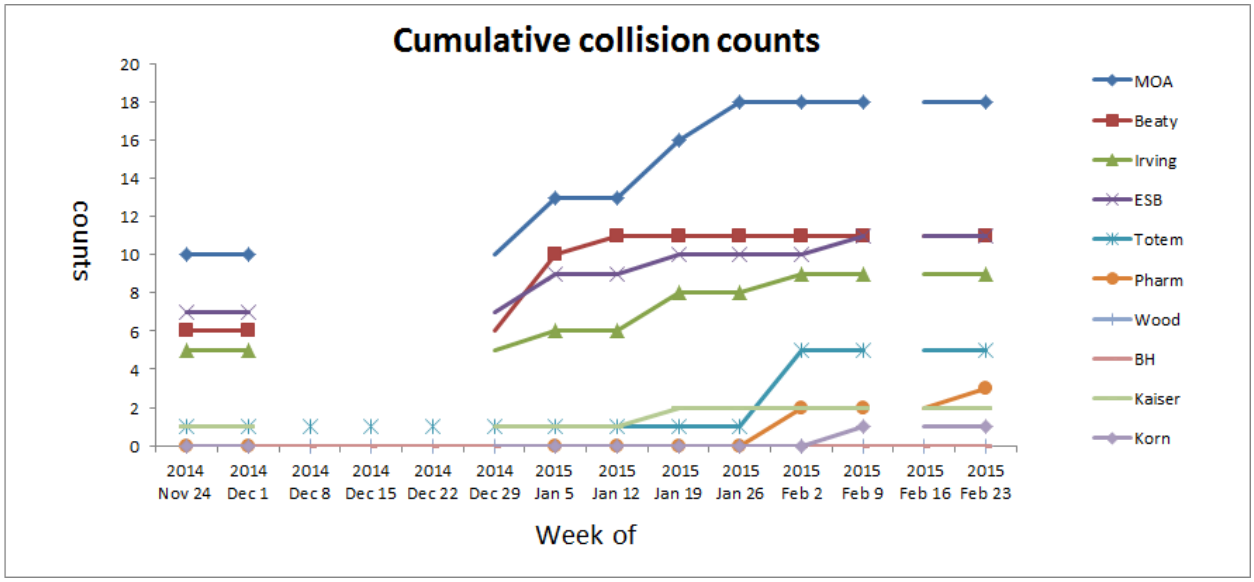
Data collected from each building were analysed and fitted into a Poisson Regression Model(graph IV) by using statistical software R. Each facade was treated as a data point on the graph. Data from Koerner Library was not included due to the green roof ledge area in front of the windows that would make the analysis invalid. The model assumes that each

facade is independent of one another, follows a linear relationship with collision counts, and is identical in residual distribution and variance.

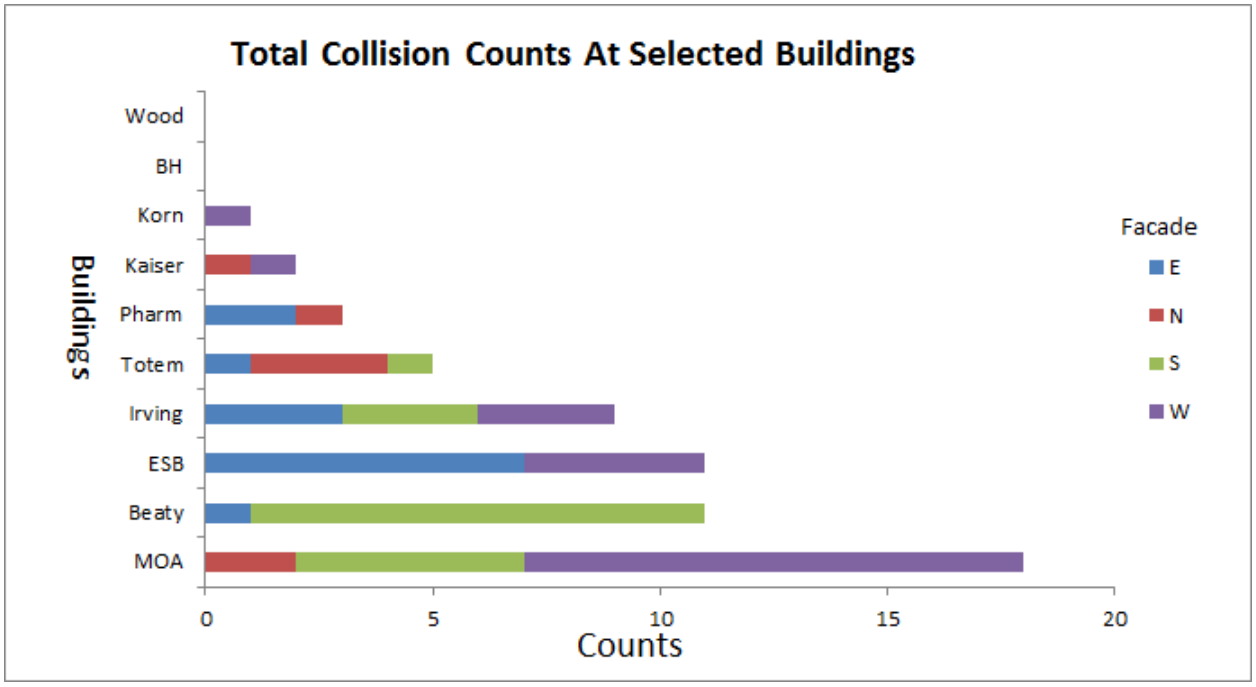
Results



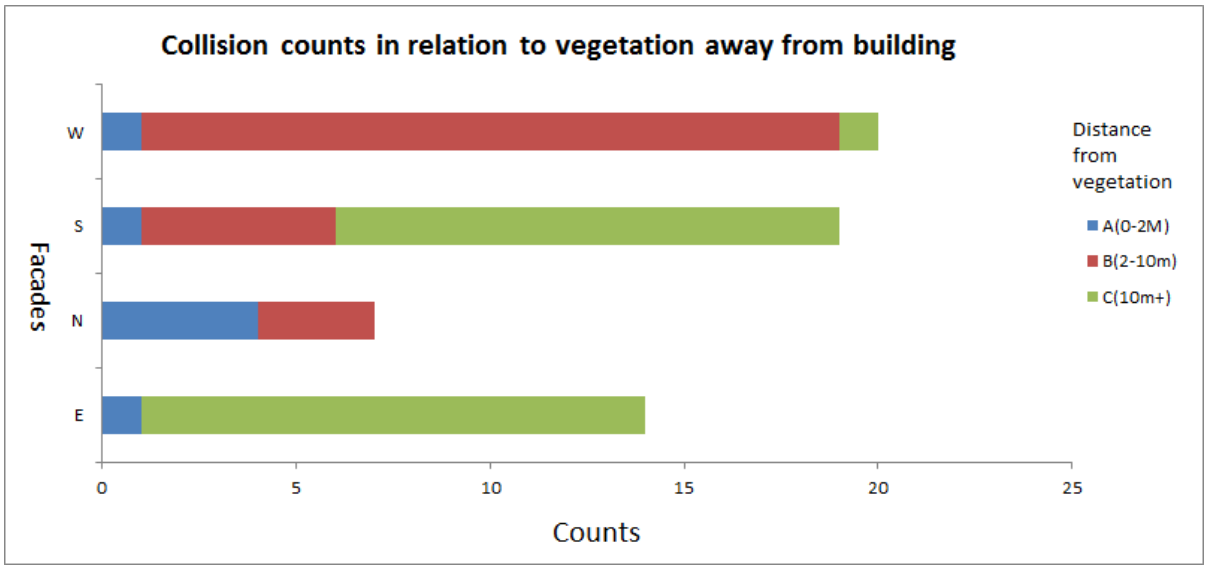
Graph I. (a) Total number of bird/window collisions over all buildings. Data collected on 27 days, across a fourteen-week period. The gaps represent the December exam period, holidays and reading break, when surveys were not conducted.



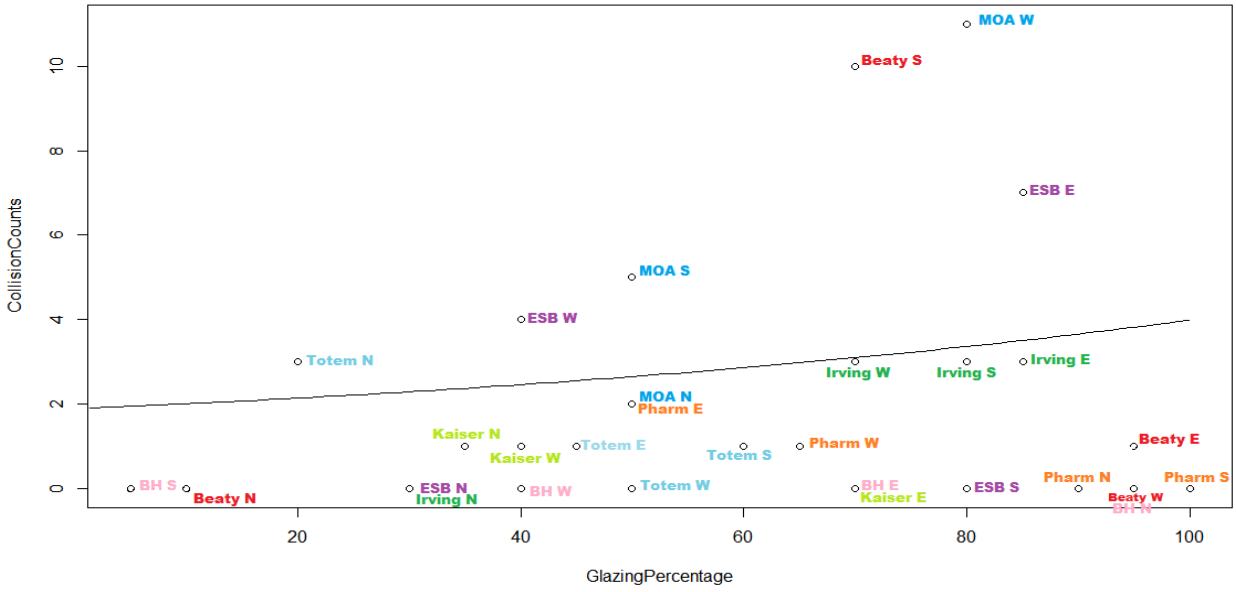
Graph I. (b) Total number of bird/window collisions for each building. Data collected on 27 days, across a fourteen-week period. The gaps represent the December exam period, holidays and reading break, when surveys were not conducted.



Graph II. Total recorded numbers of birds hitting windows ("collision counts") at the ten buildings being monitored in this study. Data collected on 27 days, across a fourteen-week period at UBC Vancouver.



Graph III. Total collision counts at each facade and their distance from the nearest vegetation. Three levels of facade distance from the vegetation were used. Level A is 0-2 meters, B is 2-10 meters and C is a building distance of 10 meters or more from vegetation. Data collected on 27 days, across a fourteen-week period at UBC Vancouver.



Graph IV. Glazing percentage versus total collision counts at each facade. Each data point is labeled with its respective facade of building. The Standard Error of estimated slope $\beta = 0.0113$ is 0.0052 which is small and the slope is statistically significant at 5% level with a P-value of 0.0294. A weak positive correlation of 0.19 was found between glazing percentage and collision counts.

Figure 4. Relative positions of the buildings and their total collision counts on campus map.

In total, at our ten buildings we found evidence for 60 collisions (see graph III). The museum of Anthropology(MOA) had the top collision count with 18 collisions, Beaty Biodiversity Museum (Beaty) and Earth Science Building (ESB) came in second with 11 counts each and Irving Library (Irving) came in third with 9 counts observed in 27 count days. Five out of ten buildings observed, MOA, Beaty, ESB, Irving and Totem, had collision counts more than 5 which is the number we defined to be a problem. These problematic buildings have many things in common. First is that they all have large and mostly clear windows. Second is that there are large open space around the buildings. The sky and trees would be reflected in the glass and birds would attempt to fly through and strike the window. Also the trees and vegetation around the buildings which attract birds would increase the chance of collisions. A possible contributing factor to the high number of strikes at the museum of anthropology could be that there is a pond combined with a forest patch in front of the 15m high window. The collision rate seems to decrease at most of the buildings towards the end of January 2015 (graph I and II). We observed that (graph IV) when the vegetation is very close to the window (within 2m) the rate of collision is lower compared to when the vegetation is farther away (above 2m) from the glasses.

A Poisson Regression analysis was used to fit on the data points of glazing percentage and total collision counts at each facade. From data points we found out that there is a weak

positive correlation of 0.19 between the glazing percentage of facades and the collision counts. The estimated regression model is:

expected # of collision= e^(-0.0925)+e^(0.0113*PercentGlazing)

For every percent increase in the glazing the collision increased by the rate e^0.0113 and it is statistically significant with a p-value of 0.0294. However the intercept value, e^(-0.0925)=0.9116, is not significant with p-value of 0.80.

In addition to the survey data, 2 emails had been received from our citizen science collection method. One reported witnessing a collision at Irving Library and the other at the Earth Sciences building (ESB).

Reports of bird carcass at buildings that are not in our study were also received during the study period: Cooper's Hawk being found at UBC Botanical Gardens, Varied Thrush at Liu Centre and Red-breasted Sapsuker at West Mall Annex.

Discussion

As shown in the results section, five of the ten buildings we targeted in our study had more than five incidences of bird-window collisions (strikes), which was our metric for determining whether a problem was present at a building. In terms of total strikes over our survey period, the foremost was the Museum of Anthropology, followed by Irving Library, Beaty Museum, ESB, and Totem residence həm'ləsəm' House.

Irving (max. 85% glazing), Beaty (max. 95 % glazing), ESB (max. 85% glazing), and həm'ləsəm' House (max. 60% glazing) all have large panes of glass in their windows exceeding at least 60% glass cover, along with other aggravating factors.

Note: max. % glazing indicates the maximum value of glazing cover percentage out of all 4 facades surveyed for each building.

The buildings have reasonably large forest patches (5-10 trees with shrubs) nearby which are attractive to birds. We also noticed (Figure 4) that buildings closer to the forest along Wreck Beach had higher incidences of strikes.The forest and forest patches are attractive because they provide food and shelter. The presence of these patches increases the number of birds present in the area, and thus increases the frequency of strikes. We measured distances from each building to nearby categories of vegetation. Our categories were shrubs, grass

(lawn), trees (sparse) and forest patches. ESB has a patch to the east side, about 30m away, shared with Beaty. The patch is to the south of Beaty within 10 m distance. Irving has a large patch nearby to the south and west, as well as having trees across the street to the east. For each of these patches of interest, we see (graph II) that the facade has a higher number of strikes than facades that point away from a patch. As well as attracting birds to an area, a patch of trees can also be reflected in the glass of the building. A bird will attempt to fly into the seemingly clear sky, only to strike the window.

The Museum of Anthropology (MoA) is the most dangerous building to birds in our study group, and possibly at UBC. It has a maximum % cover glazing of 80 %, and is close to a forest habitat. In our analysis, we have not included strike evidence found during our first week, because we are unable to tell the age of the evidence. However, it is interesting to note that if we include our first surveys, we have evidence for the Museum of Anthropology as having had over a hundred bird-window collisions. The Museum is a significant problem building due to several factors.
First, it is a large building, and so will have more strikes proportionately, but this is not enough to explain the numbers of strikes. The presence of water at the north end, the “Yosef Wosk Reflecting Pool” installed in August 2010 (UBC Project Services, 2010), serves to attract birds to the area. There are also trees that some species of bird would use for habitat, also making this area attractive.

The most important hazard is the large, 15m high windows present on the north end of the Museum of Anthropology, facing the water and trees. We know from the literature (Klem, 1989), (Bayne, 2012), that clear, large windows are hard to see from a bird’s perspective. Birds are trying to fly into the large display area of the MoA, and are colliding with the window. Reflections in windows also pose a hazard to birds, as mentioned earlier: a bird can see the reflection in the window, mistake it for open sky, and collide with the window.

In summary, we observed that the distances between the building to the nearby vegetation, in which is the most problematic, range from 2 to 10+ m. This is because if the nearby vegetation is too close to the building then it cannot be reflected off the glass windows, and instead blocks the window from view. For vegetation further from the window (2m+), the birds are relatively more easily tricked into seeing reflections of the nearby vegetation - increasing the number of bird collision occurrences as described above. As well, we also notice that % glazing cover of at least 60% as in the case of həm'ləsəm' House, Museum of Anthropology,

ESB, Beaty Museum, and Irving Library indicates the minimum % of glazing that makes the birds more prone to strike windows of the buildings.

UBC as an Ecological Trap

In ecological trap theory, a trap is a low quality habitat which is preferably selected (Battin, 2004). Traps are problems because they can result in a population extinction, as 'animals abandon superior habitats to settle in poor ones" (Battin, 2004). While we lack enough concrete data to state whether or not UBC is an ecological trap for birds, we can highlight some areas for future study. More research is required for estimates on the total number of bird births and deaths on campus and the surrounding area. This is necessary to determine the severity of the 'trap.' If birds on campus are dying at only slightly higher rates than in surrounding natural locations, then UBC is not that much a lower quality location than the (supposed) higher quality locations around it. This would make local population extinctions far less likely. There could also be benefits for birds on campus that result in higher nesting success or adult survival rates, excluding UBC from trap status.

Recommendations

The important thing is to reduce the hazard of large windows. Mitigation methods are available to reduce the invisible clarity of windows already present on campus. At the Museum of Anthropology, measures that could be taken would be the use of wind curtains (Figure 5a), window screens or decals (5b) to create a design that is unintrusive and gives a visual indicator to birds of the window's presence. Wind curtains are cords hung from the top of the window which move with the wind and provide a visual reference for birds. Window screens are lengths of cloth screen which are installed to hang down several inches in front of a window. A bird will collide harmlessly with the soft screen instead of the window. If either of these methods are chosen to reduce the hazard of the windows, a pattern with gaps of only 5 cm vertically or 10 cm horizontally is required, and be at least 0.32 cm wide. Importantly,decals or other markers must be applied to the

Figure 5a - Wind Curtains

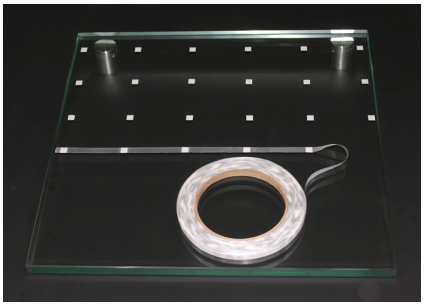


Figure 5b - DIY Residential Tape

Photos: Acopian and Feather Friendly®

outside of windows, or the reflective window will prevent them from being visible during much of the day.

We do not recommend the removal of water sources such as the Yosef Wosk Pool. While increasing bird presence in the area leads to more collisions, clean water will also support more diverse species. Melles (2003) found that some types of birds were three times more likely to be present in an area if clean water was available.

In future building planning, the avoidance of wide clear and tinted windows would do much to reduce collision numbers. A study by Klem (1989) showed that he “found or collected no records of strikes at opaque, translucent, or stained glass windows which present other visual effects.” The City of Toronto (2007) released guidelines on other options to provide a visual marker to birds. Their recommendation that gaps in patterns and grilles is out of date: they recommended gaps of “less than 28cm, with 10cm being optimal.” We now know that gaps of 5cm vertically, or 10cm horizontally are necessary, and dimensions of 5cm by 5cm are needed for smaller birds such as kingfishers and hummingbirds (FLAP Canada, 2015). The City’s other suggestions, such as decorative grilles, films like those used for advertising on transit vehicles and multiple paned glass, are still examples of useful visual markers to birds. Sunshades to reduce reflections and angling the glass to reflect the ground (City of Vancouver, 2014) can also be beneficial.

Conclusion

All in all, we determined that five of the ten buildings had a bird strike problem at the UBC Vancouver campus: Museum of Anthropology, Irving Library, Beaty Museum, ESB, and The Totem həm'ləsəm' House. In echo with the research questions, the collision rates have been fairly steady from November to February, as we did not observe any sudden spikes. We are unable to perform a comparison between collision counts in the winter and spring months, because it is invalid to relate three winter months of data collection with 1 month of spring survey. As a result, referring to the definition of a bird strike problem with an identification of five or more birds hitting a building, it can be summarized that the suspected bird strike problem can no longer be neglected and immediate actions need to be taken towards it. Some recommendations that have been proposed to minimize the negative effects of the issue are in addition to putting up visual markers, reducing large-sized glass windows, and possibly replacing them with tinted or opaque windows. Being the first project of its kind, it

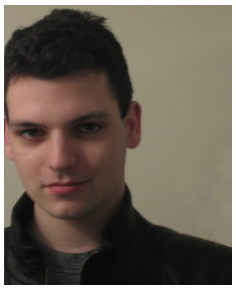
hopefully can add to the University's plan of consideration when partaking in any infrastructure construction in the future.

Acknowledgements

This project would not have been nearly as successful without the input of a great many people. We'd like to thank Mike Giannias of Building Operations, and Ildiko Szabo of the Beaty Museum. We'd also like to thank our very informative community partners Krista De Groot, Hannah Brash, and Penny Martyn, as well as our professors Bernardo, Tara, Sara and Kari, and our classmates for their feedback.

Team

The data for the Bird Strike Study on selected UBC buildings was collected and analyzed by dedicated fourth year students majoring in Environmental Sciences. They are Andy Chien, Gordon Cavers, Carmen Leung and Tiffany Nam. Andy, Gordon and Carmen are currently in the land, air and water area of concentration, while Tiffany is in the ecology and conservation area of concentration.

References:

Battin, J. (2004). When good animals love bad habitats: ecological traps and the conservation of animal populations. Conservation Biology, 18(6), 1482-1491.

Bayne, E. M., Scobie, C. A., & Rawson-Clark, M. (2012). Factors influencing the annual risk of bird–window collisions at residential structures in Alberta, Canada. *Wildlife Research*, **39**(7): 583-592.

Butler, Robert W., Gary W. Kaiser, and G. E. J. Smith.(1987) Migration Chronology, Length of Stay, Sex Ratio, and Weight of Western Sandpipers,(Calidris mauri) on the South Coast of British Columbia (Cronología de la Migración, Periodo de Estadía, Proporción de Sexos y Peso de Calidris mauri, en la Costa sur de la Columbia Británica, Canada. *Journal of Field Ornithology*, **58**(2):103-111.

Butler, R. W., & Kaiser, G. W. (1995). Migration chronology, sex ratio, and body mass of least sandpipers in British Columbia. *The Wilson Bulletin*, **107**(3):413-422.

City of Toronto Green Development Standard. (2007). Bird-friendly development guidelines. Retrieved from http://www1.toronto.ca/city_of_toronto/city _planning/zoning __enviro nment/files/pdf/development_guidelines.pdf on March 13th, 2015.

City of Vancouver. (2014). Bird Friendly Design Guidelines. Retrieved from http://vancouver.ca/files/cov/bird-friendly-strategy-design-guidelines-draft-2014-09-01.pdf on March 13, 2015.

C. Sheppard. (2011) Bird-Friendly Building Design. *American Bird Conservancy*, The Plains, VA, 58p

De Groot, K.. (2015) Personal communication.

Drever, M. C., Lemon, M. J., Butler, R. W., & Millikin, R. L. (2014). Monitoring populations of Western Sandpipers and Pacific Dunlins during northward migration on the Fraser River Delta, British Columbia, 1991–2013. *Journal of Field Ornithology*, **85**(1), 10-22.

FLAP Canada. (2015). Bird Building Collision Reduction. Retrieved from http://www.flap.org/commercial_new.php. on April 11, 2015.

Hager, Stephen B., Craig, Matthew E. (2014) Bird-window collisions in the summer breeding season. *PeerJ* **2**, e460. Online publication date: 1-Jan-2014.

Klem Jr., Daniel. Farmer,Christopher J. Delacretaz,Nicole. Gelb, Yigal. Saenger, Peter G. (2009) Architectural and Landscape Risk Factors Associated with Bird-glass Collisions in an Urban Environment. *The Wilson Journal of Ornithology*, **121**(1):126-134.
DOI: http://dx.doi.org/10.1676/08-068.1

Klem Jr,Daniel. (1989) Bird: Window Collisions. The Wilson Bulletin, Vol. 101, No. 4 (Dec., 1989), pp. 606-620 Published by: Wilson Ornithological Society
Article Stable URL: http://www.jstor.org.ezproxy.library.ubc.ca/stable/4162790

Klem Jr, D. (2014). Landscape, Legal, and Biodiversity Threats that Windows Pose to Birds: A Review of an Important Conservation Issue. *Land*, **3**(1): 351-361.

Macek, Michael. (2014). Introduction to Avian Challenges. *International Zoo Yearbook*, **48(**1): 1-6.

Melles, S., Glenn, S., & Martin, K. (2003). Urban bird diversity and landscape complexity: species-environment associations along a multiscale habitat gradient. *Conservation Ecology*, *7*(1), 5.

Reed, E. T., Cooch, E. G., Cooke, F., & Goudie, R. I. (1998). Migration patterns of black brant in Boundary Bay, British Columbia. *The Journal of wildlife management*, **62**(4):1522-1532.

UBC Vancouver Construction Update. (2014). Retrieved October 10, 2014 from http://www.infrastructuredevelopment.ubc.ca/infrastructure/projects/construction.htm

University of British Columbia Project Services - Yosef Wosk Reflecting Pond. Retrieved March 13, 2015 from http://www.projectservices.lbs.ubc.ca/portfolio/public-realm/yosef-wosk-reflecting-pond.htm