Monitoring the Frequency and Severity of Bird Collisions: An Analysis of Factors Influencing the UBC Chan Centre and Wall Institute

Prepared by: Rachel Little
Prepared for: Campus + Community Planning, Environment and Climate Change Canada

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Abstract

Bird-building collisions are the leading cause in avian mortality, accounting annually for millions of mortal collisions in Canada. Because of the important contribution birds have to the ecosystem, it is necessary to understand how and why these collisions occur. Using modified methodology, this monitoring project aims to determine the frequency and severity of bird collisions at the Chan Centre and Wall Institute located on UBC's Vancouver campus. Over an eight week period between February 5th 2024 and March 29th 2024, building facades were monitored frequently and collision evidence recorded. It was found that 30 total collisions occurred over this period, with significantly higher frequency located at facades with continuous glass and high proximity to vegetation. The high frequency and severity of bird collisions located at the Chan Centre and Wall Institute during this period is evidence that proactive solutions are needed in order to reduce collision occurrences. As this is the first year the Chan Centre or the Wall Institute are being monitored, future research is needed to identify the frequency of collisions and the priority areas for migration.

Monitoring the Frequency and Severity of Bird Collisions: An Analysis of Factors Influencing the UBC Chan Centre and Wall Institute

In North America, one of the leading causes of avian mortalities are bird-window collisions (Scott et al., 2023), annually causing 16-42 million mortal collisions in Canada (Machtans et al., 2013). These figures are considered an estimate, since accurate estimates of nation-wide mortality rates are considered to be more, but are difficult to establish due to scavenger removal, observer bias and postponed lethality of strikes (Hiemstra et al., 2020). Nevertheless, these are alarming figures, as birds are important contributors to our ecosystems with 21% of species already facing extinction threats (Nichols et al., 2018). As ecological contributors, birds have a significant role for seed dispersal and as geographical pollinators (Tabur et al., 2010).

Birds are susceptible to building collisions for a variety of reasons, primarily environmental and physiological factors. Building construction, building location, facade continuity and window angle are all abiotic factors that influence bird-building collisions (Zulian et al., 2023). Bird collisions can occur year round, at any time of day or in any type of weather, but have an increased probability during the fall migration period and during clearer days (Zyśk-Gorczyńska & Żmihorski, 2022). Green spaces surrounding buildings have also been shown to increase bird abundance, and therefore can increase the likelihood of bird collisions (Basilio et al., 2020). Physiologically birds' visual systems vary significantly from humans (Martin, 2011). Bird’s eyes are positioned more laterally than forward, and they primarily rely on their peripheral vision, meaning thay have a reduced field of vision looking forward, and

therefore more susceptible to collisions. Their fast flying speeds and slow reaction rate are also contributing factors, since birds are unable to avoid collisions until too late (Martin, 2011).

The purpose of this monitoring project is to determine how frequent bird collisions are at the Chan Centre for Performing Arts and the Peter Wall Institute for Advanced Studies. Based on past literature on the subject, it is predicted that an increase in building facade and vegetation will yield an increase in frequency and severity of bird collisions.

Materials and Methods

Study Site

The study site chosen for our survey is located on the Vancouver campus of the University of British Columbia (UBC), on the traditional lands of the Musqueam peoples. The UBC Vancouver campus is situated in the Coastal Western Hemlock biogeoclimatic zone and is predominantly populated by coniferous trees such as western hemlock (*Tsuga heterophylla*), western red cedar (*Thuja plicata*) and douglas firs (*Pseudotsuga menziesii*) (UBC Faculty of Forestry, 2013). The buildings chosen to be surveyed for bird collisions were the Chan Centre for Performing Arts (figure 1) and the Peter Wall Institute for Advanced Studies (figure 2). Both buildings are located on the northern side of campus and are surrounded with varying levels of vegetation. Both buildings are constructed of majority continuous glass facades with no bird friendly architecture in place.

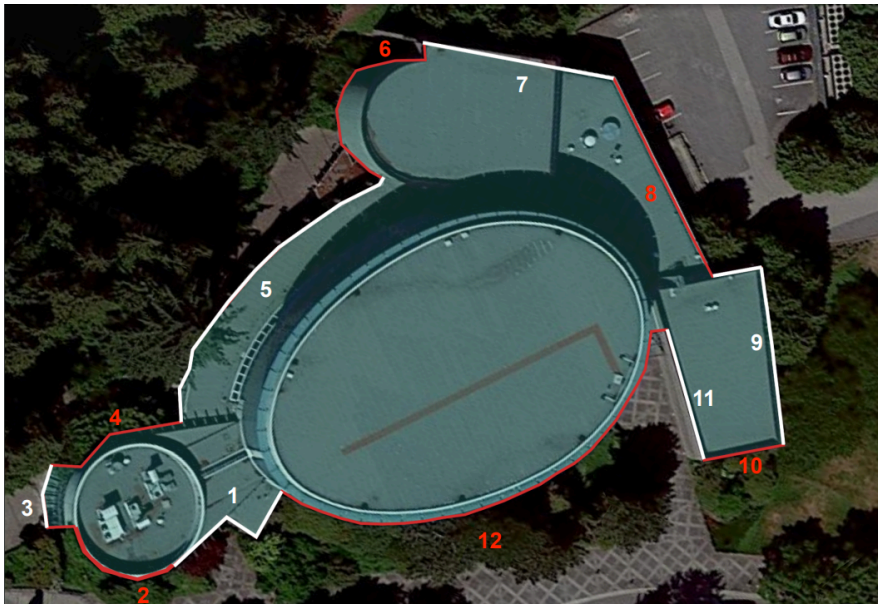

Figure 1. Aerial facade map of the Chan Centre for Performing Arts.

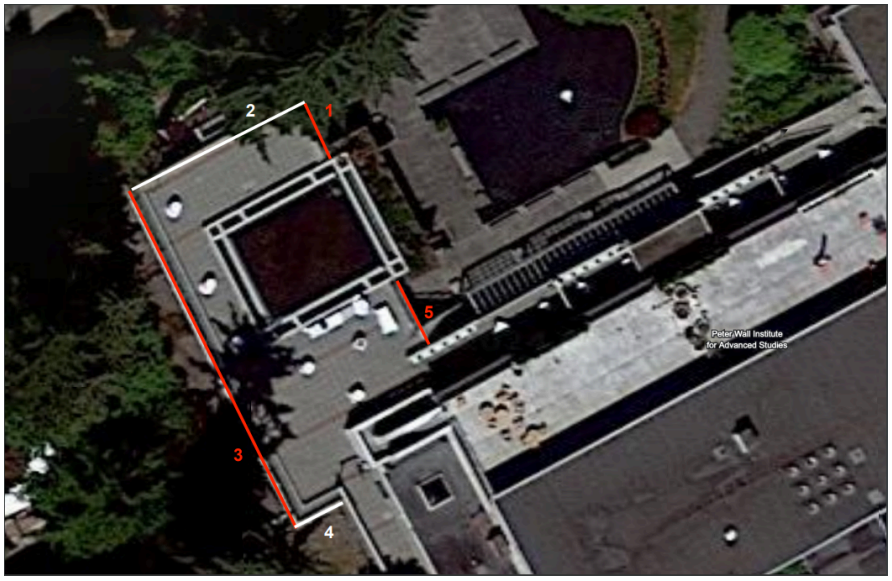

Figure 2. Aerial facade map of the Peter Wall Institute for Advanced Studies.

Survey Procedure

Protocols outlined by Hager and Consentino (2014) and Hager et al. (2017) were adapted to conduct building surveys over an eight week period. Surveys were conducted three times a

week on Mondays, Thursdays and Fridays between February 5th 2024 and March 29th 2024. Surveys were conducted at 10am during the monitoring days as suggested, since window collisions often peak in the morning and slowly decline as the day continues (Hager and Consentino, 2014). Prior to the first day of monitoring, surveyors were given materials for the process of monitoring and the collection of evidence such as high-vis vests, disposable gloves, alcohol spray, paper towels, clean plastic bags and sharpie markers. An initial cleaning was done on the facades at the Chan Centre and Wall Institute to remove all evidence of prior bird collisions before the first day of monitoring. During the day of monitoring, two surveyors would work concurrently, walking the entire perimeter of the buildings in opposite directions. The surveyors would search for evidence on the building facades and within 2m of the facades, including within and under vegetation. After the surveyors had conducted their individual surveys around the perimeter of the buildings, any evidence found was collected and recorded.

Collision Evidence

For this survey, evidence included feather smears (figure 3), feather piles (figure 4), carcasses (figure 5) and scavenged carcasses (figure 6). A feather smear is defined as a feather stuck to a facade following a collision event. For feather smears, photos and descriptions were taken of the evidence and location and, if within reach, was cleaned to avoid double counting. If a feather smear is above a feather pile or carcass, it is recorded as a factor in those collisions and not as a separate piece of evidence. For feather piles, photos and description of evidence, including approximate or actual number of feathers in pile, were taken and recorded. A feather pile consists of a minimum of 10 feathers within a 1m radius, feather approximates were taken when feather piles included more than 15 feathers. Once the evidence is recorded, it is collected

and labeled with the date, building code, facade number and species (if known). For scavenged or intact carcasses, 3 photos were taken of the carcass' ventral view, dorsal view and lateral view, with a description of the evidence and location. A scavenged carcass consists of the presence of feet, wings or bill in addition to a feather pile. Once recorded, the evidence is collected and labeled with the date, building code, facade number and species (if known). All evidence is collected using disposable gloves and delivered to a freezer in the H. R. Macmillan building.

Figure 3. Example of feather smear evidence, collected at the Chan Centre on February 20th 2024.

Figure 4. Example of feather pile evidence, collected at the Chan Centre on February 26th 2024.

Figure 5. Example of carcass evidence, collected at the Chan Centre on February 26th 2024.

Figure 6. Example of scavenged carcass evidence, collected at the Chan Centre on February 20th 2024.

EpiCollect5

The platform used to record evidence during each monitoring day was the EpiCollect5 app. EpiCollect5 is a mobile data-gathering platform used to record data by surveyors during monitoring. The data recorded included the initials of the surveyors conducting the monitoring, the date of monitoring, the start and finish time the monitoring took place and the weather conditions the day of monitoring. When evidence was identified, photos were taken as directed and uploaded to the form with a description of the evidence and where it was collected. After the monitoring session, all data collected was uploaded to the EpiCollect5 cloud to be reviewed by the Community Partner.

Carcass Persistence Trials and Searcher Efficiency Trials

In addition to regular building monitoring during the eight week survey period, two trials were also conducted to correct for biases in estimated collision rates. A Carcass Persistence Trial (CP Trial) is conducted to measure bias in collision evidence going unreported due to the

scavenging of carcasses (DeGroot et al., 2021). During the trial, two carcasses were placed 2m from randomly selected facades at the Chan Centre and the Wall Institute. The hallux of each carcass was clipped to indicate to surveyors that this carcass was a part of the trial, and not collision evidence. The carcasses were then periodically observed for the next 3 days to monitor the time taken for them to be scavenged or disappear.

A Searcher Efficiency Trial (SE Trial) is conducted to measure the probability of surveyors locating carcasses on successive searches (DeGroot et al., 2021). During the trial, two carcasses were placed 2m from randomly selected facades at the Chan Centre and the Wall Institute. The hallux of each carcass was clipped to indicate to surveyors that this carcass was a part of the trial, and not collision evidence. The location of the two carcasses are unknown to the surveyors, but should the carcass from the trial be found it would be entered in the "Searcher Efficiency" tab on the data sheet. Carcass checks are performed until surveyors either identify the carcass or it has gone by the end of the 5th day.

Results

After eight weeks of monitoring, the results of the survey found that a total of 30 pieces of evidence was collected. A total of 24 pieces of evidence were collected at the Chan Centre and 6 pieces of evidence were collected at the Wall Institute (figure 7).

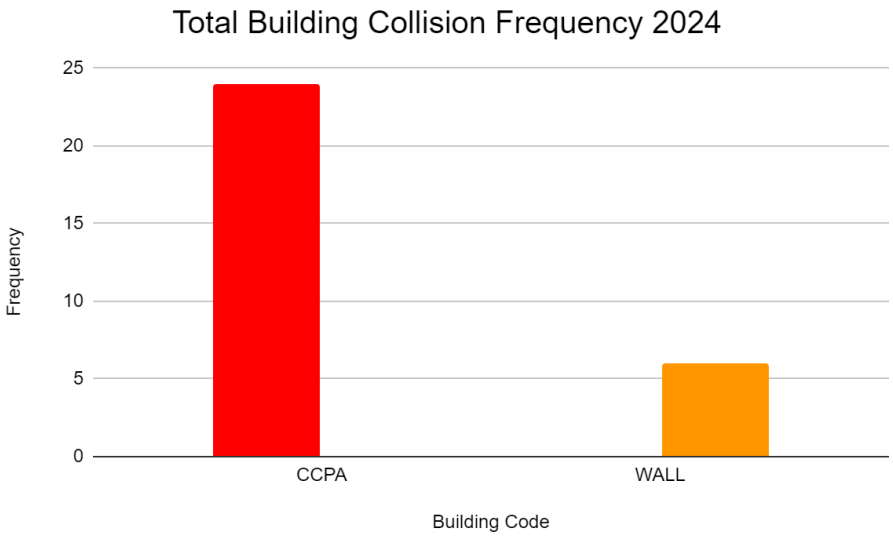

Figure 7. Total building collision frequency in 2024 for the Chan Centre and the Wall Institute.

Chan Centre for Performing Arts

At the Chan Centre for Performing Arts, monitoring was conducted from February 5th 2024 to March 29th 2024. During this period, collision evidence was collected at facades 1, 3, 4, 5 and 8 while no evidence was collected at facades 2, 6, 7, 10, 11 and 12 (figure 8). Of the facades with collected evidence, the most collected evidence was found at facade 5 with 16 pieces of evidence, facade 4 had 5 pieces of evidence collected, facade 1 had 3 pieces of evidence collected and facades 3 and 8 had the least amount of collected evidence with 1 piece of evidence collected at each. Of the 24 pieces of collision evidence collected at the Chan Centre, the majority of the evidence collected were feather smears and feather piles, with carcasses or scavenge carcasses being the least observed (figure 9). From the facades with collected evidence, facade 1 had 2 feather smears and 1 feather pile (figure 10), facade 3 had 1 feather smear (figure 11), facade 4 had 2 feather smears and 3 feather piles (figure 12), facade 5 had 11 feather smears, 4 feather piles and 1 carcass (figure 13), and facade 8 had 1 feather smear (figure 14).

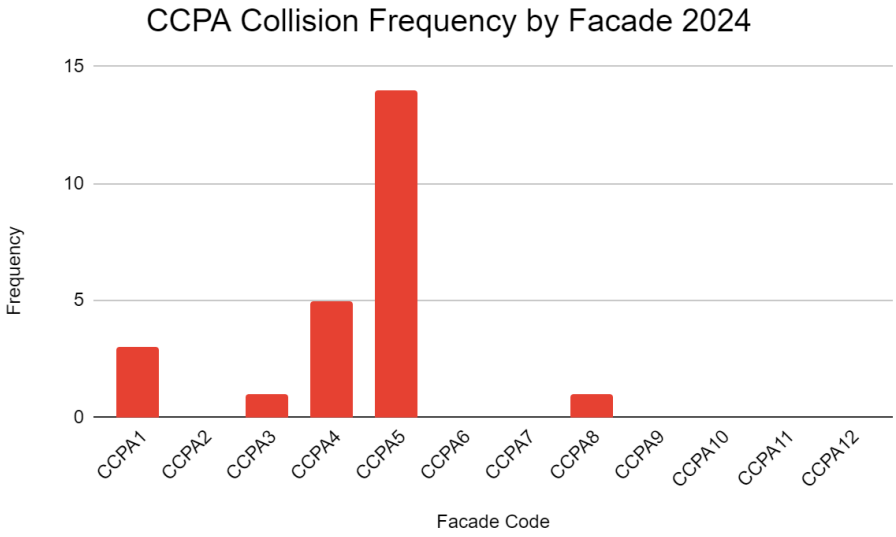

Figure 8. Total building collision frequency by facade for the Chan Centre in 2024.

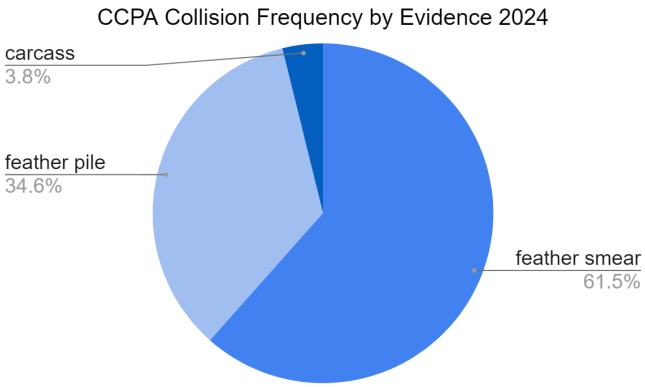

Figure 9. Total building collision frequency by evidence type for the Chan Centre in 2024.

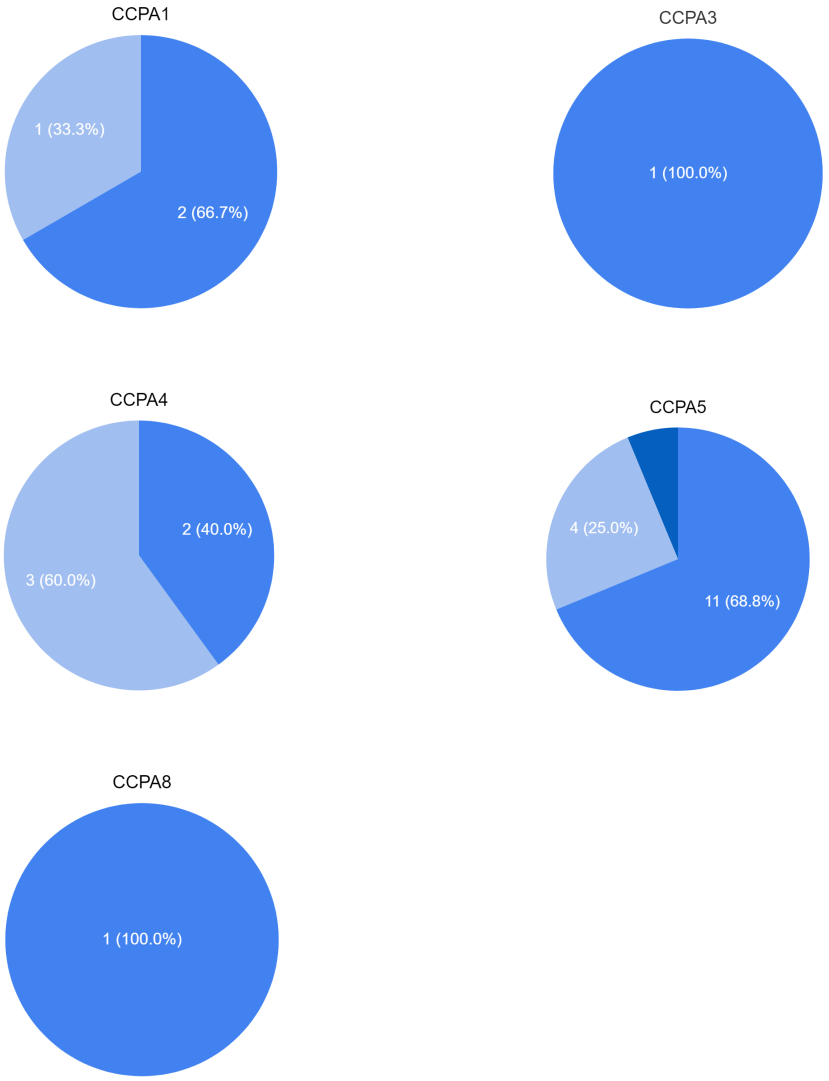

Figure 10-14. Total amount of collision evidence collected from facades 1, 3, 4, 5 and 8 at the Chan Centre in 2024. Collision evidence is classified by feather smears (bright blue), feather piles (light blue) and carcasses (dark blue).

Peter Wall Institute for Advanced Studies

At the Peter Wall Institute for Advanced Studies, monitoring was conducted from February 9th 2024 to March 29th 2024. During this period, collision evidence was only collected at facade 3 (figure 15). At this facade, with 6 pieces of collision evidence collected, all 6 were feather smears (figure 16).

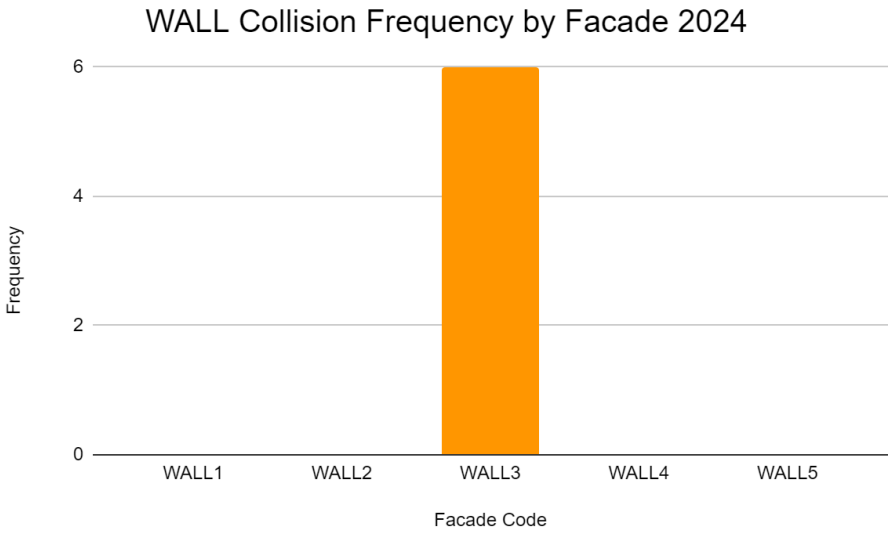

Figure 15. Total building collision frequency by facade for the Wall Institute in 2024.

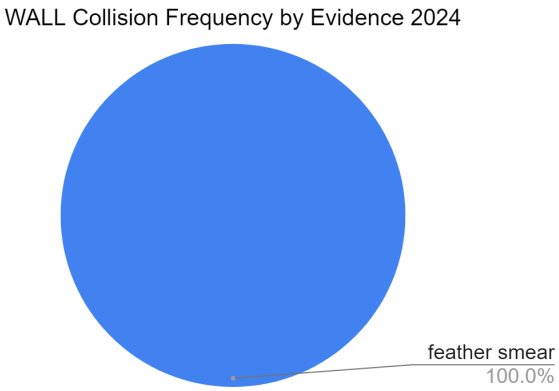

Figure 16. Total building collision frequency by evidence type for the Wall Institute 2024.

Carcass Persistence Trial and Searcher Efficiency Trial

The CP Trial was conducted on March 14th 2024 at approximately 10:00hr. The carcass at the Chan Centre was a Lincoln Sparrow and was placed at facade 5. The carcass at the Wall Institute was a Varied Thrush and was placed at facade 2. At around 12:00hr that same day the carcass at the Wall Institute disappeared and did not leave behind a feather pile. The carcass at the Chan Centre persisted until around 17:00hr on March 16th 2024 where it disappeared and did

not leave behind a feather pile (figure 17). However, since no scavenged carcass or feather piles were found at either location, it is unknown if the carcasses placed were scavenged or removed by human interference.

Past SE Trials conducted on UBC's Vancouver campus found that the average surveyor is successful at identifying collision evidence 57% of the time (DeGroot et al., 2021).

Date & Time	03/14/24 ~10:00	03/14/24 ~12:00	03/14/24 ~17:00	03/15/24 ~12:00	03/15/24 ~17:00	03/16/24 ~12:00
CCPA	Placed	Intact	Intact	Intact	Intact	Removed*
WALL	Placed	Removed*	-	-	-	-

Figure 17. Timeline of results from the CP Trial at the Chan Centre and the Wall Institute 2024.

Discussion

At the beginning of this monitoring project, the primary research question was to identify how frequent and how severe bird collisions were at the Chan Centre and the Wall Institute. One finding that came from the evidence collected during the monitoring period was the positive correlation identified between facade size and collision evidence. Facades with large continuous glass, such as facade 5 of the Chan Centre and facade 3 of the Wall Institute, had the most recorded collision evidence. Of the collision evidence collected during the monitoring period, the majority of the evidence found at these facades was feather smears. Though feather smears are not direct evidence of bird mortality, such as feather piles or carcasses, most bird collisions do end as mortalities (Riding et al., 2019). In addition to feather smears, there was also a high concentration of feather piles found at facade 5 and 4 of the Chan Centre. Though facade 4 of the Chan Centre is not made of continuous glass, its proximity to facade 5 could indicate that this facade was the original collision site. To contrast, facade 12 of the Chan Centre was the second

largest facade surveyed during the monitoring period but received 0 collision evidence, as this facade was not constructed of continuous glass. In addition to facades made up of continuous glass, there was also an increased amount of collision evidence collected at facades with high proximity and percentage of vegetation, such as facade 4 and 5 of the Chan Centre and facade 3 of the Wall Institute. It should be of note that the raw collision data makes up only a fraction of true bird collisions, so facade mortality rates can be assumed to be higher.

Limitations

During the monitoring project, one of the major limitations was bias, which was corrected through the CP Trial and the SE Trial. Past results of CP Trials conducted on UBC's Vancouver campus found that winter persistence of a carcass was 2.23 days. It was found that the probability of persistence is 81% on day 1, and decreases to 63% on day 2 and 0.43% on day 3 (DeGroot et al., 2021). The results from the CP Trial conducted on the Chan Centre and Wall Institute corroborate this, with the Wall Institute carcass disappearing within 2hrs of being placed and the Chan Centre carcass disappearing within 3 days of being placed. It should be of note that it is unclear if the carcasses in the CP Trial were scavenged or removed from human interference, since there was no evidence of feather piles found at either site. For the Wall Institute CP Trial, facade 2 has little vegetation cover and is highly trafficked. For the Chan Centre CP Trial, facade 5 also has little vegetation cover, but high vegetation proximity, and is significantly less trafficked. For the data collected during this monitoring project, correcting for bias in carcass persistence is a method to measure the average length of time a carcass persists in a given location. Therefore, this provides an estimate of how much collision evidence goes unreported between monitoring days. In conjunction with the CP Trial, past SE Trials conducted on UBC's

Vancouver campus found a searcher efficiency rate of only 0.57, meaning collision evidence is only identified by surveyors 57% of the time (DeGroot et al., 2021).

Another limitation identified during this monitoring project was the monitoring schedule. Since the days selected to monitor were unevenly selected throughout the week, there is an increased probability that collision evidence would go overlooked by surveyors. Since 3 days stand between monitoring on Mondays and Thursdays, as well as on Fridays and Mondays, there is an increased probability that evidence of collisions that occurred between those days would be scavenged, removed or washed away by weather.

It should be of note that since this is the first year or record that the Chan Centre and the Wall Institute are being studied for collision evidence, there is no historical data for these buildings. Because of this, at this time it is not possible to reflect on how collision trends for these buildings change by season or by year.

Future Research Directions

An interesting finding during the monitoring project was the effect of weather on collision trends. On days with collected collision evidence, the weather was recorded in the dataset. For the Chan Centre, the majority of the days with collision evidence experience cloudy or overcast skies or clear with few cloud skies (figure 18). For the Wall Institute, the majority of collision evidence collected experienced clear or few cloud skies or cloudy or overcast skies (figure 19). This may be an indication that weather could have an effect on facade reflection effects, and therefore increase the probability of collisions. There is also a possibility, however, that collision evidence was recorded more often on these days due to harder to see collision evidence, such as feather smears, being more visible against these facades. In future it would be

interesting to explore if and how clouds or rain drops against facades affected the probability of bird collisions.

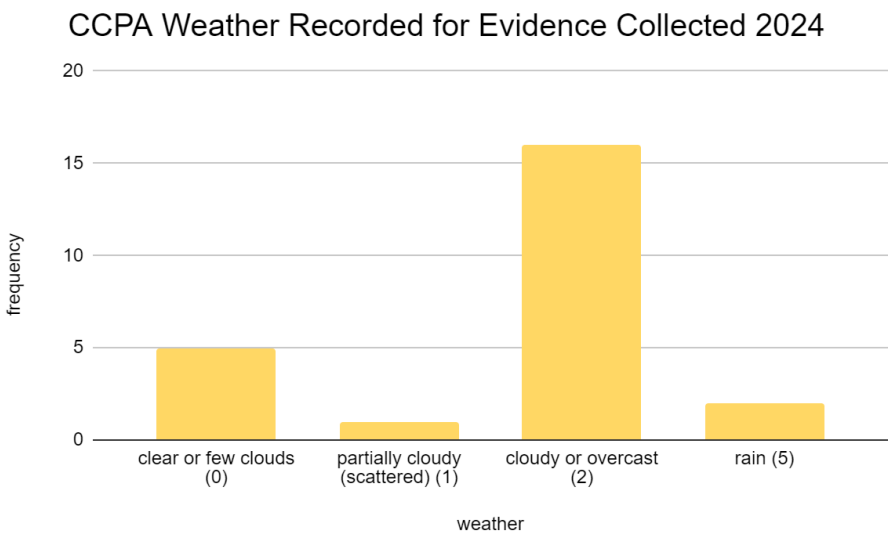

Figure 18. Weather recorded for evidence collected for the Chan Centre 2024.

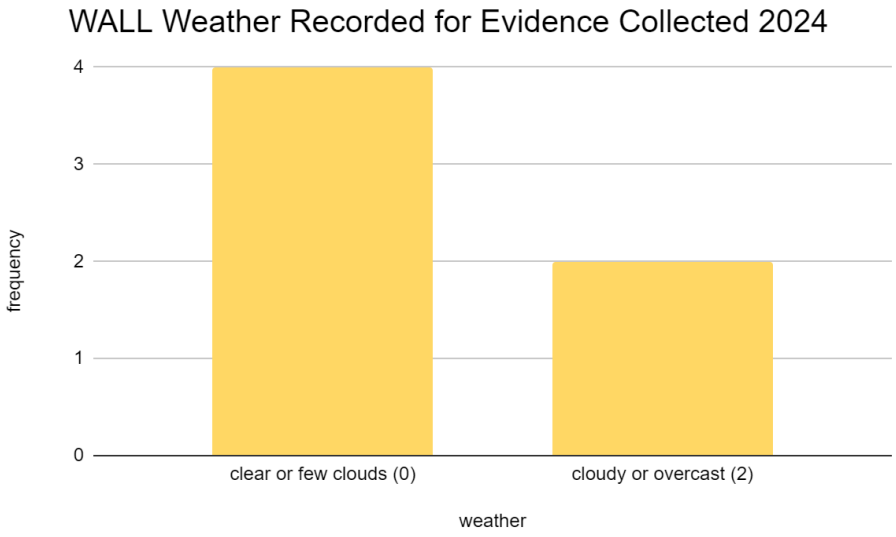

Figure 19. Weather recorded for evidence collected for the Wall Institute 2024.

Management Implications

Based on the findings during the monitoring period, the greatest need in order to reduce the frequency of bird collisions is increased public awareness (Loss et al., 2023). In addition, proactive solutions, such as adaptations to the UBC Bird Friendly Guidelines for Buildings, should be taken in future. The frequency and severity of bird collisions recorded during this survey is evidence that retrofitting needs to occur.

Chan Centre for Performing Arts

Facade 5 at the Chan Centre was the location for the majority of bird collision evidence at the building. The large continuous glass facade has high aesthetic value for the building, and cost effective collision mitigation methods, such as feather friendly stickers or painted murals, may decrease from this value. Because of this, UV treatment of glass would be the best fit for this building (DeGroot et al., 2021). UV treated glass is visible to birds but undetectable to humans, and has shown to have a 66-71% reduction in collision occurrences (DeGroot et al., 2021). It should be of note that replacement of glass facades with UV treated glass is costly, so out of consideration to the building managers it is suggested this mitigation method be implemented when the glass is in need of replacing. Since bird collisions are more frequent and severe at this building, implementing mitigation methods are of a higher priority.

Peter Wall Institute for Advanced Studies

Facade 3 at the Wall Institute was the location for the majority of the collision events at this building. Since the facades at this building are all continuous glass, but of low height, cost effective mitigation methods would be most appropriate. Feather friendly stickers have shown to have a 95% reduction in collision occurrences when used properly, and painted murals have been

shown to disrupt reflectivity (DeGroot et al., 2022). Since the main function of the Wall Institute is for recreational activities, introducing feather friendly stickers or painted murals may add to its aesthetic value. Since bird collisions are less frequent and severe at this building, implementing mitigation methods are of intermediate priority.

Conclusion

Results from this monitoring project have shown that there is a high frequency and severity of bird collisions at the Chan Centre and Wall Institute. Reducing this frequency is necessary for bird conservation and the protection of migrating species, which are most vulnerable to collision mortality. High continuous glass facades, proximity to vegetation and lack of bird friendly architecture are all contributing factors to these trends displayed by the Chan Centre and the Wall Institute. All facades surveyed with collision evidence during the duration of this monitoring project were made of continuous glass, or in close proximity to facades made of continuous glass, and were located in areas with high amounts and proximity to vegetation. The results of the CP Trial and the SE Trial also corrected for a bias in the identification and recording of collision evidence collected by surveyors during monitoring. Since monitoring days were unevenly spaced out during the week, and past SE Trials have shown there to be high observer bias, there is a high probability that collision evidence that occurred during the monitoring period went unobserved or unrecorded. Because of these results, the raw collision data makes up only a fraction of true bird collisions, so real collision rates can be assumed to be higher. In order to reduce the frequency and severity of bird collisions to the Chan Centre and Wall Institute, it is necessary to implement proactive solutions. Feather friendly stickers, painted murals and UV treated glass are all mitigation methods shown to significantly reduce the

frequency of bird collisions when implemented. The results of this monitoring project show that management actions and further research are needed to reduce collision frequency and severity at buildings on UBC's Vancouver campus.

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