

# **Drone Strikes are the Least of Our Worries**



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## **I. Introduction**

As the world continues to develop more sustainable practices, institutions of higher education begin to emerge as prominent figures in the progressive battle for establishing a more sustainable future. Colleges and universities are becoming key players in developing not only the next generation of adults, but developing the core of their sustainability principles as young professionals. Around the country, new coursework/curriculum are being created in order to prepare and inform students of their role as rising change agents in a sustainability challenged world. Colleges like Macalester are incorporating sustainability by offering new degree programs for students (Environmental Studies Major), while others, like The Methodist University Sustainable Program, insert it into existing degree programs (Chase and Rowland, 2004).

Although places of higher education have become pinnacles of progressive sustainability projects, the idea of protecting those animals that currently live in our environment has not taken off as well. Macalester College and any other areas with a large density of glass, have long been subject to bird mortalities. Window collisions are an additional threat for birds as they fail to recognize them as barriers due to the transparent/reflective nature of glass. As a result, birds do not perceive the glass as a solid object, but instead as a reflection of their natural habitat or nothing at all. The vast majority of birds that do collide with these glass windows either die from the initial impact or are injured and become easy prey. Bird mortalities due to collisions account for an annual loss in the range of 2-9% of the total estimated North American bird population (Loss et al., 2014). This does not include airports and airplanes however, which is an entirely different and equally important problem that will not be discussed in this paper. Migration routes have become littered with dangerous buildings that birds did not have to deal with in the past and bird collisions are particularly frequent during the spring and fall migration seasons (usually Mid-March through June & August-November). The occurrence of these bird collisions rings

strong, particularly with these sustainable campuses that have begun to tout their environmental practices in order to gain student approval. Macalester College is a prime example of this, as their student body is highly motivated to protect the environment and they use their eagerness as a beacon to attract other potential students with similar drives.

Bird-window collisions cause an estimated one billion bird deaths annually in the United States alone (Ocampo-Penuela et al., 2016). The issue of bird strikes within the industrialized areas of the world is an urgent problem facing many institutions and is an emotionally charged issue attracting the attention of students across the country. In order to continue the push for more sustainable practices, Macalester must work with departments and student organizations across campus to develop curriculum infusion to create opportunities of awareness related to bird strikes. The building characteristics and the habitats surrounding them must attempt to account for the threat to birds. Although Macalester is doing its best to create sustainable buildings for other issues regarding the environment, they are often built with more glass in order to take advantage of natural light. A possible long-term solution to mitigating bird strikes could involve the addition of patterned glass or UV-reflective films in new buildings. However, it could prove difficult to retroactively fit this glass to current problem buildings.

Other areas of environmental sustainability can have underlying impacts on the frequency of bird strikes. For example, Macalester's landscaping sustainability practice could possibly influence the amount of bird-window collisions by attracting birds to the nearby vegetation (Hager & Craig, 2014). Although this might not apply everywhere, it is important to understand the implications of other sustainability work and continue to develop methods that assist all environmental efforts. The fundamental goal of this paper is to create advocacy for bird strikes as an important environmental sustainability practice; and to demonstrate the scope of bird

casualties on campus, along with how they may best be mitigated. If the projects we outline in this paper were similarly implemented across campuses, there would be an opportunity for substantial conservation benefits for birds.

## **II. Macalester**

At first glance, Macalester College doesn't seem like a bird-unfriendly campus. There are wide expanses of grass and tall trees, as well as small landscaped areas filled with shrubs for birds to hunt for food in. In addition to these easily visible features, Macalester has a strong commitment to sustainability-- From the Zero Waste by 2020 initiative to being carbon neutral by 2025, Macalester undeniably strives towards sustainability. One of the biggest claims to eco-friendly fame is Markim Hall, which was the first LEED Platinum certified university building in the state (Laskin, 2009). Janet Wallace Fine Arts Center is also designed with high environmental awareness, meeting the set of requirements for another government sustainability certification.

Despite the leaps in energy efficiency and runoff reduction these buildings have achieved, they actually pose a serious threat to birds. "Green" building design generally tries to take advantage of natural light as well as heat from solar radiation, and this means an increase in windows over non-green buildings (Ocampo-Penuela et al., 2016). Janet Wallace is a hot spot for bird collisions on campus, with the new building featuring floor to ceiling windows on several of its sides. Professors housed in the art building have complained of routine strikes-- around 1 per week in just one classroom during the 6 hours per week of class time. (Dischlinger et al. 2016)

Janet Wallace is an obvious choice that was brought to the foreground by complaints from professors, but we wanted to identify what the other likely threats to birds on campus were in order to develop the best solution to the problem. Though we didn't expect to see any collision

marks or victims of a collision, we looked at previous studies to locate probable indicators of building risk. The most important and most obvious factor is overall amount of glass, specifically large unseparated areas of glass (floor to ceiling windows and skyways), but there are other factors that heavily contribute to mortality. Clear glass alone is not always enough to confuse a bird-- When glass is paired with vegetation, either reflected from outside or visible from the inside of the room, bird mortality skyrockets, tripling in one Manhattan study (Gelb & Delacretaz, 2009). The last important factor for explaining collision mortality is another no brainer: Avian density. An area with a higher density of birds will experience a higher mortality rate than a less dense area (Hager et al., 2008). This is a secondary variable, however-- an area with fewer birds can still have higher mortality if there is a more dangerous combination of vegetation and window area.

These variables in mind, we walked the campus and identified the areas we expect to have the highest rates of avian collision mortality. Areas identified, in order of priority, are listed below:

1. Janet Wallace Fine Arts Center
  - a. Highest density of glass (*first draft note: get actual numbers from facilities re: sqft of glass on buildings*).
  - b. Trees nearby to reflect off the glass.
  - c. Professor and student reports of constant collisions.
  - d. Some studio rooms have plants inside near the windows.
2. Kagin Commons
  - a. High density of glass.
  - b. Lots of vegetation nearby to reflect.

- c. This is what would be expected to be the most problematic building, but reports from Janet Wallace bumped it to the top of the list. Perhaps since nobody works constantly in the upstairs of Kagin, reports are skewed.
- 3. Olin Rice Hall of Science
  - a. Large glass areas, specifically in the back facing the fields and to the right of the main entrance.
  - b. Vegetation situated directly in front of nearly all windows .
- 4. Weyerhauser Memorial Chapel
  - a. Very large glass windows.
  - b. Nearby vegetation.
- 5. Skyway between Neill Hall and Olin Rice
  - a. Very obscured, in an abnormal location with open space below.
  - b. High density of vegetation
- 6. Campus Center
  - a. Glass area near entrance, though no vegetation near.
  - b. Vegetation near other smaller windows.
- 7. Leonard Center
  - a. Fair amount of glass, though little to no vegetation in problem areas

### **Other Campuses//working subheading**

It's ironic that the most dangerous areas for birds are the same areas with the highest density of vegetation, which is what most people probably imagine to be the best thing a campus could do to be bird friendly. Apropos of these factors, nearly all college campuses become perfectly designed bird death-traps-- Large, modern buildings with lots of window space are the new attractive design style (natural light goals aside) and can be found on every campus at an increasing rate. Luckily, colleges are also the perfect environment for researching and solving the problem.

Courses like Sustainability and the Campus, which are beginning to emerge at other undergraduate institutions, are the perfect driver for allowing more obscure sustainability problems, like bird collisions, to be brought to the foreground. This idea of “problem and project based learning”, or PPBL, creates a way for the institution to accept and sponsor important projects without going through the red tape associated with adding a goal to the sustainability

plan or changing the way facilities operates (Elmhurst & Grady, 2017). This student sponsored approach is crucial, and it is what we believe will produce the most success.

Part of the on-campus changes that need to happen in order to promote bird safety is a general paradigm shift of what “sustainability” is. It’s undeniable that the most pressing global environmental issue is climate change, and so it’s natural that most sustainability programs focus on things like clean energy and green buildings that will help to minimize carbon footprint. Macalester actually has a more holistic sustainability plan than many institutions, including operations not just in clean energy but also in fields like water, landscaping and waste management (Macalester College, 2011). However, notably missing is the idea of making campus a green space not just for the sake of being green, but to protect and foster the wildlife that call campus home. Mark Davis, a biology professor, has documented 72 different species of birds on campus, ranging from the common House Sparrow to more rare sightings like White Pelicans (Dischinger et al., 2016). There are important fauna communities on campus, and without recognizing this more immediate side of being sustainable, things like bird-window collisions will continue unchecked and the ecology of the campus will deteriorate. Though not part of our immediate plan for combating bird collisions on campus, it’s worth looking towards possible expansions of the environmental studies major to require a campus-focused sustainability course or changing the kind of environmental problems that classes focus on. Incorporating a PPBL approach to the requirements of Environmental Studies could be a very valuable tool for maintaining a bird-window collision project year to year (as opposed to letting things flounder after a year or two of support), not to mention other directions projects could go in.

### III. Case studies

Within the time constraints of this class, we weren't able to run a real research study looking at bird-window collisions on campus and mitigation strategies. Although there's no solid data from Macalester, several other similar institutions have conducted studies that can be extrapolated to Macalester. Analysis of each study will follow a similar format explaining what the motivation for the project was, how the study was carried out and how the mitigation efforts were enacted, what they actually used to prevent collisions, and if it worked. Each case study will provide conclusions and next steps that can be applied to Macalester, and the most important takeaways and methodologies will be summarized in the form of a Macalester-focused proposal.

#### Temple University-- *Elmhurst & Grady 2017*

\_\_\_\_\_At Temple University, bird-window collisions were actually brought to the forefront quite recently. Temple is located right on the Atlantic Flyway, a bird migration route that follows the Atlantic coast of the US, and every year during migration season, students noticed high numbers of bird fatalities on campus. The university recognized this to be a perfect issue to bring to the head of the sustainability program under their "living laboratory" and project based learning goals, citing "the pathos associated with the collisions" (Hager et al., 2008, pg. 4) as a powerful motivational tool both for the immediate project and to create more interest in other sustainable curriculum options. At Temple, though bird strikes wouldn't necessarily fit into their "Climate Action Plan", students were so upset by the injured birds that it was treated as an urgent issue and adopted by both students and faculty (Hager et al., 2008).

In 2004-2005, monitoring programs were set up to identify the most problematic buildings, and they were repeated in 2009. The initial studies were performed by student workers at Temple, and the later ones were carried out by Audubon in partnership with the Philadelphia

Zoo. Since 2009, students have again taken the lead on continuing the monitoring efforts, utilizing both student workers and volunteers to document collisions. They both reported that the most collision-prone buildings were those with large swaths of reflective glass that were situated next to vegetation-- these types of structures accounted for 75% of all collisions.

These monitoring studies provided the framework needed for mitigation efforts to come into play, and these were also student-led. In 2011, a student tested a patterned window film on one of the problem buildings, finding that a 4"x4" box pattern (slightly larger than the recommended 2"x4") was not greatly effective at reducing strikes. Another project took a different approach, covering windows in cheap crop netting that wouldn't prevent birds from crashing, but would cushion their impact and allow them to bounce off without harm. The netting appeared to be effective, though the only monitoring effort was looking at the ground below for any dead specimens-- which were not found, thus confirming the efficacy of the nets.

The awareness spread by these projects created curricular and co-curricular efforts to combat bird collisions, and design classes picked up on the cause, holding contests to design protective window films (that were later proven to be effective). The entire campus appears to have rallied behind the issue of bird-window collisions as a result of the PPBL approach, and it looks like mitigation efforts will continue to be developed and employed.

Duke University-- *Ocampo-Peñuela et al. 2016, Lucas 2016*

\_\_\_\_\_Students at Duke University also conducted a study on bird-window collisions that had an advocacy approach, collecting enough data to make a recommendation to the campus for mitigating bird fatalities. This project was not as PPBL based, and is a more formal research study, which has both pros and cons. The benefits include more rigorous data collection and analysis as well as more detailed results and conclusions, but it comes at the price of the

interdisciplinary and co-curricular approach Temple embodied. Overall, the goal of Duke was to serve as a proving ground and example for the rest of the country, aiming to show how many birds could be saved if the mitigation techniques they tested were applied nationwide.

This study provides much more solid numbers than the Temple project and gives a real look at the factors involved in bird collisions. They did rigorous carcass surveys on 6 buildings with varying glass coverage and vegetation presence, and though the sample size was still too small for traditional statistical analysis, the quantitative data is clear enough to draw conclusions. The most dangerous building (71% of fatalities) was 57% glass and had 33% surrounding forest cover, while a building with similar glass area but no forest cover had only 11% of collisions. One building in the study had bird-deterrent “fritted” glass, and it had only two fatalities (the lowest in the study) despite being 97% glass, effectively proving the functionality of that technology. Other problems identified included glass skyways (which Macalester has 2 of) and the predominance of glass in LEED certified buildings, which was brought up earlier.

The students involved in the study used this data to convince Duke to retrofit the building responsible for 71% of the bird deaths, citing student support as well as the presence of hard scientific data as the chief motivators of university action. The upper windows of the building are being faux-fritted by applying a dotted film that can peel off, leaving just the dotted pattern in place on the glass.

#### Yale University--Yale University, 2015

Yale’s project doesn’t include a research study or student-led action, but is important to look at nonetheless. After picking up dead birds for many years all over campus, groundskeepers convinced the administration to install fritted glass on a building with giant floor to ceiling

windows, in order to improve heat efficiency and hopefully decrease avian mortality. Though no study has been conducted, the groundskeeper that reported picking up dead birds for years has said he has not found a single one in the 2 years since the fritted glass was installed.

### Macalester College

\_\_\_\_\_Awareness of this issue is low at Macalester, but not nonexistent. After experiencing a large number of annoying bird strikes on his classroom window, art professor Eric Carroll instructed his 2-D design class to come up with sticker designs that could be placed on the windows to make them more visible to birds. Professor Carroll said that the final design was a small bird shaped sticker that they put several of on the windows. He says he wasn't sure how effective they were, and this year they have been replaced with a giant "VOTE" window display. However, he said that blocking the window with something large like that just isn't feasible, and he's still interested in finding a better solution.

### Other solutions

In addition to these collegiate case studies, there are other products and applications that have potential. There are many different types of bird-safe glass, some of which are only around 5% more expensive than a non-fritted alternative (Audubon Society). However, the dots and stripes of these patterns are an eyesore for some, so UV alternatives are being developed by companies like ORNILUX, which claims to have achieved up to 77% deterrence rates with their proprietary UV solution, invisible to the human eye (ORNILUX.com). There are other similar glass products available, but some of them come at a cost-- the new Vikings stadium in Minneapolis was under fire for being a very bird-unfriendly structure, but a retrofit to include bird safe glass would have come at an estimated cost of \$1 million.

#### **IV. Recommendations**

There are several different directions to move in to improve bird safety on campus and expand this study towards real world solutions. This section will outline the options, critique them, and identify the most promising choices. Regardless of the direction chosen, it's important to always keep the data flowing-- Continued research and survey efforts are crucial to future success, and that's echoed in the case studies examined in this paper.

The first choice is doing nothing towards mitigation for the time being, but augmenting this small project and turning it into an actual research study that, after a year or so, could provide solid quantitative data on the scale of the problem and the efficacy of specific solutions on Macalester's campus, not just on a general level. Thinking realistically, this is probably necessary before any kind of expensive solution could be proposed, just because real numbers are usually the only thing that can motivate significant expenditure.

The most obvious real solution is using bird safe glass, but there's multiple dimensions to this. Something that shouldn't pose too much of a problem is to integrate bird-safe glass into new construction products in some aspect, since there is already a bird safety component in LEED guidelines-- it just isn't usually brought to the forefront. What would be more difficult is achieving a retrofit of existing buildings, but regardless of if the target is future or existing structures, the type of bird-safe glass still poses another problem.

Several options have already been discussed, from fritted glass to high-tech UV solutions or even transparent films, and the distinction really comes down to cost. Basic fritted glass that has a visible pattern on it is the middle of the road option, while the higher-tech (but fully transparent and more aesthetically pleasing) solutions cost more. The cheapest option, as well as the most amenable to retrofitting, is the application of a transparent dotted film, which has been

proven to work by Duke University. It's not the most unobtrusive or the cleanest solution, but it's the cheapest and the most feasible, especially for pilot studies since it can be removed and re-applied easily.

These options in mind, the best course of action that our findings have shown would be to continue to study bird strikes at Macalester to obtain solid data on the existence of a problem, and if there is sufficient evidence, to move forward quickly with the easy and relatively cheap solution of applying dotted films to the most problematic window areas. It's a much more elegant solution than removing vegetation or retrofitting with new and expensive glass, and seems to be the clear choice— But it must come as a result of research and public awareness, which can't stop after the film is applied. Complex and obscure sustainability issues like these can't just be treated and then put back in the closet, and bird-window collisions on campus is a perfect example of what a true sustainability ethic can look like.

## **V. Conclusion**

The overall challenge involved with making bird strikes an important part of developing sustainable environmental practices on campuses should not be understated. This paper attempts to inform the dialogue around this topic and hopefully helped encourage those on the fence, or those ignorant of the problem, about the necessity to advance the sustainability learning objectives at Macalester. The impact of bird strikes can be seen frequently by students, who can walk by dead or injured birds as they move about their daily lives on campus. In fact, I have personally encountered an injured bird below the De Witt Library overpass and was unable to do more than simply move it to a nearby tree during the time between classes. By connecting students to the relevant sustainability problems on campus, we hope to spread a message not just

about how the environment can be preserved, but one that includes aiding creatures who are directly impacted by our decisions. Macalester can use its reputation as an environmentally progressive school to utilize the imagination and interest of its students to empower sustainability practices inside and outside the classroom.

Having students take a campus tour that identifies dangerous buildings, similar to the one we did as part of this project, could enlighten those who are ignorant of the problems many buildings pose for birds all across North American campuses. Implementation of curricular and research strategies can enable students to gain a deeper understanding of the bird strikes issue and can aid in developing essential sustainability practices. While these practices may not be able to reach the greater Minneapolis area, a better understanding of the issue can help identify strike mitigation tools that are effective, financially reasonable, and visually pleasing. In the future, we are hopeful that this awareness will spur a movement of change outside Macalester Campus; where huge buildings dominate the landscape with little to no acknowledgement environmental issues, let alone bird strikes.

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