

# Quantifying Avian Window Strike Mortality on Ramapo College Campus

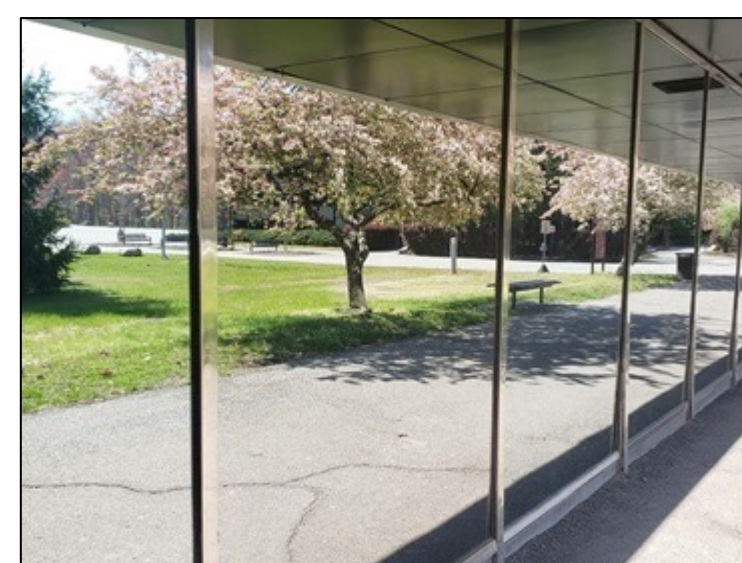
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## Introduction

Window strikes are among the most common causes of premature bird death, killing an estimated one billion birds per year worldwide. Especially problematic are buildings with mirrored glass in rural and suburban settings, which reflect surrounding habitat and cause birds to mistake the solid surfaces for vegetation and open air (Figure 1). This issue is exacerbated in areas of high-quality habitat such as Ramapo College's forested campus, which is attractive to a wide variety of birds. A multi-year study was conducted to quantify how many birds have harmful and fatal interactions with the mirrored glass academic buildings on Ramapo's campus.

## Methods

Starting in 2018, daily surveys were conducted to count dead and injured birds that hit windows around the Ramapo College campus during spring and fall migration. Participants in the project walked a set route along campus buildings, including the main academic buildings A-E, G, H, the Anisfield School of Business, and the Adler Center (Figure 2.) All dead and injured birds were documented by noting an individual's species, date, building struck, and any pertinent notes. Dead birds in good condition were collected under state and federal salvage permits to be transferred to natural history collections; birds in poor condition were disposed of per legal requirements. Injured birds were safely collected and transferred to a wildlife rehabilitation facility for treatment. The project took place during spring and fall migration only in 2018-19 and included additional buildings. The project expanded to daily year-round monitoring in April of 2020 and collection at buildings of low impact was abandoned. The project is ongoing.



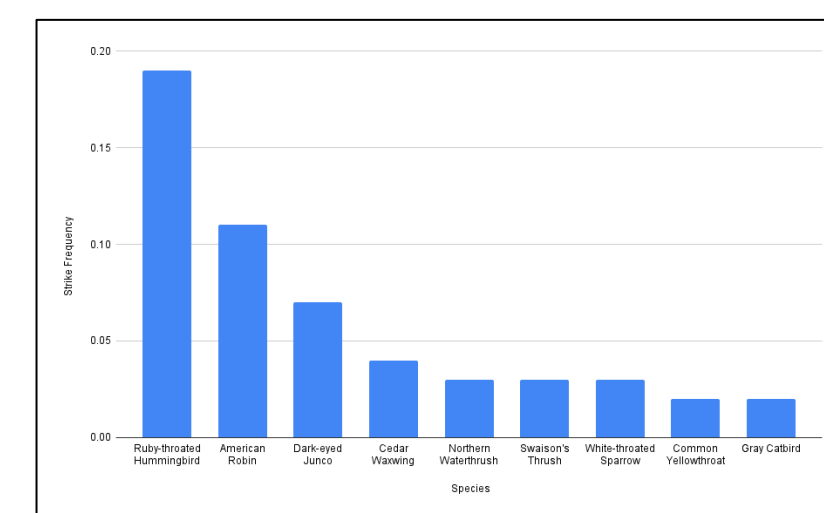
**Figure 1.** Mirrored glass on the Ramapo campus reflecting habitat



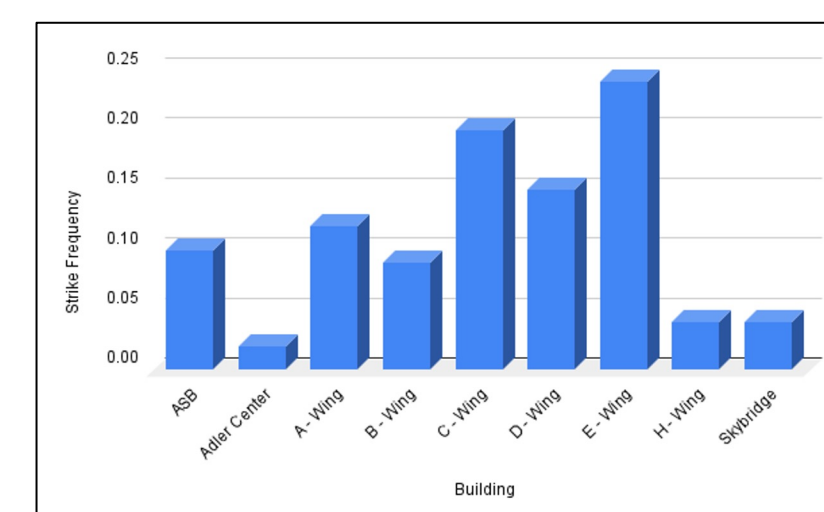
**Figure 2.** Map of buildings on Ramapo College campus surveyed for bird collisions in this study

## Results

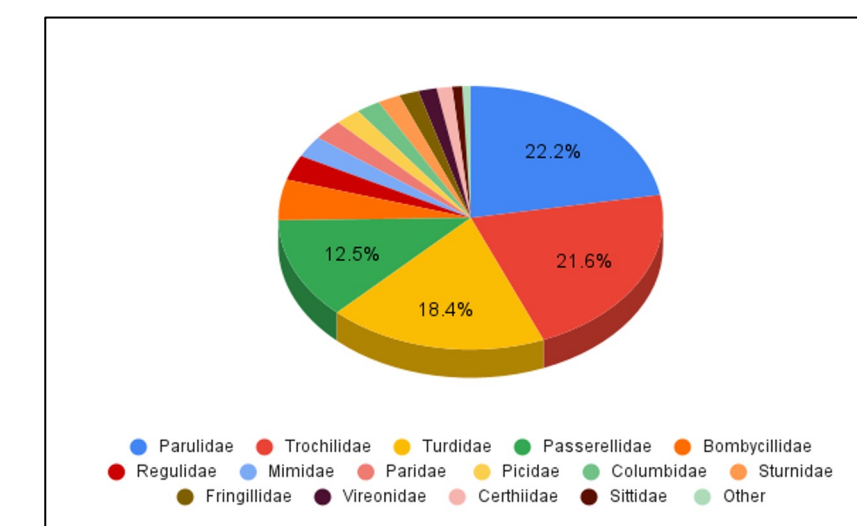
Data show that at least 400 birds a year collide with windows on campus with 86 species from 22 families affected over the past five years. The most affected species are Ruby-throated Hummingbirds (19% of all birds), American Robins (11%), and Dark-eyed Juncos (7%, Figure 3). The avian families most affected were warblers (*Parulidae*) and hummingbirds (*Trochillidae*) at 21% each, thrushes (*Turdidae*) at 18%, and sparrows (*Passerelidae*) at 15% (Figure 4). Academic buildings C and E were responsible for the most collisions, representing 20% and 24% of morality events on campus respectively (Figure 5). Buildings D (15%) and A (12%) were the next most problematic. The specific building faces with highest mortality were inner E facing the courtyard and the outer corner of C facing the lake, together accounting for 47% of deaths (Figure 6). Data from year-round collection show that the majority of strikes (81%) occurred between May and October with 46% of morality events occurring in September and October (Figure 7). May was the next worst month with 13% of deaths, then July at 10%. Very few strikes occurred over the winter. Data from 2018-19 are consistent with this trend, showing a majority of strikes in the fall with a second peak in May. Some buildings' architecture allowed for observing the level at which birds struck; on these buildings, upper windows accounted for 71% of strikes while 29% struck the first floor (Figure 8). The majority of birds (91%) who survived a window strike were successfully rehabilitated (Figure 9) but only 68 birds were found alive.



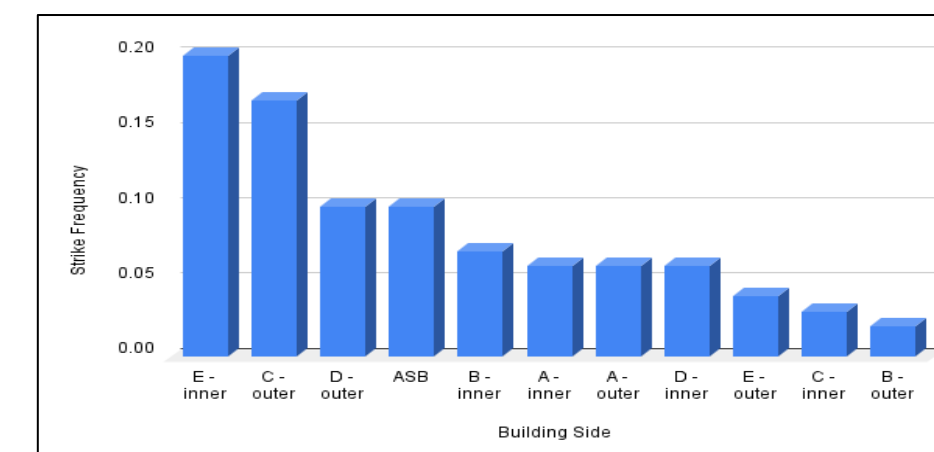
**Figure 3.** Frequency of window strikes of the nine most affected species



**Figure 5.** Number of observed window strikes per building



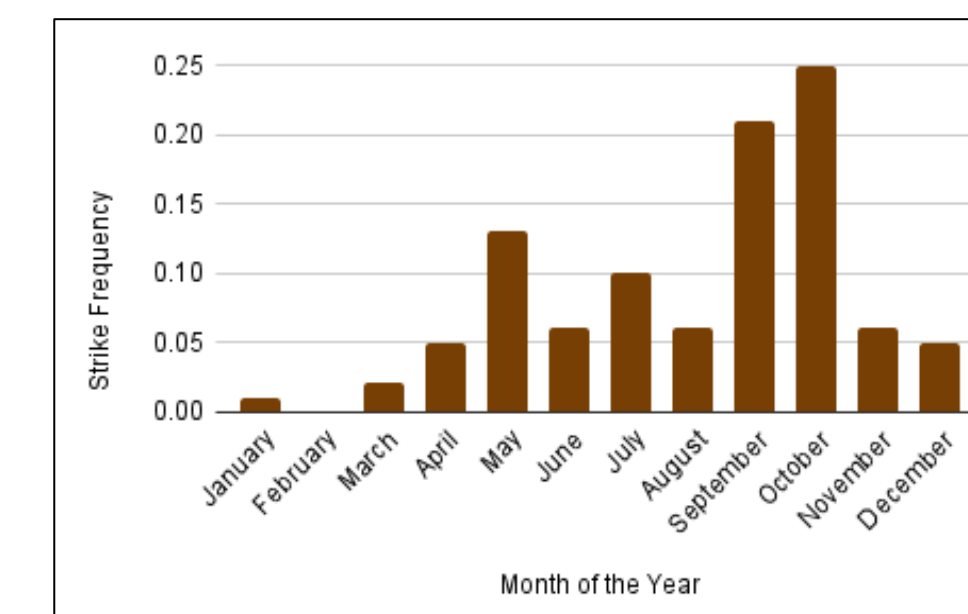
**Figure 4.** Proportion of window strike victims from various avian families; "Other" represents 6 additional families



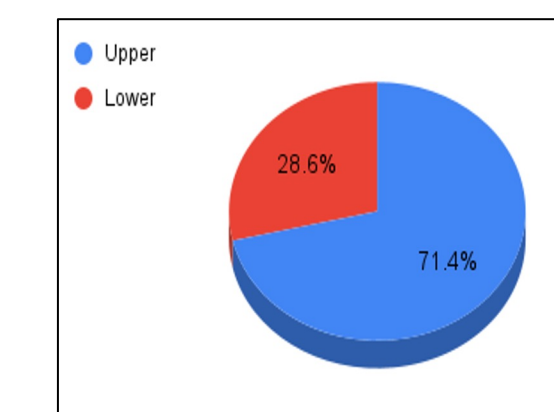
**Figure 6.** Frequency of strikes at most deadly buildings by building side

## Discussion

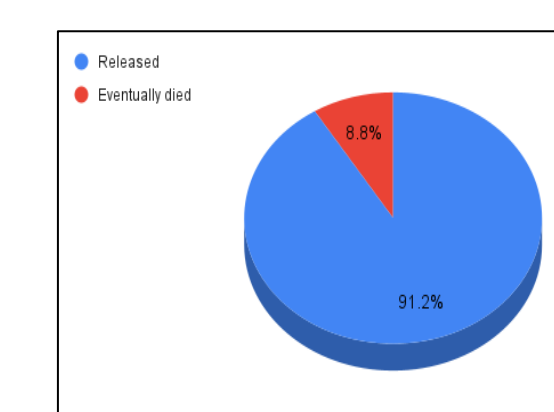
Many avian species from many families have been documented colliding with windows on campus, usually resulting in death. Ruby-throated Hummingbirds are the most affected species, especially young birds, which account for most of the strikes in May. American Robins are strongly affected, especial newly fledged birds responsible for the increase in July. Juncos are badly affected as well and represented most deaths in slower months over winter. Warblers were the most affected family with 22 different species found dead on campus. The inner side of E and C corner are the most deadly to birds. The courtyard-side of the main academic buildings are highly problematic as well as the L shape of A-E traps birds on two sides, reflecting suitable habitat they attempt to fly to. The fall migration period was the most deadly to birds and spring migration also had relatively high mortality. Migrating birds are new to the environment and are unfamiliar with the landscape. Many birds also died in the summer, especially hatch-year birds that fledged on campus. Summer deaths included females with brood patches, meaning their young still in the nest died with them. The low winter morality was likely because of the low number of individuals overwintering on campus combined with the familiarity of the landscape to long-term inhabitants. Effective solutions to this problem exist such as window applications that make glass more visible. FeatherFriendly and CollidEscape have been proven to be effective in preventing window strikes. Thankfully, Ramapo College is looking into these mitigation strategies, starting with the most problematic buildings.



**Figure 7.** Frequency of window strikes by month from 2020 – 2022



**Figure 8 (left).** Percent of strikes that were a result of impact with upper or lower window



**Figure 9 (left).** Percent of birds found alive after a strike that recovered vs died later

## Acknowledgements

Thank you to all volunteers involved in data collection since 2018, especially Michael Turso and Allison Gore, and to all faculty and staff at Ramapo working towards mitigating this issue, especially Edward Roessler, Michael Cunningham, Eric Weiner, and Ashwani Vasishth.