Breeding season bird mortality from window collisions: Comparing species-specific abundance with mortality rates

Nicole Biagi & Robert Blair, Ph.D., Research Advisor --- Department of Fisheries Wildlife and Conservation Biology

University of Minnesota

Introduction

Window collisions are the second largest (after cats) anthropogenic cause of bird mortality in North America, killing 365 to 988 million (median = 599 million) birds every year in the United States alone[6].

- Most studies regarding bird-window collisions focus on migrations seasons rather than breeding season.

Relative to estimated abundance, some species of birds have been found to collide with buildings more frequently than others.[1,2,6]

- This poorly understood phenomenon may cause increased rate of population decline for species already under pressure.
- Only a small number of studies have attempted to compare collision rate to local abundance
- There are a variety of ecological differences that could possibly explain the variability in collision rates per species including traits such as feeding, nesting, foraging style, typical habitat requirements, etc.[3,4]

Hypothesis

It was hypothesized that collision vulnerability would vary among species, and that ecological differences such as those listed above would provide a stronger explanation for the relative vulnerability than would the relative abundance alone.

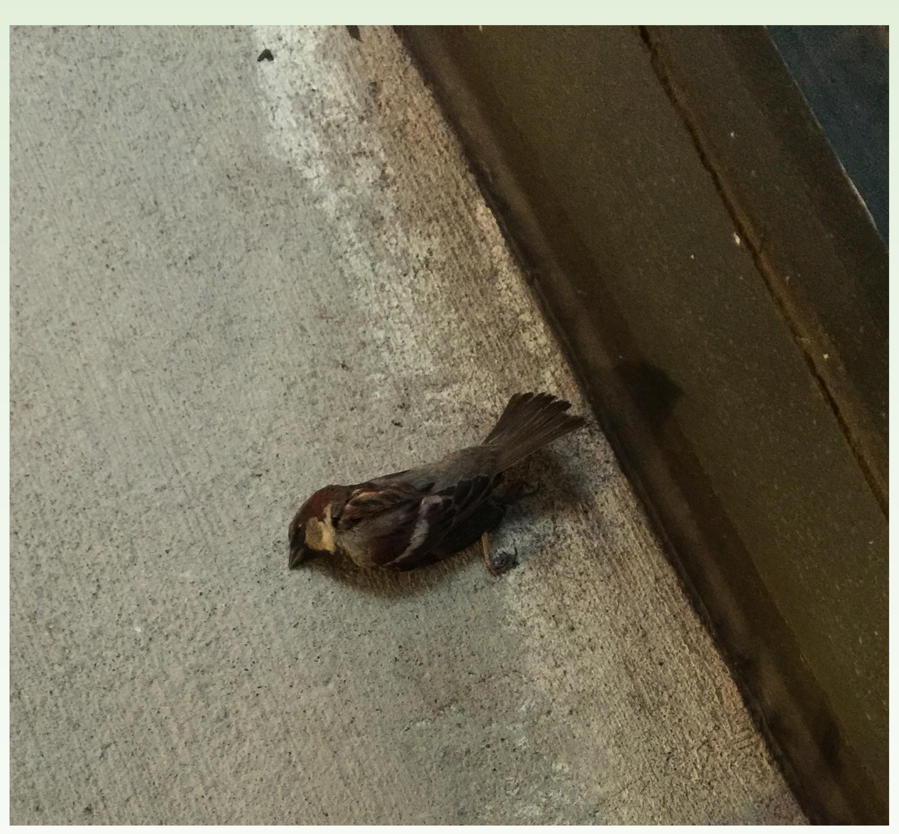

Image 1. A bird carcass found next to a window at sunrise is assumed to have collided and therefore collected as collision data. Photo: Abbie Anderson, 2017.

Objectives

1. Provide much-needed quantitative data regarding species-specific bird-window collision rates during the breeding season
2. Analyze which, if any, species are more or less likely (based on relative abundance) to collide with windows in a downtown business district zone
3. If possible, provide mitigation suggestions for city planners to lower the number of collisions

Methods

Data Collection

During the breeding season of 2017, bird collision and bird abundance data were collected from a two-mile route in downtown St. Paul.

- Route was surveyed at sunrise for 26 days
- Collisions: Bird carcasses found under windows and skyways were collected
- Abundance: 10 6-minute point counts were conducted at each of the 16 corners

Figure 1. Map of St. Paul Monitoring Route. A collision monitoring route (in red) of 3.32 km was established as part of a larger monitoring project from 2007-2016 with Project BirdSafe[5]. Corners chosen randomly for point counts are marked by transect buffers of 50 m and lettered. Buildings which include a facade along the route and skyways that cross the route are shaded dark gray.

Data Analysis

Using Program R and the lme4 package[3]:

- To test the significance and strength of abundance as an explanatory factor of collisions among bird species
- Best model had a fixed effect of abundance and a random effect of week nested within species
- Species origin (i.e. native or introduced) was then added as a second fixed effect to test with abundance.

Results

During surveys, 1,551 live birds and 21 collision mortalities were counted. However, four collision specimens were removed from the data set because identification was uncertain leaving a collision count of n=17 (Table 1).

- Live detections: 8 species
  - 59% house sparrow (n=875)
  - 22% rock pigeon (n=320)
- Collision detections: 10 species
  - 18% house sparrow (n=3)
  - 18% house finch (n=3)
- Only 3 species were detected both alive and dead: house sparrow, house finch, and American robin

Results

Table 1. Total number of detections (live and dead) for each of 15 species. The live proportion and collision proportion are relative to the total number of live detections (n=1,551) and collision detections (n=17), respectively.

Species	Live Detections	Live Proportion	Collision Detections	Collision Proportion
House sparrow	875	0.5916	3	0.1765
Rock pigeon	320	0.2164	0	0
House finch	179	0.1210	3	0.1765
European starling	49	0.0331	0	0
American robin	44	0.0297	1	0.0588
Mourning dove	8	0.0054	0	0
Black-capped chickadee	3	0.0020	0	0
Peregrine falcon	1	0.0007	0	0
Indigo bunting	0	0	2	0.1176
Mourning warbler	0	0	1	0.0588
Cedar waxwing	0	0	2	0.1176
Yellow warbler	0	0	1	0.0588
Common yellowthroat	0	0	2	0.1176
Red-eyed vireo	0	0	1	0.0588
Northern cardinal	0	0	1	0.0588

According to the best supported model, there is weak evidence that collision vulnerability is positively correlated with abundance ($\Delta AIC = 1.72$; $\beta = 0.1867$; p-value = 0.101).

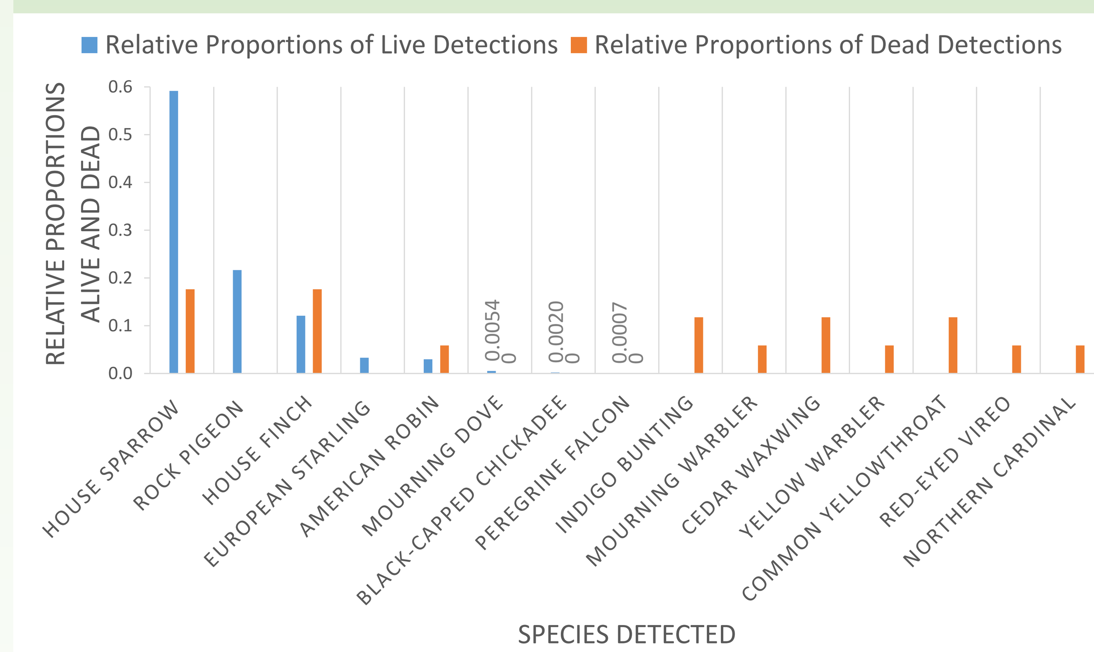

Figure 2. Relative proportions of species detected alive during point counts are depicted by blue bars. Likewise, relative proportions of species detected dead (i.e. found as carcasses along route) are depicted by orange bars. If a bar cannot be seen, it is because there were no detections in that category, except with mourning dove, black-capped chickadee, and peregrine falcon where the relative detections were so low that they cannot be seen.

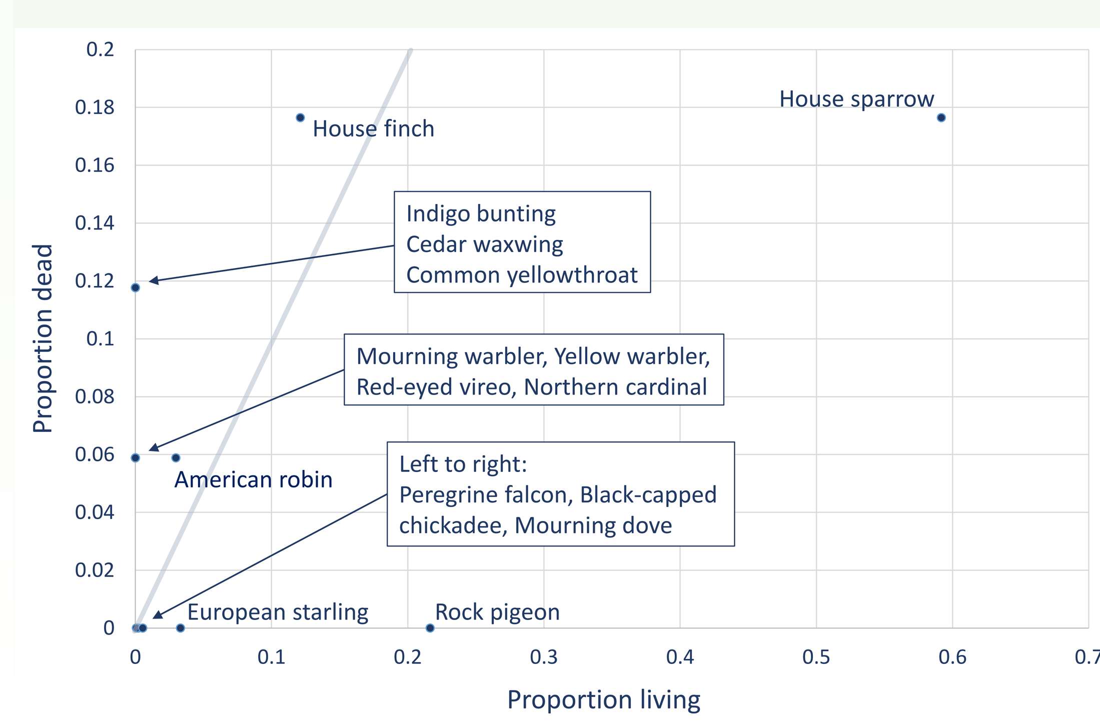

Figure 3. Relative number of collisions per species are depicted as a function of relative frequency of each species. A hypothetical one-to-one line is shown in gray to depict the null hypothesis. Species that fall along the one-to-one line (American robin and house finch) collide relatively proportional to their frequency. However, the species that fall above the line (in this case on the vertical axis), have a higher collision rate relative to their frequency, and the species that fall below the line (house sparrow and those on the horizontal axis), have a lower collision rate relative to their frequency.

Conclusion

As a result of surveying only one breeding season, the collision data set collected was rather small (n=17). The data did not support the hypothesis that non-native species would be less vulnerable to collisions. However, it did suggest a weak positive association between abundance and species-specific collision vulnerability.

It is likely due to the small data set that there was not a significant relationship between collision vulnerability and species origin.

- Three of the four species in this study that are non-native (European starling, rock pigeon, and house sparrow) suggest the hypothesis is correct (figure 3).
- They had relatively low rates of collision as would be expected for non-native species which are often more well adapted to human-dominated environments[7].
- However, because there was such a small number of collision detections and an even smaller number of species detected both alive and dead, house finch (a non-native species) was able to skew the significance.

Anecdotal Takeaway

- Out of the 15 species detected, only 3 species were detected both alive and dead.
- Five species were detected alive but never found dead, and seven species were found dead but never detected alive.
- This suggests that there is a distinction between species which are more or less likely to collide because the relative collision counts do not line up with the relative frequency of each species.

Acknowledgements

This research was made possible by the generous funding from the Undergraduate Research Opportunity Program.

I would like to thank my thesis advisor, Professor Robert Blair from the Department of Fisheries Wildlife and Conservation Biology (FWCB) for all of the time and effort he has put into this project. I would also like to thank Abbie Anderson for allowing me to use her data collection method and providing me with invaluable guidance throughout this experience. Finally, I would like to thank my readers, Professor Todd Arnold from the Department of FWCB, Joanna Eckles from Joanna Eckles Consulting, and an anonymous reviewer from the Minnesota Undergraduate Research Academic Journal (MURAJ) for all of the critical feedback they provided.

References

[1] Anderson, personal communication, 2017

[2] Arnold, T.W. and Zink, R.M. (2011). Collision mortality has no discernible effect on population trends of North American birds. PLoS ONE *6(9)*, e24708.

[3] Bates, D., Maechler, M., Bolker, B., and Walker, S. (2014). lme4: Linear mixed-effects models using Eigen and S4. R package version *1(7)*, 1-23.

[3] Blair, R. B. (1996). Land use and avian species diversity along an urban gradient. Ecological Applications *6(2)*, 506-519.

[4] Blair, personal communication, 2017

[5] Eckles, personal communication, 2017

[6] Loss, S. R., Will, T., Loss, S. S., and Marra, P. P. (2014). Bird–building collisions in the United States: Estimates of annual mortality and species vulnerability. The Condor *116(1)*, 8-23.

[7] Shochat, E., Lerman, S.B., Anderies, J.M., Warren, P.S., Faeth, S.H., and Nilon, C.H. (2010). Invasion, competition, and biodiversity loss in urban ecosystems. BioScience *60(3)*, 199-208.