Banisteria, Number 53, pages 11–21

Investigating Campus Features that Influence Bird-window Collisions at Radford University, Virginia

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ABSTRACT

Window collisions pose a serious risk to birds, second only to domestic/feral cats. We sought to quantify the impacts of this threat at Radford University, a campus situated within a rural landscape and along a major migratory route (New River). We searched for evidence of bird-window collisions (BWCs) at 15 buildings in 2018 and 2019. In nearly 1,000 hours of surveys we discovered 51 birds (23 species) thought to result from BWCs. Increased window area tracked with a greater number of mortalities/building. Building height and surrounding vegetation metrics were not significantly related to BWCs. Species' residency status did not significantly influence mortality events. Compared to BWC surveys nationwide, our number of mortalities was low, especially relative to our substantial surveying effort. Although this finding might suggest that Radford University buildings are not a significant source of mortality for birds, we recognize that (1) *a priori* surveying biases likely underestimated actual mortalities, and that (2) Radford University's architectural changes in the last several years are increasing the likelihood of BWCs in the future. We suggest that Radford University explore window decals on current windows and incorporate "bird-friendly" glass on aspects that comprise large proportions of glass. Both of these steps contribute to Radford University's goal of increasing the number of LEED-certified buildings on campus.

Keywords: avian migration, avian mortality, building height, deterrents, time-of-day, vegetation, window area.

INTRODUCTION

Bird-window collisions (BWCs) are a substantial anthropogenic source of bird mortality, accounting for an estimated 365–988 million bird deaths annually. BWCs are the second largest cause of bird deaths, behind domestic and feral cats (*Felis cattus*; Loss et al., 2014; Kahle et al., 2016). Collisions typically are not limited to a particular avian taxon, and they can negatively affect common birds as well as species of conservation concern (Loss et al., 2014; Hager et al., 2017).

Previous BWC studies have covered the gamut of building scenarios, from high-rises in a metropolis (Chicago: Briscoe & Dampier, 2019; Manhattan: Gelb & Delacretaz, 2009) to myriad college campuses (Hager et al., 2017). Multiple studies have investigated landscape and geographic metrics, as well as species-specific natural history features that may significantly affect the likelihood of BWCs. Features of the buildings, such as total window area and building height have been analyzed in several studies. While Bayne et al. (2012) found that collision rates were higher in rural areas where building density was lowest (Alberta, Canada), multiple studies found the opposite trend – higher building densities resulting in higher collision rates (Loss et al., 2014; Schneider et al., 2018). Hager et al. (2017) explained this difference along the spectrum of land development: building height and window area had a proportionally larger influence on BWCs in rural areas than in urban areas. This difference was most apparent during peak migration times, as non-resident birds were more likely selecting rural landscapes as suitable routes, and low-density buildings had a proportionally greater number of BWCs than buildings of the same size (height, window area) in an urban landscape. Artificial light also may increase BWCs, as nocturnal migrants may be confused by and attracted to them in flight (Hager et al., 2017).

Features immediately surrounding buildings also have been studied as potential predictors of window collisions. Because surfaces like windows may reflect images of nearby vegetation, birds are likely confused, seeing it instead as a perching site or other suitable habitat (Hager et al., 2017). In many studies, vegetation effects were significant, but never primary metrics that influenced BWCs. Qualitative measures of vegetation have been implemented, but categories varied by study. The presence/absence (Chin, 2016) of vegetation was one method, while others loosely categorized density, using "some" vs. "extensive" vegetation (Gelb & Delacretaz, 2009) or "vegetated" vs. "less vegetated" (Gelb & Delacretaz, 2006). Quantitative vegetation metrics have covered the gamut of methods, but many used broad-scale vegetation metrics that relied on existing GIS-based layers. For example, Hager et al. (2017) utilized percent "vegetation" within 50 m of a building, while Schneider et al. (2018) examined percent landcover class within the same radius (e.g., lawn, trees, ornamental vegetation). Quantitative vegetation measures *in situ* were utilized less often, and were not always collected by the authors (e.g., Kummer et al. [2016a] asked citizen scientists to report the average height of vegetation around their residence). It is clear that no consistent method to measure vegetation exists for BWC studies. In these referenced studies, vegetation seems to have no more than a secondary effect on BWCs (typically less influential than window area or generalized building structure). Although avian and mammalian studies not focused on BWCs have successfully utilized metrics such as total vegetation volume and the Levins diversity index to quantify vegetation *in situ* (Francl & Schnell, 2002; Leighton et al., 2009), to our knowledge, no BWC studies have utilized these quantitative on-the-ground metrics to encapsulate vegetation effects. However, there is evidence that metrics are related to bird community composition (Mills et al., 1991; Francl & Schnell, 2002).

Aspects of avian natural history may compound the anthropogenic/structural effects described above. In temperate regions, timing of migration (if the species migrates) and circadian activity patterns may affect the chance of BWCs. Kahle et al. (2016) found that BWCs increased during the periods of migration (April and October) and in mid-summer (July) when most birds are breeding. Numerous studies also concluded that BWCs were greatest during migration periods (Johnson & Hudson, 1976; Codoner, 1995; O'Connell, 2001; Gleb & Delacretaz, 2006; Hager et al., 2008). Despite the seasonal timing of these collisions, Klem (1989) concluded migratory status (as well as sex, age, and weather) did not affect BWCs. Supporting this, Blem & Willis (1998) and Kahle et al. (2016) concluded that migrating birds may not be major contributors to collisions. An examination of circadian activity patterns also presented us with conflicting data. While time of day was not a significant factor for BWCs by Klem (1989), others found clear trends in timing of collisions across daylight hours. Kahle et al. (2016) studied BWCs in an urban park (Golden Gate Park, San Francisco, California) and found that the greatest number of strikes occurred during mid-morning hours, 0900 – 1100 h. They found a steady decline in collisions throughout daylight hours. However, 83% of their documented BWCs occurred in daylight hours, as their pre-0900 h (early morning) surveys documented just 17% of the collisions. Other BWC studies concluded *a priori* that collisions were more likely during daylight hours, and limited their carcass surveys to afternoon time periods (e.g., 1400 – 1600 h; Hager & Consentino, 2014; Hager et al., 2017).

In Virginia, BWCs have been investigated at a coastal campus at Old Dominion University (as part of a 40-campus national survey, individual results not presented in Hager et al., 2017) and in the western montane regions at the Virginia Tech Corporate Research Center (VTCRC) in Blacksburg. Although not the university campus proper, VTCRC does include 28 buildings (mostly 2-story, with maximum window areas of 693 m^2) across 93 ha. In their study, they documented 240 bird casualties across 298 survey days. They discovered more BWCs with increased window area and an increase in ornamental vegetation around the buildings (Schneider et al., 2018). From this publication stemmed questions about nearby Radford University – a suburban campus set in a rural landscape – similar in land area to VTCRC but with taller buildings at greater densities.

Radford University, an 82.6-ha campus (37.13870°N, 80.55759°W; Fig. 1), is situated along a recognized migratory bird highway, the New River (e.g., VDGIF includes portions of the New River on its Bird & Wildlife Trail networks, VDGIF, 2019). Located about 20 km southwest of VTCRC, this campus includes >30 buildings that are 3-4 stories tall, and one residence hall that is 13 stories tall. Construction on new and renovated buildings occurs year-round. Although the university seeks to build or renovate buildings so that they are LEED-certified, no buildings to date have incorporated bird-deterring windows or bird-deterring window decals (M. Biscotte, Office of Planning and Construction, Radford University). Furthermore, windows have been a substantial (window area > 1500 m^2) component of facades at new or renovated buildings along major thoroughfares (Center for the Sciences, College of

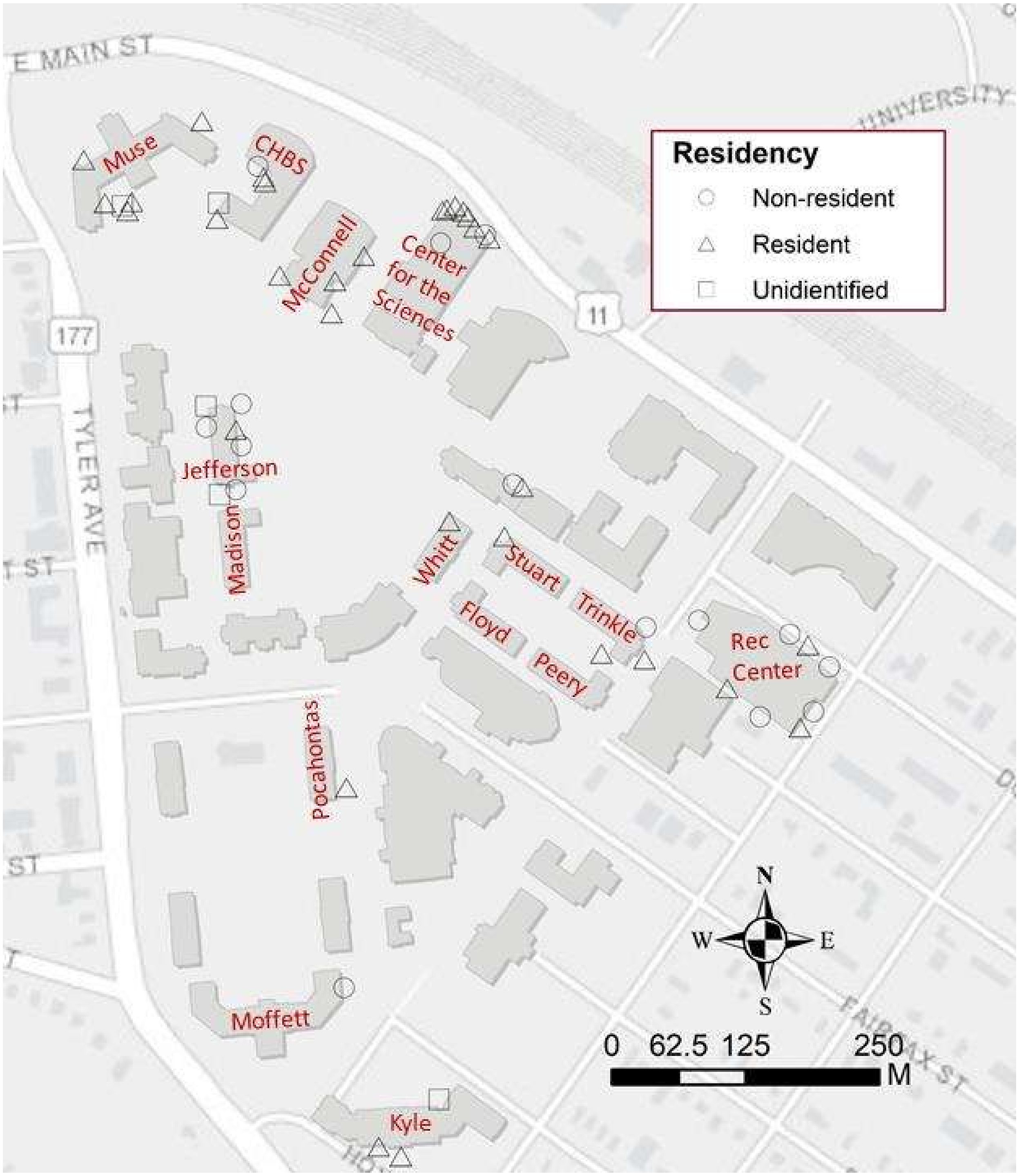

Fig. 1. Radford University, Virginia campus map, with 15 buildings (labeled with names, in red) surveyed for bird-window collisions in 2018 and 2019. We recorded 0 – 8 hits/building. Locations of 51 documented BWC casualties, identified by species classified by residency status: non-residents (circle; N=15), residents (triangle; N=31), or unidentified (square; for birds not identified to species level, N=5).

Humanities and Behavioral Sciences [CHBS] on Main street, Student Recreational Center on Jefferson St.; Fig. 2A, B, C).

With these building additions and transformations in mind, we began a multi-year study to investigate BWCs at Radford University. Building on previous findings, we chose to investigate a number of potential landscaping or building features that could influence the location and number of BWCs: window area, building height, and two *in situ* vegetation metrics (total vegetation volume and the Levins index of vertical diversity). Next, we investigated features about the avian community: whether the birds were migratory (non-resident, transitory) or presumed resident species, and whether collisions likely occurred overnight or during daylight hours. We hypothesized that we would detect a greater number of BWCs at our newer buildings that possessed relatively greater window area, and that buildings with greater amounts and diversity of vegetation (which we perceive would reflect in the windows) would result in more BWCs. We further hypothesized that we would find no differences in BWCs between non-resident and resident species, and that most documented collisions would be discovered in the morning hours.

METHODS

Bird-window Surveys

With the contributions from more than 30 Radford University students, we surveyed the perimeter of 15 campus buildings once or twice daily, ideally once in the morning and once in the afternoon. Buildings were selected to represent the full spectrum of building size (height and areal footprint), window area, and landscaped vegetation on campus. We completed surveys from 1 February 2018 through 15 November 2018, and from 7 February 2019 through 5 May 2019. From 6 May through 17 June 2019, we surveyed sporadically on 15 days.

Following the protocol of Hager & Consentino (2014), surveyors walked within 2 m of building edges, scanning for potential bird hits; when a bird was discovered, photos were taken and its location was recorded in UTM. We classified legitimate hits as a cluster (>5) of feathers, partial body fragments, or whole bodies. Live, stunned birds also were also included as legitimate hits. We also collected carcasses opportunistically on campus, even if not collected at the 15 buildings and/or not during set surveys. For this reason, not all BWCs documented were included in every analysis.

Bird Identification

Participating students worked together to identify frozen full bird carcasses to species level, if possible, using standard bird field guides and museum specimens. For identification of partial carcasses and groups of feathers, we relied entirely on comparisons to preserved specimens from the Radford University Biology Department’s natural history collection (https://www.radford.edu/content/csat/home/biology/facilities/natural-history-collection.html). Although not considered a valid BWC in this study, we collected and identified single feathers or small groups of <5 feathers, and retained them to build a library of known bird artifacts. If unidentifiable specimens contained tissue, they were examined via DNA barcoding analyses (see Paniagua-Ugarte et al., 2019).

Landscape Analyses

We (Powers) calculated total window area (m^2) through analysis of architectural drawings of each of the 15 buildings. We (all authors) visited buildings and completed in-person measurements to confirm drawing specifications and remove from calculations windows that were opaquely painted. We determined maximum building height (m) through elevational metrics provided in the architectural drawings.

Following methods similar to Francl & Schnell (2002), we measured vegetation *in situ* at points in ca. 40-m increments, around each building (5–18 points/building). We used a range pole, divided into seven 0.5-m increments (0–0.5 m, 0.5–1.0 m, ... 2.5–3.0 m, >3 m). We focused on vegetation at heights of 3 m or less because other studies reported that vegetation only affected BWCs at lower building floors (e.g., Gelb & Delatacruz, 2009). Standing ca. 1 m from the building facade, we documented a vegetation “hit” in the 0.5-m increment when vegetation was directly touching or within 10 cm of the pole. From these hits, we calculated two vegetation metrics: total vegetation volume (TVV; Mills et al., 1991) and the Levins index of vertical diversity (Levins, 1968). We estimated TVV using the formula:

$$\mathrm{TVV} = h/10v$$

where h = number of intervals for which we documented vegetation hits, and v = total number of intervals (the number of points samples around the building).

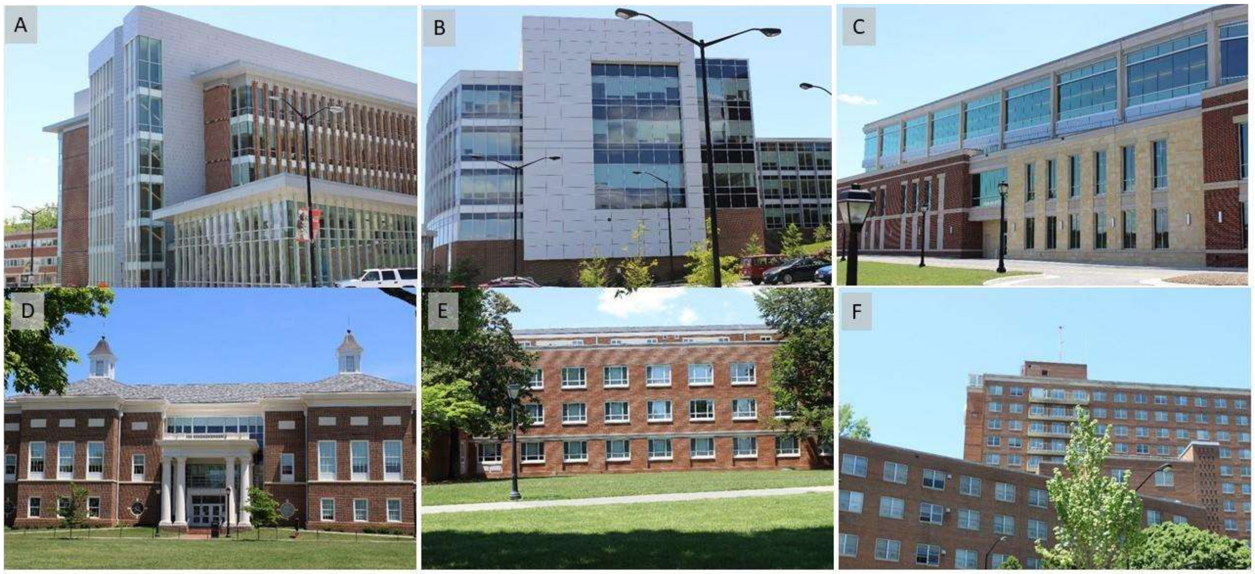

Fig. 2. Examples of surveyed buildings at Radford University, documenting new (<5 years old) buildings on campus that incorporate large window areas (A: Center for the Sciences, B: College of Humanities and Behavioral Sciences [CHBS], C: Student Recreational Center) and more traditional buildings with lesser total window area (D: Whitt Hall, E: Trinkle Hall, F: Muse Hall). Photos by H. Reed, 2019.

The Levins index is defined as: $L = \sum 1/ [(d_i)^2]$

where $d_i = \dfrac{\text{total number of hits recorded for a 0.5-m increment "i"}}{\text{total number of points measured around the building}}$

Statistical Analyses

We utilized a forward stepwise regression comparing the number of BWC casualties per building to four metrics of each building: total window area, maximum building height, total vegetation volume, and Levins index. Setting a p-value of 0.25 to be included in the model, *a priori*, we ran the regression in JMP Pro 13 (SAS Institute, Cary, NC). We utilized a chi-square goodness of fit test in Microsoft Excel (Microsoft Excel 2019 MSO, Redmond, Washington) to determine if an equal number of carcasses were discovered in the morning (AM) versus the evening (PM) surveys. We considered morning hits as those discovered in daylight surveys completed from ca. 0600–1200 h. Evening hits were those discovered from 1201–1800 h. We recognize that hits that occurred overnight (1801 h–0559 h) are lumped with the morning collections, and we would therefore expect that, if collision patterns were random, we would expect 75% of carcasses to be collected during morning surveys and 25% during evening surveys. Further, we limited our analyses to birds collected on dates in which two surveys/day were completed, so that we could confidently assign the correct collision time block.

In the same manner, we used a chi-squared goodness of fit test in Microsoft Excel to determine if an equal number of hits occurred for birds considered residents versus those actively migrating (i.e., suspected to collide with buildings while in novel surroundings). Here, we defined "resident" as a bird who is present in the area year-round or migratory but a full-time inhabitant during summer months. These birds would be expected to be familiar with the surroundings. Birds were assigned migratory, non-resident status if they were collected during the species' known migration period; we assumed the area was unfamiliar to them. Residency status was derived from Cornell Lab of Ornithology's Birds of North America (Rodewald [Ed.], 2015) using geographic range maps, text, and annual cycle figures (when available). For questionable birds whose migratory status was unclear in southwestern Virginia, we further investigated status utilizing information from the Virginia Breeding Bird Atlas (https://ebird.org/atlasva) and Christmas Bird Counts (https://www.audubon.org/conservation/science/christmas-bird-count) from the region. Migratory status could only be assigned for ca. six months of the year (3 months for spring migrations, three months for fall migrations) and resident status could be assigned year-round. Therefore, we expected to detect twice as many residents as non-residents by chance alone.

RESULTS

In >975 hours of surveys across 393 days, we documented 51 BWCs across 23 species at Radford University (Appendix 1; Figure 1, 3). BWCs/building ranged from 0–8. Of the 51 birds, one American robin (*Turdus migratorius*) was founded alive but stunned (Fig. 3D); it flew away when the observer attempted to collect it. Sixteen full carcasses (deceased, Fig. 3A, B, C) and 34 partial carcasses or piles of feathers also were collected (Fig. 3E, F). Fifteen individuals across 10 species were non-residents. We found that 31 individuals among 15 species were resident species. Five songbird individuals were not able to be fully identified to the species level, and were not included in this analysis (Fig. 1). A chi-squared goodness-of-fit test for these 46 individuals revealed no significant difference between resident and non-resident species BWC rates (χ^2=0.011, df=1, p=0.917).

In the 392 days of surveys, we completed 863 individual campus walks. In 827 walks in which time was recorded, 368 were completed in the morning time block and 459 were evening surveys. When we factored out days in which single walks were completed (i.e., we were not able to confidently determine which time block the collision actually occurred), our sample size was reduced to 18 documented collisions. Recording ten hits in the AM block and eight in the PM block, our chi-squared goodness-of-fit test suggested that PM hits occurred marginally more than expected by chance alone (χ^2=0.363, df=1, p=0.056).

Forty-eight of our 51 BWCs occurred at the 15 buildings for which we calculated window area, building height, and quantified vegetation. Our forward stepwise regression, comparing the number of hits per building versus the four variables reported that the only significant variable was window area (r^2 = 0.335, F = 6.558, p=0.024; Table 1). As window area increased, so did the number of BWCs/building.

DISCUSSION

Our finding that window area was the only metric significantly affecting BWC was not surprising, as the majority of BWC studies have detected this same primary factor across the landscape. Building height may have been less of a factor on this campus because, as originally stated, most buildings are of similar height; however, newer constructions and renovations incorporate markedly more windows into their facades. Perhaps time since construction may have been a co-predictor (with window area) of BWCs on campus, but this metric may not be transferrable to other studies. We also failed to find any vegetation effects on BWCs. Because of the plethora of metrics utilized to measure these features, we either selected metrics that did not accurately account for vegetation around buildings, or we looked at too fine of a scale for vegetation to have affected these birds. Perhaps future studies will rely instead on a broad-scale GIS component, as several studies did find significant, though secondary, effects of vegetation on BWCs (e.g., Hager et al., 2017; Schneider et al., 2018).

The discovery of only 51 bird carcasses in nearly 1,000 h and 393 days of surveys is surprisingly low, compared to other BWC studies across the continent. Locally, Schneider et al. (2018) documented 240 individuals in a shorter time span, only surveying "when schedules and weather allowed." Our efforts were highest (2 surveys/day) during the fall and spring semesters, which should have corresponded with migratory patterns of birds. We were, at the very least, consistent (1 survey/day) during summer months and when school was not in session. Our efforts attempted to minimize time for scavengers to access the carcasses, yet only 16 (17 if the stunned, live bird is included) full, intact carcasses were discovered. The remaining 34 birds suggested scavenging had occurred (Fig. 3E, F). Nocturnal scavenging events would be expected, as

Table 1. Results of forward stepwise regression, examining factors influencing number of bird-window collisions per building at 15 buildings on Radford University's campus, 2018–2019. Of four metrics, window area alone explained 33.5% of total variance; no other variables were included in the final model.

Parameter	**Estimate**	**DF**	**SS**	**F**	**p**
Intercept	1.6770	1	0	0	1.000
Window area (m^2)	0.0017	1	44.576	6.558	0.023
Building height (max., m)	0	1	1.537	0.212	0.653
Levins	0	1	1.231	0.170	0.688
TVV	0	1	7.535	1.119	0.311

Fig. 3. Examples of casualties from bird-window collisions. Of the 51 documented collisions, 16 were whole bodies - deceased (e.g., A: House Finch [*Haemorhous mexicanus*], B: Chimney Swift [*Chaetura pelagica*], C: Yellow-billed Cuckoo [*Coccyzus americanus*]), 1 was stunned but recovered (D: American Robin [*Turdus migratorius*]), and the rest were portions of scavenged carcasses (e.g., E: Gray Catbird [*Dumetella carolinensis*], F: White-breasted Nuthatch [*Sitta carolinensis*]). Photos by six participating students at Radford University, 2018-2019.

personal observations include Striped Skunks (*Mephitis mephitis*), Raccoons (*Procyon lotor*), Virginia Opossums (*Didelphis virginiana*), and feral cats as on-campus visitors. Future studies may involve setting a wildlife camera on planted carcasses to determine frequency of and time until documented scavenging or unanticipated anthropogenic disturbances, like students or facilities workers collecting the carcass.

As multiple studies have acknowledged, it is likely that our 51 mortalities are underreporting the actual number of BWCs (Bayne et al., 2012; Kummer et al., 2016b). Besides carcass scavenging (Hager et al., 2012), observer bias plays a significant role in documenting BWCs. With over 30 (albeit trained) students contributing to our project, we assume the visual acuity, mental focus, and ability to detect feathers and partial or full carcasses varied by student (Hager & Cosentino, 2014). In other bird carcass surveys, researchers suggest that the actual number of bird mortalities is 2.3–5 times greater than what is discovered (Dunn, 1993; Zimmerling et al., 2013).

Furthermore, despite the finding from other studies (e.g., Gelb & Delacretaz, 2006; Kahle et al., 2016) that most BWCs occurred during daylight hours, and a marginally significant finding to support that, we are not confident about our sample size. Our intensive twice-daily surveying efforts were too inconsistent across the study, and we could only include 18 of the 51 carcasses for statistical analysis. Our future efforts on campus may investigate short (2–3 week) efforts at buildings with the highest rate of collisions. We might complete three surveys daily, at 8-h intervals, to tease apart collision-time trends. The shorter time frame and subset of buildings might make such studies temporally feasible, given student schedules.

The near-absence of rare or protected species in our observations is interesting. Indeed, none of the 23 species are listed as species of greatest conservation need in the Virginia Wildlife Action Plan (VDGIF, 2015), and none are afforded state-threatened or endangered status. Although we documented three fairly uncommon warblers – Magnolia (*Setophaga magnolia*, 10 October

2018; S2B status – suggesting they are rare breeders in Virginia, Wilson & Tuberville, 2003), Cape May (*S. tigrina*; 29 September 2018), Worm-eating (*Helmitheros vermivorum*; 7 May 2018) - all were collected during peak migration periods. Indeed, eBird records document other individuals in the area – some along the New River in Radford – within a two-week window of these finds (https://ebird. org/atlasva/explore). Of the 23 species documented, only the Swainson's Thrush (*Catharus ustulatus*) was an unexpected seasonal find. Documented on 30 June 2018, the timing is long after the putative migratory season has concluded; the only Radford record of this species on eBird was on 23 May 2016 (reported by C. Kessler, https://ebird.org/ atlasva/map/swathr), coinciding with migration periods. Furthermore, just one June record has been reported from nearby counties (Giles Co., VA/Monroe Co., WV line, C. Kessler, pers. comm.). Our mid-summer collision record suggests this individual may have been maintaining a summer residence in the area. This species was identified only by DNA analyses (Paniagua-Ugarte et al., 2019), and we cannot know the age, sex, or any other natural history characteristics of this individual. This species is state-ranked as S1B (Wilson & Tuberville, 2003), suggesting that it is an extremely rare breeder in the Commonwealth. The Virginia Fish and Wildlife Information Service (VaFWIS) system also indicates that this species has not been documented in Radford City in June and that all regional records of Swainson's Thrush were reported during the migratory seasons (S. Watson, VDGIF, pers. comm.). The natural history of this species in our region certainly warrants further investigation.

Twenty-one of our 51 BWCs occurred at only three buildings, all newly-constructed in the last five years (Fig. 2A, B, C) and all possessing substantial window areas (1685-3865 m^2). As it appears that Radford University is implementing greater window areas in new construction, we strongly suggest that bird-deterring efforts be applied. Window decals can be useful on a small-scale, and even applied on a window-by-window basis by concerned faculty members (as many personal offices contain windows). However, it is unlikely that decals, typically with patterns to make the window more visible to the birds, could or would be utilized on aspects whose window areas comprise nearly 100% of the facade (e.g., Fig. 2A, B, C). The American Bird Conservancy has published a number of window types and the related "threat factor" for BWCs (American Bird Conservancy, 2012). Patterned glass (simple, vertical lines are suggested), translucent glass, and glass coated with UV-reflecting lines all could reduce BWCs, and contribute to LEED-certification (Klem, 2009; Green Building Alliance, 2016). Currently, bird-deterring window modifications offer a pilot credit towards said certification (American Bird Conservancy, 2012). Our project, therefore, provides useful information to the Radford University Office of Planning and Construction, as they design and implement the renovations and new construction on campus. Our data will help the university identify existing areas for potential treatment, as funds become available (M. Biscotte, Radford University Office of Planning and Construction). Implementing such building modifications could establish Radford University as a leader in "green" architecture and provide new research opportunities for students in coming years.

ACKNOWLEDGEMENTS

We are grateful to the more than 30 Radford University students who contributed to BWC surveys. We thank Michael Biscotte and Benny Skeens of the Radford University Office of Planning and Construction providing historical and contemporary architectural drawings of the campus buildings. The Radford University Department of Biology supported this research-based course in bird-window collisions.

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Appendix 1. List of 51 individual birds across 23 confirmed species that were BWC casualties at Radford University in 2018 (February–October) and/or 2019 (February–June). An "*" indicates that one individual was confirmed via genetic analyses of carcass tissue (Paniagua-Ugarte et al., 2019).

Family	Scientific name	Common name	Number of individuals
Order Caprimulgiformes			
Apodidae	*Chaetura pelagica*	Chimney Swift	1
Order Columbiformes			
Columbidae	*Columba livia*	Rock Dove	6
Columbidae	*Zenaida macroura*	Mourning Dove	4
Order Cuculiformes			
Cuculidae	*Coccyzus americanus*	Yellow-billed Cuckoo	1
Order Passeriformes			
Bombycillidae	*Bombycilla cedrorum*	Cedar Waxwing*	2
Cardinalidae	*Cardinalis cardinalis*	Northern Cardinal	1
Certhiidae	*Certhia americana*	Brown Creeper	1
Corvidae	*Corvus brachyrhynchos*	American Crow	2
Fringillidae	*Haemorhous mexicanus*	House Finch	1
Fringillidae	*Spinus tristis*	American Goldfinch	2
Icteridae	*Molothrus ater*	Brown-headed Cowbird	1
Mimidae	*Dumetella carolinensis*	Gray Catbird	2
Paridae	*Baeolophus bicolor*	Tufted Titmouse	3
Parulidae	*Helmitheros vermivorum*	Worm-eating Warbler	1
Parulidae	*Setophaga magnolia*	Magnolia Warbler	1
Parulidae	*Setophaga tigrina*	Cape May Warbler*	1
Passerellidae	*Melospiza melodia*	Song Sparrow	1
Passerellidae	*Spizella passerina*	Chipping Sparrow	1
Passeridae	*Passer domesticus*	House Sparrow*	2
Sittidae	*Sitta carolinensis*	White-breasted Nuthatch	1
Turdidae	*Catharus ustulatus*	Swainson's Thrush*	1
Turdidae	*Sialia sialis*	Eastern Bluebird	2
Turdidae	*Turdus migratorius*	American Robin	8
		Unknown songbird	5