A PRELIMINARY SURVEY OF BIRDS KILLED BY WINDOW COLLISIONS IN GEORGIA BASED ON MUSEUM SPECIMENS

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Abstract

Bird deaths from window collisions occur in residential and urban environments worldwide. Research into this problem is ongoing, although there has been little work done on this issue in the southeastern United States. We conducted a preliminary survey of songbird collisions with windows in Georgia to elucidate temporal patterns, and to determine if certain groups of species are more prone to collisions. Using data from specimen labels of curated birds in the Georgia Museum of Natural History, we identified individuals likely to have been killed by window collisions. Of the 1035 songbird specimens collected in Georgia, we determined that 20 (1.9%) had died from window collisions. The bird group with the highest frequency of window kills was the thrushes of the genus *Catharus* (i.e., 8% of *Catharus* specimens examined died from probable window collisions). There was a seasonal pattern to the window collisions, with high frequencies coinciding with the timing of spring and fall migration. Results from this preliminary study were generally consistent with prior field surveys of window-killed birds in other regions of the country.

Introduction

Each year billions of birds throughout the world die from striking windows (Klem 1990), and as human populations increase, and urbanized areas expand, this problem will intensify. Most research on this problem has focused on the characteristics of windows and buildings (or landscapes) associated with the most collisions. For example, bird collisions with windows in urban areas are positively related to window size (Borden et al. 2010, Hager et al. 2013). In residential areas, bird strikes can be directly correlated with the abundance of bird feeders near windows (Dunn 1993). Overall, estimates of annual mortality in the United States range from 1-10 birds per building (or house) per year (Dunn 1993) to 55 birds per building per year (Hager et al. 2008). Bird mortality from window collisions occurs at all times of the year, although most reports indicate it is higher during migratory periods (O'connell 2001, Gelb and Delacretaz 2005, Borden et al. 2010).

To our knowledge, there have been no investigations or surveys of mortality caused by birds colliding with windows in Georgia or even in the southeastern United States. This paper describes a project we undertook to begin to address this knowledge gap. In most studies of this subject researchers perform field surveys, counting and identifying carcasses. We chose a different approach, conducting an analysis of curated songbird specimens housed at the Georgia Museum of Natural History, where we estimated the numbers of individuals in the collection that had been killed by window collisions. Since we focused on specimens collected only in Georgia, this information will be useful for planning future field surveys in this region, as we identified times of year when bird strikes are most frequent, and whether or not particular bird groups are more prone to this type of mortality.

Methods

Museum Records

We obtained records from the Georgia Museum of Natural History, Athens, GA, on all passerine specimens collected in Georgia (Fig. 1A). This data set consisted of 1035 records representing 150 species of birds, and included the species name, date and location of collection, age and sex of the bird (if known), and in most cases, notes regarding the location or collection event.

Determining Window Kills

We analyzed the museum data in an attempt to identify those specimens that had died from window collisions. In certain cases, the notes associated with the specimen indicated specifically that the bird flew into a window (Fig. 1B). There were other cases where window collisions were not specifically indicated, but the bird was found outside of a building (often on the University of Georgia campus; Fig. 1C). For these cases, we assumed the bird was killed via window collision. This assumption was based on personal experience of the authors; whenever dead birds are found adjacent to buildings on the university campus, it is usually near a window.

We calculated the frequency of window-killed birds for each month of the year to elucidate temporal patterns. We categorized the museum records into groups of related species (Table 1), and then calculated the frequency of window-kills within each group. We also calculated the frequency of window kills according to the age of the bird, using only specimens of known age (which was assessed at the time of preparation by museum staff). Chi-square tests were used to compare frequencies as needed, using the online statistical program, Graphpad (www.graphpad.com).

Results

Of the 1035 records examined, we determined that 20 (1.9%) died from window collisions. The bird group with the highest frequency of window kills was thrushes in the genus *Catharus* (Table 1), followed by finches, tanagers and mimids. In fact, the frequency of window strikes of *Catharus* thrushes (8%, or 4 out of 50 thrush specimens) was significantly higher ($\chi^2 = 8.156$, $P = 0.0043$) than the norm for the entire collection of songbirds. The frequencies of window strikes for finches, tanagers and mimids were not significantly different ($P > 0.05$) from the overall frequency for all other species.

There appeared to be a seasonal pattern to the window collisions, with distinct peaks in frequency during the spring and fall months (Figure 2). There was a non-trivial number of window strikes in the winter (January-February) as well, which included House Sparrow (*Passer domesticus*), Purple Finch (*Haemorhous purpureus*), and Yellow-rumped Warbler (*Setophaga coronata*). We did not find any labeled window collision mortalities for the middle of the summer (June and July). The spring and fall peaks appeared to coincide with the timing of migration of songbirds in Georgia. The frequency of window collisions in migration months (March through May and August through November) was 2.5%, compared with a frequency of collisions in non-migratory months of 1.0%, and the difference in these frequencies approached significance ($\chi^2 = 3.167$, $P = 0.0751$).

There was a slightly greater tendency for juvenile birds to die from window collisions than adults: of the specimens where age was known, 3 out of 70 juveniles (4.3%) died from window collisions compared to 15 out of 847 (1.8%) adult birds. However, these frequencies were not significantly different ($\chi^2 = 2.125$, $P = 0.1449$).

Discussion

Research into the nature of bird-window collisions has grown in the past 2 decades, with studies using a variety of approaches, including experimental placement of window panes (Klem et al. 2004), citizen science surveys (Dunn 1993) and direct surveys of carcasses around buildings (Hager et al. 2008, Klem et al. 2009, Borden et al. 2010, Hager et al. 2013). Our study appears to be the first to utilize museum specimens in this respect. Given that our results were generally consistent with those from studies that used other techniques, we feel this approach was justified.

Two patterns in this study are consistent with prior work. The temporal pattern of window collisions we observed, with peaks in spring and fall (Figure 2), was consistent with most prior studies that indicate window collisions peak during migration (O'connell 2001, Hager et al. 2008, Gelb and Delacretaz 2009, Borden et al. 2010). Moreover, the higher frequency of window-killed juvenile birds in this study, although not statistically significant, has also been shown before (Hager et al. 2013).

Considerable attention has been focused on the effect of bird feeder location in relation to the probability of window collisions (Dunn 1993, Klem et al. 2004). However, in our study the majority of specimens that we suspected had died from window strikes (13 of 20 total, or 65%) were species that do not regularly visit bird feeders. In fact, the group with the highest frequency of window mortality (*Catharus* thrushes) feed mostly on fruits and invertebrates in Georgia, and are unlikely to visit feeders regularly (Schneider et al. 2010). Furthermore, there were no window-kill specimens from species that are known to be associated with residential areas and/or feeders, such as chickadees, titmice, House Sparrows, robins, starlings and nuthatches (Table 1). This may stem from the fact that a large proportion of museum specimens were collected on the University of Georgia campus, which is a landscape that features few bird feeders. However, this pattern has also been observed in field surveys of carcasses in urban environments where feeder-friendly birds make up less than half of the species composition of window-kills (O'connell 2001, Hager et al. 2013). In residential environments, surveys of homeowners who have birdfeeders showed that most window-kills tend to be feeder-using species (Dunn 1993). Thus, species that dominate lists of window strikes likely are directly correlated with the characteristics of the environment in question (i.e., urban or residential).

Our survey indicated that *Catharus* thrushes are prone to window collisions, consistent with other studies where susceptible bird groups have been identified (O'connell 2001, Gelb and Delacretaz 2005, Borden et al. 2010, Hager et al. 2013). However, these studies also report large numbers of window-killed warblers and sparrows in their surveys, whereas our survey found relatively few specimens from these groups. Since museum collections primarily contain specimens that have been found and brought in by the general public, it may be that the smaller size of warblers and sparrows, compared to thrushes, means that window-killed carcasses of such species are more likely to go unnoticed, and they are therefore underrepresented in museum collections.

Our survey found relatively few individuals (20 specimens, approximately 2% of the total songbird collection) to have been killed by window strikes, which seems surprisingly low relative to published estimates of 1-55 birds killed per building per year (Dunn 1993, Hager et al. 2008). This discrepancy may be due to a low rate of opportunistic collection of dead birds by the public relative to live-taken specimens for museum collections, low rates of detection, and relatively short persistence of carcasses in the environment (e.g., Klem et al. [2004] showed that scavengers remove 13% of carcasses under windows). Alternatively, our method of determining window-strikes based on museum specimen labels may actually underestimate the true frequency of this phenomenon, since a number of specimen labels (approximately 20%) contained no information regarding cause of death or location of collection.

While this project was preliminary in nature, we hope to continue this research in the future with our own field surveys of window-killed carcasses in a semi-urban environment (i.e., the University of Georgia campus). Similar projects have already been undertaken at university campuses across the country (Somerlot 2003, Hager et al. 2008, Borden et al. 2010), and are important for documenting temporal patterns in window collisions as well as risk factors in terms of building design and landscaping principles (i.e., window size and placement, placement of surrounding vegetation, etc.). We anticipate gathering additional information that has not been considered in previous studies, specifically relating to the characteristics of the specimens themselves, such as their size, fat levels and possibly feather growth rates. This will allow us to determine if window-killed birds represent a non-random subset (i.e., suboptimal individuals) of the avian population.

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Table 1. Summary of songbirds killed from window strikes based on specimen records from the Georgia Museum of Natural History. Bird groups are ordered according to the percentage of individuals killed by window collisions.

Group	Number in collection	Percentage killed by window strikes
Catharus Thrushes	50	8.0
Finches	33	6.1
Tanagers	20	5.0
Mimids	25	4.0
Corvids	26	3.8
Vireos	44	2.3
Emberizids	47	2.1
Wrens	47	2.1
Warblers	283	2.1
Sparrows	186	1.6
Bluebirds	13	0.0
Creepers	7	0.0
Flycatchers	57	0.0
Gnatcatchers & Kinglets	20	0.0
Icterids	75	0.0
Larks	5	0.0
Nuthatches	18	0.0
Pipits	7	0.0
Robins	9	0.0
Shrikes	11	0.0
Starlings	5	0.0
Swallows	16	0.0
Titmice & Chickadees	22	0.0
Waxwings	9	0.0
Total	**1035**	**1.9**

Figure 1. (A). Specimens of Catharus thrushes from the Georgia Museum of Natural History in Athens, GA. (B). Image of typical museum specimen identification tag indicating that the specimen had died from hitting a window (dashed circle). (C). Image of a museum tag indicating the specimen was found at a building on the University of Georgia campus (dashed circle), which we assumed meant the bird died from a window collision

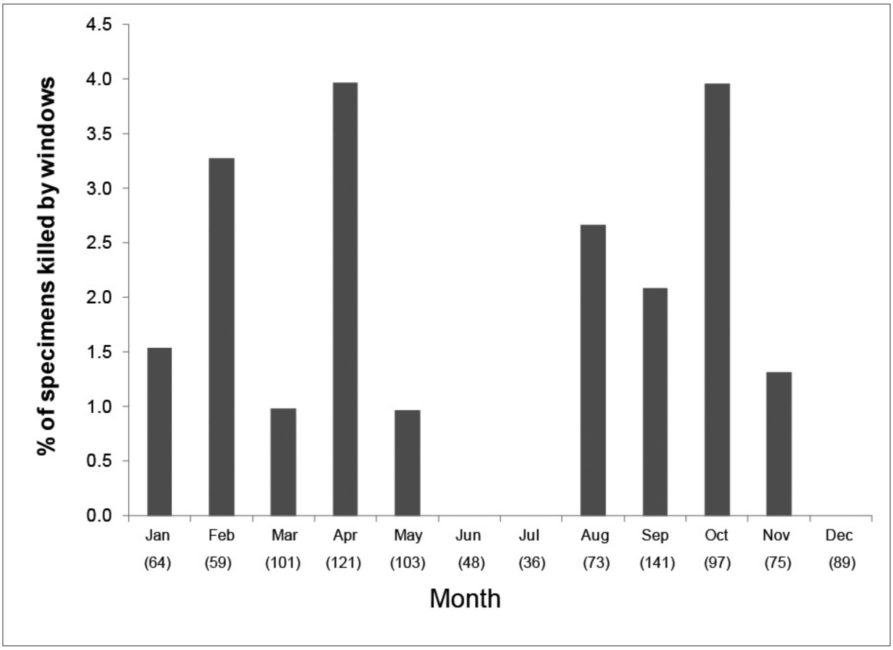

Figure 2. Percentage of bird specimens (passerines only) killed by window strikes per month in Georgia, based on specimen records at the Georgia Museum of Natural History, in Athens, GA. Numbers in parentheses indicate sample sizes for each month.