**ABSTRACT**

Aircraft collisions with wildlife cause roughly $718\text{ million (USD, valuation in 2013) in aircraft damages, and have resulted in 26 deaths and 379 injuries over a 24-year period in the U.S. alone. Bird strikes make up 97% of all wildlife-aircraft strikes, and are on the rise despite management plans due in part to a 61% increase in U.S. airports between 1990 and 2008, quieter engines and increasing bird populations. Current research focuses on the immediate airport environment, however, we believe that birds react to aircrafts in predictable ways, and altering pilot behavior in anticipation of bird behavior is a promising avenue to reduce strikes. We gathered data concerning these interactions from pilots in targeted surveys and interviews, resulting in 7 participating pilots, 6 of which indicated an interaction with more than 13 species or groups of birds. While 3 of the pilots employed active responses to specific birds, which involves the pilot maneuvering to avoid a collision, all pilots demonstrated a passive response to other birds, which involves the bird maneuvering to avoid a collision. Despite a low number of responses, we feel confident that pilots can anticipate a bird’s reaction to aircrafts. With an appropriate amount of flight experience, craft familiarity, and bird knowledge, we believe that pilots can mitigate strikes.

**BACKGROUND**

Wildlife strikes cause roughly $718\text{ million in aircraft damage each year in the U.S. (U.S. DOT, 2013). With continued urbanization, birds increasingly utilize the large open areas afforded by airports. Wildlife exclusion efforts have resulted in a decrease in the number of strikes below 500 feet above ground level, but despite their efforts, bird-strikes overall are on the rise due to a 61% increase in commercial jets between 1990 and 2008 (Dolbeer, 2014b), and faster, quieter aircrafts (Burger, 1983). At the same time, the population of species deemed hazardous by the FAA are on the rise due to conservation actions such as the Endangered Species Act of 1973, Migratory Bird Treaty Act of 1918, and banning the use of DDT in 1972 (Cleary 2010). While bird strikes occur at all phases of flight, current wildlife strike research focuses on the airport environment, however, we believe that birds react to aircrafts in predictable ways, and altering pilot behavior in anticipation of bird behavior may be an immediate, long-term solution with benefits for both birds and pilots.**

**METHODS**

A survey was developed to gather information from pilots pertaining to their experiences concerning bird behavior. Consent was obtained with a form detailing the study, the rights of the participant and our contact information. This survey was distributed at a Washington Seaplane Pilots Association event where roughly 65 pilots were in attendance. The survey was also adapted to an online version, where Internet seaplane groups were permitted for participation. Finally, through online seaplane enthusiast groups, telephone interviews were performed where pilots were asked the same questions supplied in the survey.

**RESULTS**

7 completed surveys were obtained over the course of the study. The pilots represented by these surveys had over 13,800 hours of flight experience combined, and indicated flight frequencies ranging from retired to 200+ flights a year. Of the 7 responses, 5 came from the paper survey distributed at the Washington Seaplane Pilot’s Association, 1 came in the form of a phone interview performed from online seaplane enthusiast sites, and another interview was performed with a pilot involved in the project. There was only one pilot who indicated no interaction with birds, while the other 6 pilots had interactions with more than 13 groups or species of birds, between <25-80% of their flights. Gulls (Laridae) and Bald Eagles (Haliaeetus leucocephalus) were the most commonly encountered species (5 pilots each). 3 of the pilots in our study employed active responses to birds, which involves a maneuver to avoid collisions, while all pilots demonstrated a passive response to birds, which involves purposefully maintaining a trajectory, allowing the bird to avoid the aircraft. 2 pilots passively reacted to gulls, with one pilot who felt that abrupt movements could put pilots in a greater risk of a strike. 2 other pilots in our study actively respond to gulls by clearing the birds (buzzing) before landing, decreasing aircraft noise and descending quickly behind birds to avoid spooking them into flight, or landing elsewhere.

**DISCUSSION**

Waterfowl: Of the 7 pilots interviewed, only 3 indicated an interaction with waterfowl. It was expected that a majority of our study group would interact with waterfowl, but that was not the case. Studies show geese are intolerant of aircrafts while ducks tend to stay on the water and dive in response to aircrafts (King, 2010; Ward and Stehn 1999; Pepper et al. 2003). 1 pilot thought waterfowl are not affected by aircrafts, while the 2 other pilots backed up the literature, with observations that ducks dive out of the way, while geese flee. One of these pilots elaborated that larger birds take off heading into the wind to achieve enough lift, and notes that landing behind them is a safe way to avoid a collision. Smaller waterfowl are typically disregarded by the pilots as the birds avoid the craft. Gulls: Gulls are listed amongst the most hazardous species group according to the FAA (US DOT, 2013) and 5 out of 7 pilots in our study group encountered gulls. Pilots 1 and 3 noted that gulls encountered in the air will dive with pilot input further elaborating that they dive when encountered from the front, and climb from the rear. Both pilots reacted passively to the gulls. Pilot 6 felt that gulls scatter when landing the craft, noting that if one bird takes flight, they will all take flight. This is supported by the literature, which found that waterfowl are as sensitive as the most sensitive individual (King, 2010; Knight and Gutzwiller, 1995). To deal with these skittish birds, pilots adjusted the noise of their craft, and/or the landing/takeoff path to avoid flushing grounded birds (pilot 6, personal correspondence). Two of these pilots (6 & 7) noted that flying over the flock cleared the water of these skittish birds, allowing them to safely circle back around to land. Conclusion: Despite low participation numbers, we feel confident that pilots can identify and appropriately respond to birds. Not all strikes occur in or around the airport environment, as such, pilots should be armed with as much knowledge as possible to protect themselves. Using the basic guidelines we outline in the study, we believe a pilot can mitigate strikes.

**ACKNOWLEDGEMENTS**

Thanks must be given to my advisor, Professor John Marzluff, whose passion for birds is contagious. A special thanks to field advisor Austin Watson, who came up with, and pushed for, this project to be done. Stay safe up there Austin! Finally, we would like to thank the Washington Seaplane Pilot’s Association for allowing us to distribute our survey at their event.

**CITATIONS**


**Figure 1:** U.S. birds struck by aircraft by year: 2012 saw the highest number of bird strikes on U.S. civilian aircrafts in one year: 10,043

**Figure 2:** Snow geese (Chen caurinae) are considered the most hazardous species by the FAA, and were involved in 399 strikes between 2003 and 2012. As the population of multiple hazardous species increases, so will the conflicts between aircrafts and birds.

**Graph by P. A. Dolbeer based on data from U.S. Fish and Wildlife Service (2012)**

**Figure 3:** North American population of snow goose, 1980 - 2012

**Graph by P. A. Dolbeer based on data from U.S. Fish and Wildlife Service (2012)**

**Figure 4:** Haliaeetus leucocephalus