Evaluating Blackbird Behavioral Response Toward Unmanned Aircraft Systems (UASs): Exploiting Antipredator Behavior to Enhance Avoidance

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ABSTRACT: Animals respond to nonlethal forms of human disturbance using behavior strategies adapted to detect, avoid, and evade natural predators. This phenomenon suggests antipredator behavior can be exploited to optimize efficacy of wildlife management tools such as visual deterrents. According to models of antipredator theory, wildlife managers could encourage animals to abandon a resource patch in zones of human-wildlife conflict by enhancing perceived predation risk associated with disturbance stimuli. One human-wildlife conflict of interest is the economic loss and human safety hazards caused by birds. For example, blackbirds (*Icteridae)* pose a significant risk to the commercial aviation industry through bird strikes and to agriculture through crop predation. Several nonlethal frightening devices have been used in an attempt to reduce negative impacts of large blackbird flocks with varying effectiveness, thus the need for new or optimized tools remains. A promising tool in the field of wildlife damage management is the unmanned aircraft system (UAS), which provides a dynamic object able to overcome mobility limitations faced by other nonlethal deterrents. We intend to evaluate antipredator response of blackbirds toward two UAS platforms. We will compare a multirotor quadcopter UAS with a radio-controlled (RC) predator model. Current UASs show promise as precision agriculture tools and are easier to fly, but may not elicit an antipredator response due to lack of similarity with natural predators. We hypothesize that blackbirds will assess platforms with different intensities of perceived predation risk, and as a result, initiate flight at farther distances from the platform perceived as more threatening. Our objectives are to 1) compare the response of captive red-winged blackbirds (*Agelaius phoeniceus)* to a multirotor quadcopter UAS and a RC predator model approaching at direct and overhead trajectories; and 2) approach wild flocks of red-winged blackbirds to gauge response of free-ranging birds toward both UAS platforms. The results of this study will help develop UASs as potential hazing tools to disperse and deter birds from areas of human-wildlife conflict (i.e., airports, agricultural areas, and municipalities).

Key Words unmanned aircraft system (UAS), antipredator behavior, alert distance, flight-initiation distance.

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Animals respond to human disturbance using behavior strategies adapted to detect, avoid, and evade natural predators (Frid and Dill 2002; Lima et al. 2015). Recently, unmanned aircraft systems (UAS) have been suggested as a nonlethal method to deter birds from areas of human-wildlife conflict (Ampatzidis 2015). Several studies have evaluated the response of wildlife toward UAS, but few have operated UAS in a manner to intentionally provoke an escape response (Vas et al. 2015; McEvoy et al. 2016). UAS can elicit antipredator behavior in birds, suggesting potential utility as a nonlethal hazing tool (Blackwell et al. 2012; Doppler et al. 2015). The antipredator behavior of animals may be exploited to optimize the efficacy of physical frightening devices such as UAS (Blumstein and Fernández-Juricic 2010). If effective, UAS could potentially be incorporated into an integrated pest management plan to reduce economic loss and safety hazards caused by birds. This study aims to evaluate blackbird antipredator response toward UAS. We will compare the response of captive red-winged blackbirds (*Agelaius phoeniceus)* to a multirotor quadcopter UAS and a radio controlled (RC) fixed-wing predator model approaching at direct and overhead trajectories. We will also evaluate the response of free-ranging blackbirds toward both UAS platforms. Our specific objectives are to identify features and flight dynamics that enhance UASs as hazing tools to disperse and deter flocks of birds from areas of concern (e.g., airport environments and commercial crop fields).

PROPOSED METHODS

Semi-natural Experiment

During trials, captive blackbirds will be temporarily placed in an enclosure (3.7 x 4.0 x 3.1 m). A single blackbird will be randomly selected to be the target individual and placed on the side of the enclosure exposed to UAS flights. Two additional birds will be placed in the opposite side of the enclosure to facilitate flock behavior, but be visually obstructed from UAS approach. To simulate foraging conditions in agricultural fields (e.g. commercial sunflower), blackbirds will be provided food in a feeding tray at 2 m height. The birds will then be approached by either the RC predator model or quadcopter style UAS at a starting distance of 300 m. We will record avian alert distance and flight initiation distance during each trial using four cameras facing the birds. Alert response will be defined as a transition from relaxed foraging behavior (e.g. pecking, preening, loafing, eating, or general scanning) to a vigilant behavior directed toward the approaching aircraft (e.g. head up and neck extended, increased scanning, or crouching; Fernández-Juricic et al. 2001; Blackwell et al. 2009; Blackwell et al. 2012). Flight initiation distance will be defined as the distance from UAS approach that a bird departs from the feeding perch.

Field Experiment

We will conduct the field study in the Prairie-Pothole Region of North Dakota, an area with a historically large red-winged blackbird population (Peer et al. 2003). Thirty commercial sunflower fields (40-160 ha) across North Dakota will be targeted for UAS flights. Upon locating a sunflower field containing a foraging flock, we will record approximate flock size and distance between wetland edge and flock edge. We will approach the blackbird flock directly at a controlled flight speed and altitude using one of the UAS platforms. An approximated flight-initiation distance from approaching UAS platforms and total flight time of the blackbird flock will be recorded.

SUMMARY

By measuring behavioral response of red-winged blackbirds, this study will evaluate the efficacy of both a quadcopter style UAS and RC predator model as potential hazing tools. If the quadcopter provokes a delayed escape response in blackbirds when compared to a simulated raptor, modifications to enhance antipredator behavior toward this UAS platform may be necessary for an effective hazing campaign. Future directions may involve evaluating the effects of speed, size, flight dynamics, and color of UAS on avian escape response (Vas et al. 2015).

LITERATURE CITED

Ampatzidis, Y., J. Ward, and O. Samara. 2015. Autonomous System for Pest Bird Control in Specialty Crops using Unmanned Aerial Vehicles, 2015 ASABE Annual International Meeting, American Society of Agricultural and Biological Engineers, p. 7.

Blackwell, B.F., T.L. DeVault, T.W. Seamans, S.L Lima, P. Baumhardt, and E. Fernández-Juricic. 2012. Exploiting avian vision with aircraft lighting to reduce bird strikes. Journal of Applied Ecology 49: 758-766.

Blackwell, B.F., E. Fernández-Juricic, T.W. Seamans, and T. Dolan 2009. Avian visual system configuration and behavioural response to object approach. Animal Behaviour **77**: 673-684.

Blumstein, D.T., and E. Fernández-Juricic. 2010. A primer of conservation behavior. Sinauer Associates, Sunderland, MA, USA.

Doppler, M.S., B.F. Blackwell, T.L DeVault, and E. Fernández-Juricic. 2015. Cowbird responses to aircraft with lights tuned to their eyes: Implications for bird-aircraft collisions. Condor 117:165-177.

Frid, A., and L.M. Dill. 2002. Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology 6: p.11.

Fernández-Juricic, E., M.D. Jimenez, and E. Lucas. 2001. Alert distance as an alternative measure of bird tolerance to human disturbance: implications for park design. Environmental Conservation 28:263-269.

Lima, S.L., B.F. Blackwell., T.L. DeVault., and E. Fernández-Juricic. 2015. Animal reactions to oncoming vehicles: a conceptual review. Biological Reviews 90**:**60-76

McEvoy, J.F., G.P. Hall, and P.G. McDonald. 2016. Evaluation of unmanned aerial vehicle shape, flight path and camera type for waterfowl surveys: disturbance effects and species recognition. PeerJ 4:e1831.

Peer, B.D., H.J Homan, G.M. Linz, and W.J. Bleier. 2003. Impact of blackbird damage to sunflower: bioenergetic and economic models. Ecological Applications 13:248-256.

Vas, E., Lescroël, A., O. Duriez, G. Boguszewski, and D. Grémillet. 2015. Approaching birds with drones: first experiments and ethical guidelines. Biology Letters 11:20140754.