Evaluating Behavioral Response of Red-winged Blackbirds (*Agelaius phoeniceus*) toward Unmanned Aircraft Systems (UAS)

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Background

Recently, unmanned aircraft systems (UAS) have been suggested as a nonlethal method to deter birds from areas of human-wildlife conflict [1].

Several studies have evaluated the response of wildlife toward UAS, but few have measured escape behavior in response to standardized UAS approaches [2,3].

UAS can elicit antipredator behavior in birds, suggesting potential utility as a nonlethal hazing tool [4, 5].

If effective, UAS could be incorporated into an integrated pest management plan to reduce economic loss and safety hazards caused by birds.

Our objectives were to compare the response of captive red-winged blackbirds (*Agelaius phoeniceus*) toward three UAS platforms approaching at direct and overhead trajectories.

We predicted that blackbirds would respond through a risk assessment process by which a predator-model UAS and direct approaches would lead to longer alert distances, longer latency to resume foraging times, and increased scanning patterns because of higher risk.

Figure 2. We conducted our experiment under semi-natural conditions in an agricultural field (27.5 x 305 m) in Cass County, ND, USA. Planted sunflower crop (~ 1.5 m height) bordered the length of the field. The arena involved a starting point, an approach path devoid of visual obstructions, and a bird enclosure.

Discussion

Blackbirds became alert quicker, resumed foraging later, and spend a greater proportion of time head-up in response to the eagle UAS compared to other platforms.

If the energetic costs of devoting time to antipredator behavior (i.e., scanning and monitoring) outweigh the benefits provided by a resource patch, an animal may decide to abandon that area [8].

Theoretically, wildlife managers can increase the costs of remaining by enhancing the predation risk perceived by target species, and ultimately encourage wildlife to abandon areas of human-wildlife conflict [5,6].

We plan to evaluate UAS as a visual deterrent on free-ranging blackbird flocks on commercial sunflower fields.

Future directions may involve evaluating the effects of speed, flight dynamics, and color of UAS platforms on behavioral response in birds [3].

Other possibilities may include installation of lighting systems to improve detection, sound speakers that play distress or predator calls, lasers, or on-board deployment systems that discharge nonlethal projectiles or repellents toward pest-species [4,9].

Methods

We launched one of six UAS treatments from 300 m south of the enclosure and approached a focal individual in the enclosure (Figure 1A).

We used three UAS platforms approaching either direct or overhead the enclosure (Figure 3A).

Flight treatments consisted of

1. Quadcopter direct approach at ~ 2 m above ground level (AGL)
2. Quadcopter overhead approach at ~ 5 m AGL
3. Fixed-wing (Plane) direct approach at ~ 2 m AGL
4. Fixed-wing (Plane) overhead approach at ~ 5 m AGL
5. Predator model (Eagle) direct approach at ~ 2 m AGL
6. Predator model (Eagle) overhead approach at ~ 5 m AGL

Following flights, we allowed blackbirds to resume foraging and ended trials following 30 seconds of active forage.

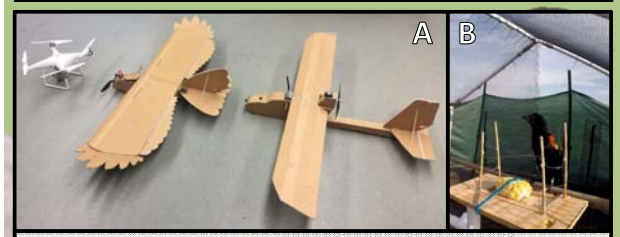

Figure 1A. We compared three unmanned aircraft platforms: a DJI Phantom 4 Pro (Quadcopter), a standard fixed-wing (Plane), and a fixed-wing modeling the form of an aerial raptor (Eagle).

Figure 1B. To simulate foraging conditions in sunflower fields, we provided food via a wooden tray at 1.7 m height, which is the approximate height of blackbirds foraging on commercially grown sunflower.

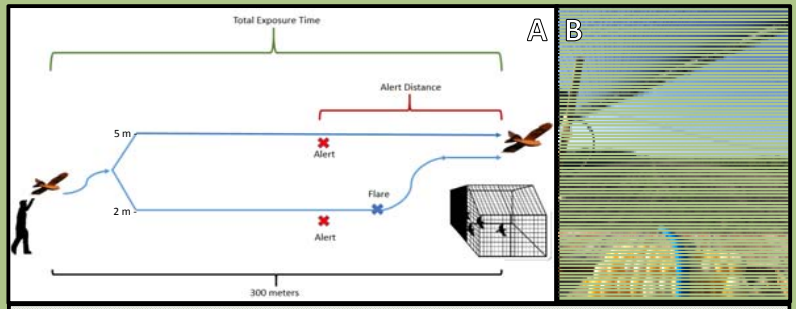

Figure 3A. We recorded the time required for the UAS to pass above the perch from the moment it launched. During direct approach treatments, UAS flared upward prior to colliding with the enclosure. We scored alert-response as a transition from relaxed behavior to a vigilant behavior directed toward the approaching UAS [4]. **Figure 3B.** Perspective of focal individuals during trials.

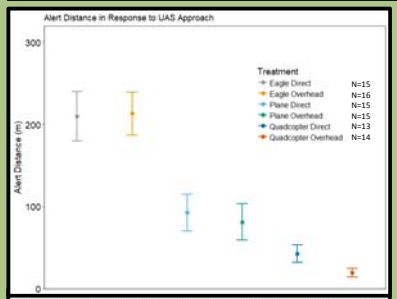

Figure 4. Alert distance is the distance between the UAS and the blackbird where the latter started showing alert behaviors. Blackbirds became alert toward the eagle UAS at farther distances than compared to both the plane and quadcopter.

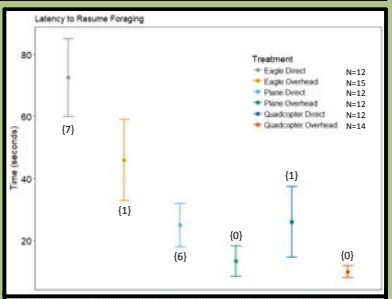

Figure 5. Following UAS approach, we recorded the time required for the bird to resume foraging. Blackbirds resumed foraging later for the eagle than compared to both the plane and quadcopter. {X} Indicates the number of birds that flushed the feeding platform in response to UAS.

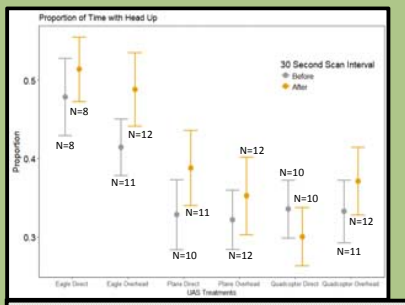

Figure 6. We recorded the proportion of time birds spent head-up versus head-down while foraging 30 seconds before and after UAS approach. Birds exposed to the eagle UAS spent a greater proportion of time with their head-up than compared to other platforms. UAS were visually exposed to blackbirds immediately prior to launch.

Acknowledgements & References

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References

[1]Ampatzidis, Y., Ward, J., Samara, O. (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. 1

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

[3]Vas, E., Lescroël, A., Duriez, O., Boguszewski, G., Grémillet, D. (2015). Approaching birds with drones: first experiments and ethical guidelines. Biology Letters 11:2, 20140754.

[4]Blackwell, B.F., DeVault, T.L., Seamans, T.W., Lima, S.L., Baumhardt, P., Fernández-Juricic, E. (2012). Exploiting avian vision with aircraft lighting to reduce bird strikes. Journal of Applied Ecology 49.4, 758-766.

[5]Blackwell, B.F., DeVault, T.L., Fernandez-Juricic, E., Gese, E.M., Gilbert-Norton, L., Breck, S.W. (2016). No single solution: application of behavioral principles in mitigating human-wildlife conflict. Animal Behavior 120, 245-254.

[6]Blumstein, D.T., Fernández-Juricic, E. (2010). *A primer of conservation behavior*. Sinauer Associates Sunderland, MA.

[7]Blackwell, B.F., Fernández-Juricic, E., Seamans, T.W., Dolan, T. (2009). Avian visual system configuration and behavioral response to object approach. *Animal Behaviour* 77(3), 673-684.

[8]Human-caused disturbance stimuli as a form of predation risk. Conservation Ecology. 6(1), 11.

[9]Chabot, D., Bird, D.M. (2015). Wildlife research and management methods in the 21st century: Where do unmanned aircraft fit in? Journal of Unmanned Vehicle Systems 3, 137-155.