Auditory Priming to Increase Risk Perception of Blackbirds to Approaching Drones

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Introduction

Blackbirds cause ~$18.7 million in damages to sunflower in North Dakota annually [1]. Drones are pest management tools to mitigate bird damage [2]. Making drones more conspicuous may increase their perceived risk to blackbirds, thereby making them more effective as avian deterrents. Broadcasting biologically-relevant sounds may increase conspicuousness and exploit natural responses to predators.

Objectives

1. Assess behavioral reaction of flocks to audio playback prior to a drone approach (i.e. priming broadcasts).
2. Assess how priming and approach broadcasts influence Flight Initiation Distance (FID) at the beginning of flush (FID_{first}) and when >50% (FID_{50}) and the entire flock (FID_{full}) flushed.

Trial Locations

Methods

- We broadcast either a threatening (Merlin call, Red-winged Blackbird alarm call) or a non-threatening sound (American Robin song), from a stationary drone 80 m AGL, including response to no sound (i.e. rotor wash) as a control.
- We primed flocks for 5 s with one sound. After 30 s, we descended on the flock with a drone starting at 70m AGL while the stationary drone played another sound.
- We recorded the drone altitude (FID) at first flush, after >50% flushed, and full flush.
- We used linear mixed models to assess the effect of sounds broadcasts on FID, controlling for flock characteristics (size, flightiness) and environmental factors (temperature, light, wind speed).
- We used trial recordings to calculate a flightiness index [3] based on time in flight and lift-offs.

Figures

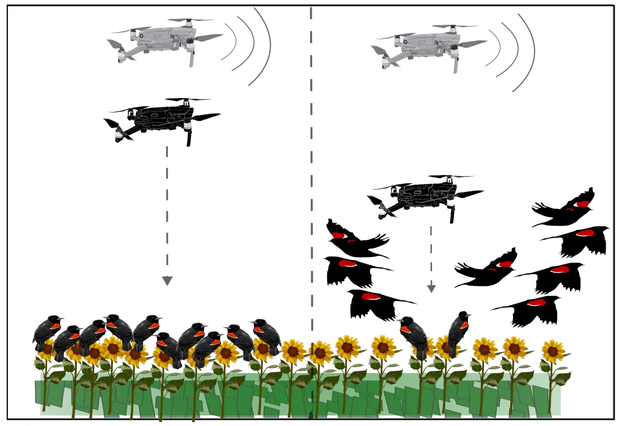

Figure 1: A sound-broadcasting drone (grey) played priming and approach broadcasts while another drone (black) descended until >50% of the flock flushed. The sound-broadcasting drone recorded video of flock behaviors.

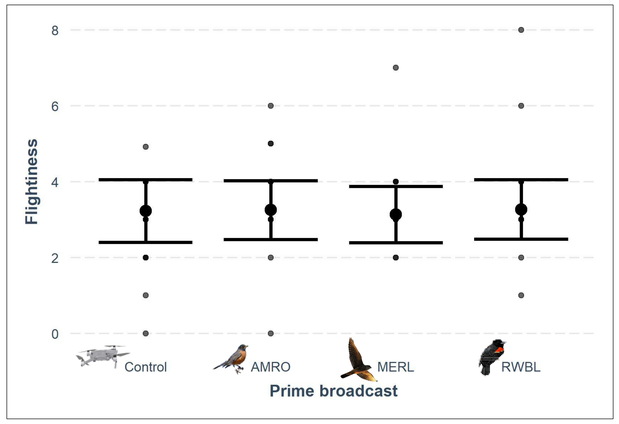

Figure 2: Blackbird flocks were not flightier (p=0.988) during threatening broadcasts (Merlin, Red-winged Blackbird alarm) compared to non-threatening broadcasts (American Robin) or no broadcast (Control).

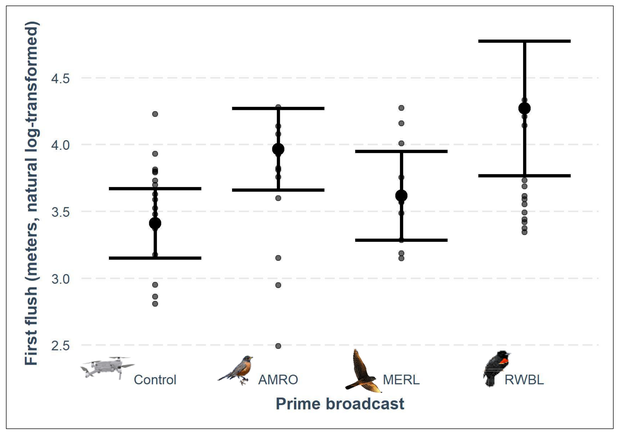

Figure 3: Flocks primed with American Robin song (p=0.014) or Red-winged Blackbird alarm calls (p=0.006) first flushed at significantly greater distances compared to control approaches.

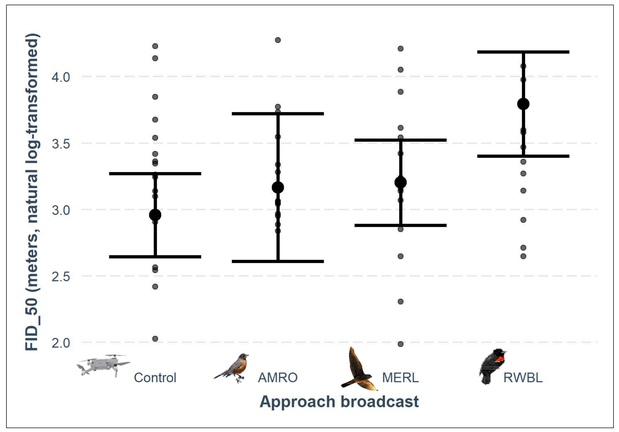

Figure 4: Flocks approached with Red-winged Blackbird alarm calls had >50% of the flock flush at significantly greater distances compared to control approaches (p=0.003).

Results

- Flocks did not differ in flightiness (p=0.988) or probability of flushing (p=0.167) with priming (Fig. 2).
- FID_{first} varied by prime broadcast (p=0.030) and the combination of prime and approach broadcasts (interaction term, p=0.037) and increased with brighter ambient light (p=0.016) and larger flock size (p=0.041).
- FID_{50} varied by approach broadcast (Fig. 4, p=0.035); increased with greater temperatures (p=0.017), starting elevation (meters, p=0.020), and flightiness (p=0.009); and decreased with greater ambient sound (dB, p=0.006) and order of approach (p=0.014).
- FID_{full} increased with higher temperature (p=0.017), starting elevation (p=0.014), day of year (p=0.047), and flightiness (p=0.006); and decreased with greater ambient sound (dB, p=0.002) and order of approach (p=0.026).

References:

1. Ernst, K., Elser, J., Linz, G., Kandel, H., Holderieath, J., DeGroot, S., Shwiff, S., & Shwiff, S. (2019). The economic impacts of blackbird (*Icteridae*) damage to sunflower in the USA. *Pest Management Science*, *75*(11), 2910–2915. https://doi.org/10.1002/ps.5486
2. Klug, P., Shiels, A., Kluever, B., Anderson, J., Hess, S., Ruell, E., Bukoski, W., & Siers, S. (2023). A review of nonlethal and lethal control tools for managing the damage of invasive birds to human assets and economic activities. *Management of Biological Invasions*, *14*(1), 1–44. https://doi.org/10.3391/mbi.2023.14.1.01
3. Friard, O. and Gamba, M., BORIS: a free, versatile open-source event-logging software for video/audio coding and live observations. (2016) Methods Ecol Evol, 7: 1325–1330. https://doi.org/10.1111/2041-210X.12584
4. Ribot, R. F. H., Berg, M. L., Buchanan, K. L., & Bennett, A. T. D. (2011). Fruitful use of bioacoustic alarm stimuli as a deterrent for Crimson Rosellas (Platycercens elegans). *EMU - Australian Ornithology*, *111*(4), 360–367. https://doi.org/DOI10.1071/MU10080
5. Abbey-Lee, R. N., Mathot, K. J., & Dingemanse, N. J. (2016). Behavioral and morphological responses to perceived predation risk: A field experiment in passerines. *Behavioral Ecology*, *27*(3), 857–864. https://doi.org/10.1093/beheco/arv228
6. Condon, T., Hakim, A., Moran, A. B. Z., & Blumstein, D. T. (2021). The effect of mobbing vocalizations on risk perception in common mynas (Acridotheres tristis). *Journal of Ethology*, *39*(1), 89–96. https://doi.org/10.1007/s10164-020-00677-9
7. Burton, N., & Yasukawa, K. (2001). THE "PREDATOR EARLY WARNING SYSTEM" OF RED-WINGED BLACKBIRDS. *Journal of Field Ornithology*, *72*(1), 106–112. https://doi.org/10.1648/0273-8570-72.1.106

Discussion

- While blackbird flocks did not drastically react (flightiness) to priming broadcasts (Fig. 2), evidence suggests that priming caused birds to alter subsequent behavior (Fig. 3) [4&5].
- Other studies on auditory priming used singular birds [6], while our focal units were flocks (200-6345 birds). Thus, group vigilance or social learning likely impacted responses.
- Blackbird alarm calls had the greatest effect on making drones appear more threatening (Figs. 3&4), supported by the "predator early warning system" the species displays. [7]
- Flocks may not have reacted to Merlin calls because this auditory stimulus may prompt birds to remain still and not draw attention of a highly-mobile aerial predator.
- If including sound in drone-based blackbird management strategies, Red-winged Blackbird alarm calls may increase the perceived riskiness of drones.
- This study was conducted over a single field season and has a relatively low sample size (N=65) for the number of treatments. Future research should explore these relationships over multiple years or at different times of the annual migration cycle.
- Although we were constrained by logistical and technical challenges, understanding the combination of auditory and visual threats will improve hazing efficacy.

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