



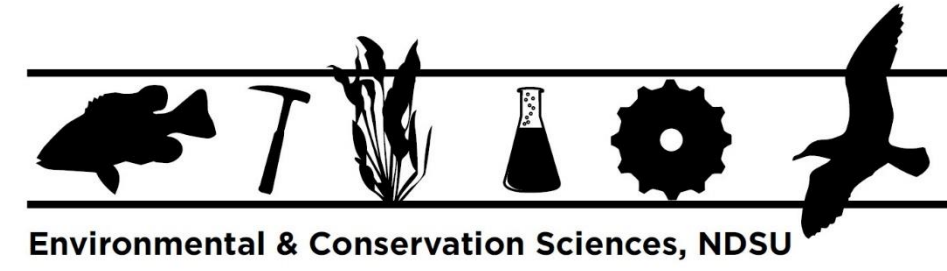
Effects of Extended Drone Hazing on Blackbird and Raptor Behavior in North Dakota Sunflower Fields

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Background

- Birds are declining across North America, but blackbird numbers and sunflower damage are increasing in ND [1,2,3].
- Blackbirds cause \$10.7 million in damages to ND sunflowers annually [4].
 - Oilseed: 4.2% yield reduction, \$36.43 lost/ha
 - Confectionary: 4.5% yield reduction, \$53.61 lost/ha
- Despite 50+ years of research, no tool has become the answer [5, 6].
 - Blackbird flocks are large and mobile
 - Range of most tools is limited in relation to field size
- Drones and raptors are dynamic, mobile, and able to capitalize on the antipredator behavior of birds.
 - Aggressively hazing blackbirds with drones allows flocks to be actively chased throughout the field [7, 8, 9, 10].
 - Encouraging the presence of raptors may create a landscape of fear, increasing the effectiveness of drone hazing [11].



Preliminary Results

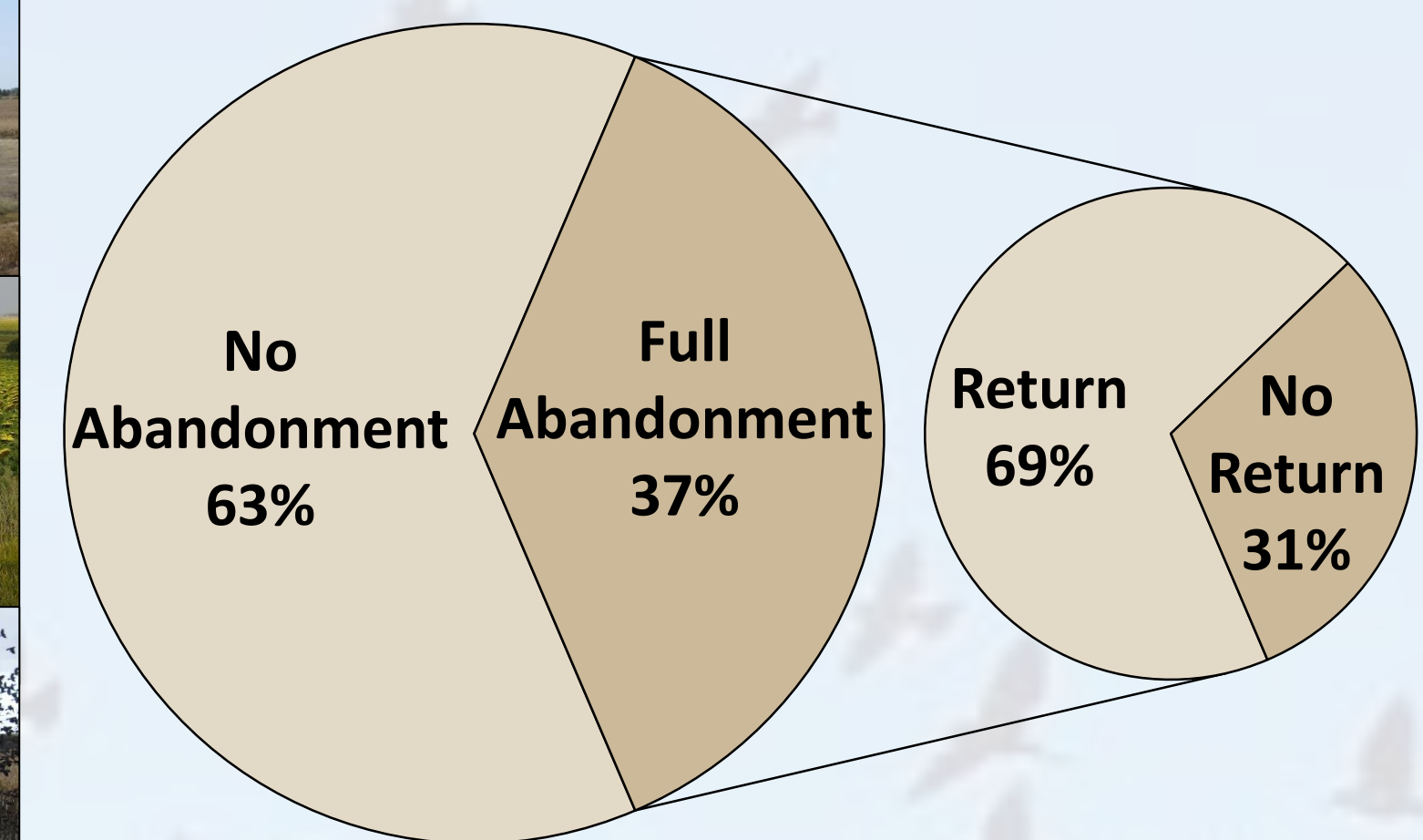
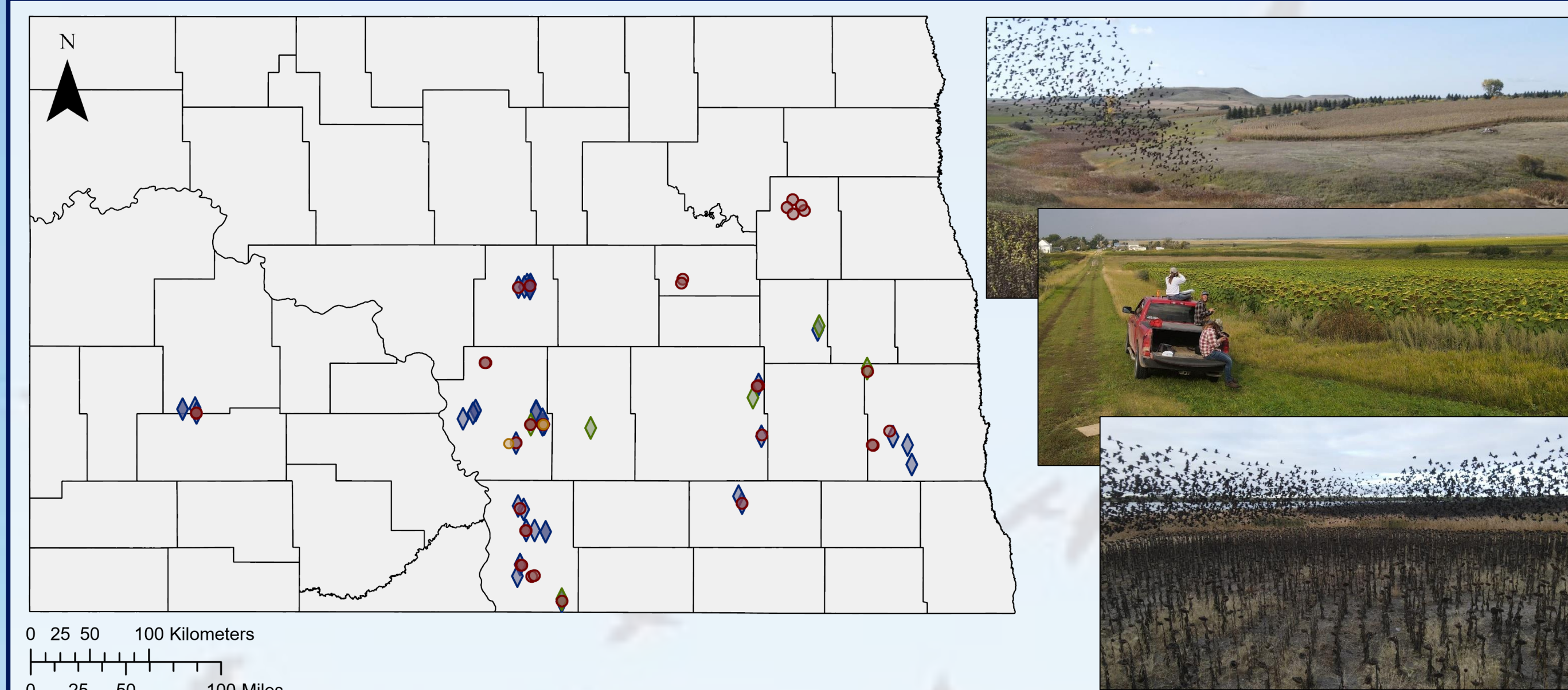
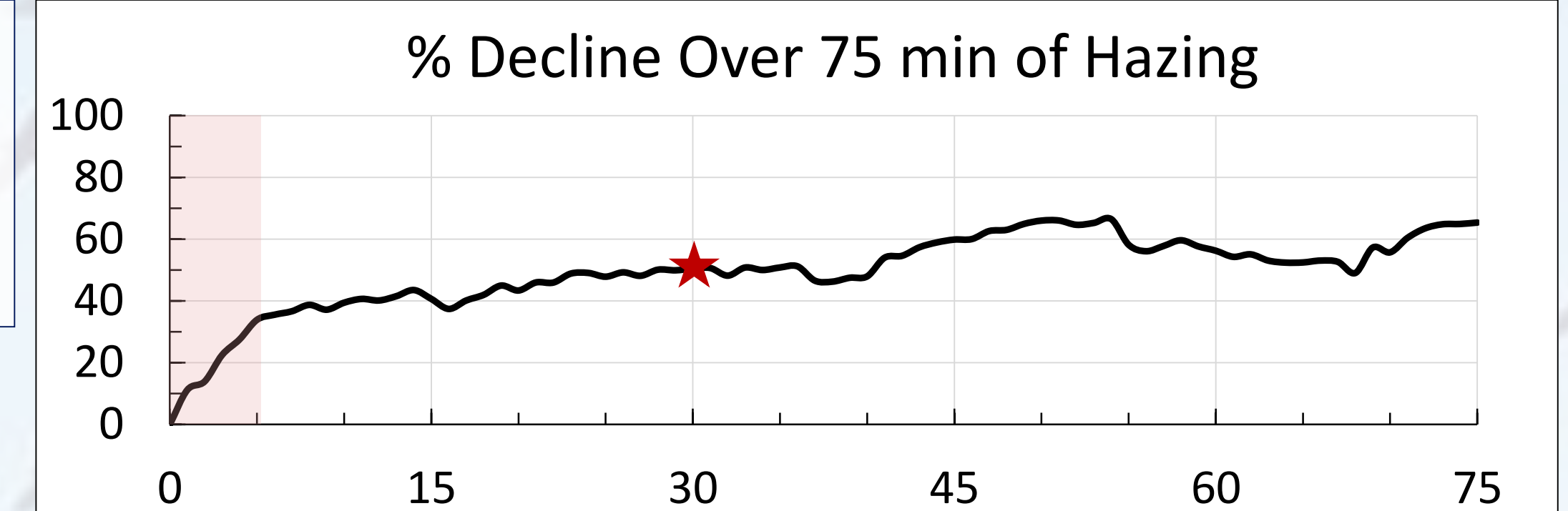


Figure 3. Probability of blackbird flock abandonment in 35 sunflower fields that were hazed for 75 min in 2023 (left). Of the 37% fields that had flocks abandon, 69% had blackbirds return (right).

Overall % Decline: $67 \pm 9\%$



Initial % decline in comparison to past studies:

- DJI Agras 10 min of hazing (2020): 41 ± 5
- DJI Agras 8 min of spraying (2021-22): 45 ± 4
- DJI Mavic models 10 min of hazing (2023): 47 ± 7

Time to Abandonment:

16 ± 6 min
(1-72 min)

Latency to Return:

8 ± 2 min
(51 sec – 15 min)

Figure 4. Percent decline of blackbird flocks over 75 min of hazing in 35 sunflower fields (top). A 50% decline in flock size was achieved in ~30 min. Percent decline increased the most within the first 10 min of hazing, comparable to past hazing studies where DJI drones hazed or sprayed for 8-10 min (middle). Time to abandonment and latency to return were calculated with flocks that abandoned and returned during the hazing period (bottom).

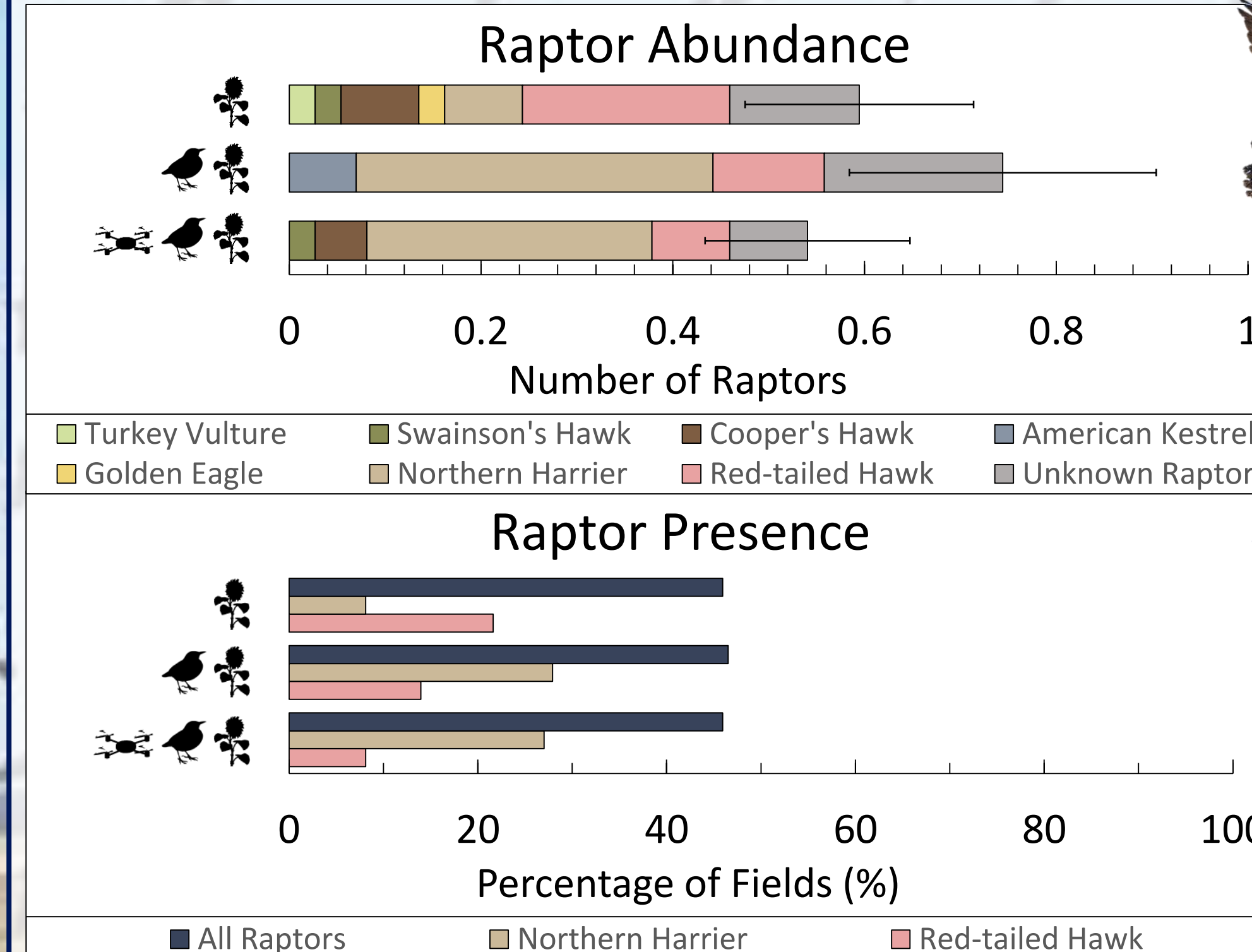


Figure 3. Raptor abundance (top) and raptor presence (bottom) in sunflower fields (n=37), sunflower fields with blackbirds (n=43), and sunflower fields with blackbirds and hazing (n=37).

Objectives

- Assess how 75 min of drone hazing affects blackbird flock probability of abandonment, time to abandonment, latency to return, and percent decline.
- Compare the presence and abundance of raptors in sunflower fields without blackbirds, sunflower fields with blackbirds, and sunflower fields with blackbirds being actively hazed by a drone.

Methods

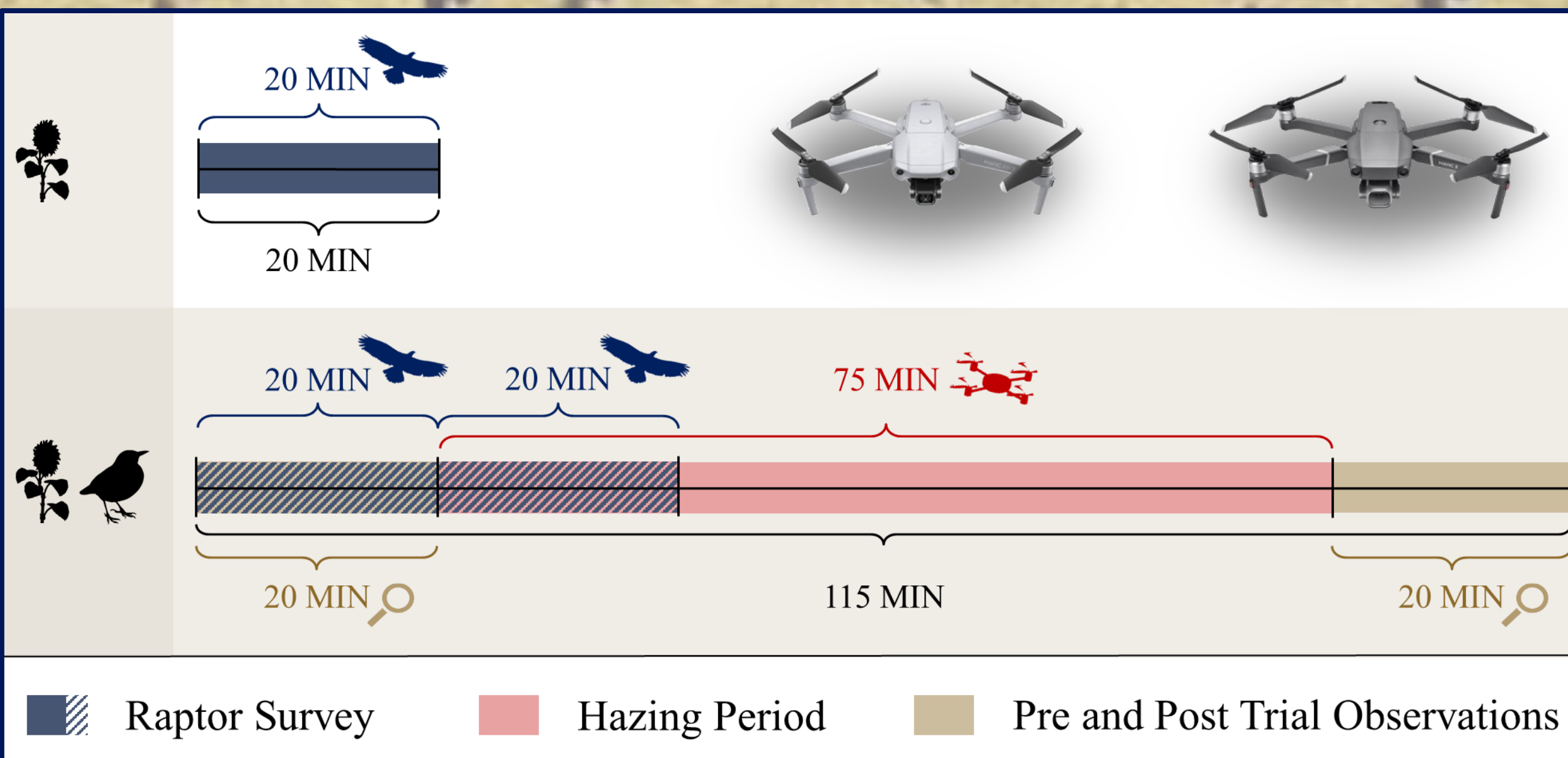


Figure 1. Timeline for raptor surveys and hazing trials, and the drones used for hazing (Mavic Air II and Mavic II Pro).

Acknowledgements

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Future Directions & Recommendations

Future Directions:

- Evaluate covariates (i.e., field, landscape, environmental, and drone flight dynamics) influencing:
 - probability of abandonment, time to abandonment, latency to return, and percent decline
 - blackbird behavior pre- and post-hazing
 - raptor presence and abundance

Recommendations: Haze for at least 10 min to lower flock size, and haze for at least 30 min to reduce the flock size by half.

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