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

Jessica Kading[1], Timothy J. Greives[1], and Page E. Klug[2]
[1]North Dakota State University, Department of Biological Sciences, Fargo ND;
[2]USDA-APHIS-Wildlife Services National Wildlife Research Center, North Dakota Field Station, Fargo ND

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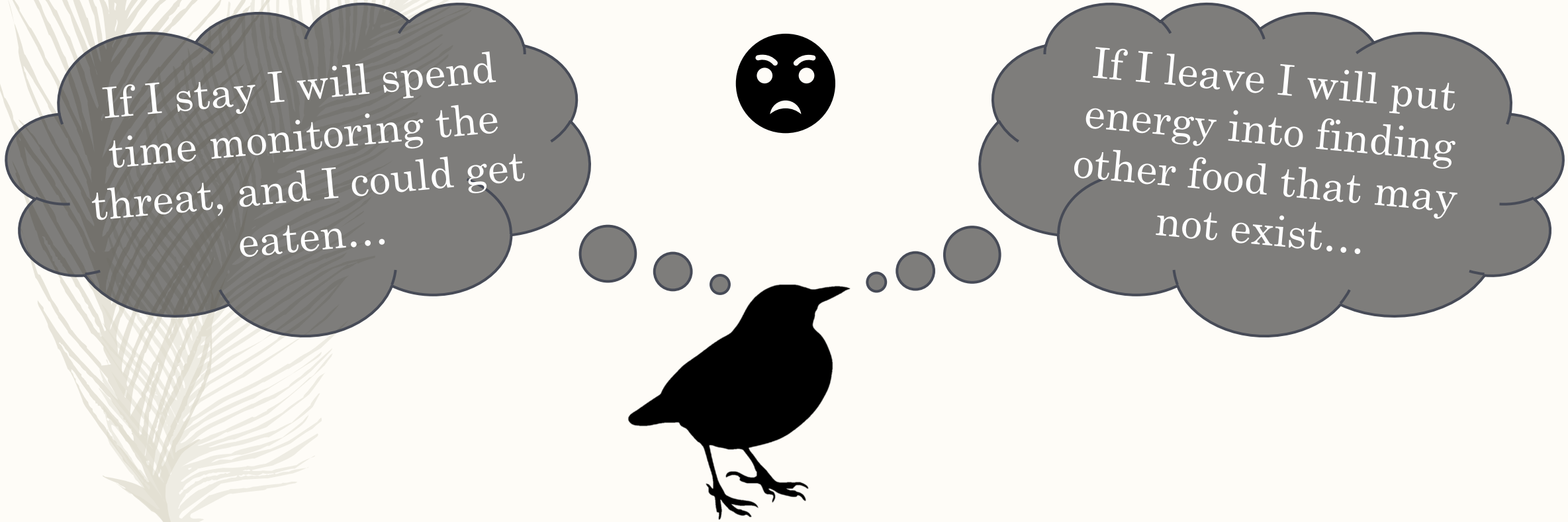
How can we reduce blackbird damage to sunflowers?

Find ways to increase risk!

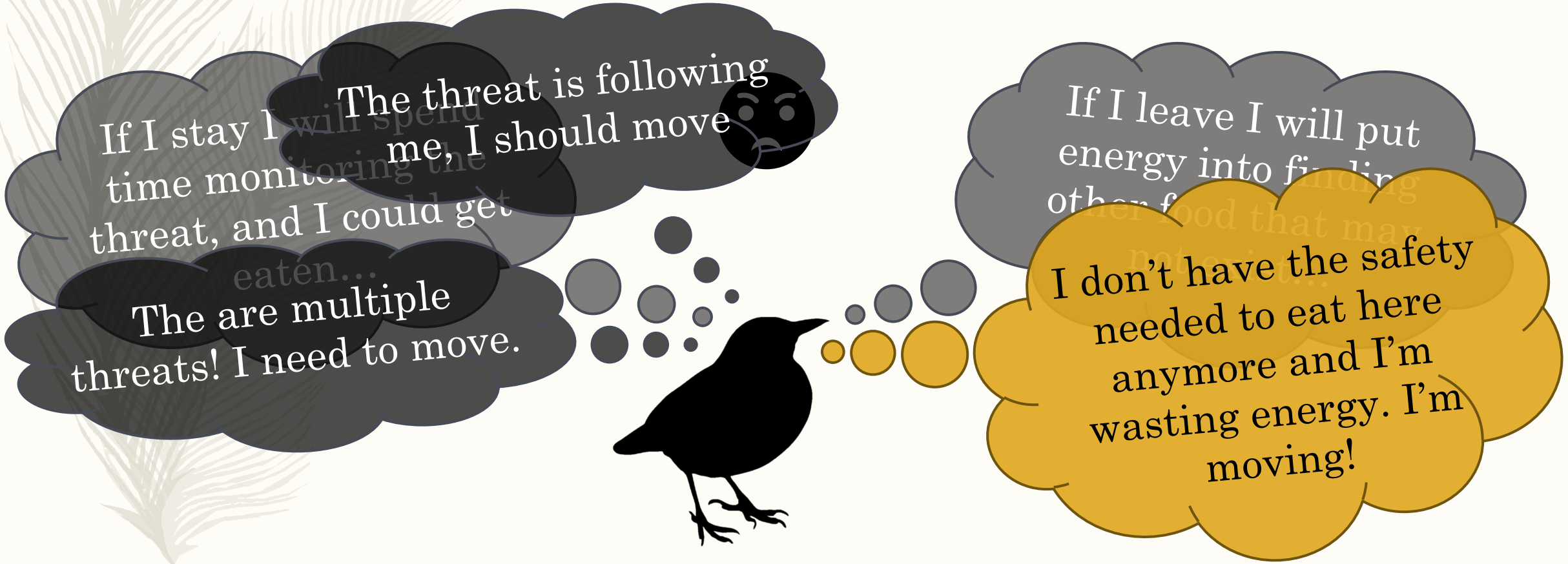
Using Antipredator Behavior Economics

– Economic model proposed by Ydenberg and Dill (1986) predicts that prey should flee a predator once cost of remaining **>** cost of fleeing



Using Antipredator Behavior Economics

– Economic model proposed by Ydenberg and Dill (1986) predicts that prey should flee a predator once cost of remaining > cost of fleeing



Blackbird flocks are very large….

and very mobile.

To Increase Risk

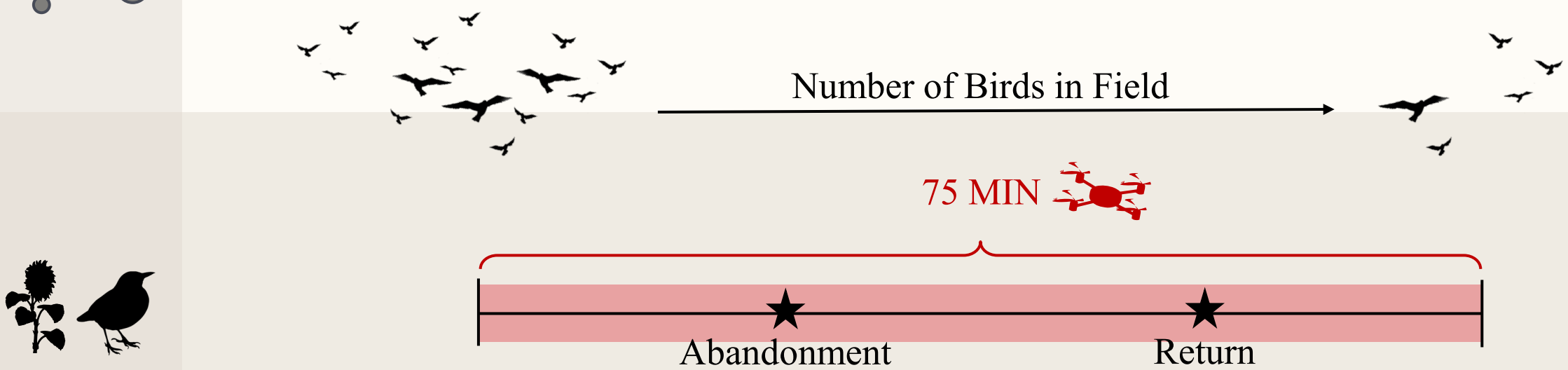
- Find mobile and risky mitigation methods
- Find ways to increase their effectiveness
- Find ways to combine and use methods in conjunction

(Mel Diotte)

Blackbird
Research Questions & Study Design

2023 & 2024

Question 1: *How does drone hazing affect blackbird flock dispersal from sunflower fields over an extended period of time?*

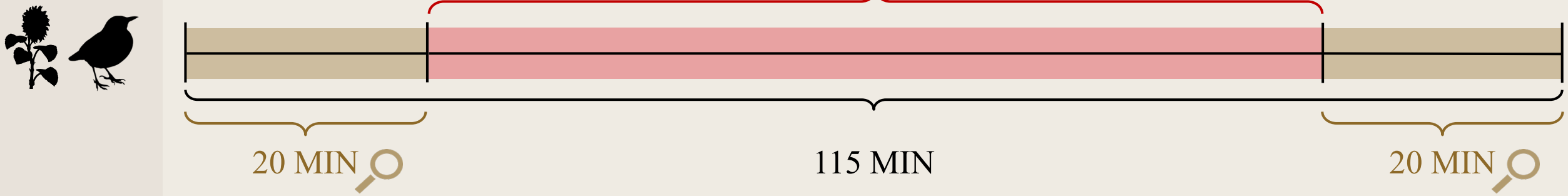


Hazing Trial

2023 & 2024

Question 2: *Do blackbirds remaining in fields after an extended hazing period behave differently than they had prior to hazing?*

Recorded flock liftoffs, proportion of time spent in flight, and cohesiveness.



Hazing Trial

Pre and Post Trial Observations

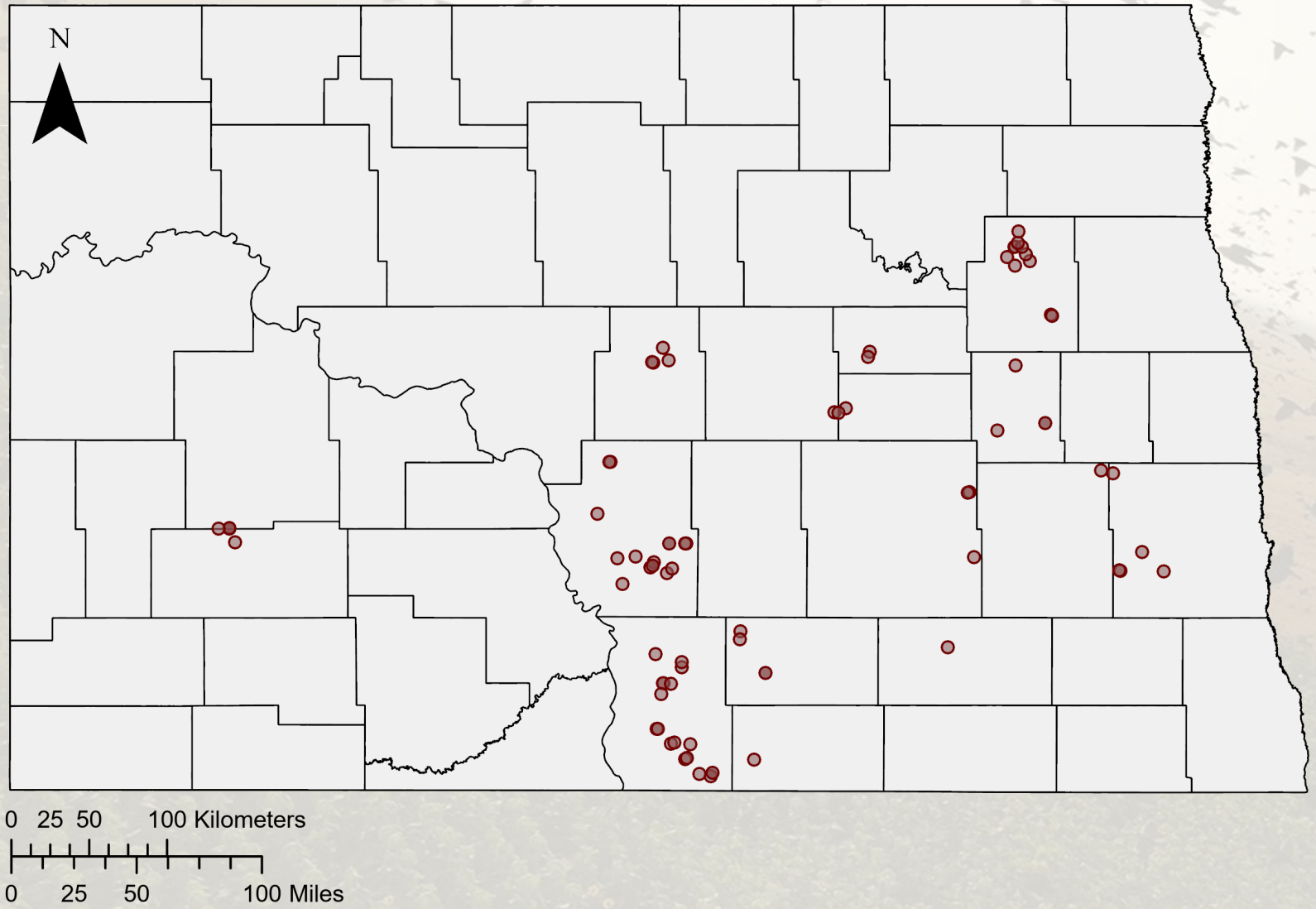
Hazing Trials:

Flying for 75 minutes

15 MINUTES

How did blackbirds respond to hazing?

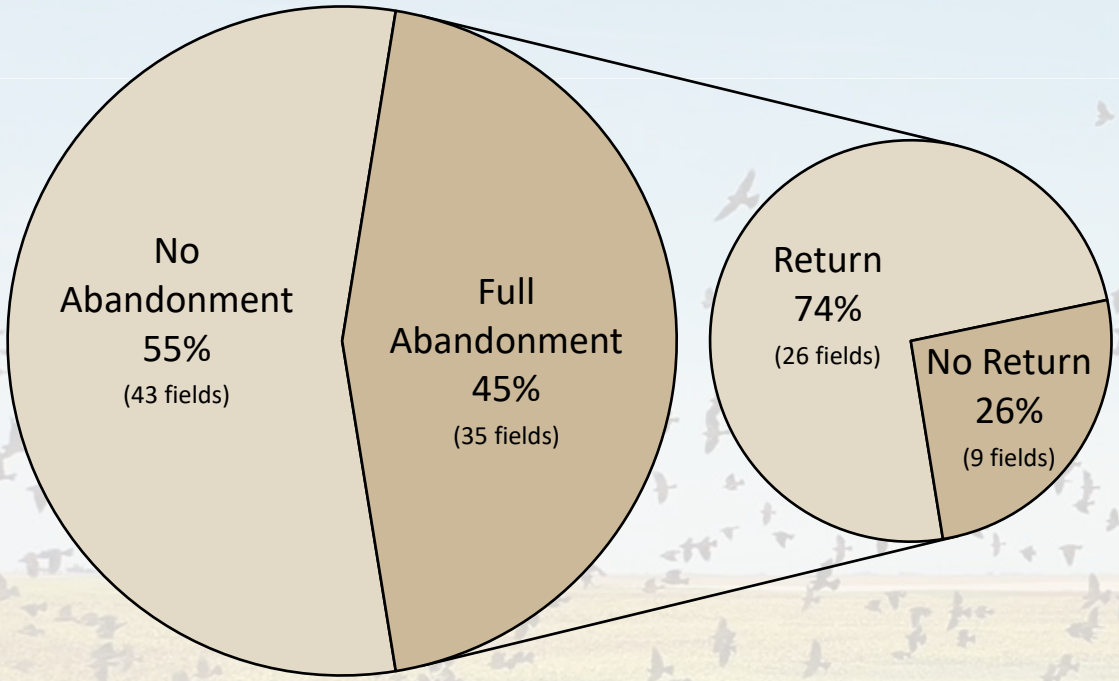
Fall 2023 & 2024 – Data Collection



– **78** full hazing trials

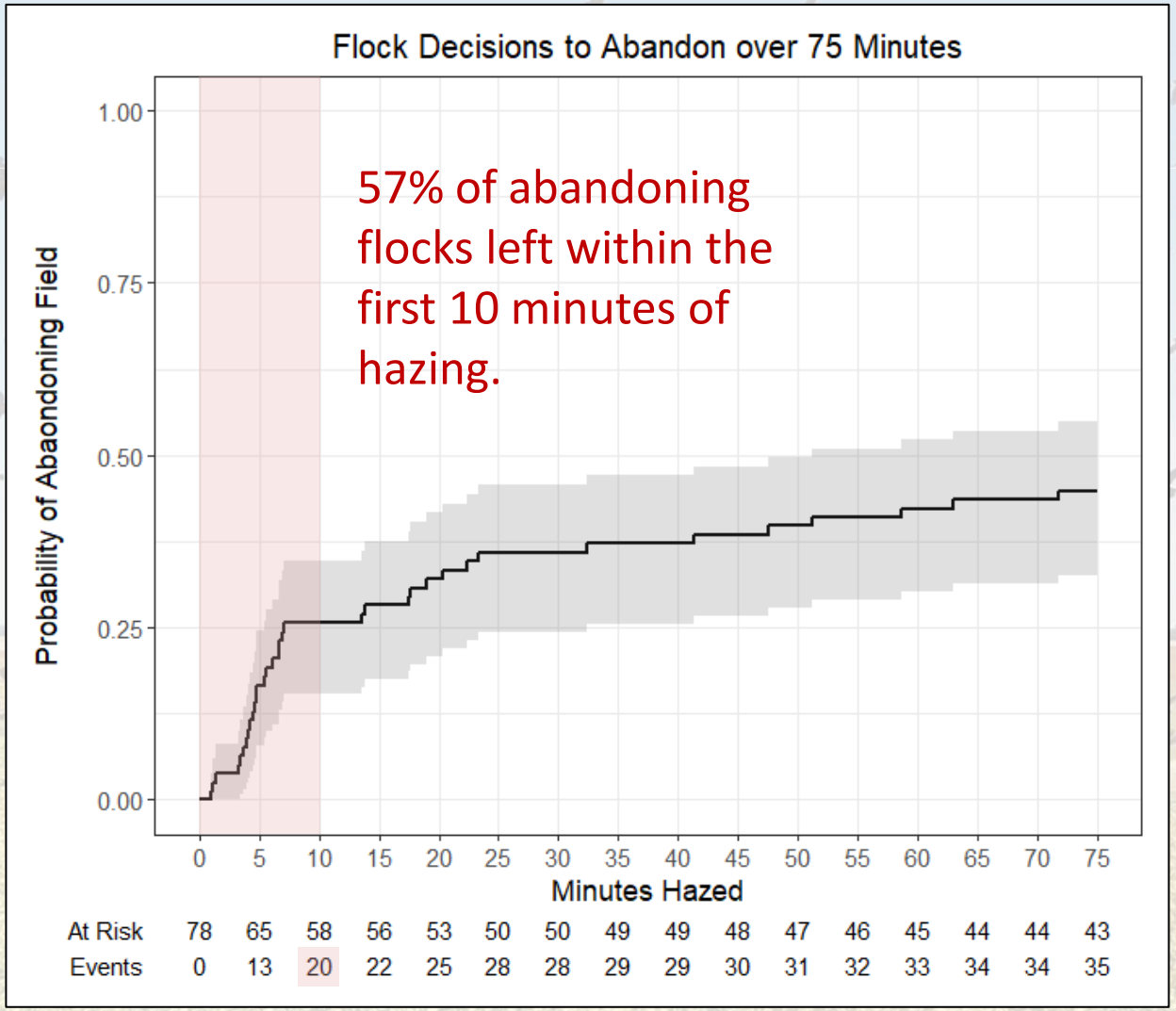
Flock Abandonment during Hazing

Probability of Abandonment:



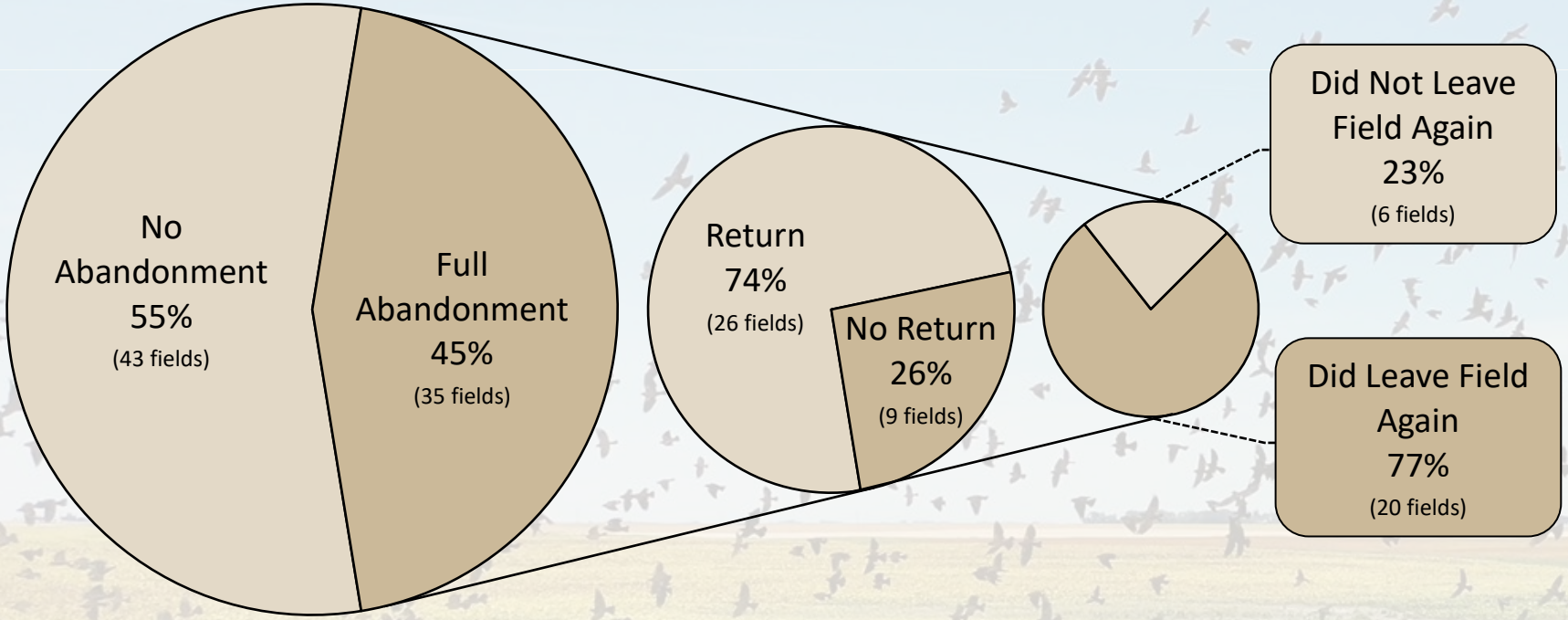
Time to Abandonment:
17 ± 3 min
(1-72 min)

Latency to Return:
9 ± 1 min
(51 sec - 25 min)



Flock Abandonment during Hazing

Probability of Abandonment:



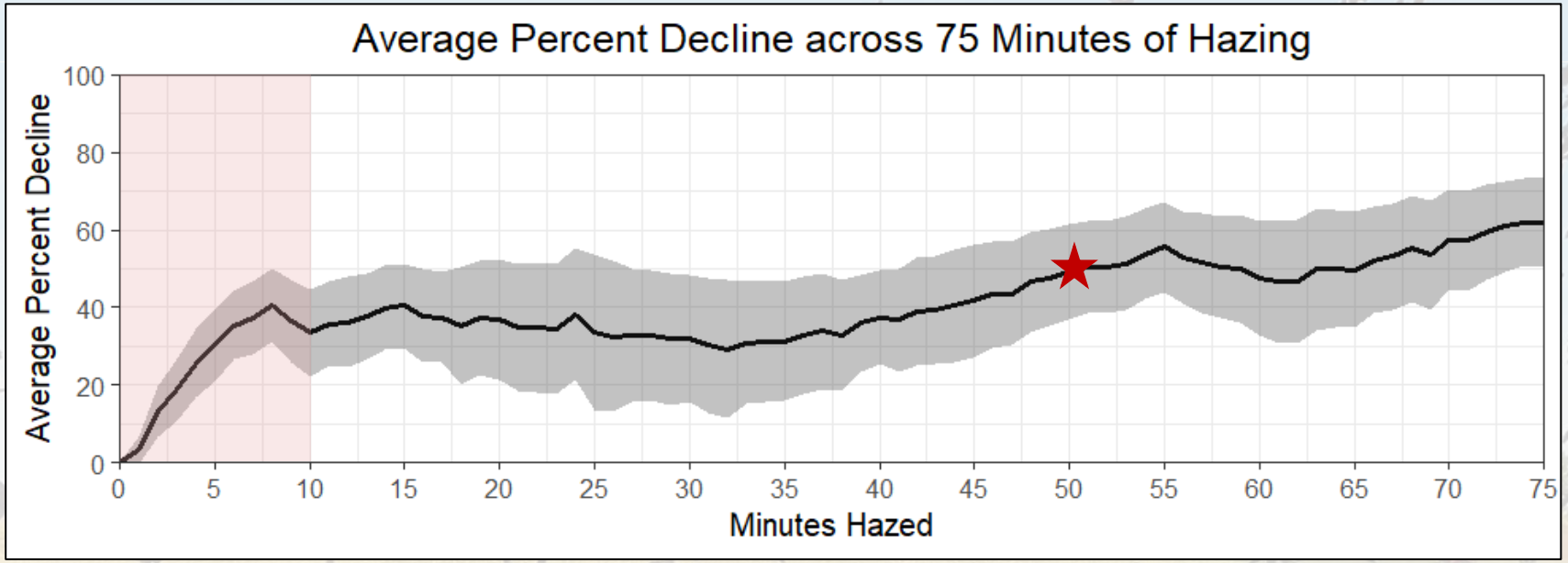
Time to Abandonment:
17 ± 3 min
(1-72 min)

Latency to Return:
9 ± 1 min
(51 sec - 25 min)

Number of Secondary Abandonments:
3 ± 0.5
(1-10)

Hazing % Decline from Start to 75 Minutes

<u>Overall Average Percent Decline:</u> 62 ± 6



On average, **51 minutes** of hazing required to reach a **50% decline** in flock size.

The **highest rate of decline** appears to occur within the **first 10 minutes** of hazing.

Hazing % Decline from Start to 10 Minutes

Average Percent Decline: 34 ± 6

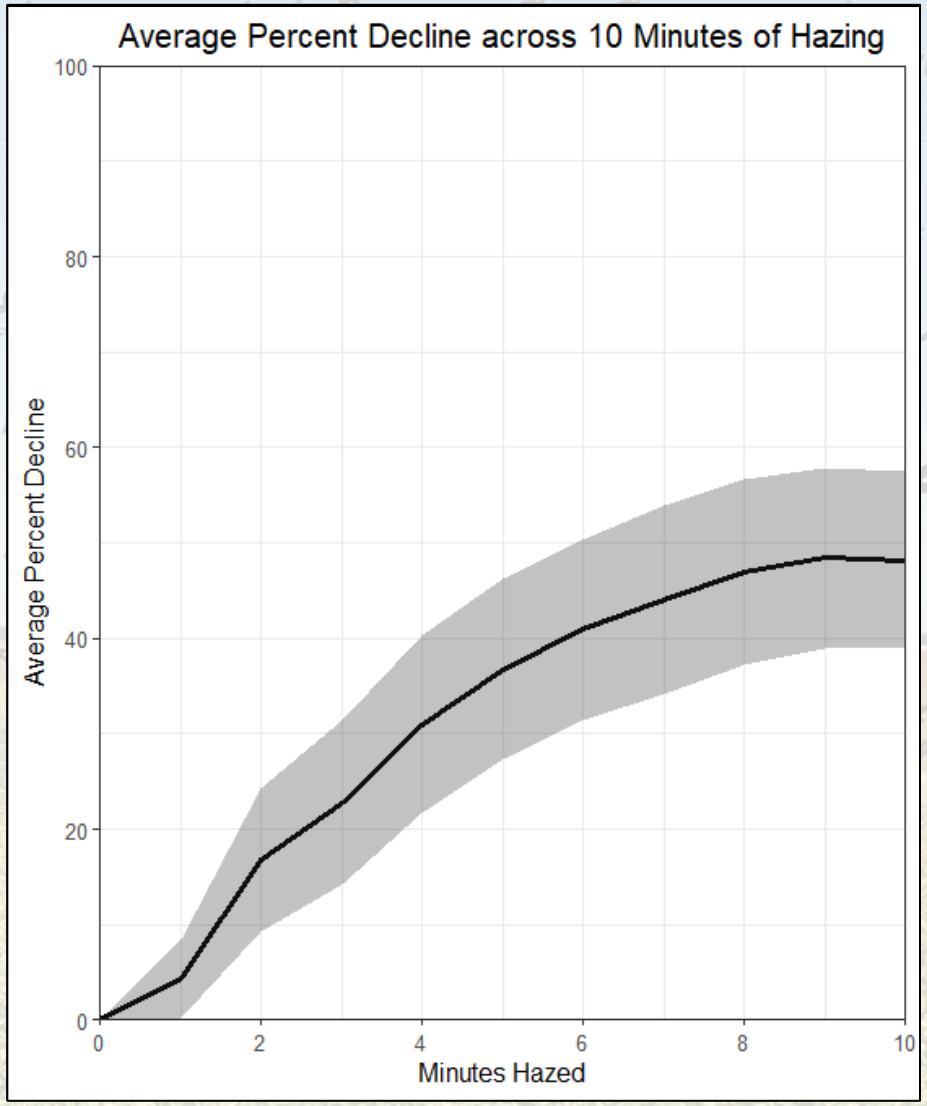
14 flocks **increased** in size

64 flocks **decreased** in size

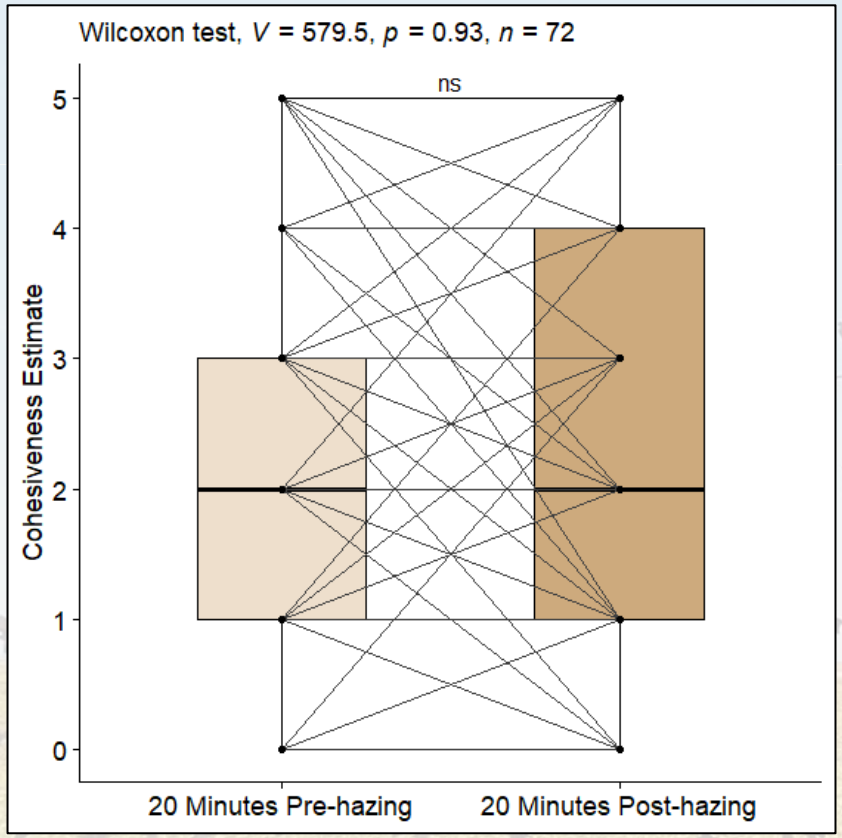
Comparable Percent Decline in Past Studies:

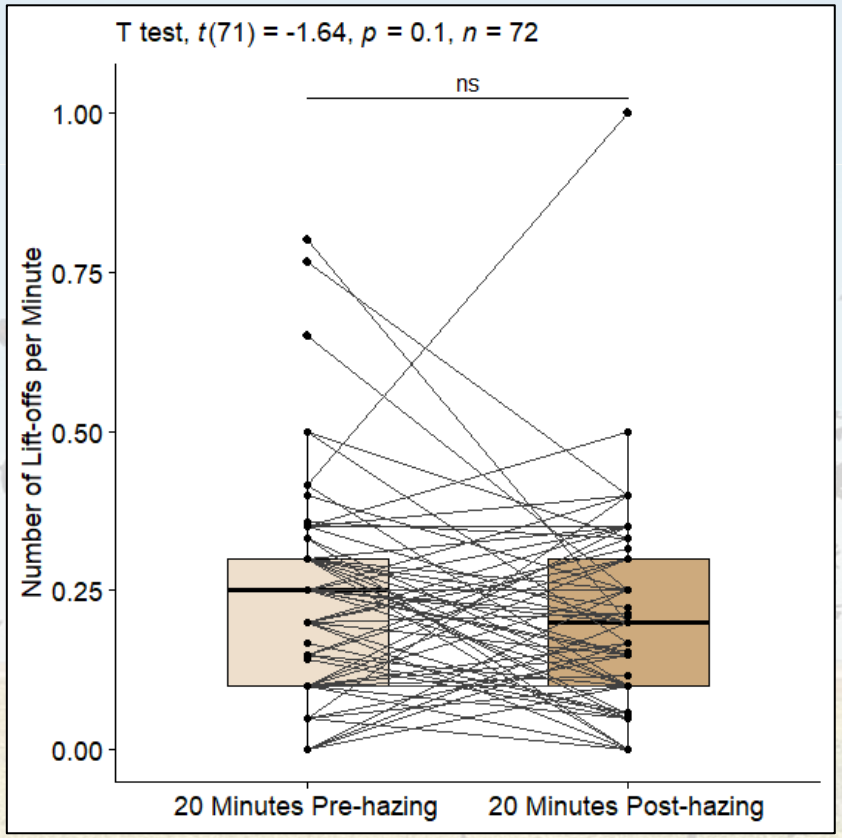
(Trials with increasing flock sizes were removed for these calculations)

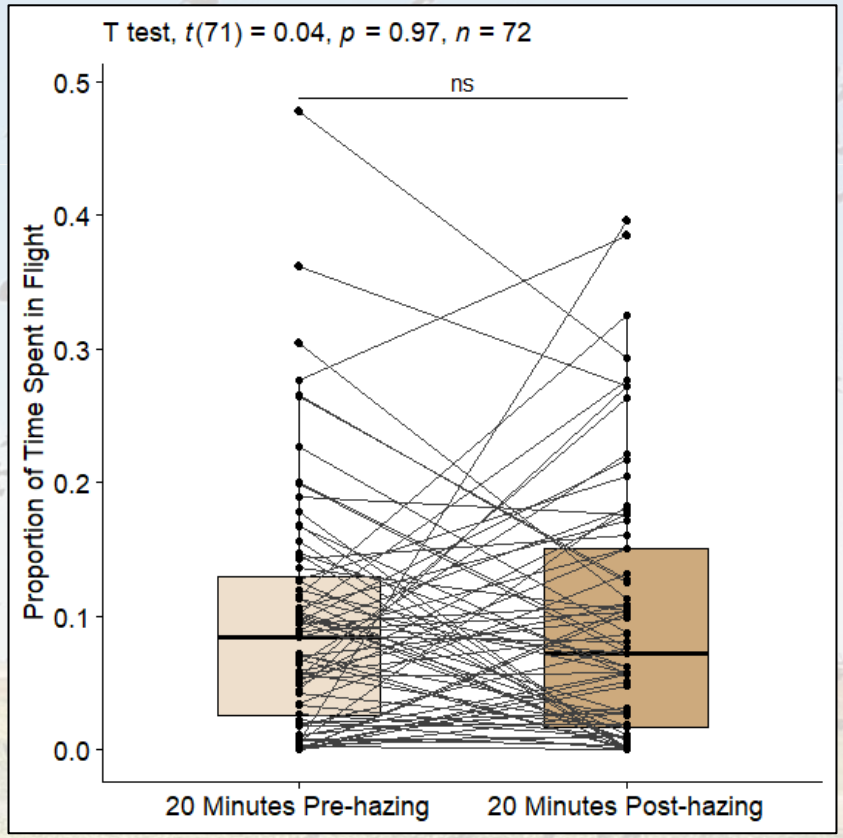
- DJI Agras 10 min of hazing (2020): 41 ± 5
- DJI Agras 8 min of spraying (2021-22): 45 ± 4
- DJI Mavic 10 min of hazing (2023-24): 47 ± 5



Flock Behavior Pre- and Post-Hazing





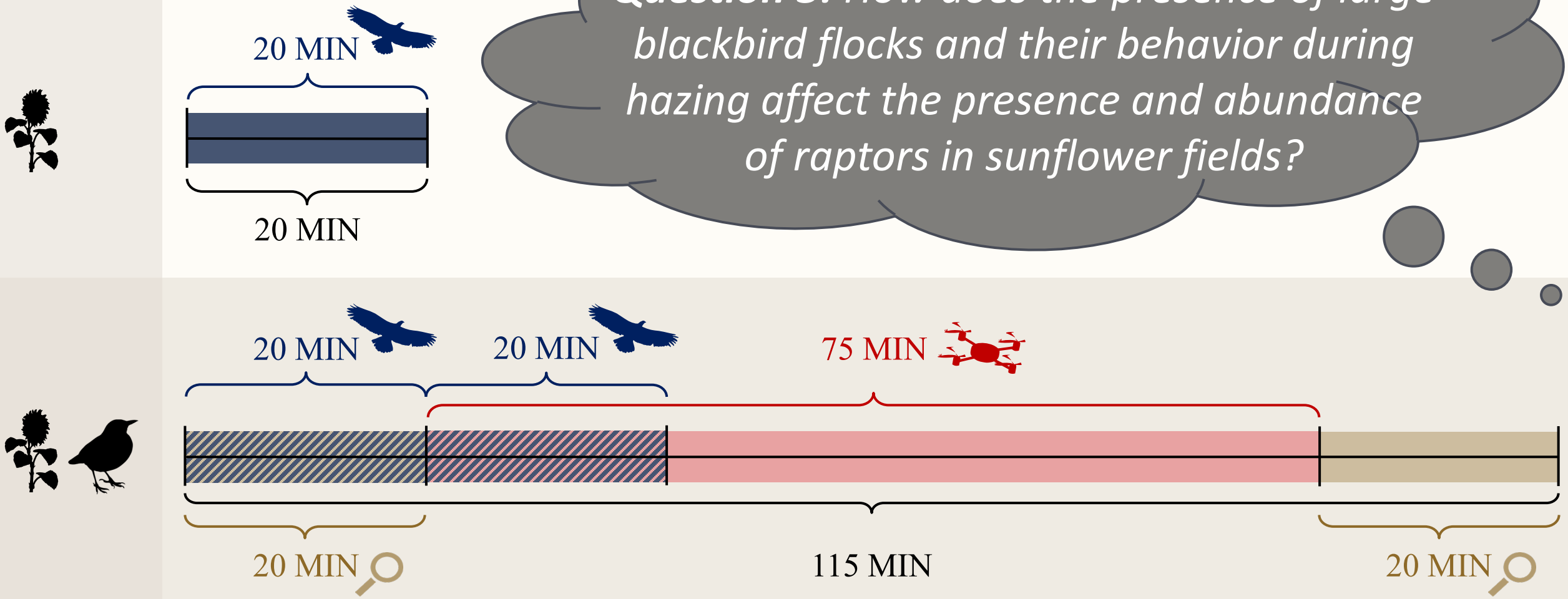


Pre-hazing Cohesiveness	**Post-hazing Cohesiveness**	**Pre-hazing Lift-offs per Minute**	**Post-hazing Lift-offs per Minute**	**Pre-hazing Prop. Time Spent in Flight**	**Post-hazing Prop. Time Spent in Flight**
2.25 ± 0.18	2.24 ± 0.21	0.24 ± 0.02	0.20 ± 0.02	0.10 ± 0.01	0.10 ± 0.01
(0 - 5)	(0 - 5)	(0 – 0.8)	(0 - 1)	(0 – 0.48)	(0 – 0.39 min)

Raptor
Research Questions & Study Design

2023 & 2024

Question 3: *How does the presence of large blackbird flocks and their behavior during hazing affect the presence and abundance of raptors in sunflower fields?*



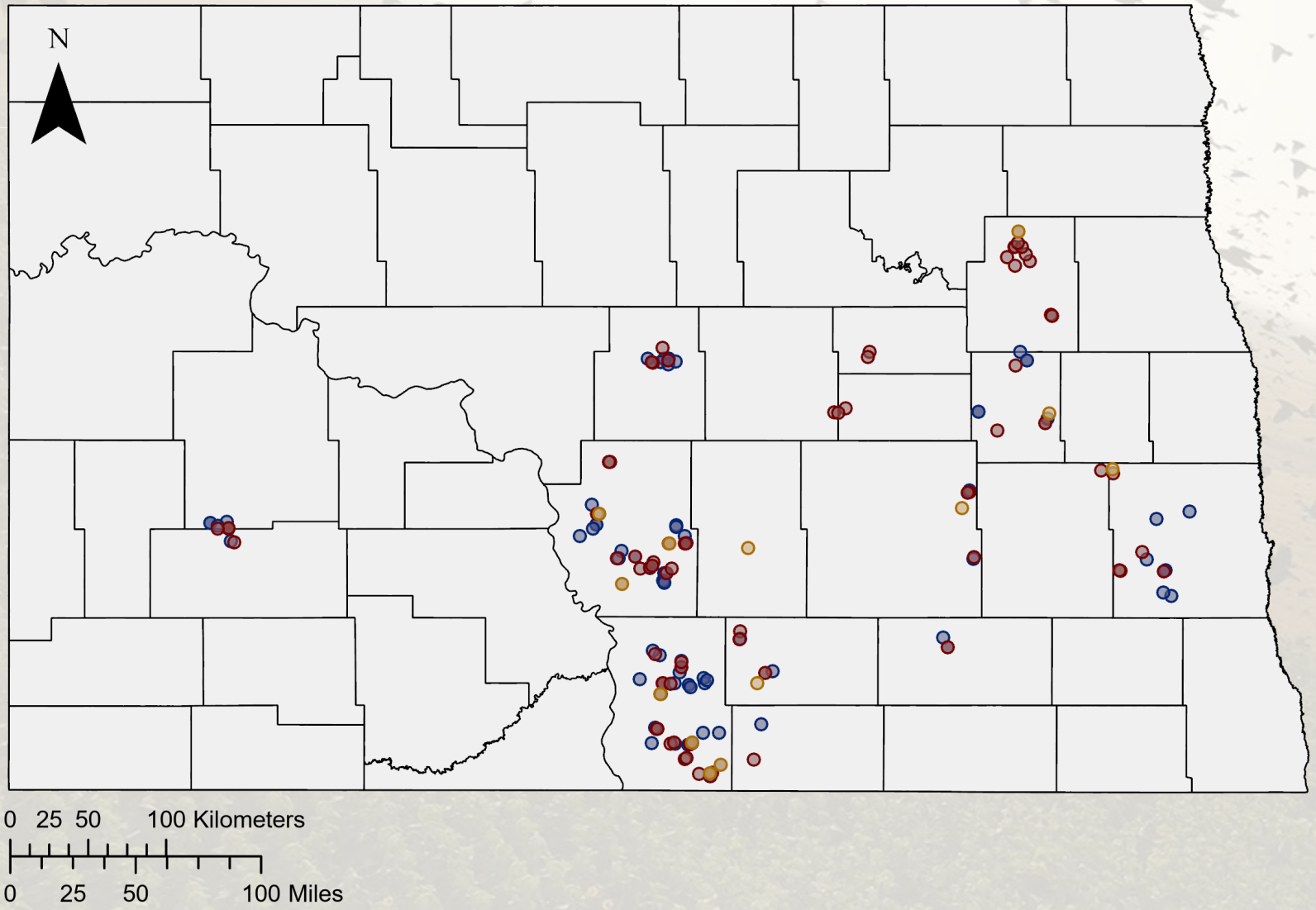
Raptor Survey

Hazing Trial

Pre and Post Trial Observations

How did raptors interact with blackbirds and hazing?

Fall 2023 & 2024 – Data Collection

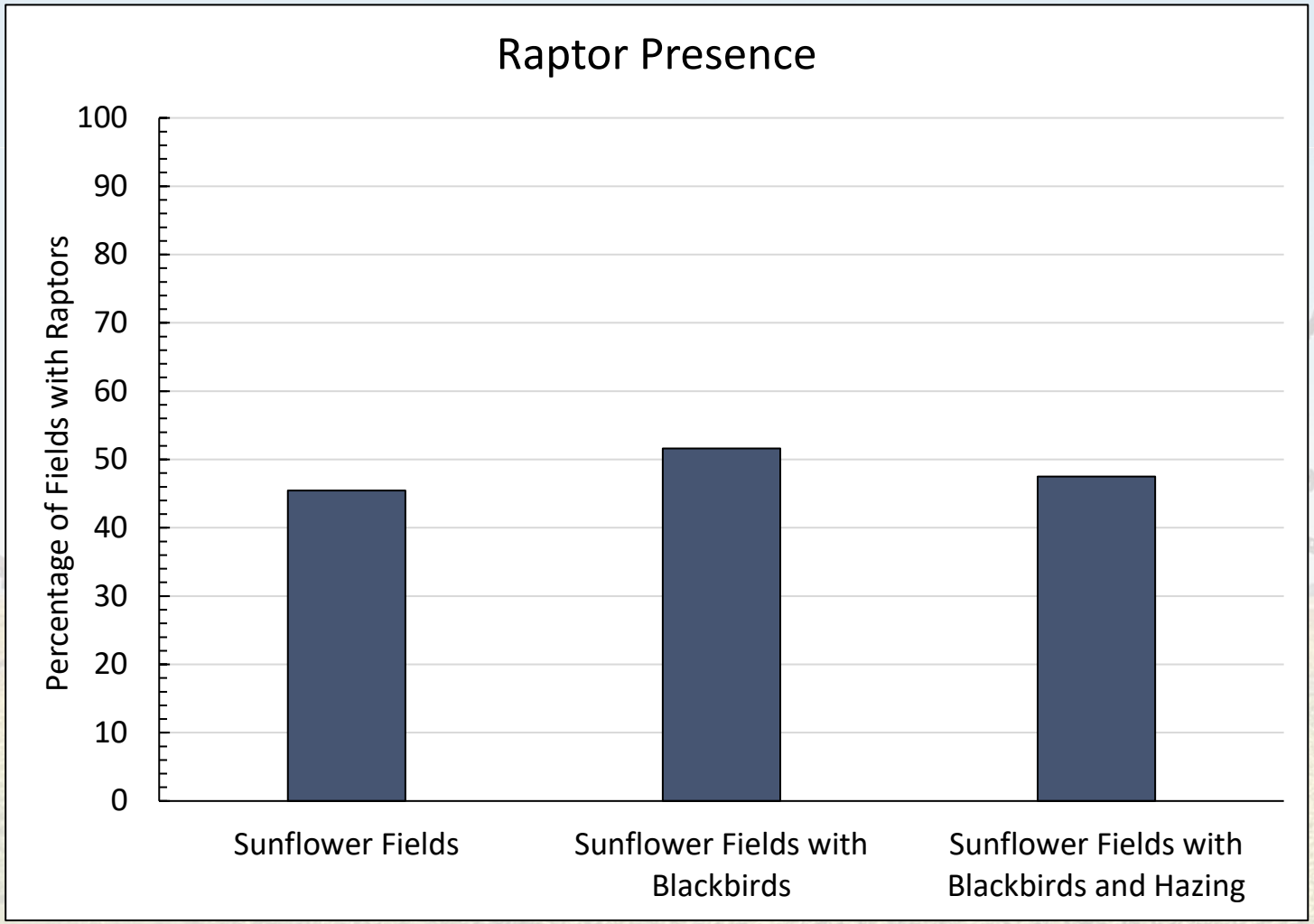


- **77** raptor surveys in fields with sunflower
- **93** raptor surveys in fields with sunflower and blackbirds (**R**&**Y**)
- **80** raptor surveys in fields with sunflower, blackbirds, and hazing

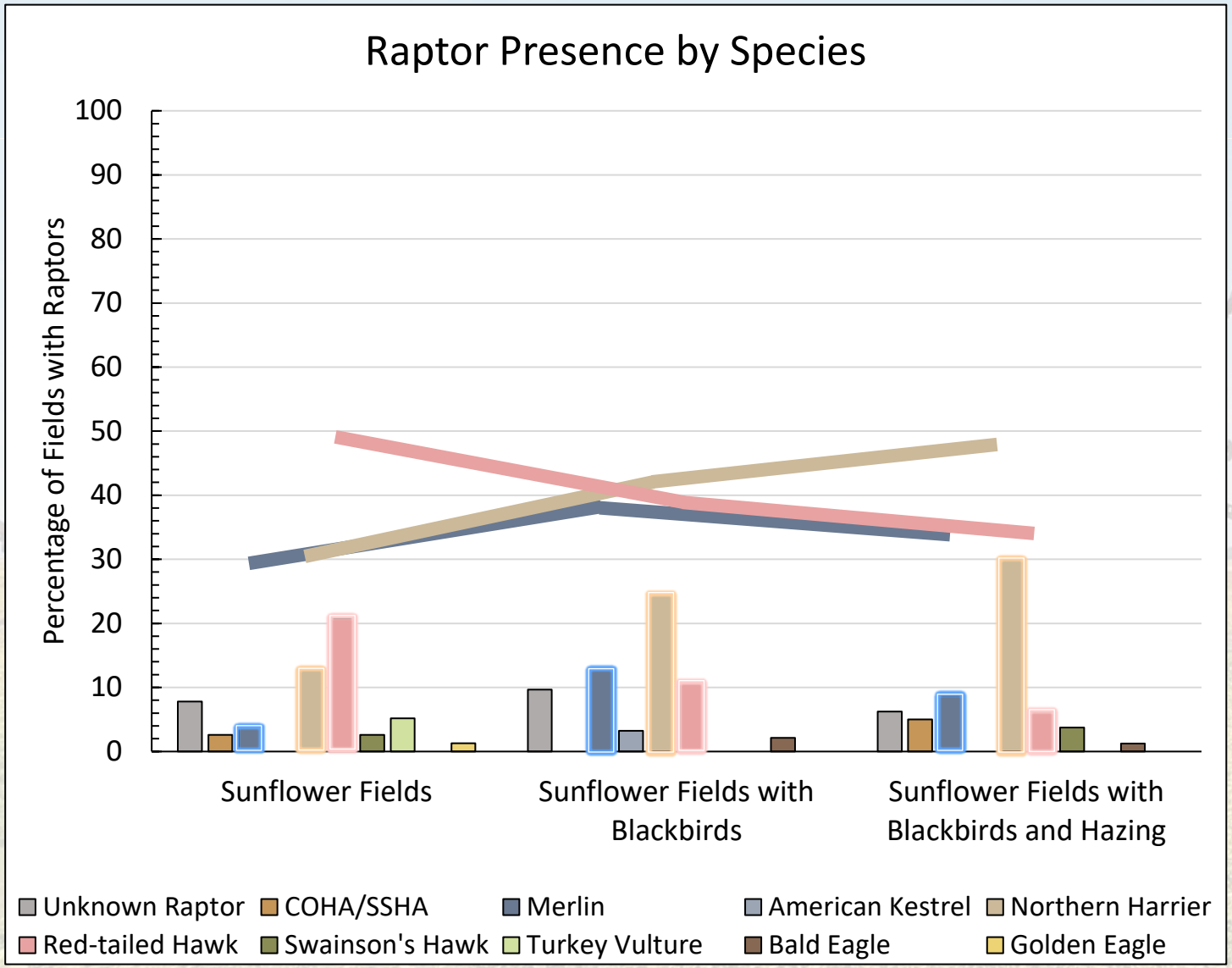
Raptors Seen

Raptors Seen

Raptor Presence

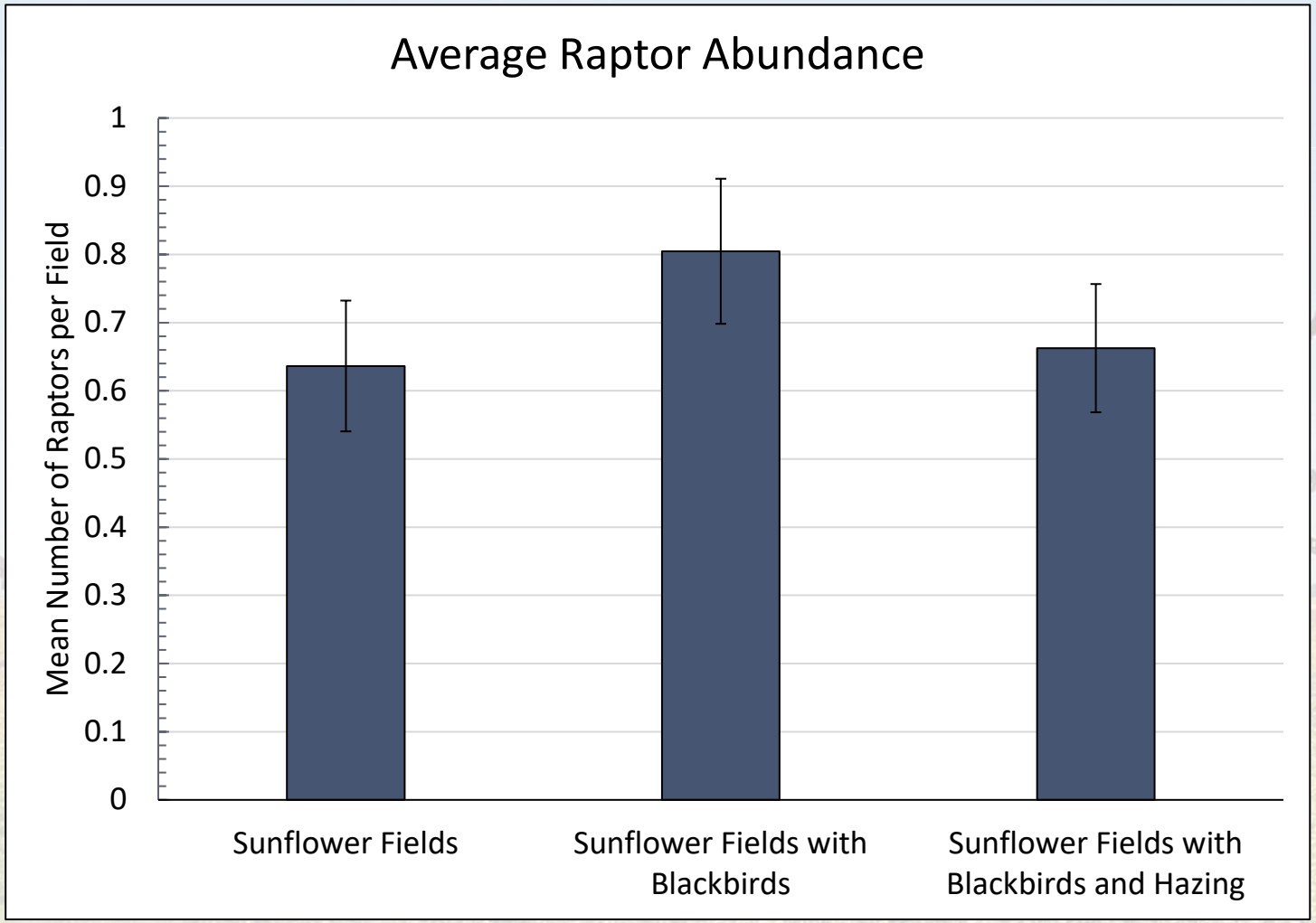


Raptor Presence

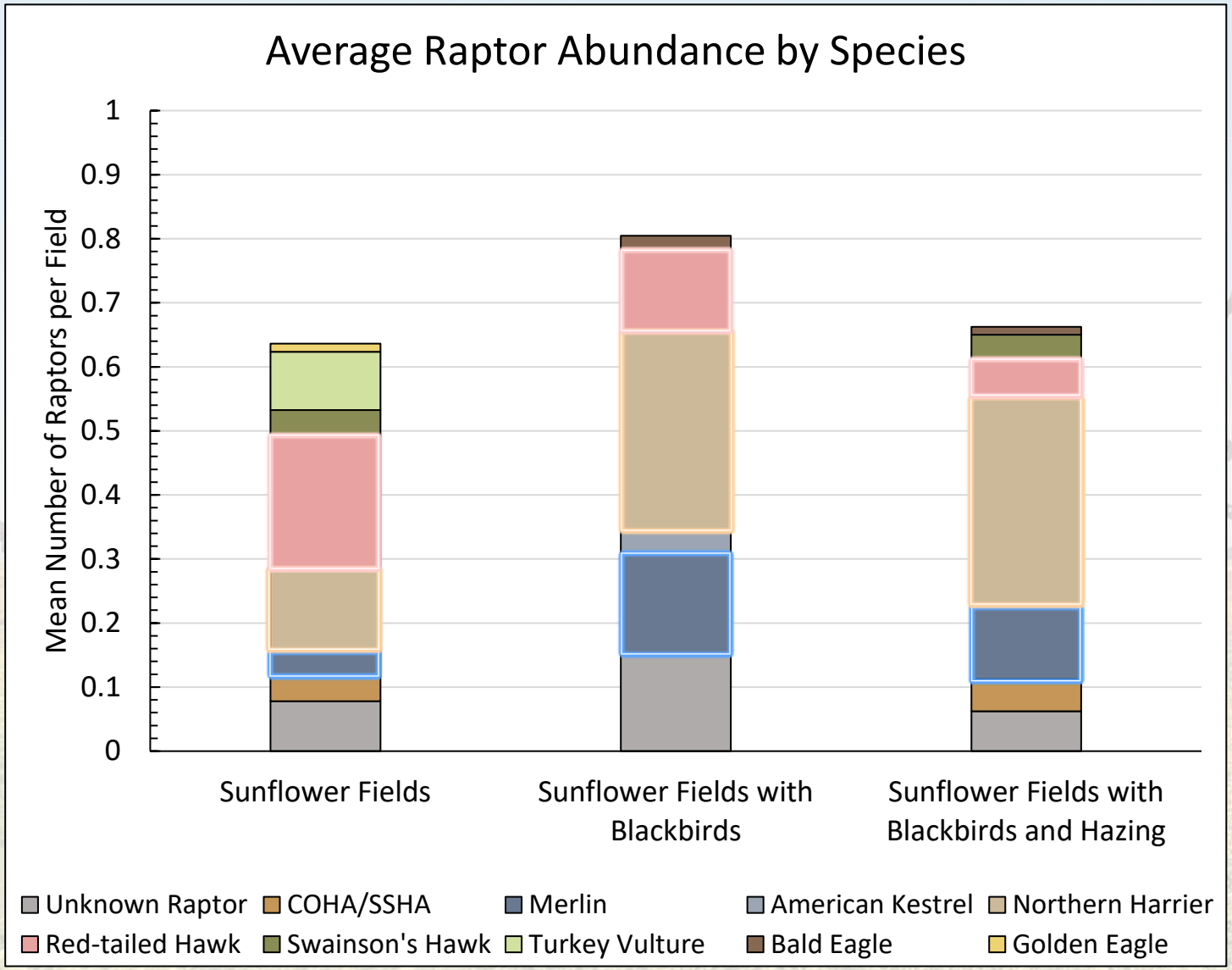


Unknown Raptor	7.79	9.67	6.25
COHA/SSHA	2.60	0	5
Merlin	3.90	12.90	8.75
American Kestrel	0	3.23	0
Northern Harrier	12.99	24.73	30.00
Red-tailed Hawk	20.78	10.75	6.25
Swainson’s Hawk	2.60	0	3.75
Turkey Vulture	5.19	0	0
Bald Eagle	0	2.15	1.25
Golden Eagle	1.30	0	0

Raptors Abundance



Raptors Abundance



Unknown Raptor	0.08 ± 0.03	0.15 ± 0.06	0.06 ± 0.03
COHA/SSHA	0.04 ± 0.03	0 ± 0	0.04 ± 0.02
Merlin	0.04 ± 0.02	0.16 ± 0.04	0.11 ± 0.05
American Kestrel	0 ± 0	0.03 ± 0.02	0 ± 0
Northern Harrier	0.13 ± 0.04	0.31 ± 0.06	0.33 ± 0.06
Red-tailed Hawk	0.21 ± 0.05	0.13 ± 0.05	0.06 ± 0.03
Swainson's Hawk	0.04 ± 0.03	0 ± 0	0.04 ± 0.02
Turkey Vulture	0.09 ± 0.06	0 ± 0	0 ± 0
Bald Eagle	0 ± 0	0.02 ± 0.02	0.01 ± 0.01
Golden Eagle	0.01 ± 0.01	0 ± 0	0 ± 0

Take-aways

- If a blackbird is going to respond to hazing, it is likely to do so within the first 10 minutes of hazing.
  - 57% of abandoning flocks left within 10 minutes
  - 47 % of individual birds left flocks within 10 minutes for flocks that decreased in size, comparable to what has been found in the past with different drone models and hazing situations
- Blackbird flocks that return after abandonment are likely to leave the field again
  - More time spent in the air and not eating
- Northern Harriers and Merlins appear to be attracted to sunflower fields with blackbirds
- Northern Harriers do not appear to mind the presence of drones

Future Directions

- Analyze how blackbirds respond to the presence of raptors during drone hazing

- 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

Thank you, questions?

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