Spraying Drones: Efficacy of applying an avian repellent to elicit blackbird flock dispersion in commercial sunflower fields.

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Background

- Birds cause >$4.7 billion annually in sunflower damage [1].
- In 2020, >1.6 million ac of sunflower were harvested in the United States – ND = 43% [2].
- Current **damage management tools drawbacks**: 1) immobility 2) lack of negative stimulus, and 3) cost or labor.
- Current avian **repellent application limitations**: 1) cost, 2) concentrations and 3) application rates [3].
- **Spraying drones** have the potential to be a **powerful in IPM and a precision ag solution** to overcome these limitations.
- **Methyl anthranilate (MA)** causes a **chemically-noxious stimuli response** when it encounters the bird's beak, nose, or eyes [4,5].

Objectives

Evaluate **efficacy of MA** at eliciting flock dispersal and **field abandonment** by blackbird actively foraging in sunflower fields.

Figure 1: We used a spraying drone (DJI Agras MG-1P) to apply avian repellent.

Methods

- Trials conducted in **sunflower fields** throughout ND from September to October.
- Each trial was **randomly assigned treatment** by alternating treatments (i.e., Trial 1 = control, Trial 2 = treatment, etc.)
- For the avian repellent trials, chemical was mixed and loaded at the **maximum concentration** stated on the product label. (1.2L Avian Control : 8.3L water)
- Regardless of treatment, a single trial was **8 minutes long**.
- The Agras sprayed continuously at **15 m AGL.**
- In the event of field abandonment, chemical was dispensed in even 'swath runs' in the area originally being damaged.
- Drone flight path characteristics were described (Airdata), flock locations were approximated, and field metrics were determined (Google Earth and ImageJ).

Results

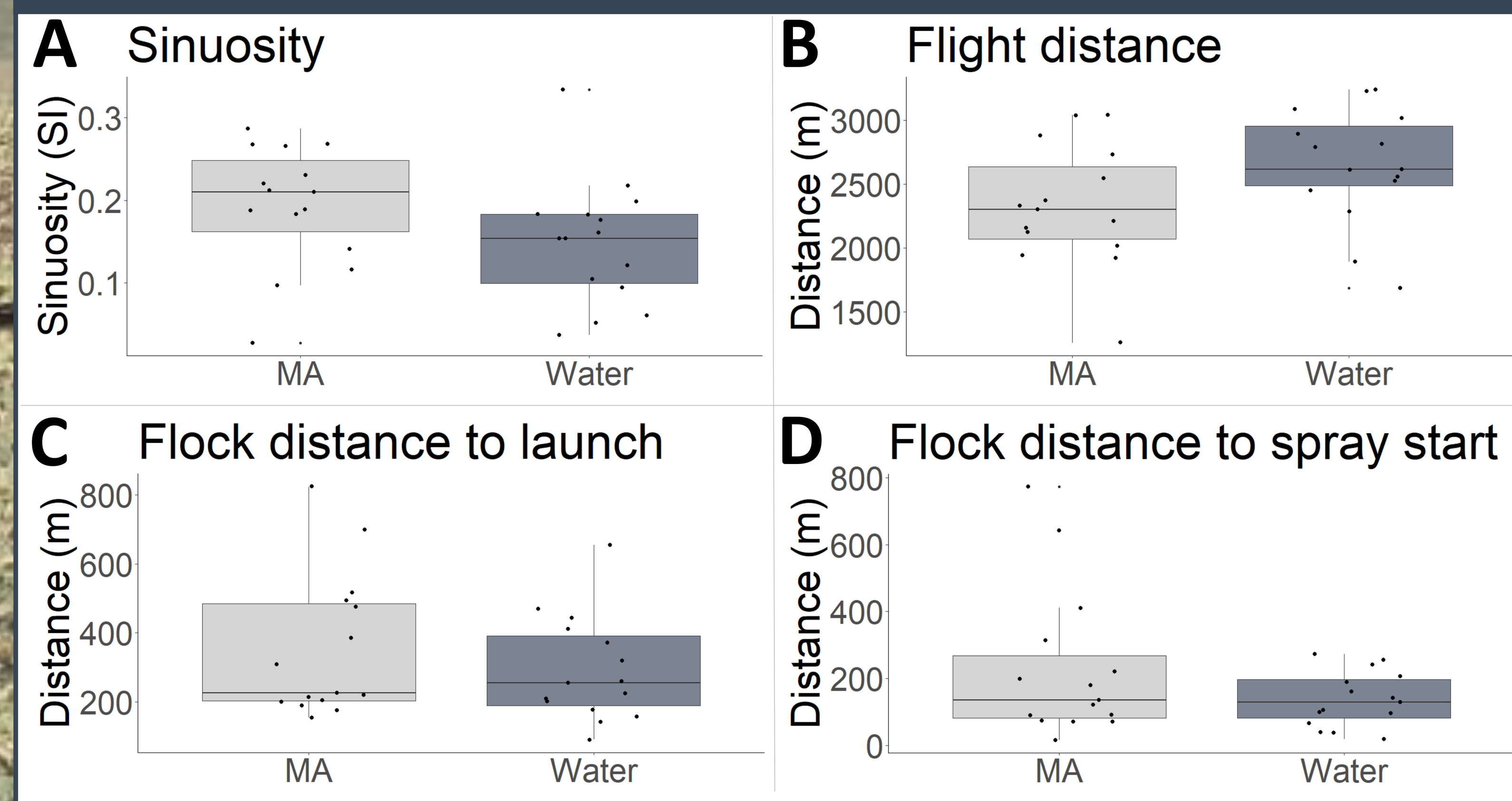

Figure 2: Drone metrics did not differ by treatment. A) Sinuosity, p=0.06, B) Flight distance (m), p=0.08 C) Flock distance to launch (m), p=0.37, and D) Flock distance to spray start (m), p=0.16.

Generalized Linear Model - Abandonment	AICc	ΔAICc	W_i
Avg. wind speed (+)	37.55	0.00	0.21
Avg. wind speed (+) + Field size (-)	38.45	0.90	0.14
Avg. wind speed (+) + Flock size (-)	38.67	1.12	0.12
Avg. wind speed (+) + Ambient light (+)	39.05	1.49	0.10
Avg. wind speed (+) + Treatment (-)	39.62	2.07	0.08
Avg. wind speed (+) + Field size (-) + Flock size (-)	39.98	2.43	0.06
Avg. wind speed (+) + Field size (-) + Ambient light (+)	40.40	2.85	0.05
Avg. wind speed (+) + Flock size (-) + Ambient light (+)	40.57	3.01	0.05
Avg. wind speed (+) + Flock size (-) + Treatment (-)	40.87	3.32	0.04
Avg. wind speed (+) + Field size (-) + Treatment (-)	40.96	3.41	0.04
Avg. wind speed (+) + Ambient light (+) + Treatment (-)	41.21	3.66	0.03
Avg. wind speed (+) + Field size (-) + Flock size (-) + Ambient light (+)	42.36	4.81	0.02

Figure 3: AICc Model Selection Table. Direction of effect indicated by sign (+/-). Greyed out rows = models that exceed +2 units of ΔAICc.

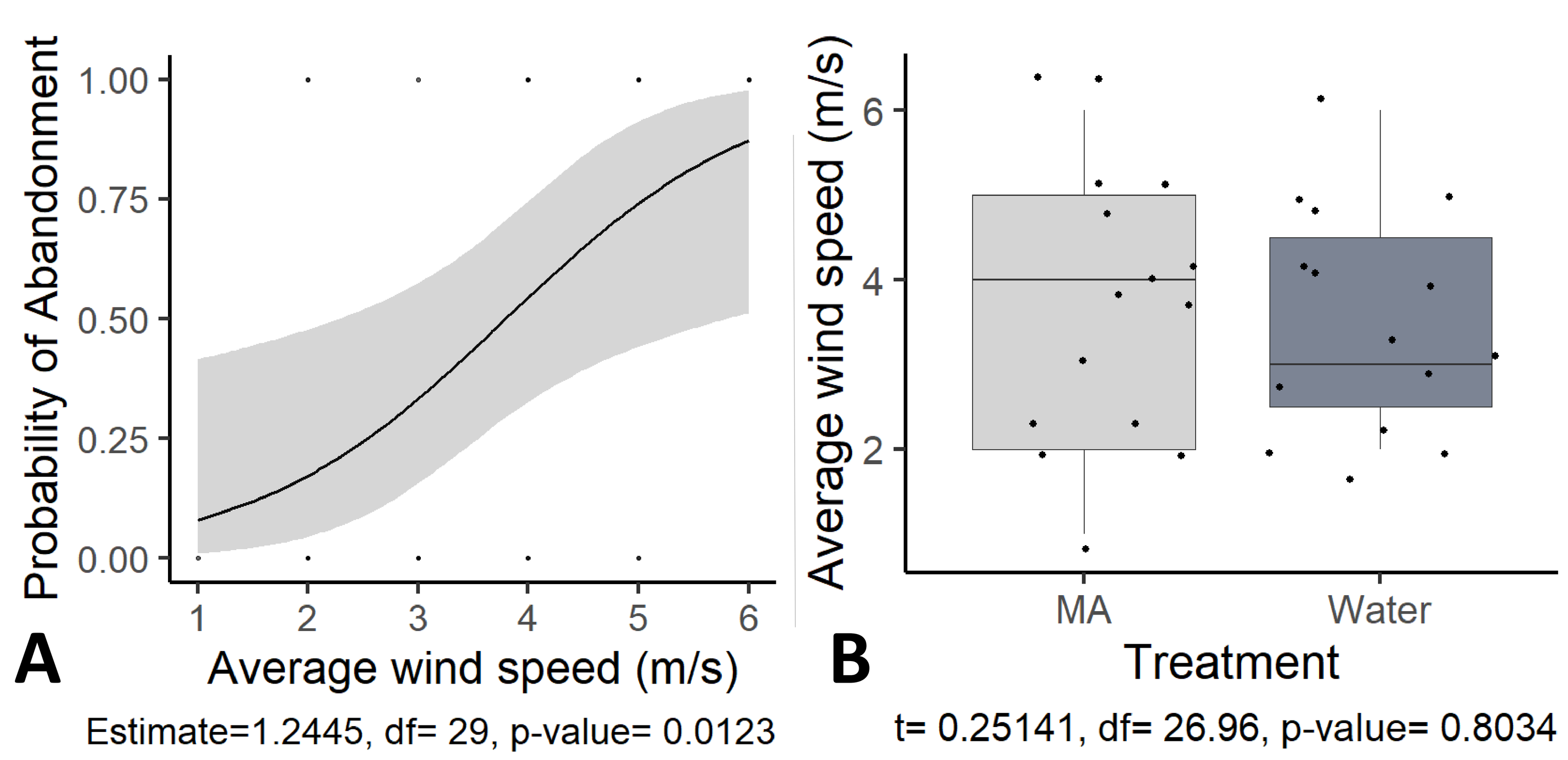

Figure 4: Importance of wind speed. A) Probability of field abandonment (entire blackbird flock) in response to the DJI Agras MG-1P spraying drone relative to variation in average wind speed. There were no other covariates in the model; shaded area represents 95% CI. B) Average wind speed in MA and water trials did not differ.

Summary

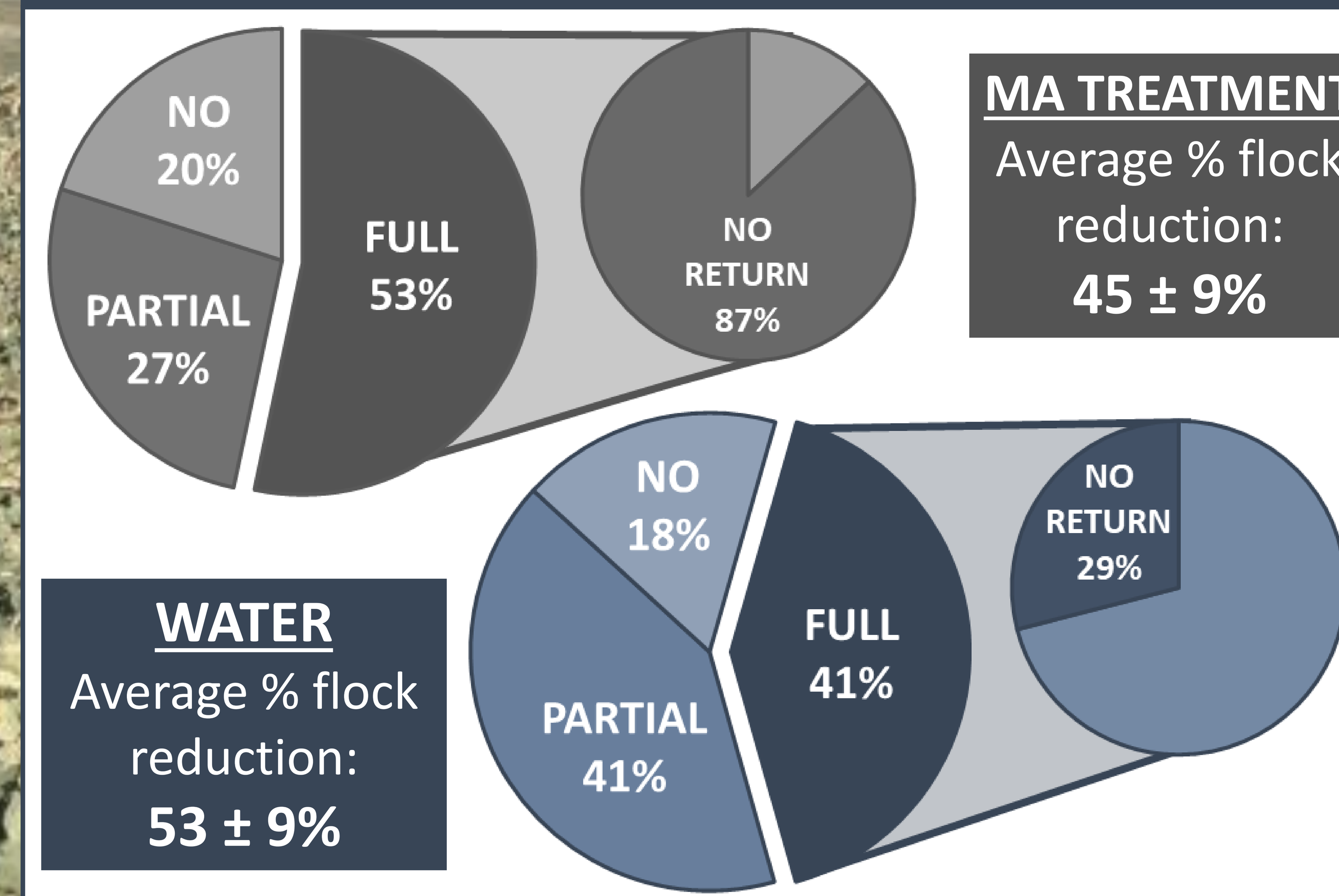

Figure 5: Percent field abandonment in the 32 trials (MA trials = 15 and water trials =17) conducted in the 2021 fall damage season along with the return rate after abandonment.

Field Size:	**Flock Size:**	**Area Sprayed:**
146 ± 16 ac	6167 ± 871 birds	0.99 ± 0.07 ac
Flock to edge:	**Flock to launch:**	**Flock to spray start:**
83.7 ± 15 m	321.9 ± 33 m	49.0 ± 2 m

Figure 6: A glimpse at measurements describing the trial scenarios. Means and standard errors shown.

Future Directions & Recommendations

Future Directions:

1) Evaluate variables influencing the change in antipredator behavior before and after drone hazing.
2) Evaluate flock composition and its influence on abandonment and antipredator behavior.

Recommendations:

- Application of avian repellent at higher wind speeds.
- Use early in the season on smaller flocks to prevent establishment of feeding areas.
- Extended periods of hazing (>8 min) or multiple drones for larger flocks (>10,000 birds)

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