Applications of a Motus Compatible Automated Radio-Telemetry Network For Birdstrike Management in and around Airfields

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What is Motus?

- Motus Wildlife Tracking System
- “International collaborative research network that uses cooperative automated radio telemetry to track small flying organisms”
- Program maintained by Birds Canada

Motus
Wildlife Tracking System

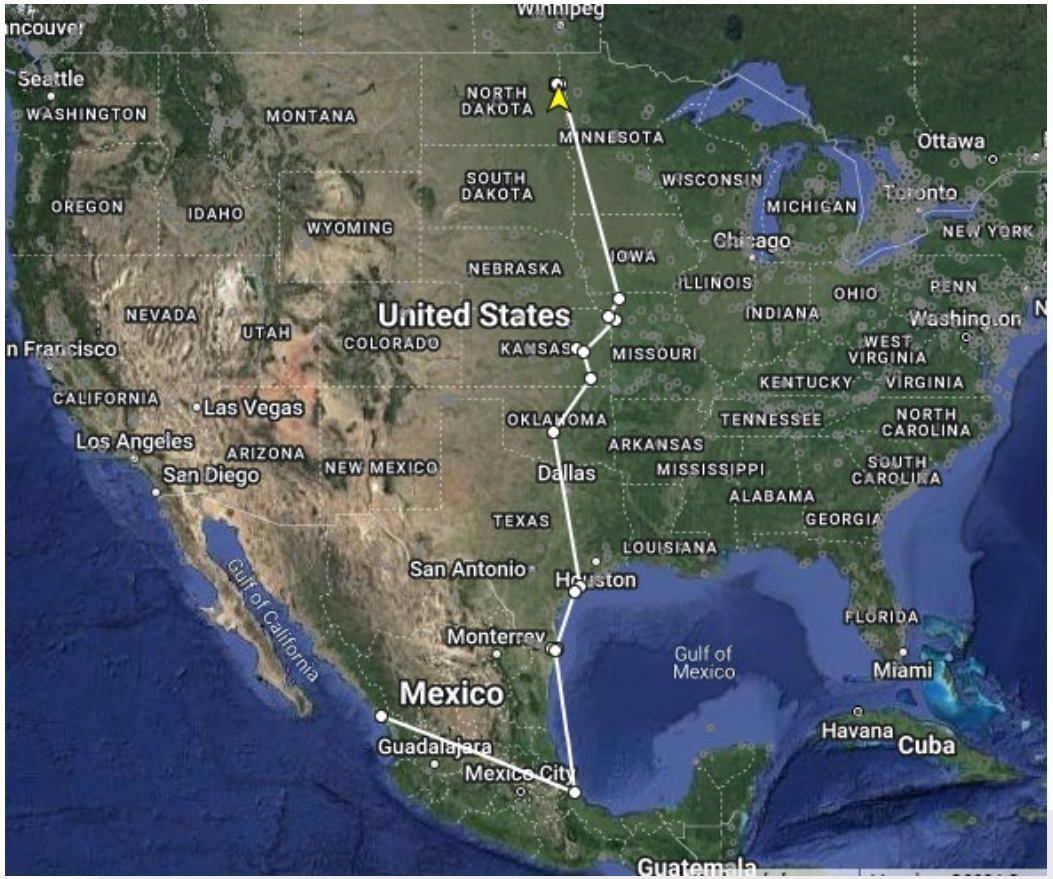
What is Motus?

- Tiny digitally-encoded tags
  - Small birds, insects, bats
  - Conservation focus

- Network of automated receiving stations (i.e., towers)
  - 2 frequencies (166 Mhz and 434 Mhz)

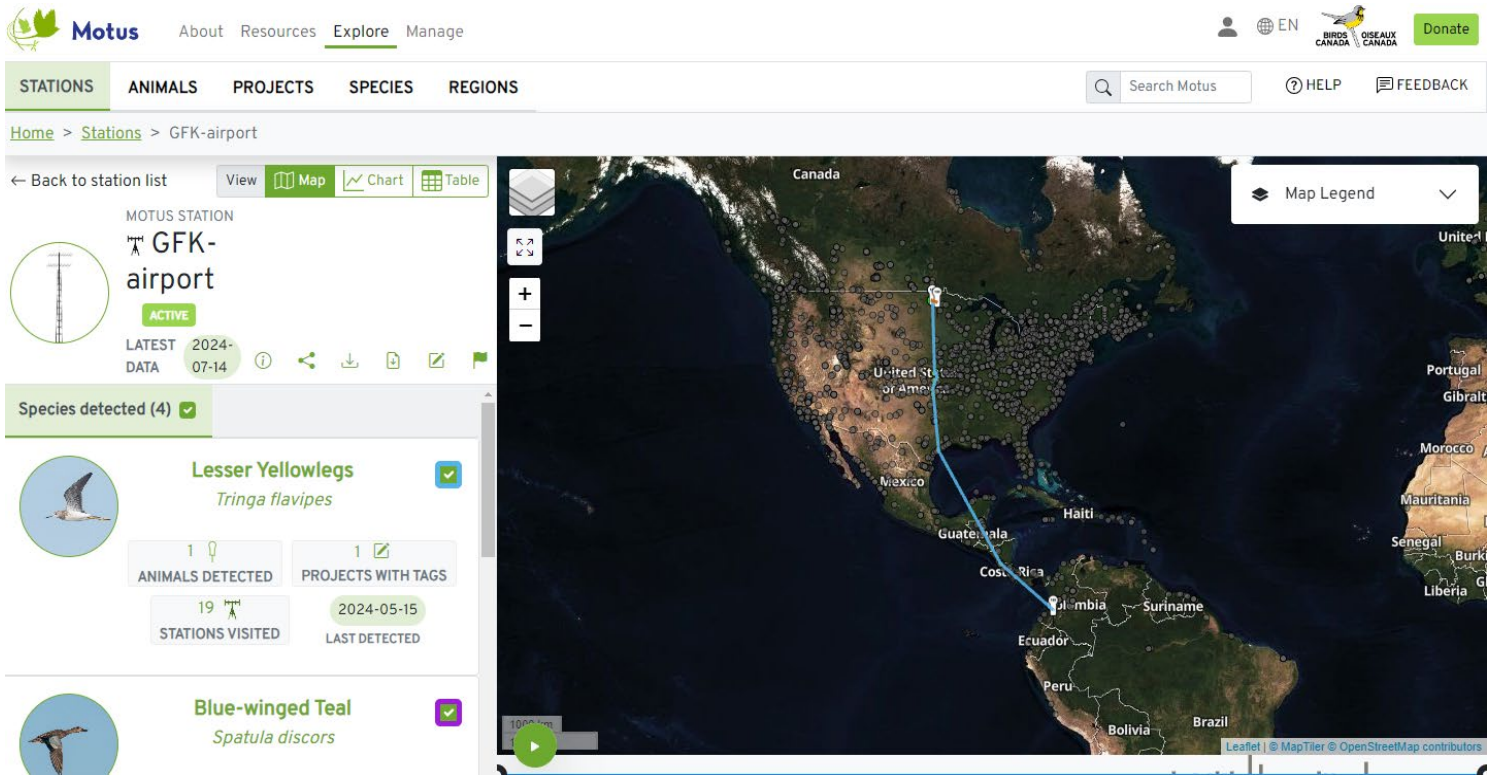
- Data shared (but can have an embargo)

- Primary goal: broad-scale detection of migratory movements



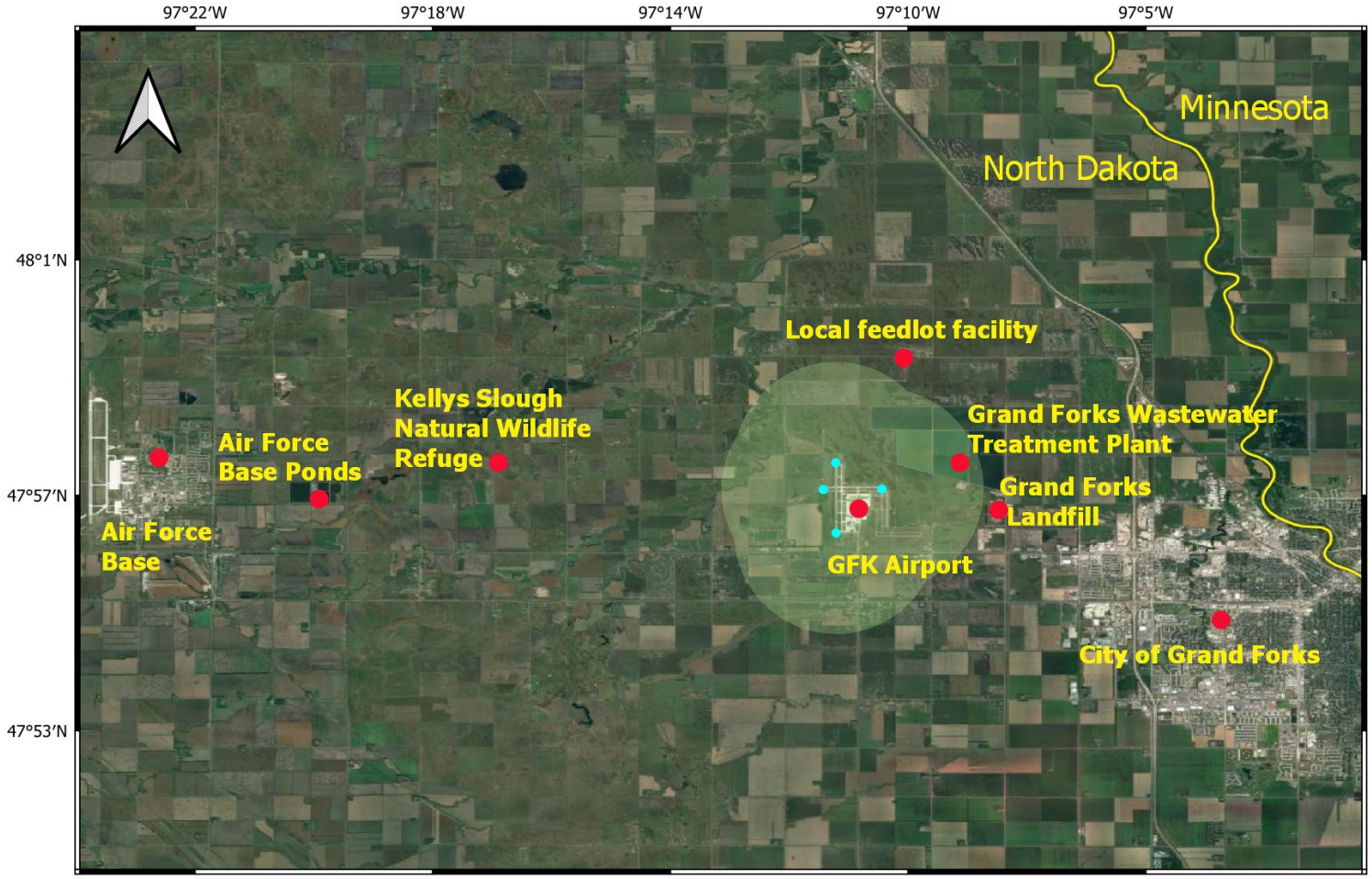
What Motus can do?

- General detections of animals
- Describe migratory timing, speed, stopover, wintering areas, and site fidelity
- Describe patterns of dispersal
- Act as a mark-recapture network to eventually obtain survival rates



Grand Forks Airfields Complex landscape

- Lots of attractants for birds surround airport
- Collaborative effort
- Facilitate use of UAS in airport context
- Expands on GFAFB and City of GF bird strike research



Motus Motivation: Bird Strike Risk & Monitoring

- Bird strikes with aircraft and bird inventory (Susan's start!)
  - Grand Forks Air Force Base (funded by the Natural Resources, GFAFB)

- Understand movement around airfield (GF Air Force Base)
  - Time spent/detections by birds tagged on surrounding conservation areas between on and off base areas and high-risk areas (north and south of runway at Air Base)

Motus Motivation:
Bird Response to UAS in a Flight Route

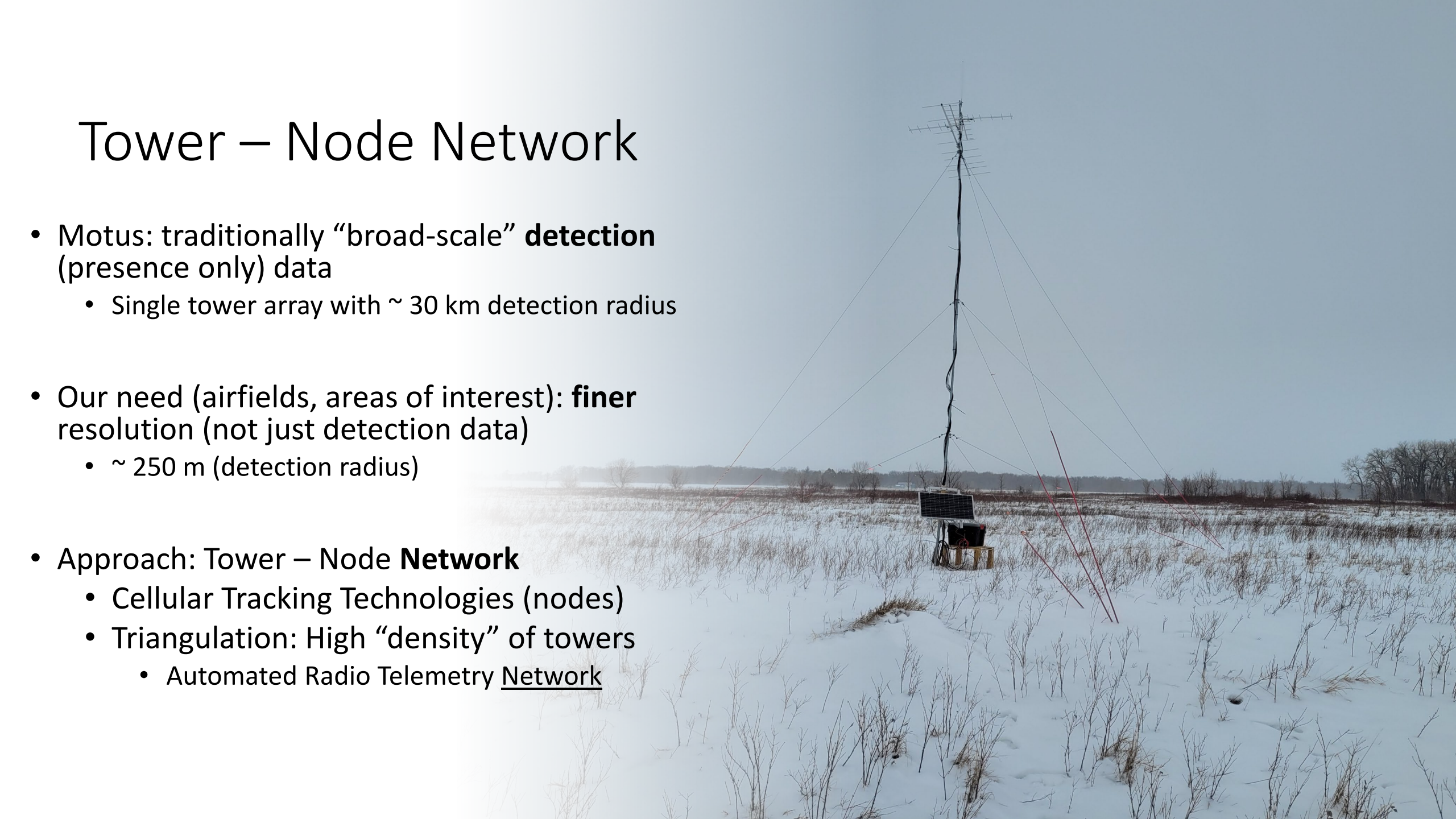
- Evaluate management specifically at GF Wastewater Treatment Plant
  - Do the birds leave in response to management (UAS hazing)?
    - If return, how long does it take?
  - Do they end up in other areas (GFK airfield, GFAFB, Refuge)?

Tower – Node Network

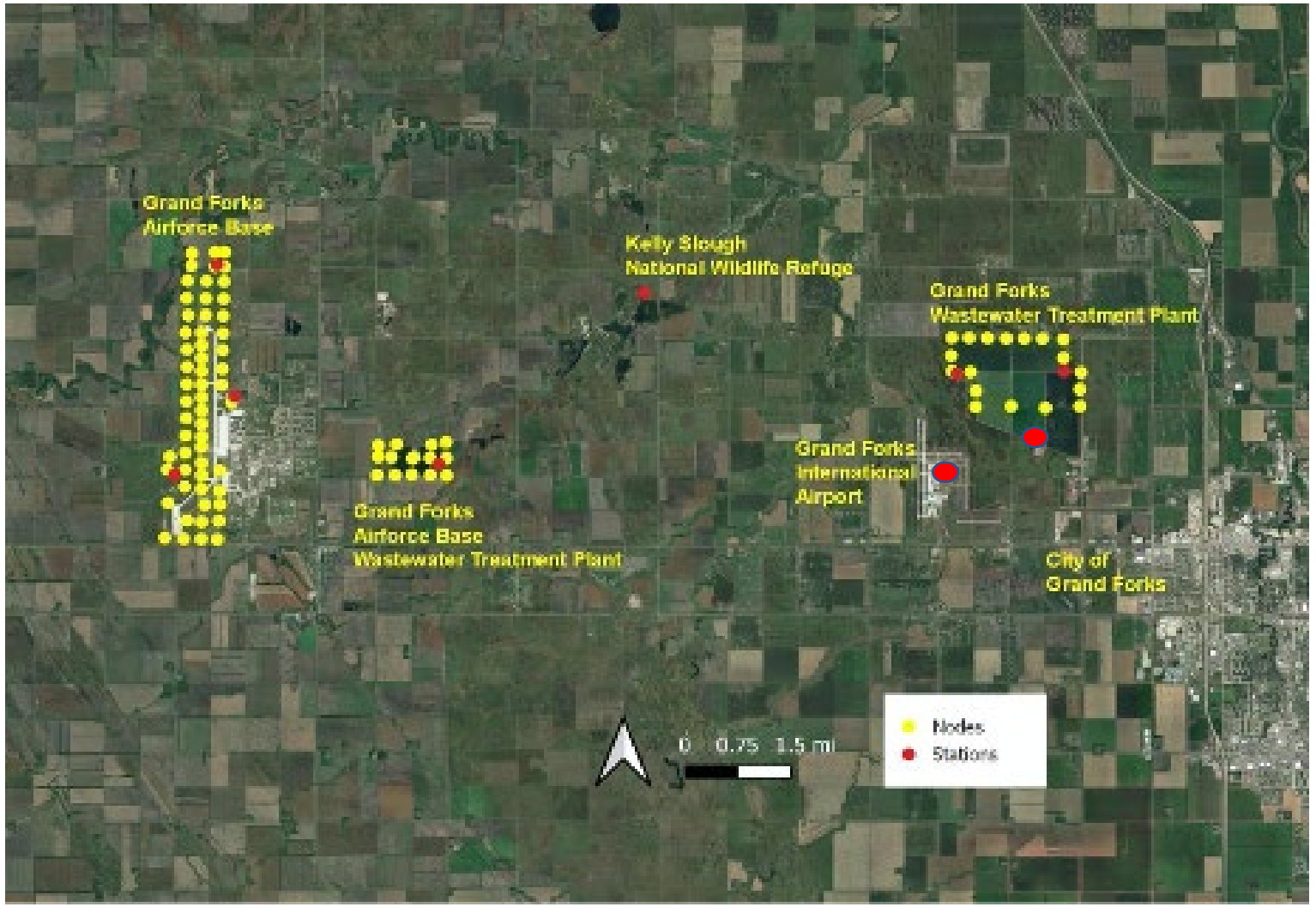
- Motus: traditionally “broad-scale” **detection** (presence only) data
  - Single tower array with ~ 30 km detection radius

- Our need (airfields, areas of interest): **finer** resolution (not just detection data)
  - ~ 250 m (detection radius)

- Approach: Tower – Node **Network**
  - Cellular Tracking Technologies (nodes)
  - Triangulation: High “density” of towers
    - Automated Radio Telemetry Network



Node (finer resolution) – Tower (coarse/fine?) network



Establishing a Motus Tower/Network

- **Motus tower ≠ off-shelf box of supplies**
  - Individually setup for objectives!
  - Buy parts and assemble!

Tower configuration

- 1: omni direction antenna (nodes; 434 MHz; CTT)
  - Tower needs to be within 1.5 km of all nodes
  - 20-25 nodes/tower
- 4: 6-element yagi antennas (434 MHz; CTT)
  - All cardinal directions
  - Our tags are all CTT
- 1: 9-element yagi antenna (166 MHz; Lotek)
  - Use larger tower network to assign direction

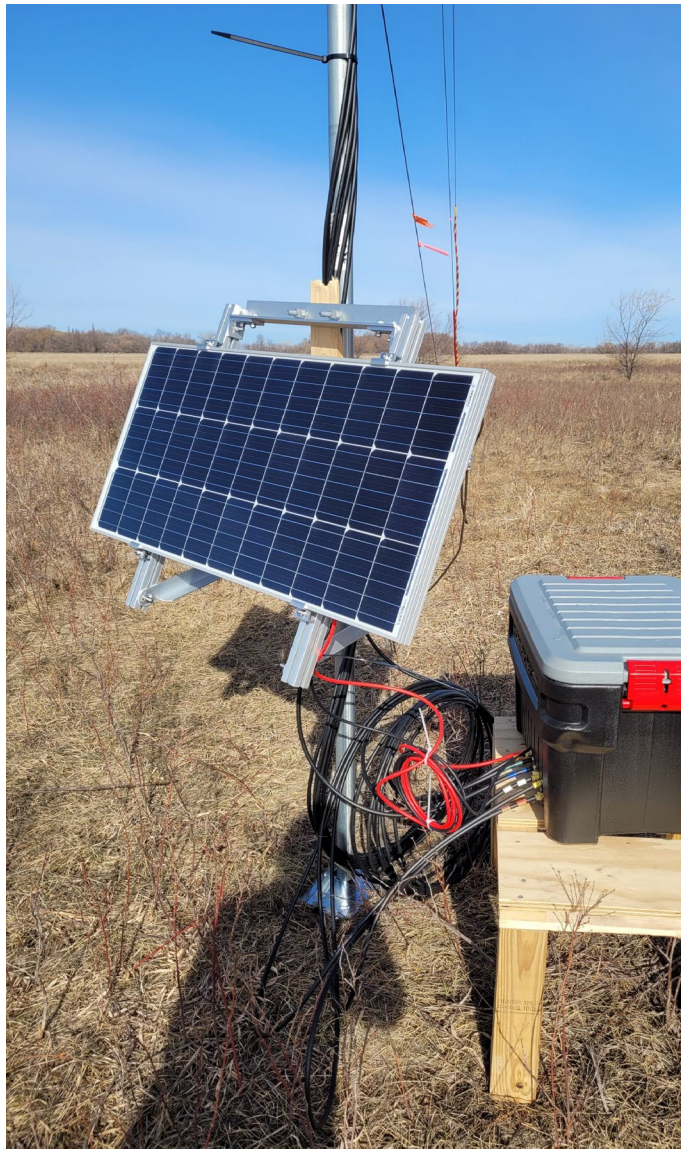
Tower set-ups

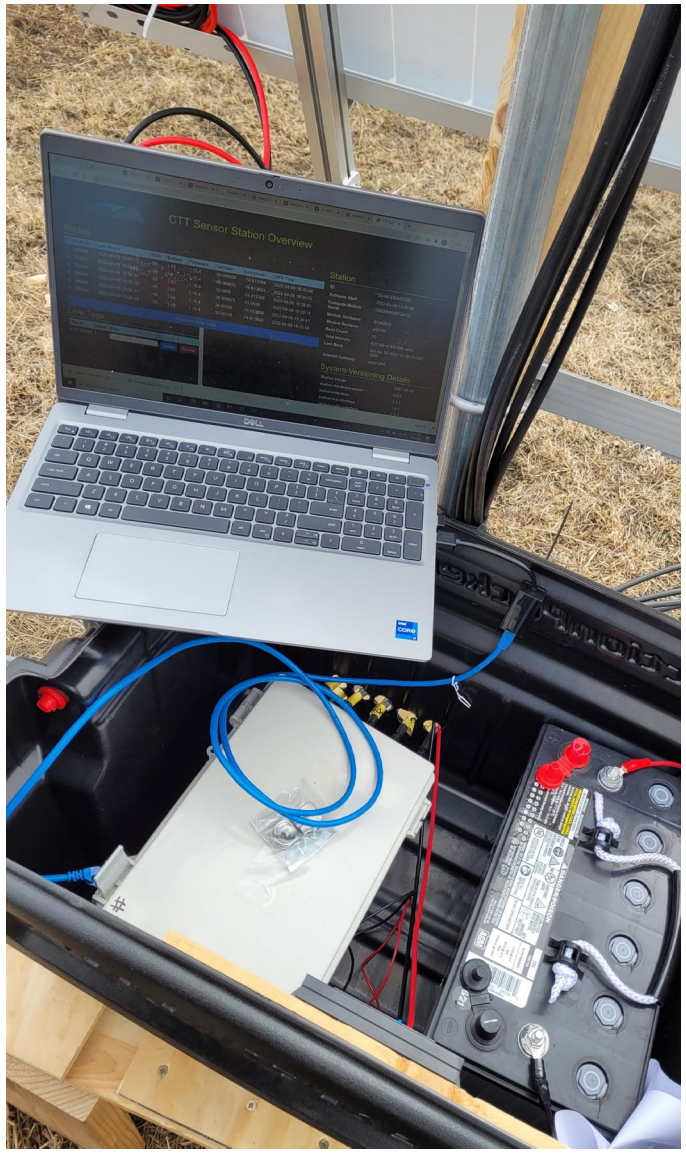
- CTT Sensornome (Action-packer)

- Solar-powered (primarily)
  - 2023: GFK Operations Building

Tower

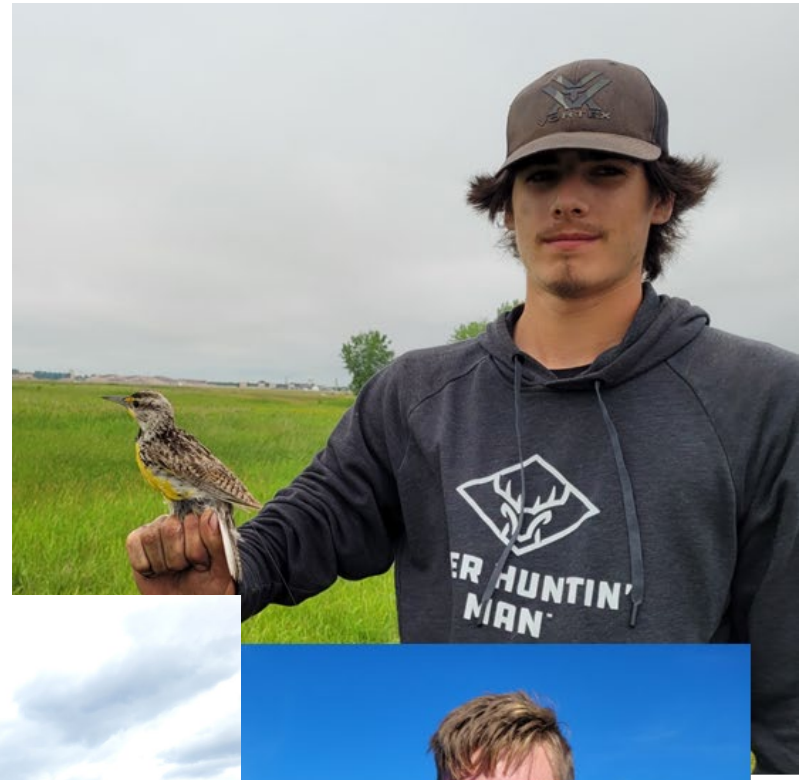
- 30 ft Rohn telescoping towers
- 9 guy wires
- Anchors vary
  - Ranging from rocks to very wet conditions





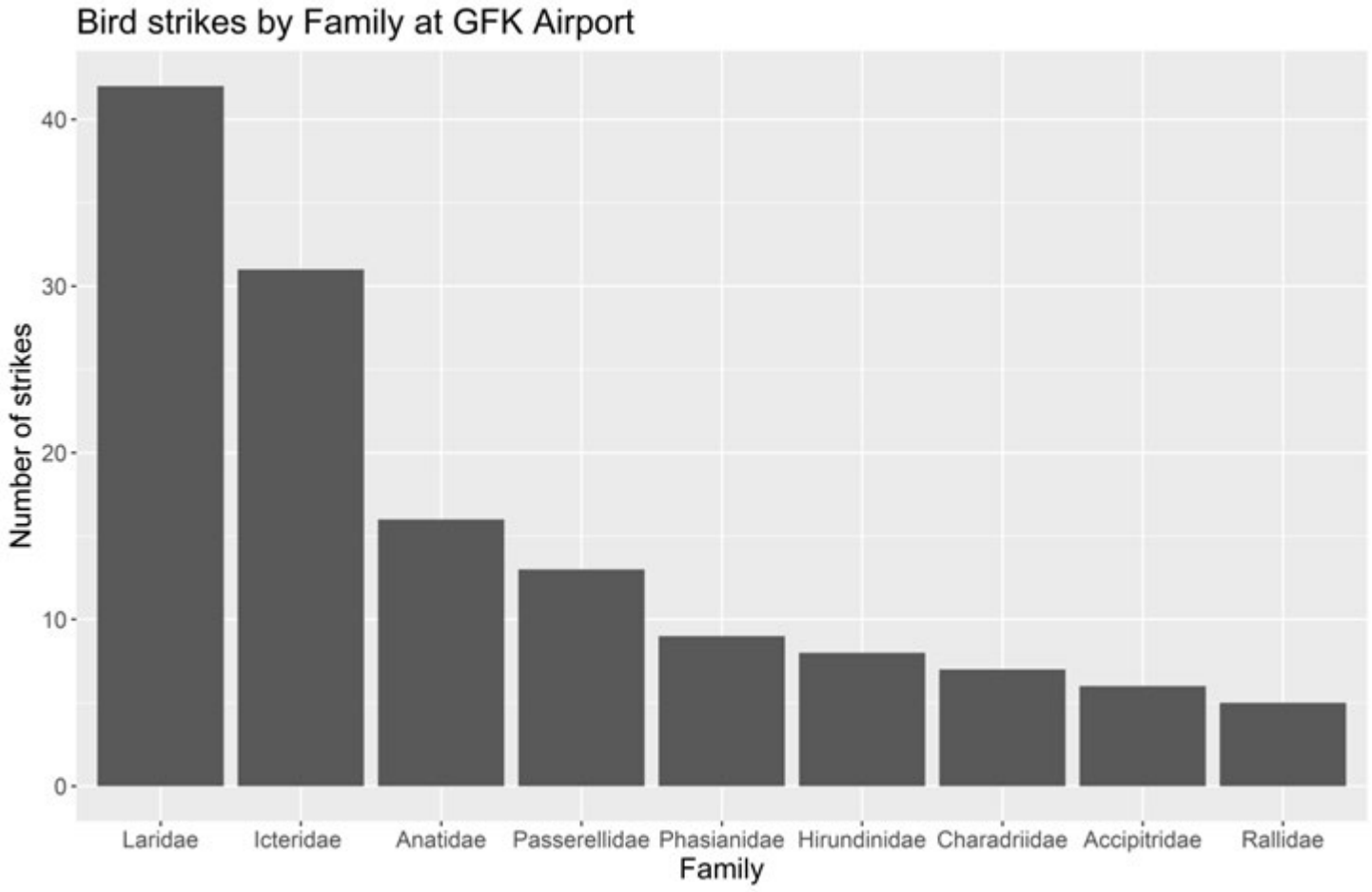
Tagging the Birds

- **GFAFB** interested in bird movement around the airfield and smaller birds can pose a larger risk
  - UAS – based mission
  - FAA strike database
    - Gulls, ducks, and Icteridae spp. (Blackbirds and Meadowlarks were most common strikes)
    - Gulls less of an issue at GFAFB



Tagging the Birds – UAS Hazing

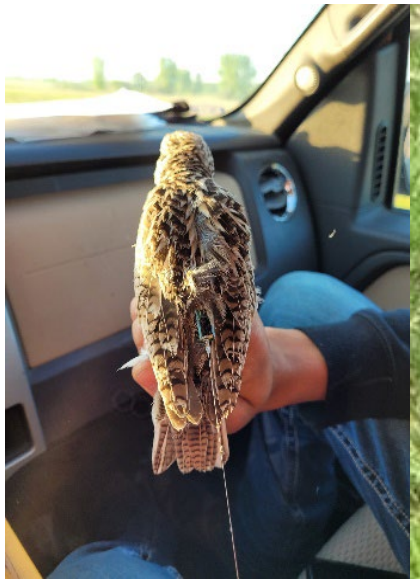
- **GFK and Wastewater** treatment plant
  - Gulls
  - Ducks
  - FAA strike database
    - Gulls, ducks, and Icteridae spp. (Blackbirds and Meadowlarks were most common strikes)
    - High hazard scores –> gulls, ducks



Tagging

- CTT Life Tags (2022; require sun to be “on”)
- CTT Hybrid Tags (2023-2024; battery)
  - Created to lift tags up so solar panels exposed to light and not buried in feathers

Standard tags



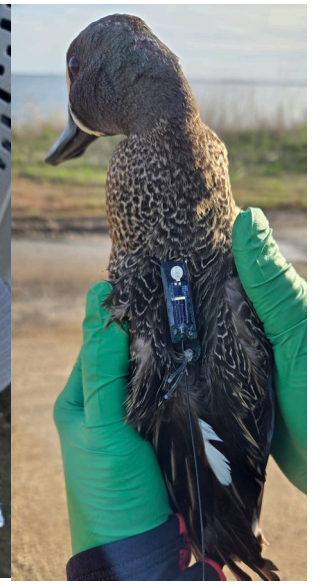
Western Meadowlark (LifeTag) 0.5 g

Red-winged Blackbird (LifeTag) 0.5 g

Mallard (LifeTag) ~2 – 3 g

Mallard (LifeTag) ~7g

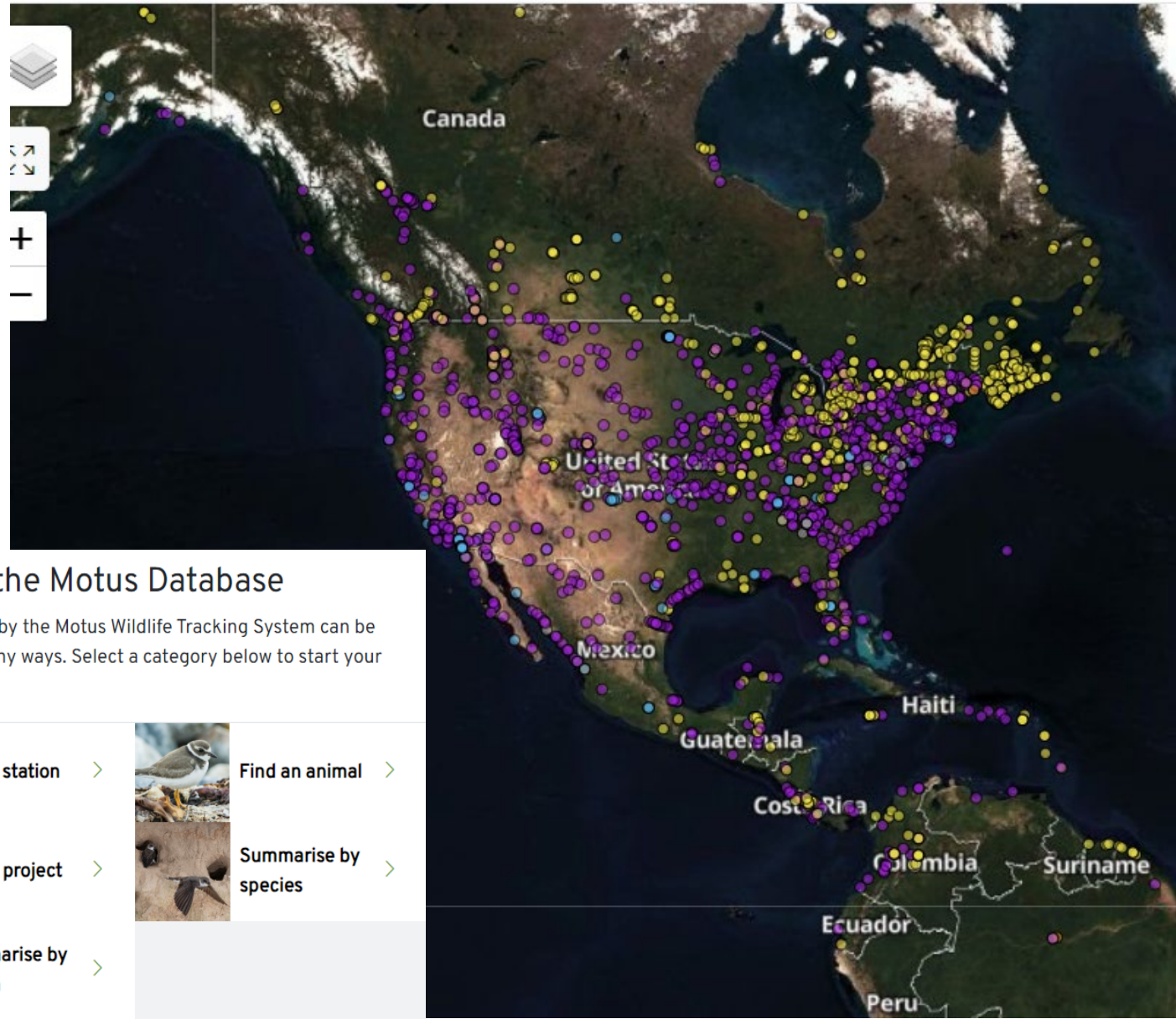
Franklin's Gull (Hybrid Tag) ~3-4 g



Blue-winged Teal (Hybrid Tag) ~3-4 g

Why Motus-compatible tags?

- Cost:
  - Tags ~$250/each
  - GPS: $1500+
- Receiving Tower:
  - Data sharing
    - Other tagged birds
    - Other tower detections
- Size: small tags, minimal impact
- **Infrastructure and Interest**: Conservation efforts → Bird strike application



Obstacles and Lessons Learned

Installations

Never AGAIN!

Scaffolding worth every penny!

Lessons Learned

- Do solar panel last or keep covered
- If a problem arises, don’t leave solar panel exposed/ connected to anything
    - Ruin the charge controller or your equipment!

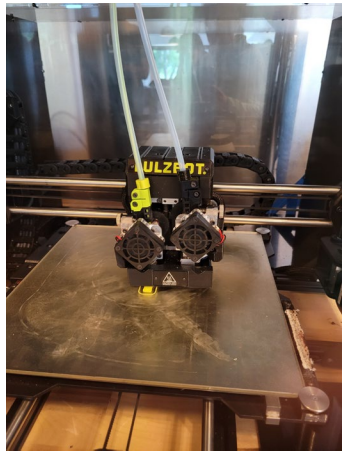
Lessons Learned - Towers

- **Lessons**
  - Be flexible/adaptive
  - Most specific projects require “customization” – understand from onset
  - No set cost (need to know specifics of your tower)
  - No off-the-shelf option
  - Data Integrity: Interference
    - Military applications – might not be aware/informed, hard to plan
  - Added expenses (tag registration, data fees!)

- **Must have:**
  - Good crew (extra hands – depending on setup)
  - Plan in place but open to adjustments
  - Equipment positioned
  - Some level of mechanical and electrical background

Tags

- If you are the first to deploy on a species/ species guild, you are beta testing!
  - Expect failures
  - Be ready to do some level of design
    - Learned to 3D print (or find collaborator)
    - Budget for creativity
  - Take lots of pictures



Small Tag

Large Tag

- Antennas fell off = almost 0 data
- Unnecessarily large --> high mortality?
- Problems with feather wear

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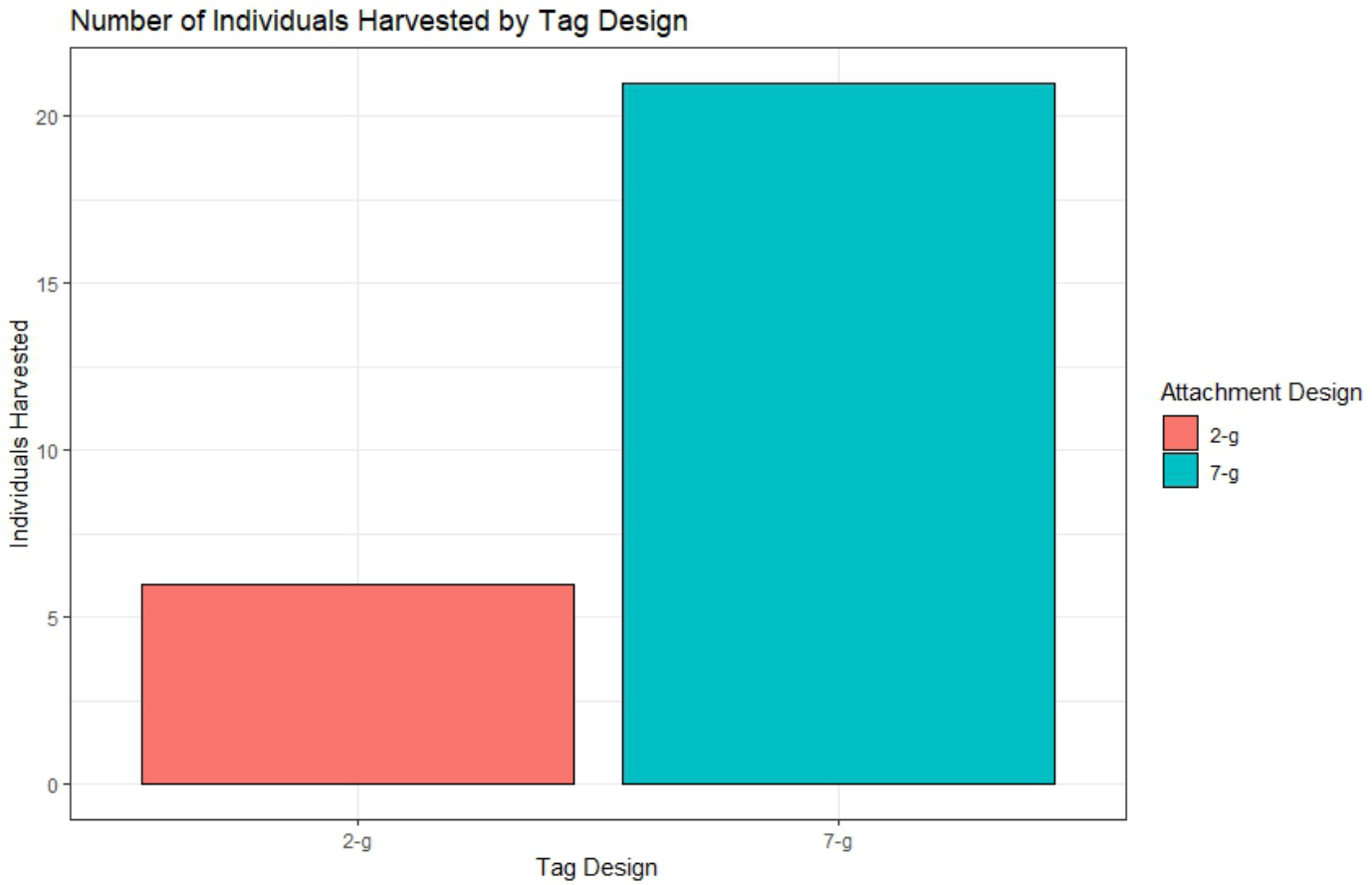
Hunter Harvests of Tagged Birds

26% of individuals equipped with the **smaller tags** were **harvested** as of February 2024.

43% of individuals with the **larger tags** were **harvested**.



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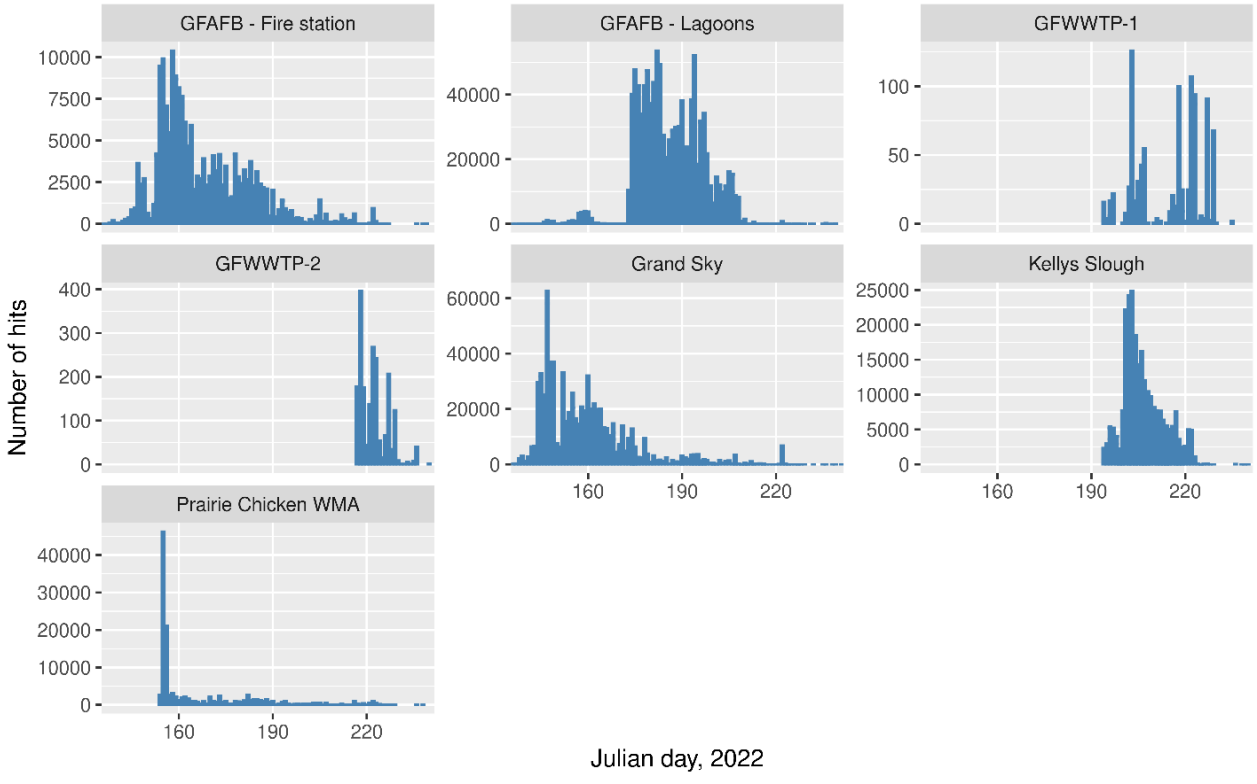
Node Network

- Extremely appealing and have great potential but…

- Frustrating
  - **Require calibration (node-level variability)**
  - Require maintenance (birds perch, birds poop) = problematic for solar power, bird strikes!
  - Require charging before deployment or if they get too low
  - Poles on runways are a “no-go” → use signs (lose height)

- Creativity
  - Install nodes on airfield signs, bird exclusion devices

Node Network – Data Deluge



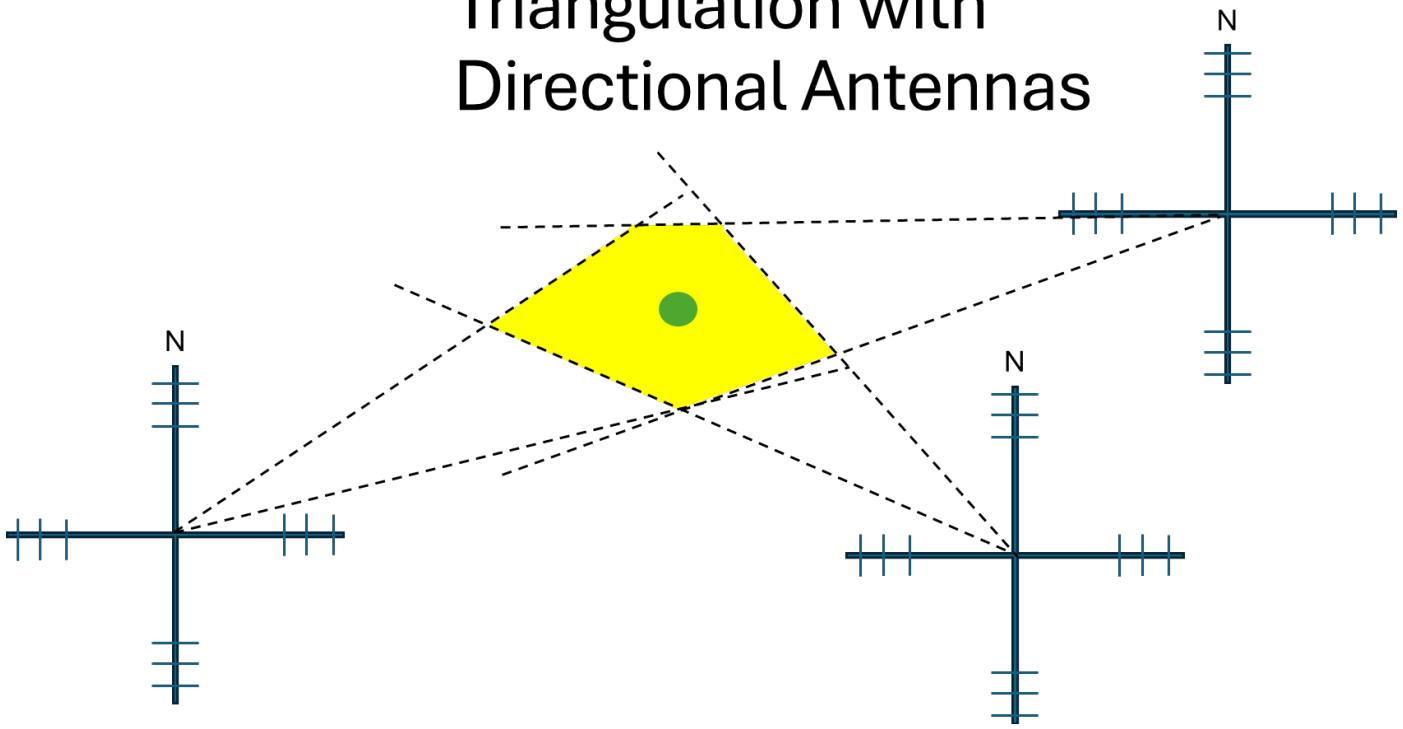
Number of **detections** for Red-winged Blackbirds between May 10th (Julian day 130) and November 22nd (Julian day 326) across the stations. Note: detections include nodes associated to the corresponding stations potentially resulting in overrepresentation of detections.

Take Away:

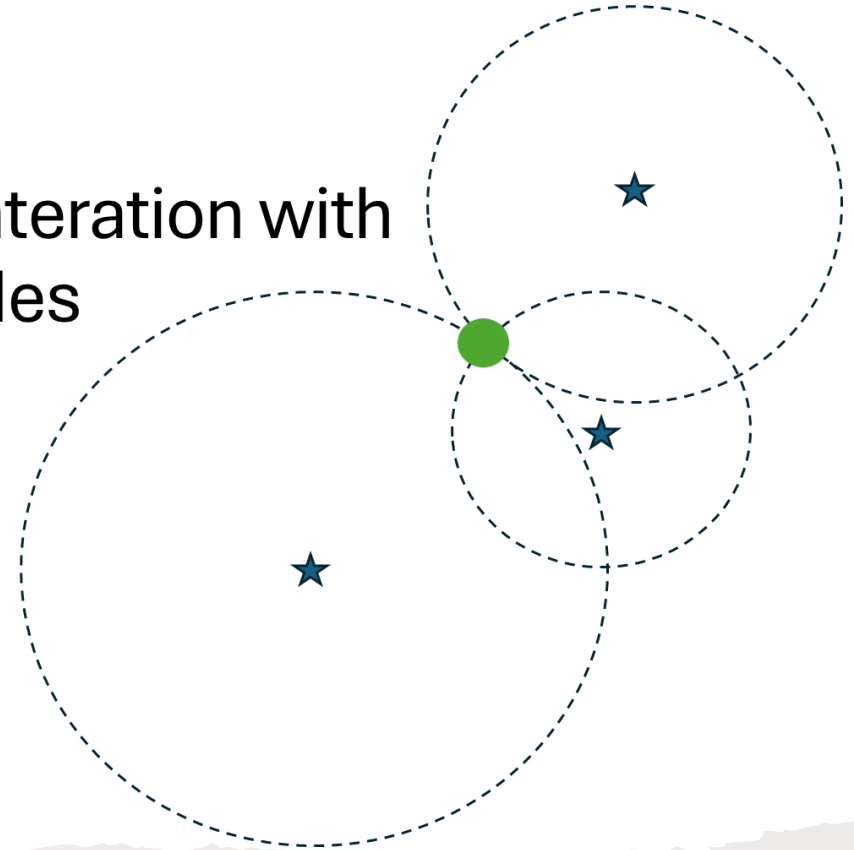
- Data Deluge
  - Adds $$
- Download extensive
- Complex
- Data analysis intensive
- Postdoc/Analyst!

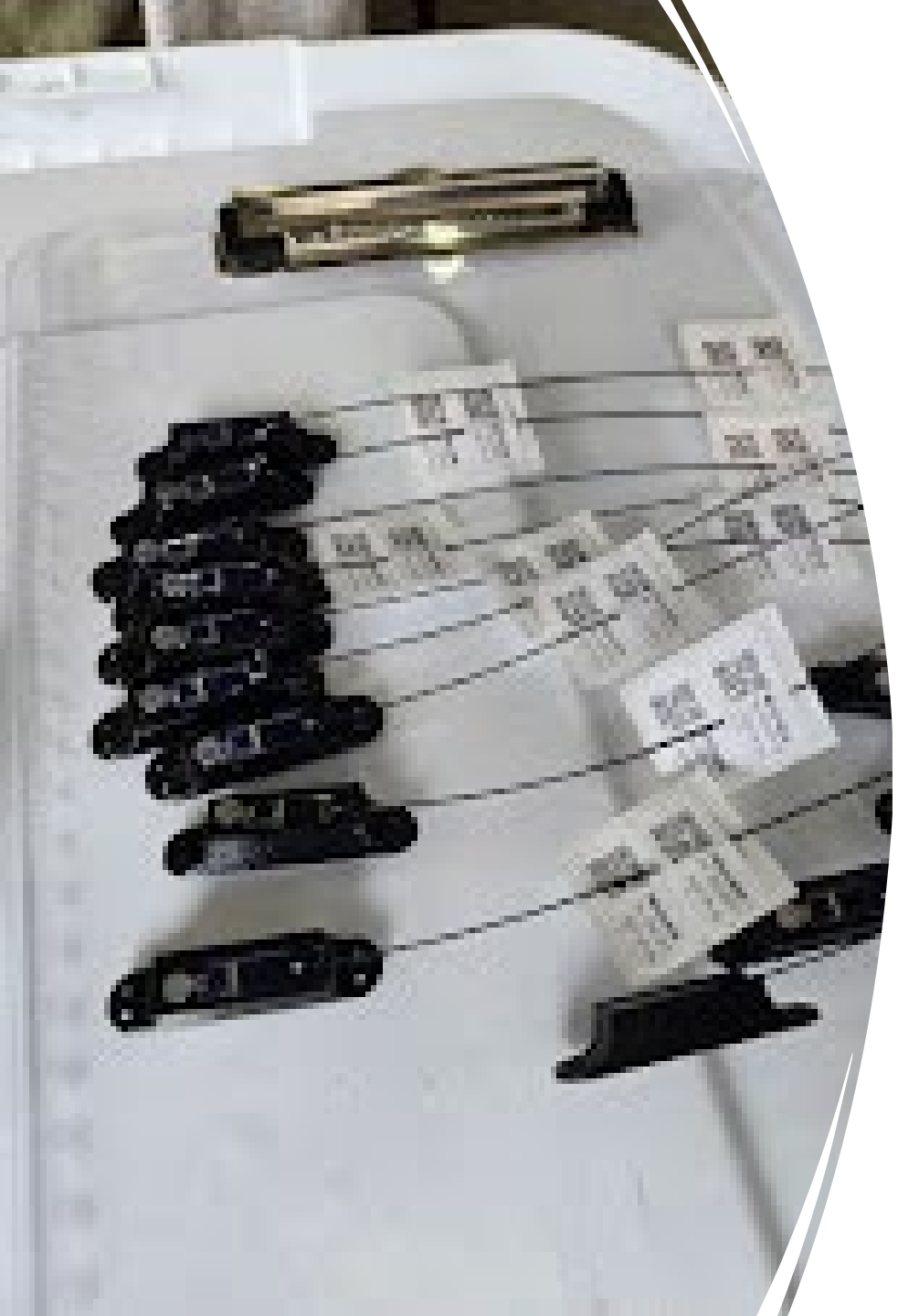
Calibration Effort - what resolution is possible?

Triangulation with Directional Antennas



Trilateration with Nodes





Parting Thought…

- Motus use requires careful consideration of **objectives**!
  - Standard approach ≠ Applications to Bird Strike beyond phenology/ general detections
  - Seek guidance from others!

Acknowledgements

- UND Team: Jake Knutsen, Hunter Beckert, Levin Brandt, Taylor Linder, Brody Salander, Mackenzie Prichard, Lawson Frey
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Questions

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