Assessing the detectability rate of Motus towers using UAS

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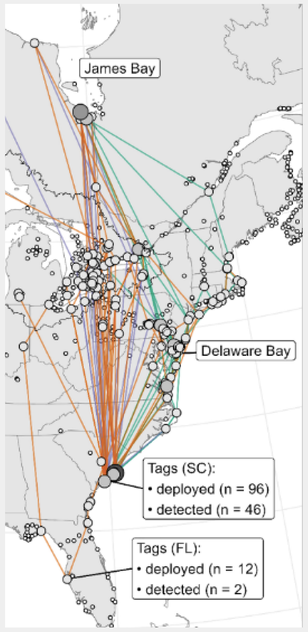
Introduction

- The Motus Wildlife Tracking System is a global network of 1,800 radio telemetry stations that track the movements of flying migratory animals that are fitted with small radio tags that emit high frequency radio waves
- The system uses tags made by the brands LoTek and CTT, which emit 166.380 MHz and 434 MHz
- The signals and data from the tags are picked up by antennas on towers, recorded and stored into a central database including time, location and signal strength
- Motus data has been used to research migration patterns of birds, bats and butterflies, which all have different patterns, altitudes and speeds



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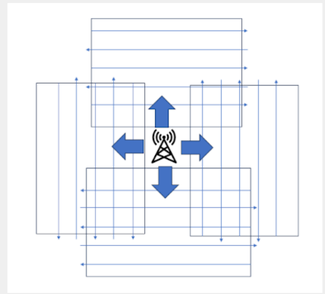
Methodology

- To test these variables, we used drones (UAS)
- NanoTags needed to be controllable in the air
- Drones have programmed flights, the same every time
  - FreeFlight6
  - Pix4Dcapture

- Payload:
  - Wire
  - Velcro
  - Hot dog (mimics flesh of migratory animals)
  - NanoTag (attached to hot dog with surgical glue)
    - Three tags represent majority of tags in use: 138, 158, 339
    - Burst intervals: how often the tag emits a signal
      - 138 - 5 seconds (highest burst rate on the market)
      - 158 - 7.9 seconds (average)
      - 339 - 13 seconds (lowest burst rate)
    - Each tag emitted 166.380 MHz signal

- Site: The Mountain Retreat and Learning Center
  - Located on Little Scaly Mountain, so there is good variance in topography
  - Motus tower at the Mountain Retreat has two antennas facing east and west, so it was able to read our tags' signals

- Data collection: Pix4Dcapture plans
  - 61 m (200 ft)
  - 122 m (400 ft)
  - Slow+ (21 km/h)
  - Normal+ (35 km/h)
- Grid strategy to test topography
- Extra south grids to test speed/altitude
- Three tags to test



Discussion

- Speed and altitude are not factors affecting signal strength
  - Tags are efficient at tracking migratory animals at various flight patterns, speeds, and altitudes
- Distance has a strong negative correlation with signal strength
  - Tags with lower burst rates could be less detectable from farther distances
- Topography has no clear relationship with signal strength
  - Cone effect: higher signal strength detected in directions of antennas (east and west)
  - Could be masking topographic effects
- Signals are being picked up regardless, which is promising

Future Directions

- More towers should be tested
  - 6 in WNC/upstate SC should produce similar results
  - Coastal variance
- Distance significance
  - Distances > 457 m
  - Heights > 400-500 m

Acknowledgments

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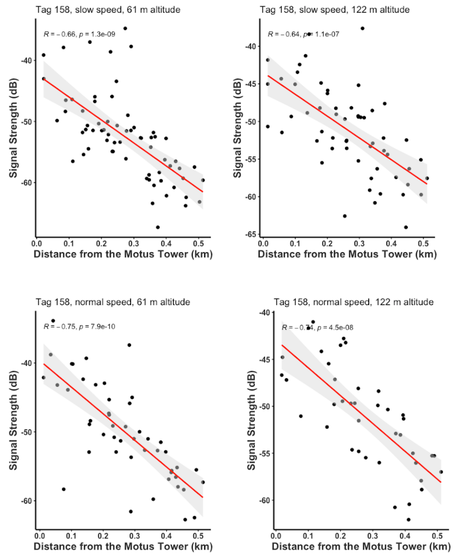
Objective

Motus towers should be able to detect signals from the tags regardless of species, migration habits and location to ensure data accuracy. We tested these variables of detectability/signal strength:

- Migration variation - altitude, speed
- Environmental variation - topography

Results - Speed and Altitude



Signal strength was compared against each tag's distance from the Motus tower.

Each dot on the scatter plot represents a ping from the tag that the Motus tower picked up.

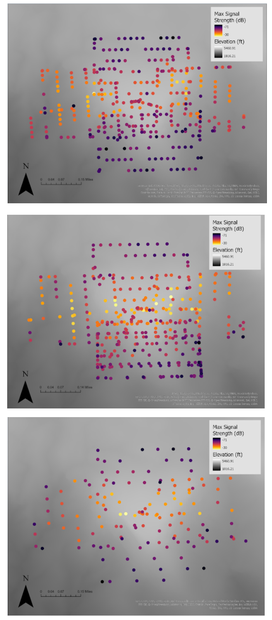
There was a significant negative correlation between signal strength and distance from the Motus tower (R=-0.66, p=1.3e-09; R=-0.64, p=1.1e-07; R=-0.75, p=7.9e-10; R=-0.74, p=4.5e-08).

Results - Topography

Signal strength was compared against each tag's location around the tower.

Each point was given an unclassed gradient, in which the yellow represents a high signal strength, and the dark purple is a low signal strength.

Behind the points is a digital elevation model raster, in which the lighter shade represents a higher elevation than the darker shade.



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