Assessing detectability rates of Motus towers using Unoccupied Aircraft Systems

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Introduction

- The Motus Wildlife Tracking System (Motus) is an international collaborative research network that uses coordinated automated radio telemetry to facilitate research and education on the ecology and conservation of migratory animals.
- Very High Frequency (VHF) nanotags are fastened to the migratory animal. As the animal nears the Motus tower, the frequency emitted from the tag is detected and added to the dataset. The Motus towers have receivers that detect either 166.380 MHz or 434 MHz frequencies.
- Unoccupied Aircraft Systems (UASs), often referred to as drones, have been a useful tool for collecting remote sensing data and have the potential to be used to test Motus tower capabilities.
- Programs such as FreeFlight6 and Pix4D Capture allow drones to perform autonomous flights, which can mimic flight paths of different migratory animals.
- In mountainous regions, there is greater potential for interference from the environment, such as the valleys and peaks of the mountains. This could affect the Motus tower's ability to detect the tags' signals in these regions.

Objectives

The objective of this study is to test the detectability rates of Motus towers in different regions using drones.

Aims: 1) assess how distance, altitude, and speed affect the signal strength of the nanotag reported by the Motus tower receiver

2) assess how different terrains affect the Motus tower receiver capabilities.

We predict that there will be more inconsistencies in the signal detection data when the drone is further away, higher up in the air, or flying at a faster speed.

Results

• Pre-planned flights flown at Mt. Berry House of Dreams Motus Tower at Berry College in Rome, Georgia.

•A Lotek Nanotag was attached to a Parrot Anafi drone and flown around the Motus tower using pre-planned flight paths that emulate different aerial animals.

•18 total pre-planned flights using Pix4D Capture

- 3 speeds: 1 m/s, 8 m/s, and 15 m/s
- 3 distances from the Motus tower: 10 m, 300 m, and 700 m
- 2 altitudes from ground: 30 m and 120 m

Conclusions

- Distance, altitude, and speed all had an effect on the nanotag's signal strength.
- Each of the three variables were found to be statistically significant in their effect on signal strength.
- As the nanotag moves further from the Motus tower, the signal strength and the receiver's ability to detect the tag decreases.
- As the tag moves higher in elevation, the signal strength and detectability rate also decreases.
- Faster speeds also cause the signal strength and detection rate to decrease.

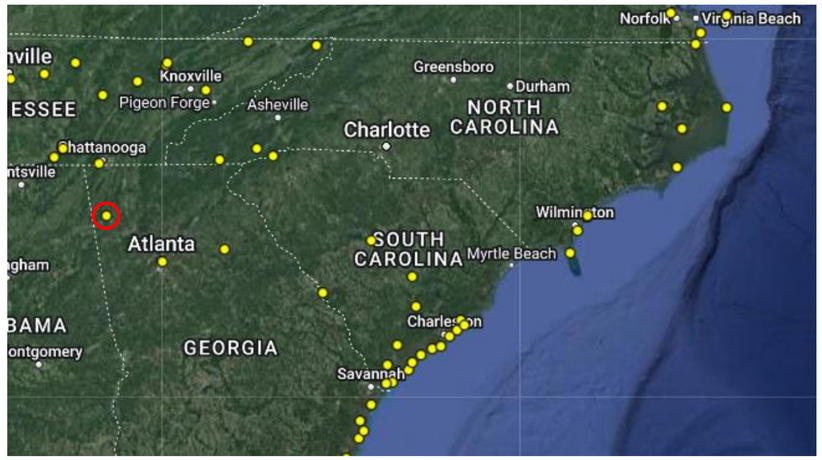

Figure 1. Motus tower locations in the southeastern United States. The red-outlined circle indicates the location of the Mt. Berry House of Dreams Motus tower, where the pre-planned flights were performed. This Motus tower is situated in Rome, Georgia at an altitude of 460 m.

Results

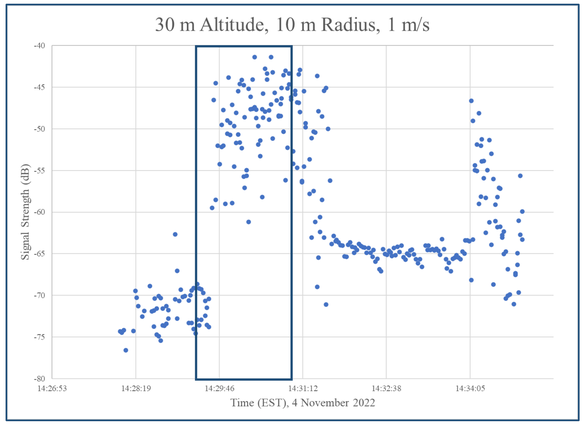

Figure 2. Scatter plot of the signal strength of the nanotag during the flight at a 30 m altitude, 10 m distance, and 1 m/s speed. The blue-outlined box indicates the time when the drone was flying the pre-programmed flights.

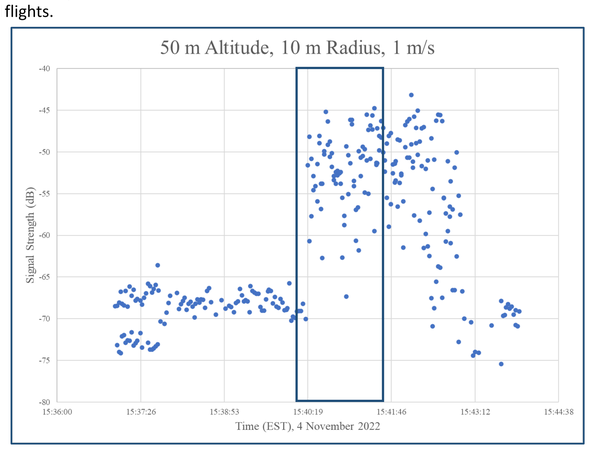

Figure 3. Scatter plot of the signal strength of the nanotag during the flight at a 50 m altitude, 10 m distance, and 1 m/s speed. The blue-outlined box indicates the time when the drone was flying the pre-programmed flights.

Results

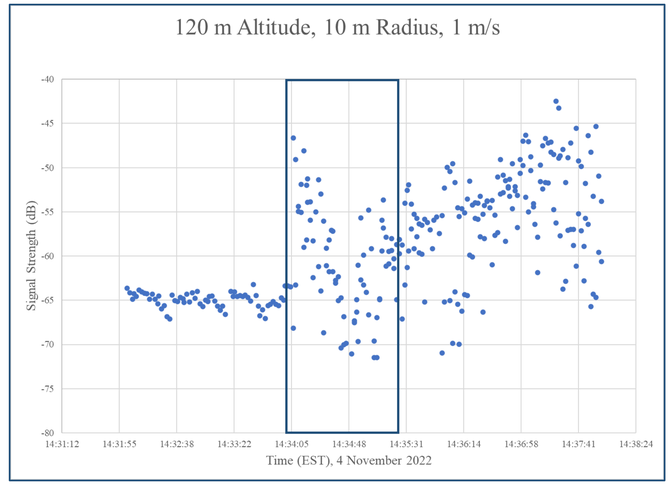

Figure 4. Scatter plot of the signal strength of the nanotag during the flight at a 120 m altitude, 10 m distance, and 1 m/s speed. The blue-outlined box indicates the time when the drone was flying the pre-programmed flights.

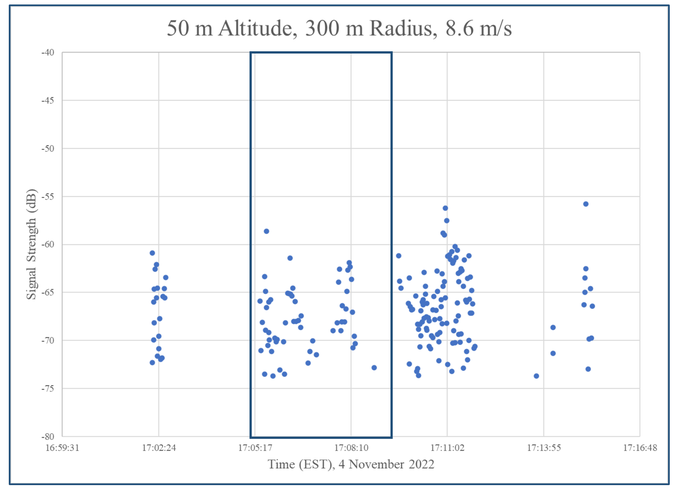

Figure 5. Scatter plot of the signal strength of the nanotag during the flight at a 50 m altitude, 300 m distance, and 8.6 m/s speed. The blue-outlined box indicates the time when the drone was flying the pre-programmed flights.

Future Work

- Fly more pre-planned flights at other locations to look at differences across different regions (mountainous, piedmont, and coastal) in the southeastern United States.
- Obtain permissions from the Federal Aviation Administration (FAA) to fly above 120 m.
- Altering pre-programmed flight paths to assess if orientation of the drone affects the signal strength and detectability rate of Motus tower receivers.

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