**Proof of concept – Using Acoustic monitoring to detect hummingbirds and estimate abundance**

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**Data:** Aug-Sep 2013 Chiricahua bird census

**Justification:**

Identifying species of interest on the landscape can be time consuming and costly.

Many species occur in locations that are logistically difficult to monitor (location, timing, etc.)

Bioacoustic technology is a potentially cost-effective tool for monitoring wildlife.

Hummingbirds are particularly difficult to monitor (size, detection probability, timing of migration).

Hummingbirds are unique because they may be identified by their vocalizations and by the sound of their wing beats.

They are important to study as they may represent early harbingers of climate change – sensitive to shifts in temperature, precipitation, phenology, and extreme weather events.

If acoustic monitoring can also estimate abundance, than it could be used to expand monitoring efforts for species that fluctuate widely in abundance throughout the year (i.e., migrating species).

Here, we test the effectiveness of using bioacoustic monitoring to 1) detect hummingbirds and 2) estimate abundance.

**What:**

We placed bioacoustic monitoring stations (Song Meter SM2+) in nectar patches known to have suitable habitat for hummingbird species during peak migration. The Chiricahua mountains are known to be on a major migratory pathway for 14 hummingbird species.

We left the stations up for (x) days in each patch to record, for (x) hours of audio.

We conducted (x) point counts in each patch to estimate abundance and diversity.

Prior to the study, at hummingbird monitoring stations, we released hummingbirds near a Song Meter to record vocalizations and wing beats for (x) species (sp1, sp2, sp3…spn).

We also collected a library of training data, consisting of known vocalizations and input parameters (Macaulay Library at Cornell Lab of Ornithology?)

We analyzed both sets of recordings using Sound Scope to manually identify (x) vocalizations and wing beats for generating the “recognizer”.

We used these recordings to develop a “recognizer” for songs and wing-beats.

We used the recognizer to identify potential hummingbird sounds for each patch.

An experienced hummingbird expert manually confirmed all identified recordings, and identified to species where possible.

**Useful products:** set of “rules” and data for monitoring hummingbird sounds, set of protocol for remotely monitoring hummingbirds, specifications for software ID

**TODO:**

* Email customer service to see what OSs Song Scope software works on
  + Do they know what radius it should reliably be able to ID sounds?
* Fly known hummingbirds over a Audio recorder (AR) to get species-specific “training data”
* Controlled observation from feeders (walk backwards from feeder) to detect bird wingbeats and vocalizations.
  + Set up AR at feeders at HMN sites. Walk the recorders away from the feeders, stopping at set distances to determine when AR is no longer able to pick up wing beats at focal hummingbird site (feeder).
* Collect training data from Cornell Lab of Ornithology (other sources?)
  + www.animalbehaviorarchive.org
* Manually identify separate vocalizations/sounds from training data using Sound Scope
* Develop hummingbird “recognizer” for Song Scope
* Choose sample rate for scanning recordings
* Set all necessary parameters for the scan, based on variation in known calls
* Use recognizer to scan recordings and identify hummingbirds on landscape
* Manually confirm all identified recordings
* Output some flag for quality
* Number of confirmed vocalizations or wing-beats per site
* How to determine abundance from audio – in the Wildlife Acoustics software
* Compare with point count estimates
* Learn how to estimate abundance using Song Scope software

**Useful figures/tables:**

Table of training data

Visualization of acoustic data

Point count abundance plotted against estimated acoustic abundance, 1:1 line

**References:**

Agranat, I.D. 2007 Automatic detection of Cerulean Warblers using autonomous recording units and song scope bioacoustics software. <http://www.fs.fed.us/t-d/programs/im/acoustic_wildlife/Cerulean%20Warbler_%20Report_Final.pdf>

Song Scope software. <http://www.wildlifeacoustics.com/songscope_web_help/>