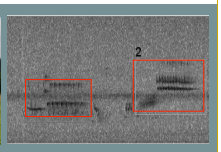
Monitoring avian abundance and distribution in inaccessible areas using acoustic methods





Emily Hockman
PhD Student
University of Tennessee
Department of Forestry, Wildlife, and Fisheries

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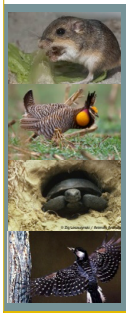
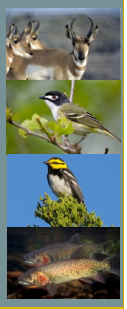
Introduction

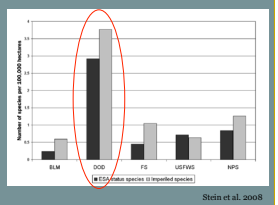


- ~30 million acres across 450 installations
- Large, isolated areas with regular disturbance and low development (Giocomo 2005, Stein et al. 2008)
  - Large inaccessible areas used for munitions testing and training
- Refuge for wildlife including numerous threatened and endangered species (Eberly and Keating 2006, Ripley and Leslie 1997)



Introduction

- DoD hosts a disproportionally large amount of threatened and endangered species (Ripley and Leslie 1997, Stein et al. 2008)
- Regulatory and Stewardship responsibilities
  - Endangered Species Act
  - Migratory Bird Treaty Act
    - Migratory Bird Rule
  - Sikes Act



Stein et al. 2008

Introduction

Impact Zone Area	
Fort Riley, KS	9,446 ha
Fort Hood, TX	4000 ha
Fort Campbell, KY	10,184 ha
Fort Bragg, NC	13,117 ha
Jefferson Proving Grounds, IN	8,827 ha

How do you monitor migratory birds and habitat integrity in inaccessible areas?

Introduction

Cornell's Audio Platform
- SERDP grant
- Fort Hood, TX
- 2004-2005
- 33 free-flights
  - 10 with target species

Introduction

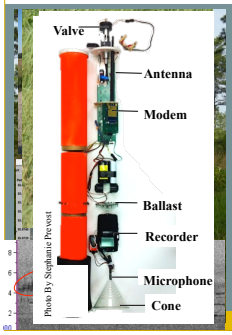
- University of Tennessee
  - 2011 ESTCP grant
  - Update components
  - Collect data on avian vocalizations across a range of installations
  - Compare accuracy and cost
  - Create a useable package for bird monitoring

Objectives

1. Quantify the geographical variation in target species' song as applied to acoustic monitoring
2. Create an acoustic analytical pathway for the automatic detection of target bird songs
3. Use acoustic recordings to determine densities and distribution of non-songbird target species

Study sites

Equipment

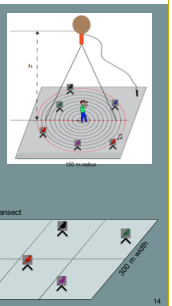


- Autonomous aerial acoustic recording systems (AAARS)
  - Computer controlled
  - Real-time communication
  - 1:2 height to diameter footprint
- Validation of AAARS performance
  - AAARS vs humans
  - "Beepers" broadcast realistic birdsongs at programmable rates

Methods: Balloon Data

- Flights in each study area
  - 10 Real-bird point counts (10 min)
  - 10 Real-bird transects (500 meter)
  - 10 Beeper point counts (10 min)
  - 10 Beeper transects (500 meter)

3 study areas per installation
2 years at each location
=
180 Beeper point counts
180 Beeper transects
180 Real-bird transects
120 Real-bird point counts



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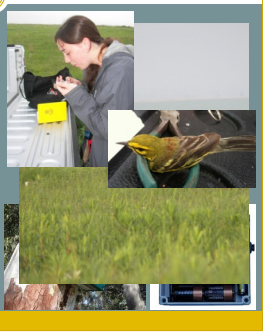
Methods: Supplemental Data Collection

- Spot-mapping of target songbirds
- Singing period and frequency
  - Band territorial males
  - Direct observation
- Red-cockaded Woodpeckers
- Lek surveys
  - Booms/min
  - Number of individuals
- 10-minute Northern Bobwhite surveys
  - Plot center
  - Staggered start times

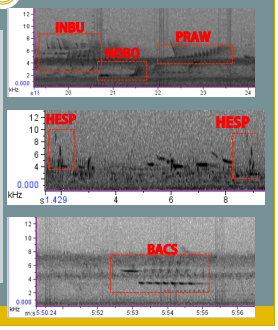


Objective 1: Geographical variation

- Identify distinguishing song characteristics

Max frequency	Length
Min frequency	Context
Mean energy	Circularity
Angle	Pulse
Repetition	Area

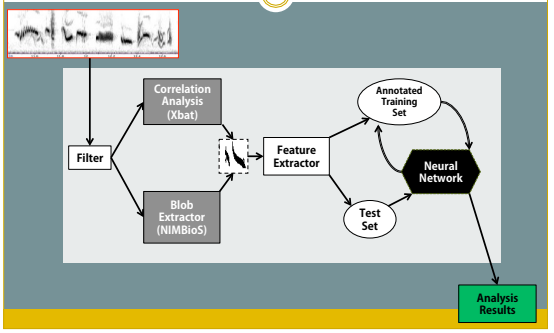
- Compare songs across study sites
  - Principle component analysis
  - Discriminate function analysis



Objective 2: Analytical Pathway

- Develop an automatic detection pathway
  - Commercial products don't always work
  - Options: Correlation
    Amplitude
    Energy distribution

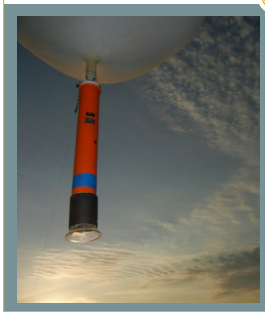
Objective 2: Analytical Pathway



Objective 3: Densities of the 'oddballs'

- Audio Analysis
  - RCW: Type and frequency of calls around nests
  - GRPC: "Boom" index
  - NOBO: Variable rates within a season
- Supplemental material

The path so far…



- ☑ Update the payload
- ☑ Three years of field work
- ☐ Analysis
- ☐ Training installation staff

Many Thanks…

- Dr. David Buehler
- Dr. John Wilkerson
- Dr. Richard Fischer
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  - NIMBios REU students
- Range Control and Environmental Staff
- Avian ecology lab mates
- 3 years of technicians
- University of Tennessee

References

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Questions?