





**Investigating the abilities of Autonomous Aerial Acoustic Recording Systems (AAARS) to monitor avian populations in inaccessible areas**

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**Outline**

- Introduction
  - Why birds?
  - Why Department of Defense (DoD)?
- Justification (Problem → Solution)
- Species
- Study Areas
- Methods




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**Why Study Birds?**

1. Ecological and economic value (Clinton 2001)
  - Biological diversity
  - Enjoyment, recreation, hunting
2. Information Value (Baillie 1991)
  - Sensitive to environmental changes
  - Indicators of ecological health
  - More practical to monitor than other taxa




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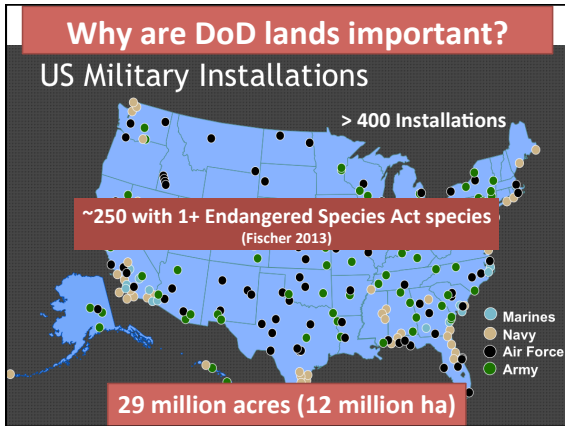
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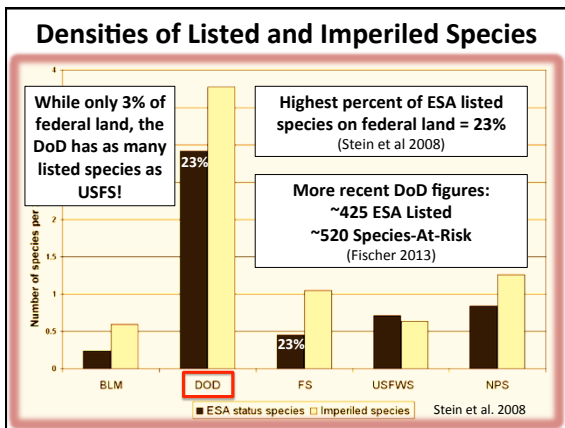
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### Legislation and Regulatory Drivers

- General
  - Migratory Bird Treaty Act
  - Endangered Species Act
  - Executive Order 13186
    - "Responsibilities of Federal Agencies to Protect Migratory Birds"
- DoD Specific
  - Sikes Act
  - Migratory Bird Rule



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### What is the problem?



## Impact Areas?

**Current Estimate:**  
**> 1 million acres of inaccessible impact areas with little to no monitoring data**



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### Solution?



**Autonomous Aerial Recording**

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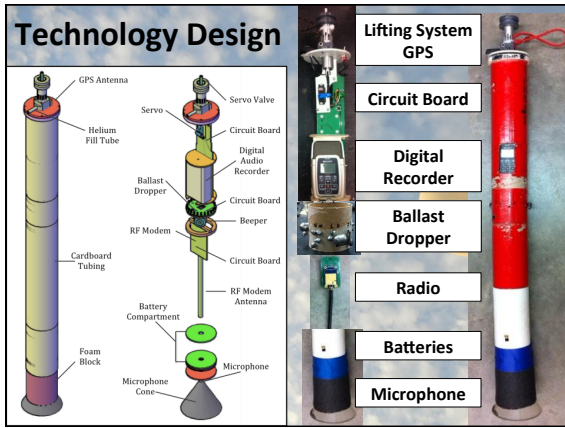
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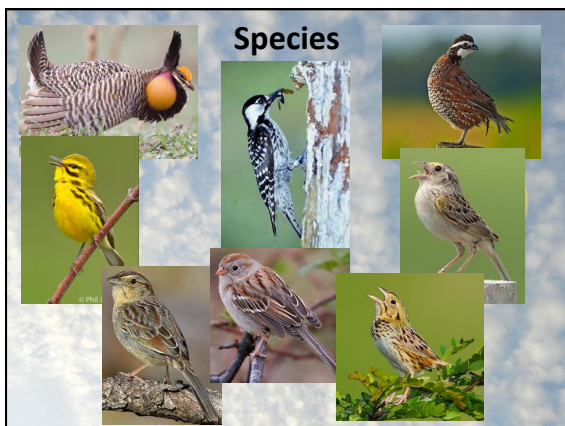
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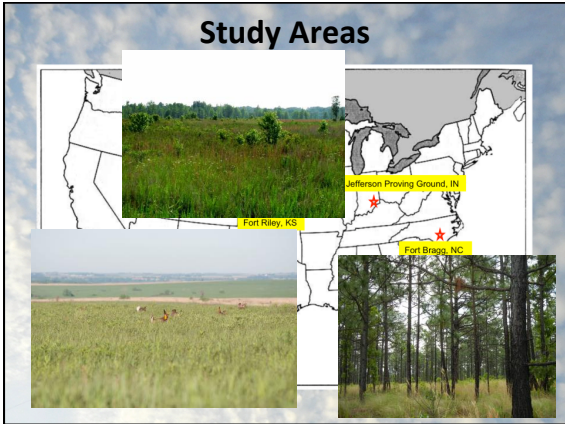
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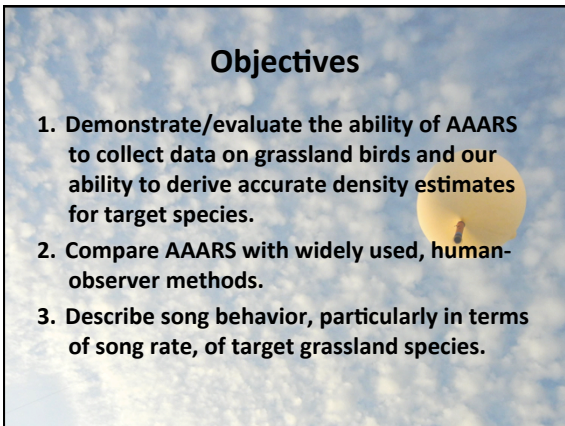
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1. Demonstrate/evaluate the ability of AAARS to collect data on grassland birds and our ability to derive accurate density estimates for target species.
2. Compare AAARS with widely used, human-observer methods.
3. Describe song behavior, particularly in terms of song rate, of target grassland species.

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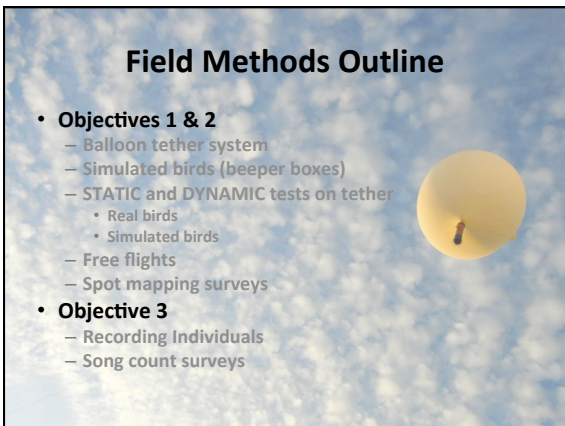
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- **Objectives 1 & 2**
  - Balloon tether system
  - Simulated birds (beeper boxes)
  - STATIC and DYNAMIC tests on tether
    - Real birds
    - Simulated birds
  - Free flights
  - Spot mapping surveys
- **Objective 3**
  - Recording Individuals
  - Song count surveys

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**Methods: Objectives 1&2**

**Tether System**

- Fishing pole
- 30 lb line

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**Methods: Objectives 1&2**

**Tether System**

- Fishing pole
- 30 lb line
- Human operator

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**Methods: Objectives 1&2**

**Tether System**

- Fishing pole
- 30 lb line
- Human operator
- Laptop base station

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### Methods: Objectives 1&2

#### Simulated Birds

- Components
  - MP3 player
  - Amplifier
  - Speaker
  - RF modem
- 16-20 per survey
- Controlled Remotely



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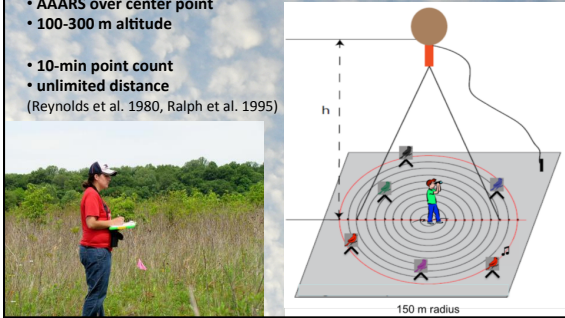
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### Methods: Objectives 1&2

#### Static Tests

- AAARS over center point
- 100-300 m altitude
- 10-min point count
- unlimited distance  
(Reynolds et al. 1980, Ralph et al. 1995)



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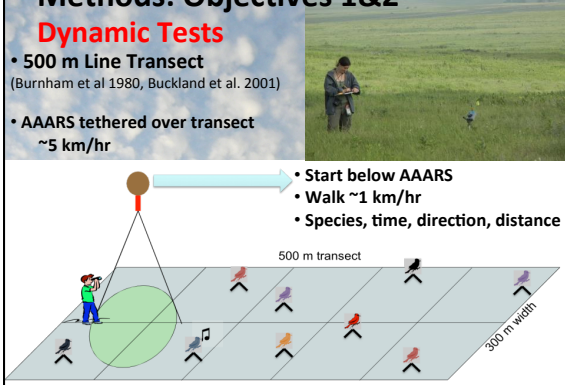
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### Methods: Objectives 1&2

#### Dynamic Tests

- 500 m Line Transect  
(Burnham et al 1980, Buckland et al. 2001)
- AAARS tethered over transect  
~5 km/hr



- Start below AAARS
- Walk ~1 km/hr
- Species, time, direction, distance

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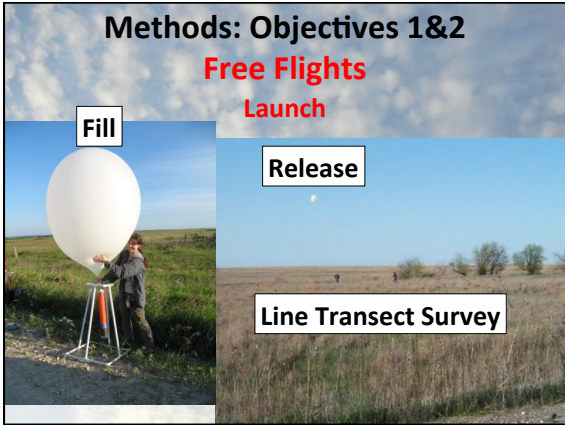
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## Methods: Objectives 1&2

### Surveys for True Bird Densities



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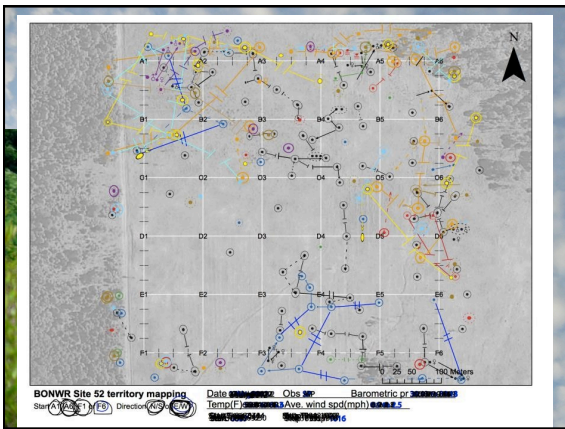
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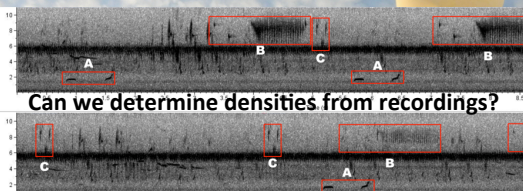
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## Analysis Objective 1

What is our ability to collect data on focal species?

Can we use pattern recognition software to automatically detect songs?



Can we determine densities from recordings?

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**Analysis: Objective 1**  
**Density Estimation Method**

1. Altitude, velocity, and flight length
2. Number of songs recorded, average song rate

Compare results with known populations

1. Simulated birds
2. Spot mapping data



Flight Area

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**Analysis: Objective 2**  
**AAARS vs. human surveys?**

1. Compare at species/individual level
2. Compare density estimates

Observer Point Count & Line Transect data

Program DISTANCE (Buckland et al. 2001)

Population Density Estimates



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**Methods: Objective 3**  
*Describe song behavior in terms of song rate.*

**Recordings**

1. Identify Individuals



Target Mist-Net → Color Band

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**Methods: Objective 3**  
**Recordings**

2. Resight individuals

Observe → Record GPS points

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**Methods: Objective 3**  
**Recordings**

3. Install Autonomous Recording Units (ARU)

Find territory center →

→ Collect data

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**Methods: Objective 3**  
**Song Counts**

• 10-min count  
 • # songs per min per individual

• 1-2 counts per wk

| Autonomous Recording Unit |          |           |           |           |           |           |           |           |           |            |       |
|---------------------------|----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|-------|
| Date: _____               |          |           |           |           |           |           |           |           |           |            |       |
| Territory ID: _____       |          |           |           |           |           |           |           |           |           |            |       |
| Observer: _____           |          |           |           |           |           |           |           |           |           |            |       |
| Time                      | 1-10 min | 11-20 min | 21-30 min | 31-40 min | 41-50 min | 51-60 min | 61-70 min | 71-80 min | 81-90 min | 91-100 min | Total |
| 1-10 min                  |          |           |           |           |           |           |           |           |           |            |       |
| 11-20 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 21-30 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 31-40 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 41-50 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 51-60 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 61-70 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 71-80 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 81-90 min                 |          |           |           |           |           |           |           |           |           |            |       |
| 91-100 min                |          |           |           |           |           |           |           |           |           |            |       |
| Total                     |          |           |           |           |           |           |           |           |           |            |       |

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## Analysis: Objective 3

### Possible steps...

1. Use song count data to verify **how many individuals** are being recorded by ARUs
2. Use software to **count songs** on recordings
  - \* (or analyze subsamples by hand)
3. **Calculate** songs per min? hour? morning?
4. **Compare** regions and time periods
5. How can we use this information for acoustic monitoring?

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## Photo/Figure Credits

- <http://www.planetofbirds.com/passeriformes-parulidae-prairie-warbler-dendroica-discolor>
  - <http://nationalatlas.gov/index.html>
  - <http://www.avianweb.com/greaterprairiechicken.html>
  - [http://farm3.static.flickr.com/2548/3894334401\\_9fee386e35.jpg](http://farm3.static.flickr.com/2548/3894334401_9fee386e35.jpg)
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  - <http://www.allaboutbirds.org/guide/PHOTO/LARGE/grass.jpg>
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  - [http://www.dutchbydesign.com/prodimg/SY8550\\_1\\_large.jpg](http://www.dutchbydesign.com/prodimg/SY8550_1_large.jpg)
  - [http://www.dirty-dozen.org/wp-content/uploads/2013/03/garmin\\_GPS\\_60CSx.jpg](http://www.dirty-dozen.org/wp-content/uploads/2013/03/garmin_GPS_60CSx.jpg)
  - [http://www.mbr-pwrc.usgs.gov/bbs/htm03/ra2003\\_red/ra02890.htm](http://www.mbr-pwrc.usgs.gov/bbs/htm03/ra2003_red/ra02890.htm)
- Field Technicians/Assistants (Leslie Brinkman)

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### Acknowledgements

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| <b>Project Collaborators</b> <ul style="list-style-type: none"><li>- Dr. Stacy Worley</li><li>- David Smith</li><li>- Emily Hockman</li><li>- Mathew Menachery</li></ul> | <b>Past/Future Technicians</b>   |



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I've got questions...

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