Can we predict animal presence and abundance statewide using remote sensing and trail cameras?

- Partner Agency
- Citizen Science / Crowdsourcing
- Remote Sensing
- Predictive Modeling
- Resource Management Objective
- Application Implementation
Zooniverse Crowdsourcing Effort

- Season 1 included 33,385 photos
- Classification of photos completed in 7 days by 1802 individuals
- A small number of people do the most number of classifications
Modeling Animals as a Function of Remote Sensing

$\psi$ Probability of occurrence

$p$ Probability of detection

$\lambda$ Expected abundance

John Clare (Ph.D. Student), Ben Zuckerburg, Tim van Deelen, Phil Townsend, *UW-Madison*
Jen Stenglein, *Wisconsin DNR*
**Occurrence/Distribution**

\[ z_i \sim \text{Bernoulli} \left( \psi_i \right) \]

A site is occupied w/ some probability

\[
\text{Logit}(\psi_i) = \beta_0 + \beta_1 X_i
\]

This probability changes with environmental conditions

\[
\text{Logit}(p_{ij}) = \beta_0 + \beta_1 X_{ij}
\]

If occupied, we observe the species with some probability that may vary over time or space

\[ y_{ij} \sim \text{Bernoulli} \left( p_{ij} \times z_i \right) \]

Our repeated presence-absence observations reflect the product of these distinct probabilities

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**Abundance**

\[ N_i \sim \text{Poisson} \left( \lambda_i \right) \]

Abundance at a site is a realization from an expected mean

\[
\text{Log}(\lambda_i) = \beta_0 + \beta_1 X_i
\]

Expected abundance varies across space

\[
\text{Logit}(r_{ij}) = \beta_0 + \beta_1 X_{ij}
\]

Each individual animal has some probability of being observed that may vary over time of space

\[ p_{ij} = 1 - (1 - r_{ij}) \]

The probability of observing the species at a specific time is proportional to individual detection and the number of individuals

\[ y_{ij} \sim \text{Bernoulli} \left( p_{ij} \right) \]

Repeated presence-absence reflects abundance and individual detection
Ongoing Work

Incorporate additional uncertainty
  • MODIS Land Cover Dynamics
  • Additional Landscape Metrics

Incorporate dynamics
Explicitly consider spatial demographic processes

Application by Wisconsin DNR
Social Science
Camera sites with elk

Distribution Maps

- Seen
- Not seen

at 144 cameras active
10 – 206 days between
Jan 2015 and Feb 2016
Sighting density of elk

Sighting Density Maps

Low to high relative sighting density

Numbers are nonzero counts of individuals at 96 cameras active July 17 – Oct 5, 2015
Citizen Science: Two ways to participate

1. Host a trail camera within a survey block

- Attend training
- Set up a camera
- Retrieve photos
- Upload & check photos
Enrolling volunteers by county

SnapshotWIsignup.org

Sawyer County
152 survey blocks

Iowa County
86 survey blocks
Citizen Science: Two ways to participate

2. Classify animals in photos

Laura Trouille (Adler Planetarium), many others
www.snapshotwi.org

Live Now! Press and Media Blitz on May 17

Welcome to Snapshot Wisconsin. Help us identify animals in trail camera images.

About Snapshot Wisconsin

Snapshot Wisconsin is an effort to monitor wildlife year-round across a network of volunteer managed trail cameras. Help us to identify the animals captured on camera and better understand the distribution and trends of our wildlife populations.
<table>
<thead>
<tr>
<th>Looks Like</th>
<th>Body Size</th>
<th>Rare/Uncommon</th>
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<tbody>
<tr>
<td>Amphibians and Reptiles</td>
<td>Fisher</td>
<td>Pig, Feral</td>
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<tr>
<td>Badger</td>
<td>Fox, Gray</td>
<td>Porcupine</td>
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<td>Bear</td>
<td>Fox, Red</td>
<td>Raccoon</td>
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<td>Grouse</td>
<td>Skunk, Spotted</td>
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<tr>
<td>Other Bird</td>
<td>Jackrabbit</td>
<td>Skunk, Striped</td>
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<td>Lynx</td>
<td>Snowshoe Hare</td>
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<td>Marten</td>
<td>Squirrels and Chipmunks</td>
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<td>Human</td>
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<tr>
<td>Elk</td>
<td>Pheasant</td>
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</tbody>
</table>

Showing 34 of 44.  
Show the project tutorial  
Done
Building an online community

7558 comments in 4934 posts to date

Talk boards are motivational to participants, but also provide us with a wealth of information

- Qualitative data on which species are difficult for individuals to identify
- Source of opportunistic data

- Social Science Research: Public Engagement in Science

Christine Anhalt-Depies (Ph.D. Student), UW-Madison
Volunteer Hashtags

Objectives:
Education   Attitudes   Engagement   Community Involvement   Build relationships
Human/vehicle detection
Remove identifiable humans/vehicles
Current version: Color based
Next version: optical flow + segmentation + ML
(under development)