Snapshot Wisconsin

Objective: Link remote sensing and animal distribution data to better understand spatial and temporal variability in occupancy and behavior.

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Balancing Act of Wildlife Management

- Monitor animal populations at broad scales
  - Improve accuracy of estimates, reduce costs, less invasive
- Deliver information to stakeholders
- Forecast changes in populations

Partnership to monitor wildlife year-round through a statewide network of trail cameras
Remotely Sensing and Citizen Science

Volunteers set up cameras

Upload photos to database

Crowdsourcing photo ID

Wildlife monitoring and modeling
<table>
<thead>
<tr>
<th>Looks Like</th>
<th>Body Size</th>
<th>Rare/Uncommon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amphibians and Reptiles</td>
<td>Fisher</td>
<td>Pig, Feral</td>
</tr>
<tr>
<td>Badger</td>
<td>Fox, Gray</td>
<td>Porcupine</td>
</tr>
<tr>
<td>Bear</td>
<td>Fox, Red</td>
<td>Raccoon</td>
</tr>
<tr>
<td>Beaver</td>
<td>Grouse</td>
<td>Skunk, Spotted</td>
</tr>
<tr>
<td>Other Bird</td>
<td>Jackrabbit</td>
<td>Skunk, Striped</td>
</tr>
<tr>
<td>Bobcat</td>
<td>Lynx</td>
<td>Snowshoe Hare</td>
</tr>
<tr>
<td>Cat, Domestic</td>
<td>Marten</td>
<td>Squirrels and Chipmunks</td>
</tr>
<tr>
<td>Cottontail</td>
<td>Mink</td>
<td>Turkey</td>
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<tr>
<td>Cougar</td>
<td>Moose</td>
<td>Weasel</td>
</tr>
<tr>
<td>Coyote</td>
<td>Muskrat</td>
<td>Wolf</td>
</tr>
<tr>
<td>Crane, Sandhill</td>
<td>Opossum</td>
<td>Wolverine</td>
</tr>
<tr>
<td>Crane, Whooping</td>
<td>Other Domestic</td>
<td>Woodchuck</td>
</tr>
<tr>
<td>Deer</td>
<td>Other Rodent</td>
<td>Nothing here</td>
</tr>
<tr>
<td>Dog, Domestic</td>
<td>Otter</td>
<td>Human</td>
</tr>
<tr>
<td>Elk</td>
<td>Pheasant</td>
<td></td>
</tr>
</tbody>
</table>
Welcome to Snapshot Wisconsin. Help us identify animals in trail camera images.

Get started ↓

You've unlocked level Fawn
Provide feedback to this pilot site [here].

<table>
<thead>
<tr>
<th>Looks Like</th>
<th>Body Size</th>
<th>Coat</th>
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</thead>
<tbody>
<tr>
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<td>Fox, Red</td>
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<tr>
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<tr>
<td>Deer</td>
<td>Other Domestic</td>
<td>Wolf</td>
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<tr>
<td>Dog, Domestic</td>
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<tr>
<td>Elk</td>
<td>Otter</td>
<td>Woodchuck</td>
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<tr>
<td>Fisher</td>
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<td>Human</td>
</tr>
<tr>
<td>Fox, Gray</td>
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Showing 43 of 43  Clear filters
Which habitat type is represented in the photo?

- Needle conifer forest
- Broad-leaved deciduous forest
- Mixed forest
- Agriculture
- Grassland or meadow
- Forest site with no overstory visible

Need some help with this task?
Currently: >1200 cameras active, 1900 locations total, >900 (host) volunteers, >20 million photos
Results of Three Papers

• Wildlife distributions as a function of remote sensing (Townsend et al.)
• Animal communities (Clare et al.)
• Wildlife behavior (Clare et al.)

• Not shown:
  • Accuracy assessment of crowdsourcing (Clare et al., *Ecol Apps.*)
  • Phenology from trailcams vs. phenology from MODIS (Liu et al.)
  • Overstory vs. understory phenology (Townsend/Liu et al.)
  • Overview paper from management agency (Locke et al.)
  • Privacy paper (Anhalt-Depies et al.)
1) Wildlife Occupancy and Relative Density:
Deer:

Modeled using Snapshot Wisconsin Data, 2015-2017
Important predictors from RS: Minimum EVI, Start-of-Season Date, Cropland %, Land Cover Diversity
Carnivores:

- Coyote
  - MCC: 0.38
  - AUC: 0.72

- Bobcat
  - MCC: 0.56
  - AUC: 0.84

- Wolf
  - MCC: 0.61
  - AUC: 0.88

- Black Bear
  - MCC: 0.65
  - AUC: 0.87
Bears

Bobcats
Adult Deer vs. Carnivores

Note that higher carnivore richness corresponds to lower deer CPUE. Before you read too much into this, the primary driver of distribution for deer in the Northwoods compared to the rest of the state is likely a combination climate+food (colder, less food available in North), which interacts with predator pressure. Key idea: This kind of comparison was not possible before because of the incompatible differences in methods for monitoring predators and deer.
Carnivores:

Diversity and Richness

- Coyote
  - MCC = 0.38
  - AUC = 0.72

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Expected Richness
- Minimum: 0.25
- Maximum: 3.67
2) Distribution of animal communities

1. What are the drivers of animal community composition across the region?

2. How do animal communities differ spatially across the state, controlling for geographic distance?

PCA of Dissimilarity Model of Composition based on geographic predictors
• PC1: Edge density (5km), EOS, landcover richness (10km), Jan. LST
• PC2: night lights and proportion developed
• PC3: core area
Terrestrial Animal Communities
(visualized by first three principal components)
On average, as a baseline community composition turns over slowly across a purely geographic space (distance only).
Terrestrial Animal Communities
(visualized by first three principal components)

Turnover is more rapid across a productivity gradient (defined by maximum MODIS EVI).
Turnover is very rapid with close proximity to development, but beyond those short distance, proximity to development has no effect.
Similar types of interpretations can be made based on phenology, fragmentation, cropland proportion and winter surface temperatures (all derived from remote sensing).
Use predictions on previous slides with k-means clustering to identify distinct animal communities (best fitting cluster number is 14 in panel F).
Occupancy

John Clare’s work:
How do these patterns relate to behavior?
3) Behavior

What drives animal behavior?
- Remote sensing measurements may be predictive of animal activity (e.g., vegetation productivity, landscape context)
- Predator density also influences behavior
Integrated predictions across the hour (but holding the time of day constant) reveals distinct trade-offs in the activity budgets for deer in different areas.
Note: prediction requires marginalizing across some “unpredictable” variables (e.g., no raster available) or using spatial products derived from related inputs (i.e., distribution of predators predicted using same data sets).
Questions?

Status:
• Phase 2 from Wisconsin DNR now supported. - 2018-2021, $2.193M (supports a Ph.D. student at UW, IT/program support, data mgmt. and visualization)
• Goal: cost-savings monitoring approach, replace/supplement 7 current monitoring programs (fawn:doe, deer pop., gamebird, wolf, furbearers, elk)
• Project was a success – it is continuing beyond NASA funding
• All counties open
Acknowledgments

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Partners