

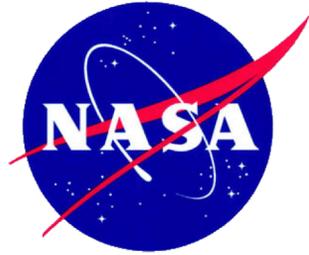
Snapshot Wisconsin

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

Phil Townsend, John Clare, Ben Zuckerberg, Nanfeng Liu, Christine Anhalt-Depies, Tim van Deelen
NASA Grant NNX14AC36G

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

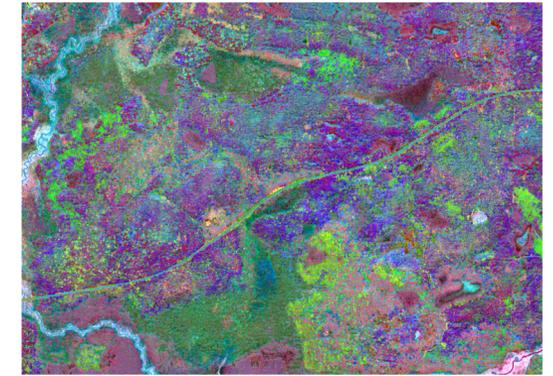


Partnership to monitor wildlife year-round through a statewide network of trail cameras



Link....

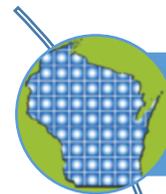
Remote Sensing and Citizen Science



SNAPSHOT
W I S C O N S I N

ZOO NIVERSE

ADLER
PLANETARIUM



Volunteers set up cameras



Upload photos to database



Crowdsourcing photo id



Wildlife monitoring and modeling



Looks Like

Body Size

Rare/Uncommon

Amphibians and Reptiles	Fisher	Pig, Feral
Badger	Fox, Gray	Porcupine
Bear	Fox, Red	Raccoon
Beaver	Grouse	Skunk, Spotted
Other Bird	Jackrabbit	Skunk, Striped
Bobcat	Lynx	Snowshoe Hare
Cat, Domestic	Marten	Squirrels and Chipmunks
Cottontail	Mink	Turkey
Cougar	Moose	Weasel
Coyote	Muskrat	Wolf
Crane, Sandhill	Opossum	Wolverine
Crane, Whooping	Other Domestic	Woodchuck
Deer	Other Rodent	Nothing here
Dog, Domestic	Otter	Human
Elk	Pheasant	

Showing 44 of 44. [Clear filters](#)

FIELD GUIDE

Done

Show the project tutorial

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

[Learn more](#)

This project has been built using the Zooniverse Project Builder but is not yet an official Zooniverse project. Queries and issues relating to this project directed at the Zooniverse Team may not receive any response.

Get started ↓

You've unlocked level **Fawn**

[Yearling](#)

[Buck](#)

[Herd](#)



Provide feedback to this pilot site [here](#).



Looks Like	Body Size	Coat
Badger	Fox, Red	Pig, Feral
Bear	Grouse	Porcupine
Beaver	Jackrabbit	Raccoon
Bobcat	Lynx	Reptiles and Amphibians
Cat, Domestic	Marten	Skunk, Spotted
Cottontail	Mink	Skunk, Striped
Cougar	Moose	Snowshoe Hare
Coyote	Muskrat	Squirrels and Chipmunks
Crane, Sandhill	Opossum	Turkey
Crane, Whooping	Other Bird	Weasel
Deer	Other Domestic	Wolf
Dog, Domestic	Other Small Mammal	Wolverine
Elk	Otter	Woodchuck
Fisher	Pheasant	Human
Fox, Gray		

FIELD GUIDE

Showing 43 of 43 [Clear filters](#)



Which habitat type is represented in the photo?

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

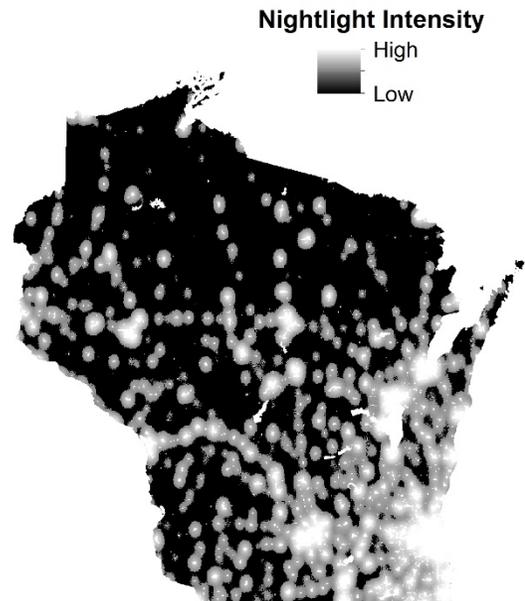
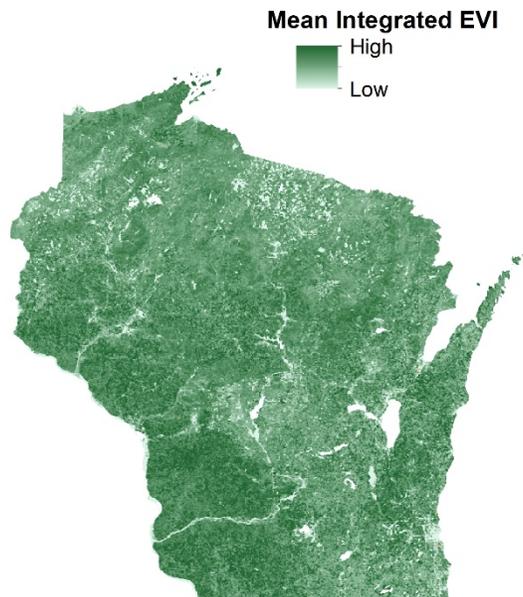
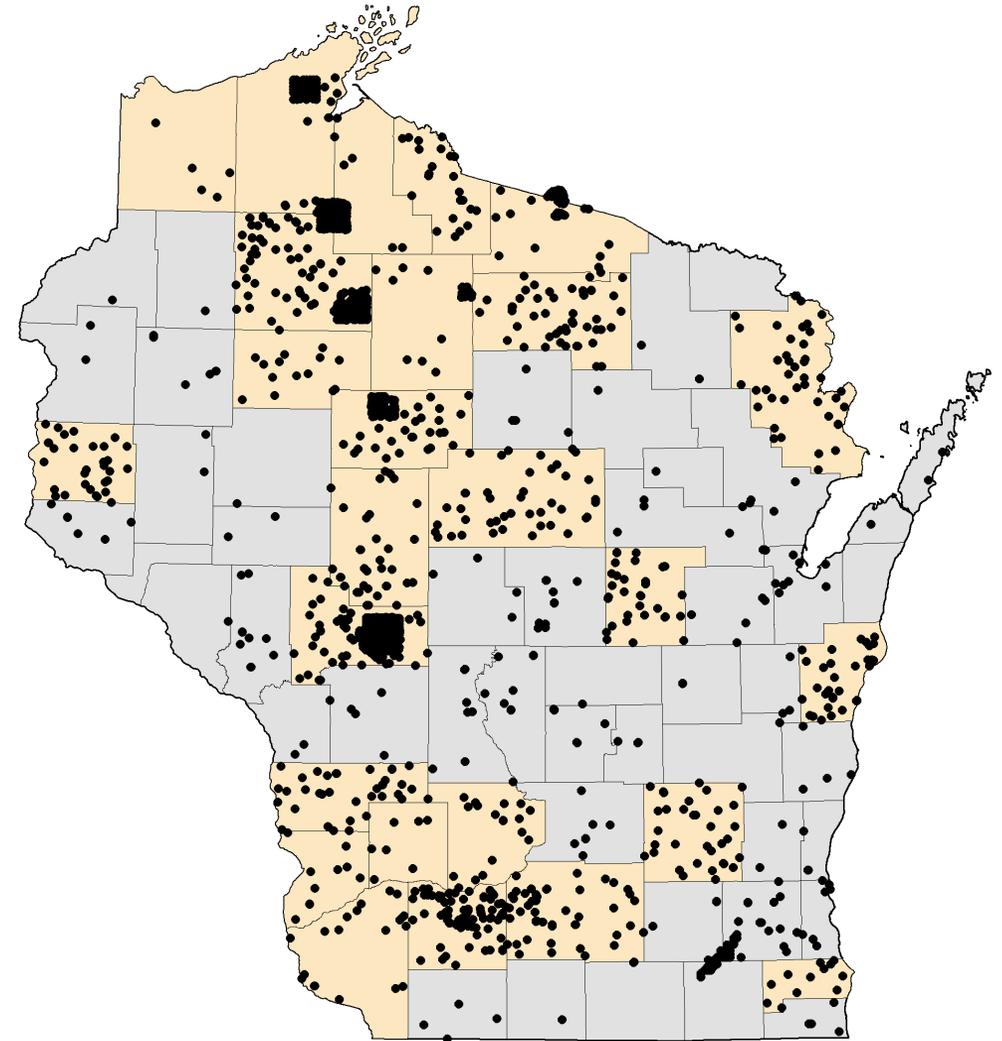
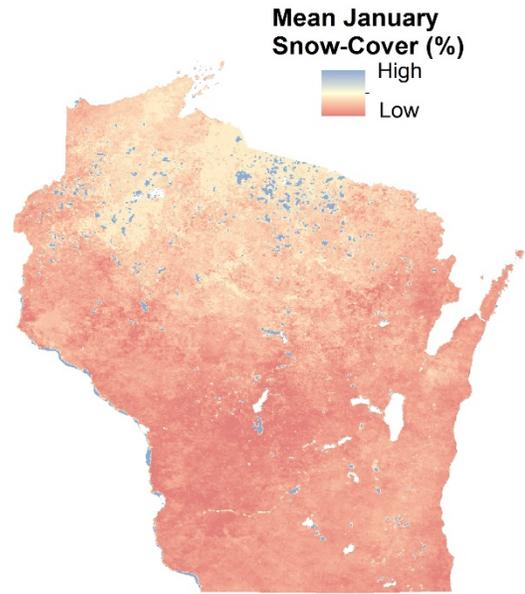
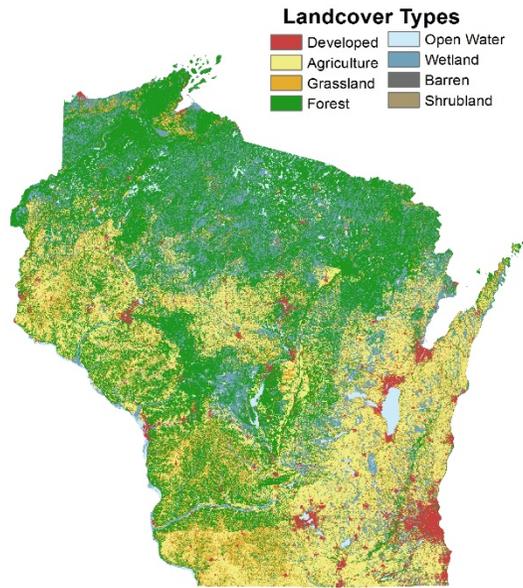
Need some help with this task?

Back

Done &
Talk

Done

FIELD GUIDE



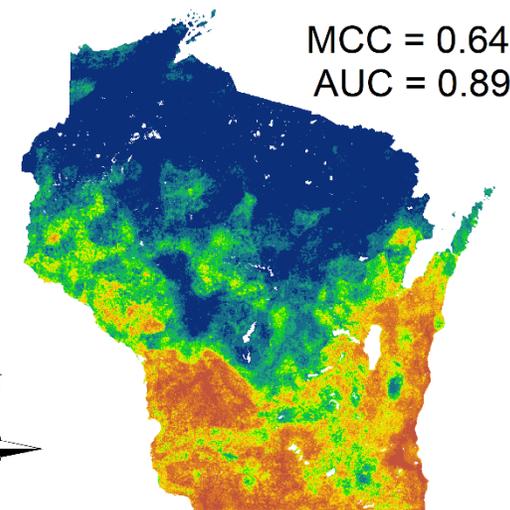
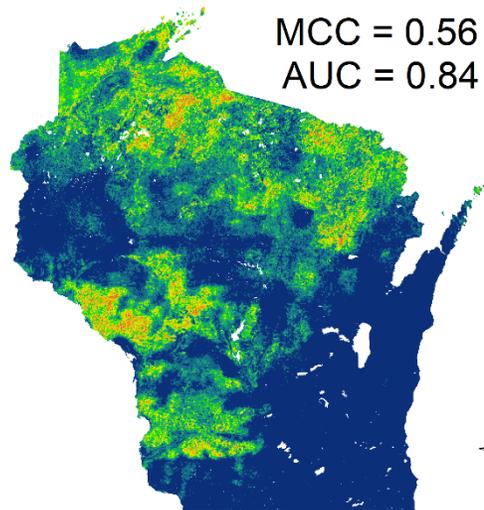
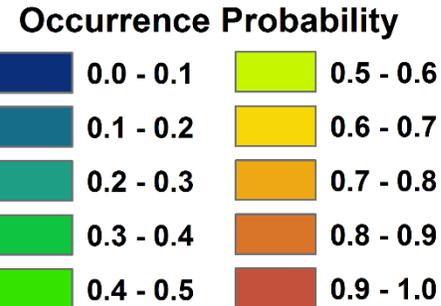
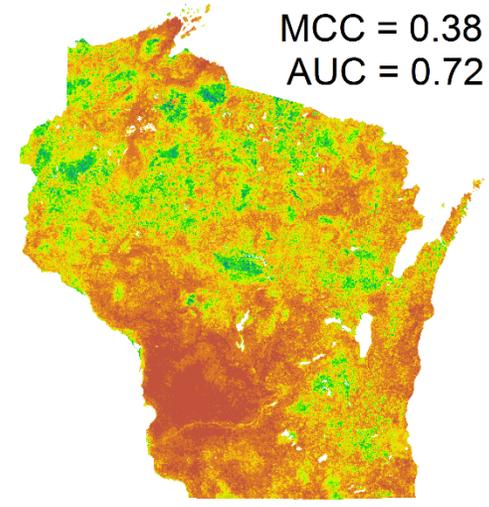
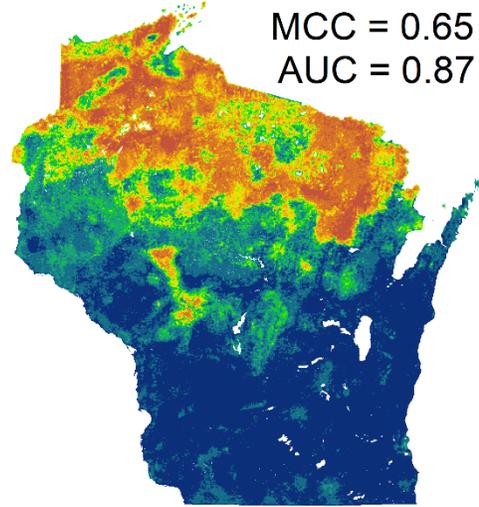
Currently: >1200 cameras active, 1900 locations total, >900 (host) volunteers, >20 million photos

Results of Three Papers

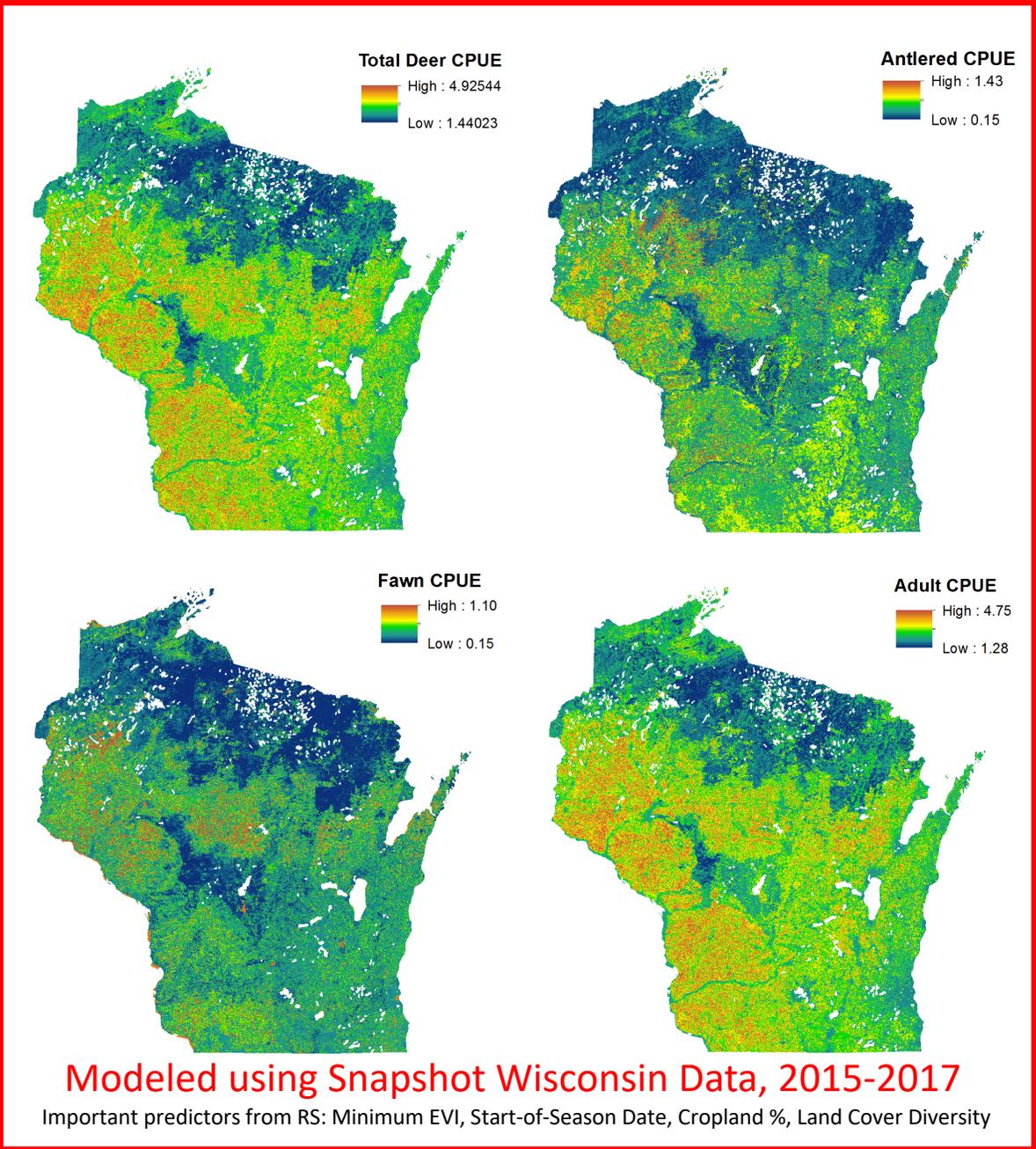
- Wildlife distributions as a function of remote sensing (Townsend et al.)
- Animal communities (Clare et al.)
- Wildlife behavior (Clare et al.)

- 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.)

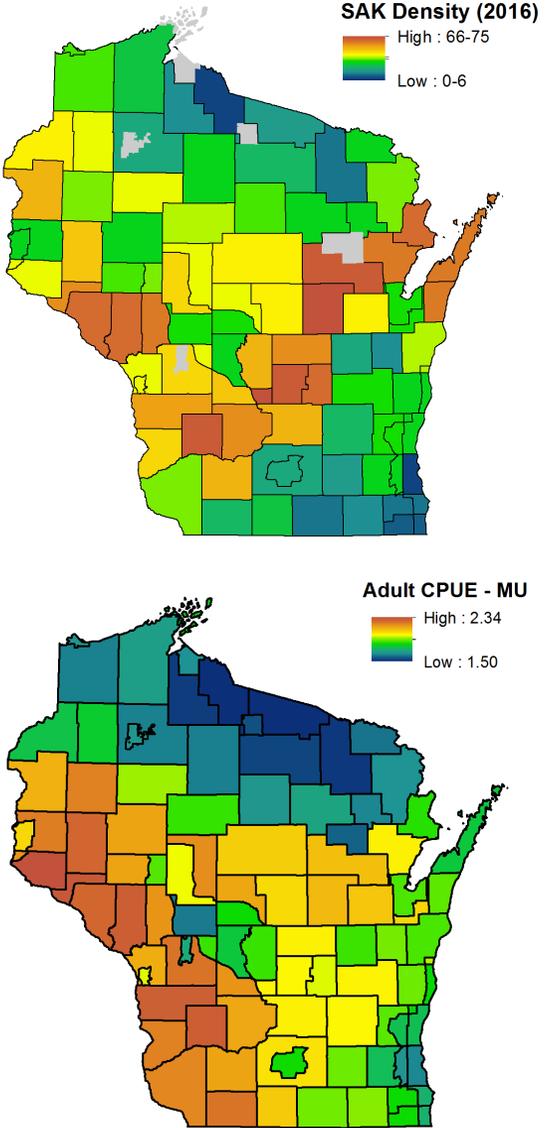
1) Wildlife Occupancy and Relative Density:



Deer:

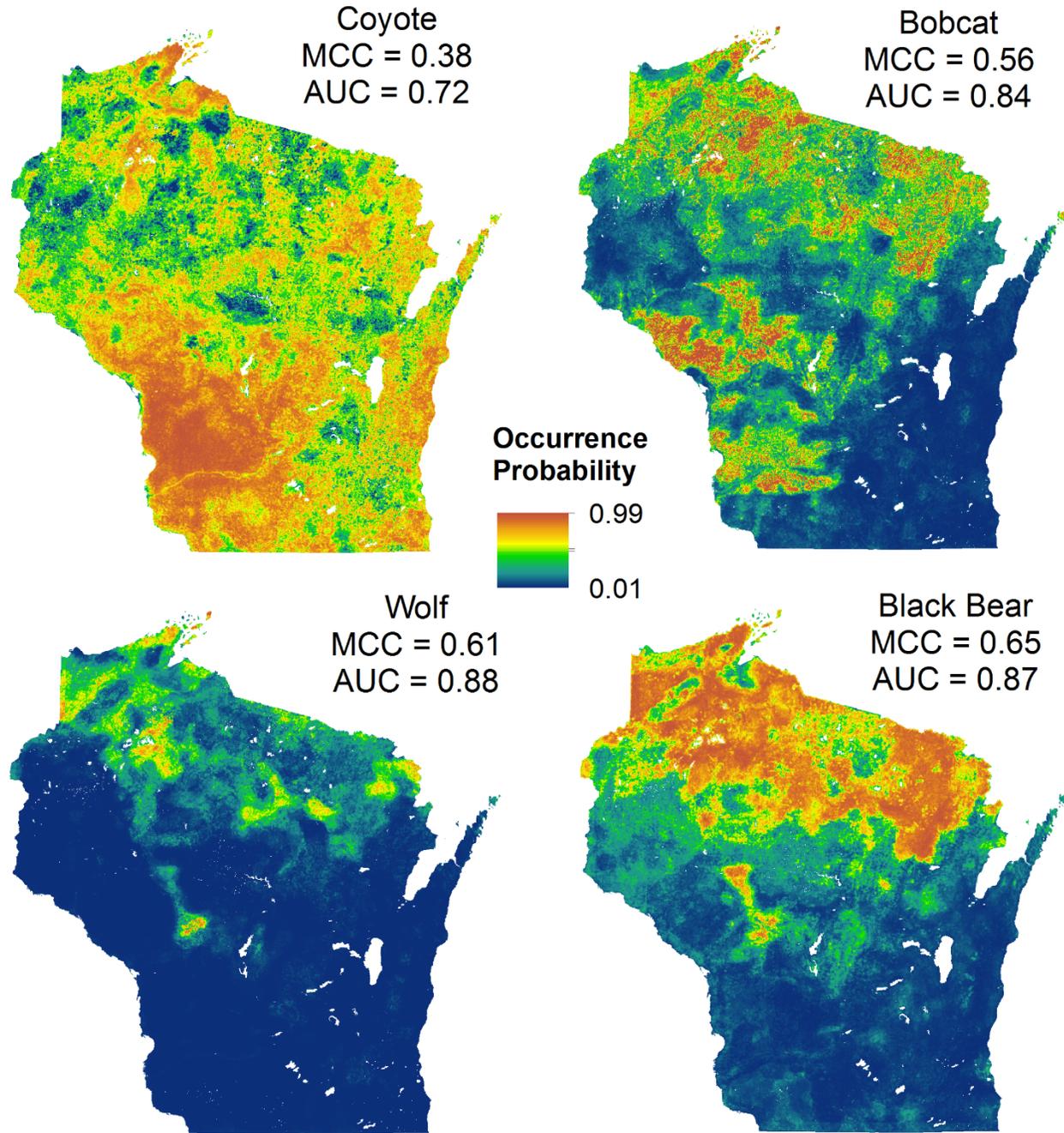


DNR Maps from SAK

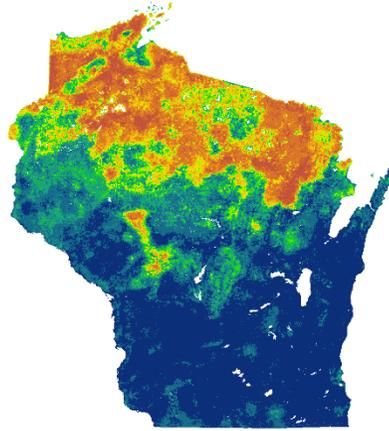


Snapshot Wi Maps aggregated to county

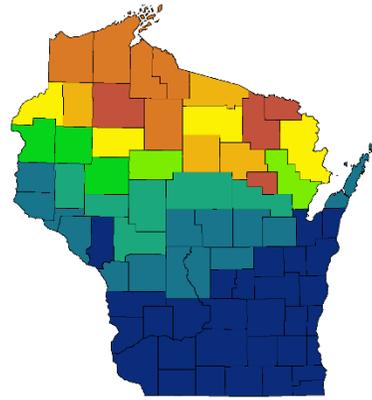
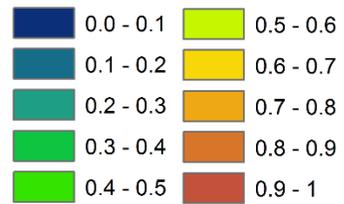
Carnivores:



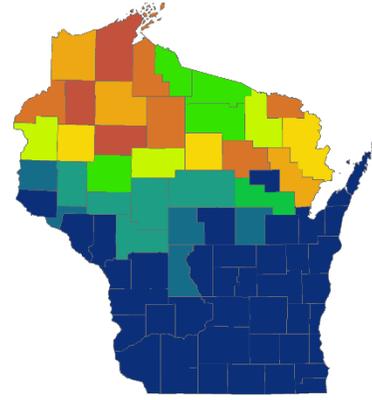
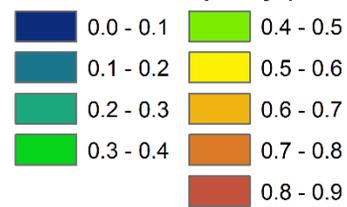
Bears



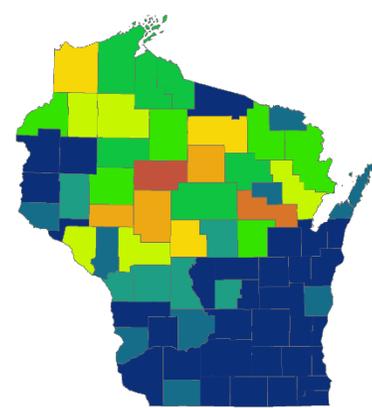
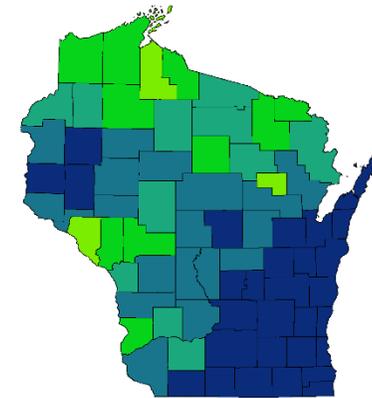
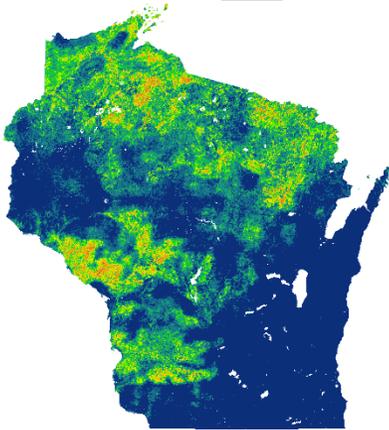
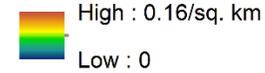
Predicted Occupancy



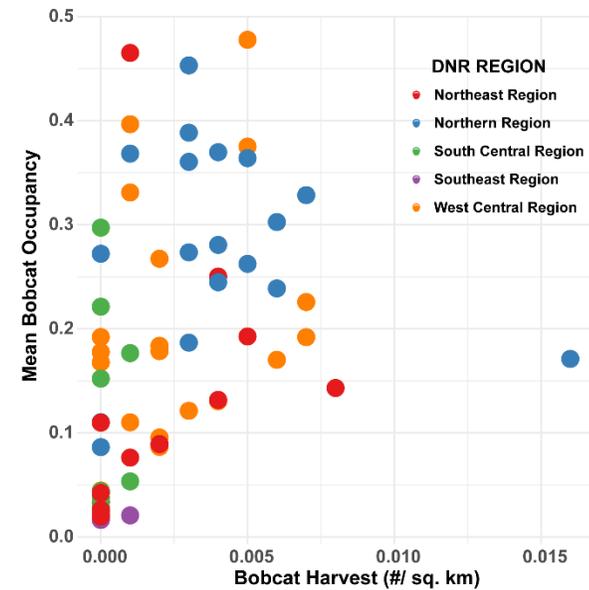
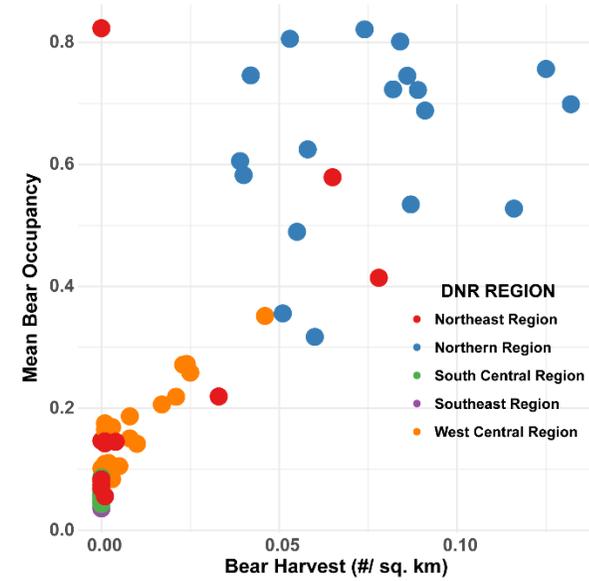
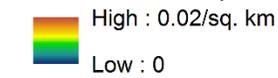
Predicted Occupancy (County)



Bear Harvest (County)



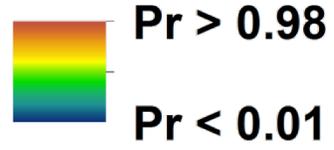
Bobcat Harvest (County)



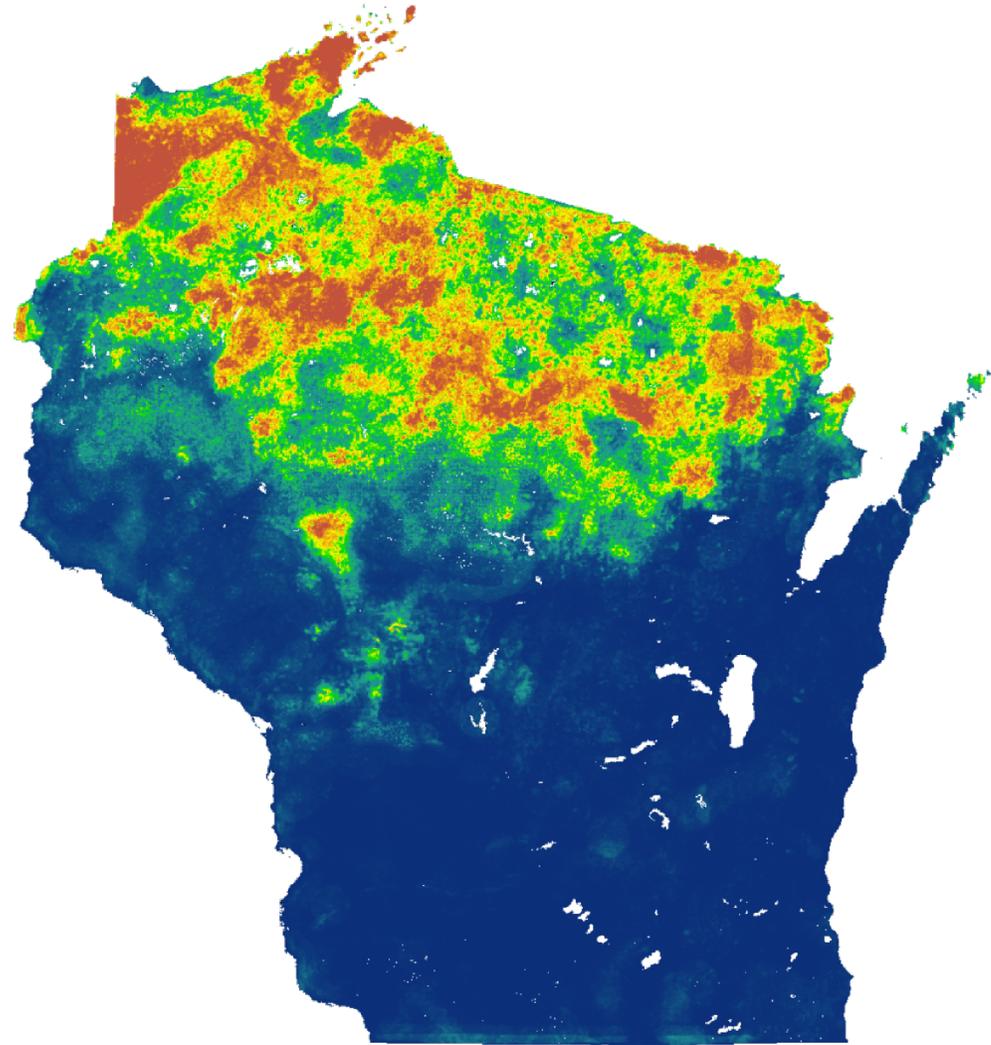
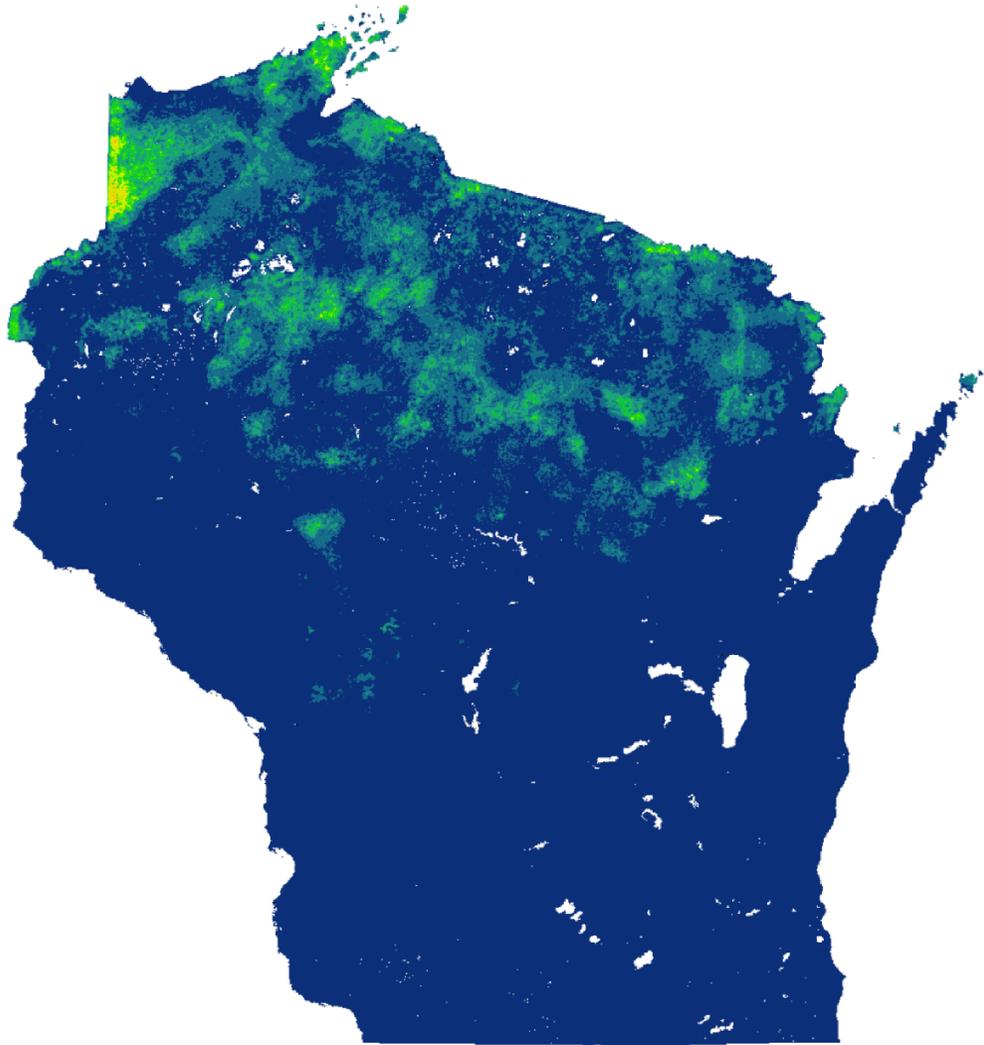
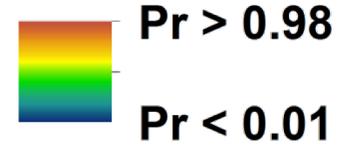
Bobcats



Bear Occurrence, April 1

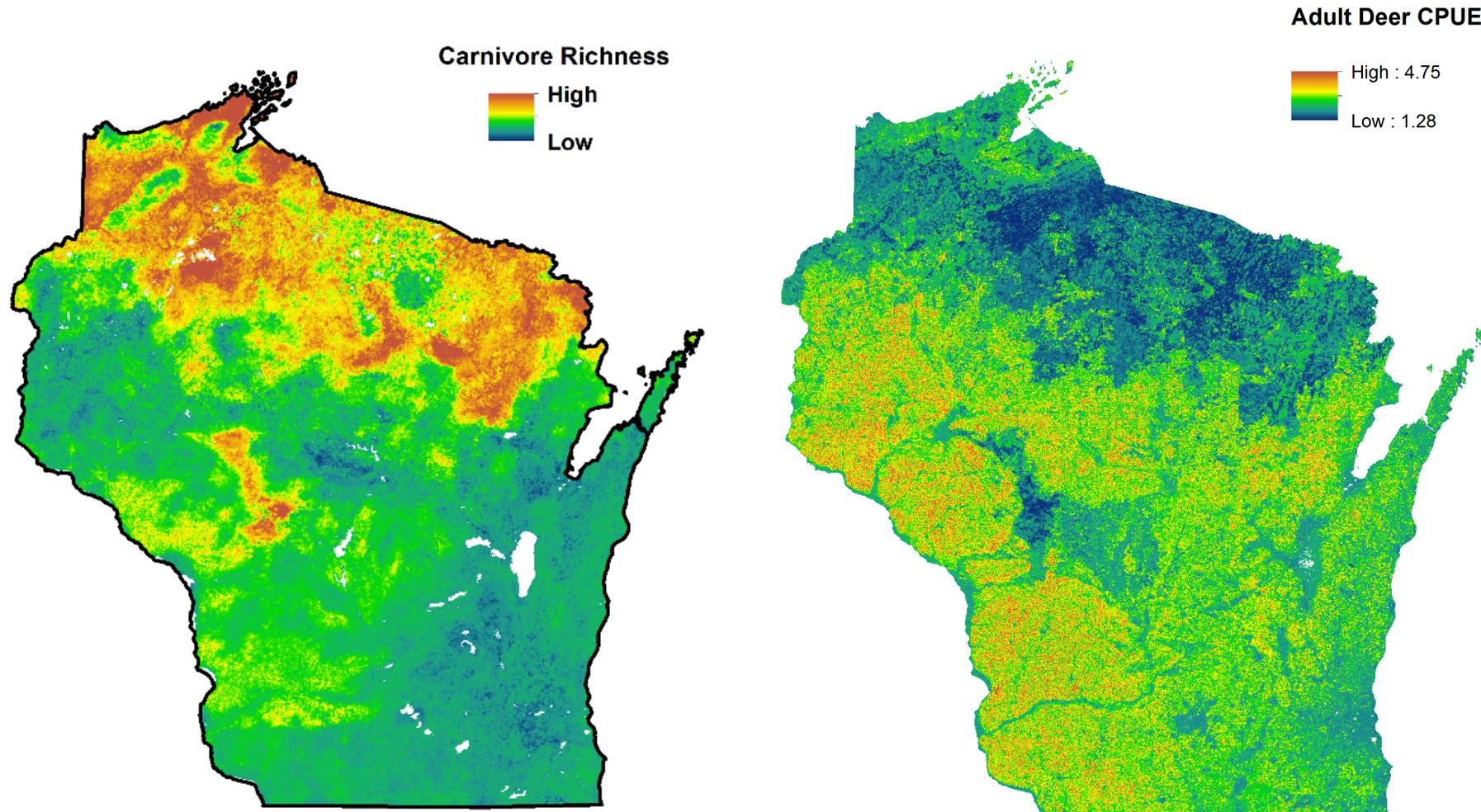


Bear Occurrence, July 1



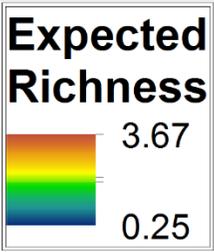
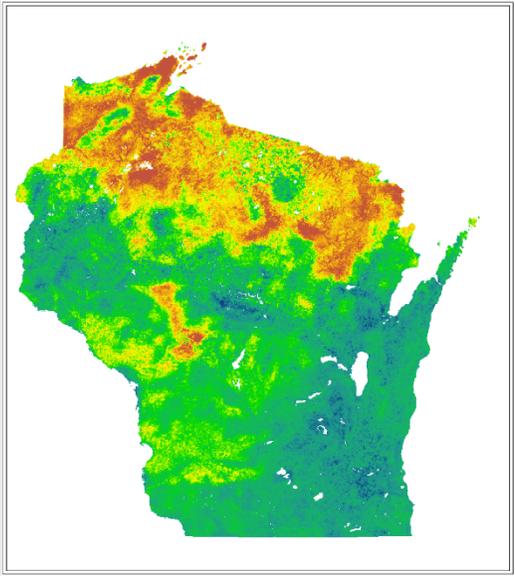
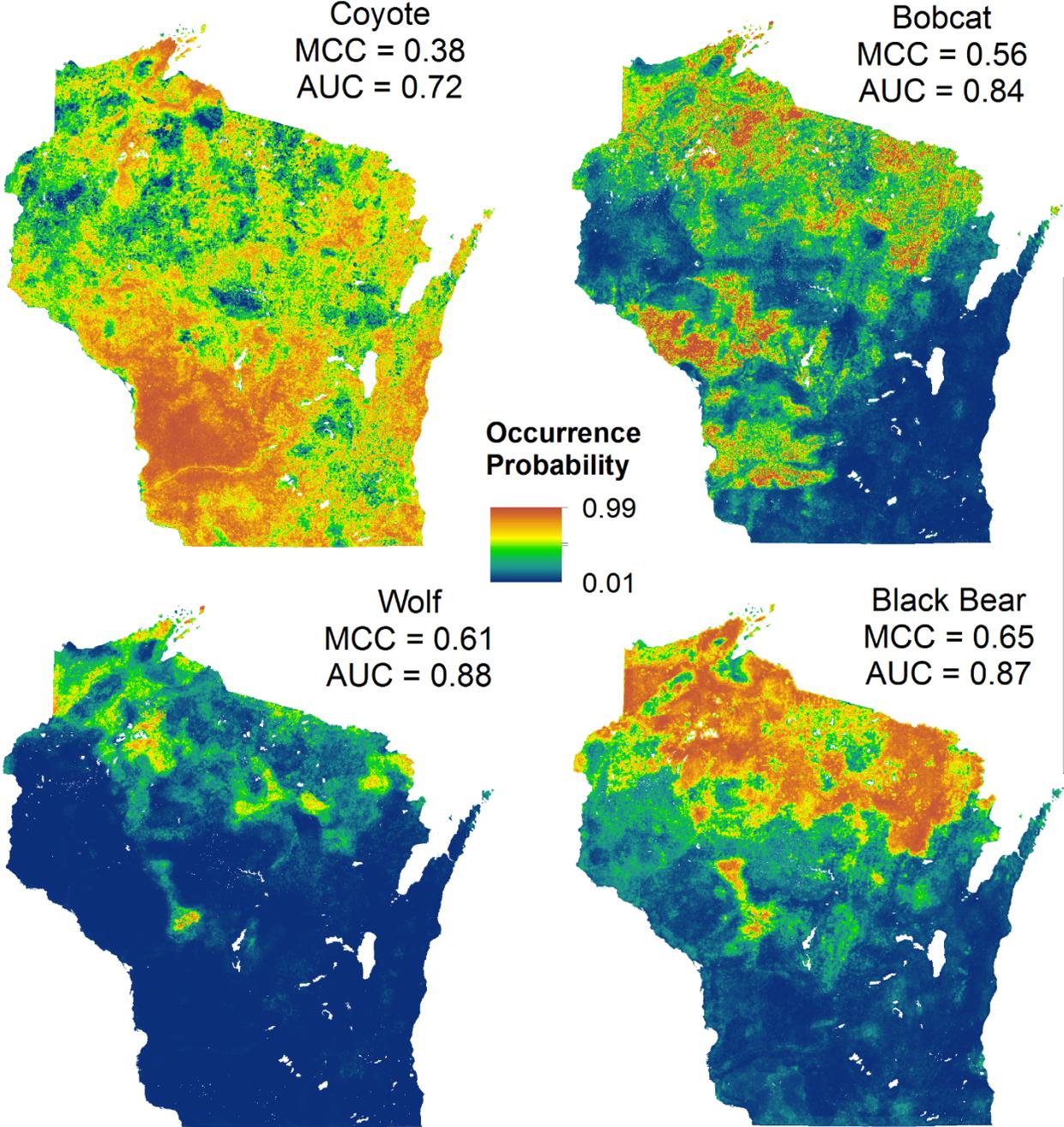
Adult Deer vs. Carnivores

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.*



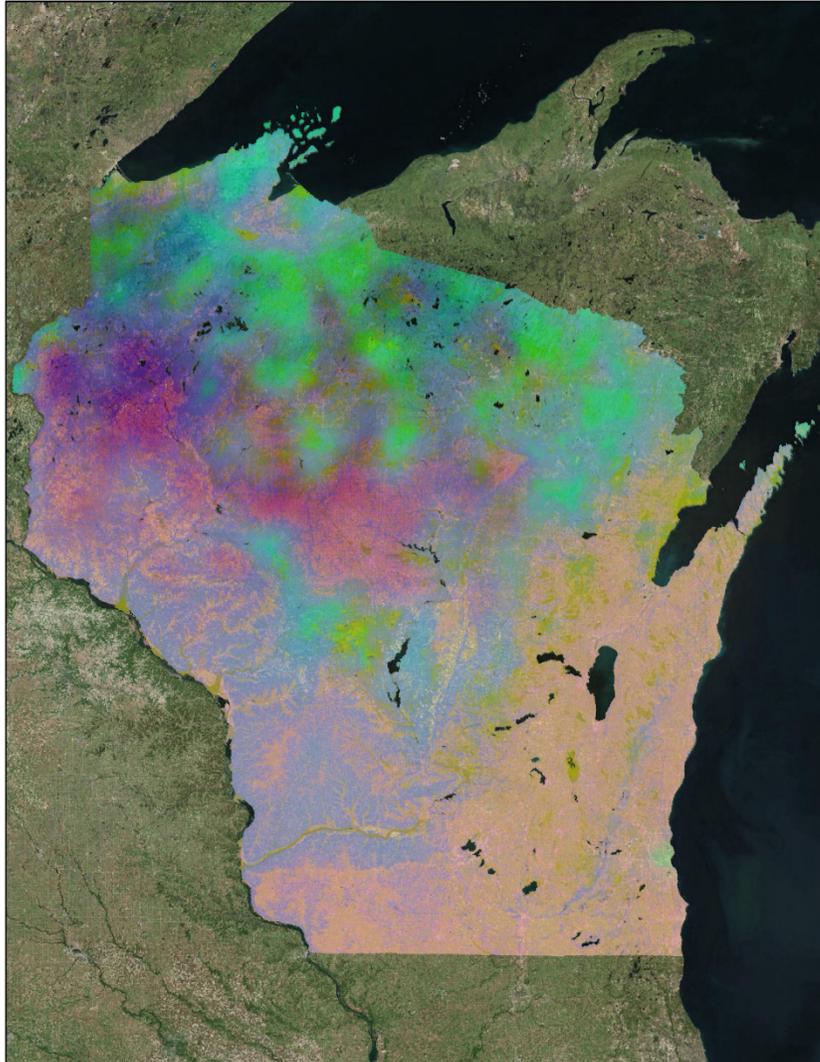
Carnivores:

Diversity and Richness





SNAPSHOT
W I S C O N S I N



2) Distribution of animal communities

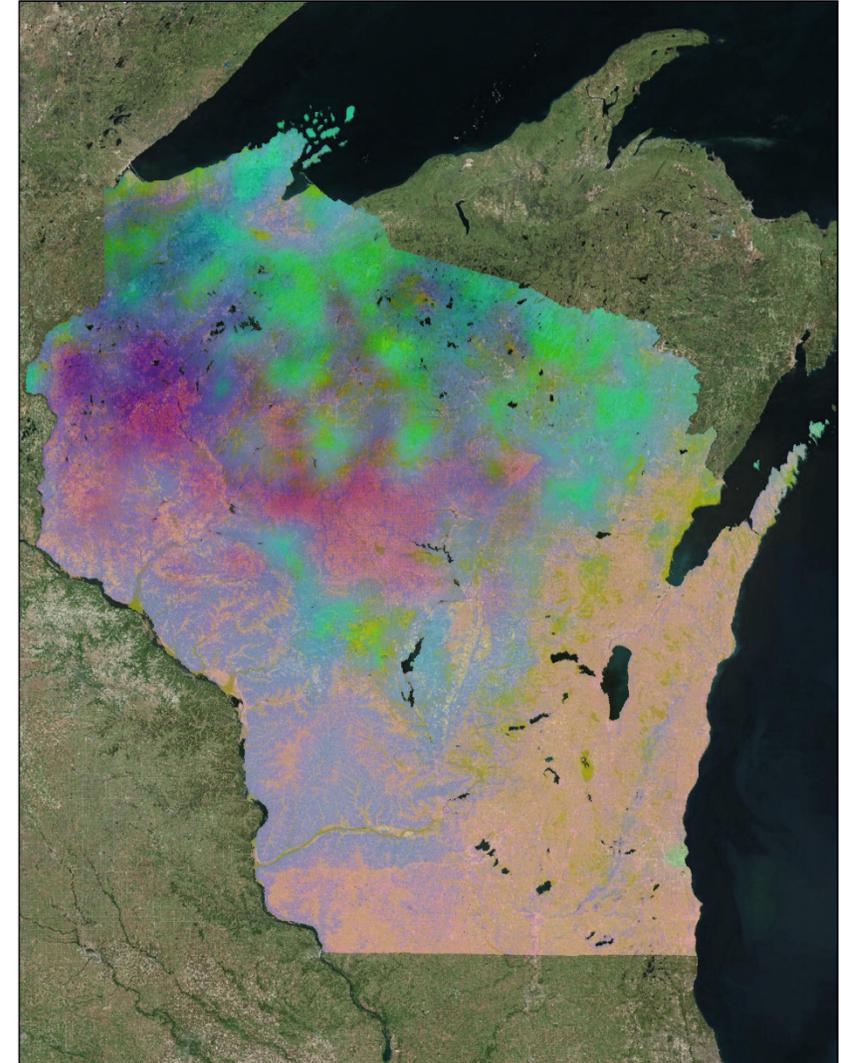
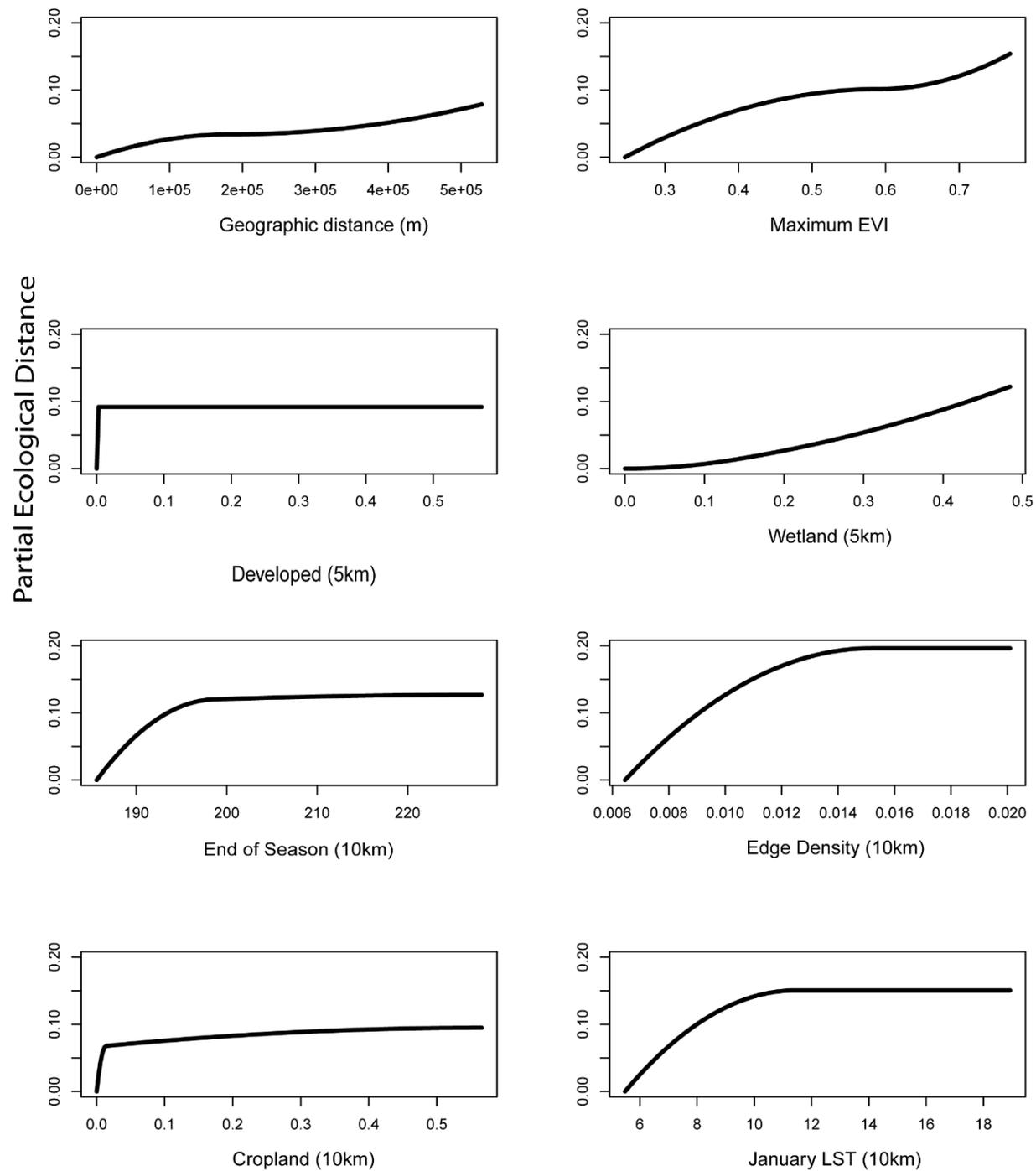
1. What are the drivers of **animal community composition** across the region?

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

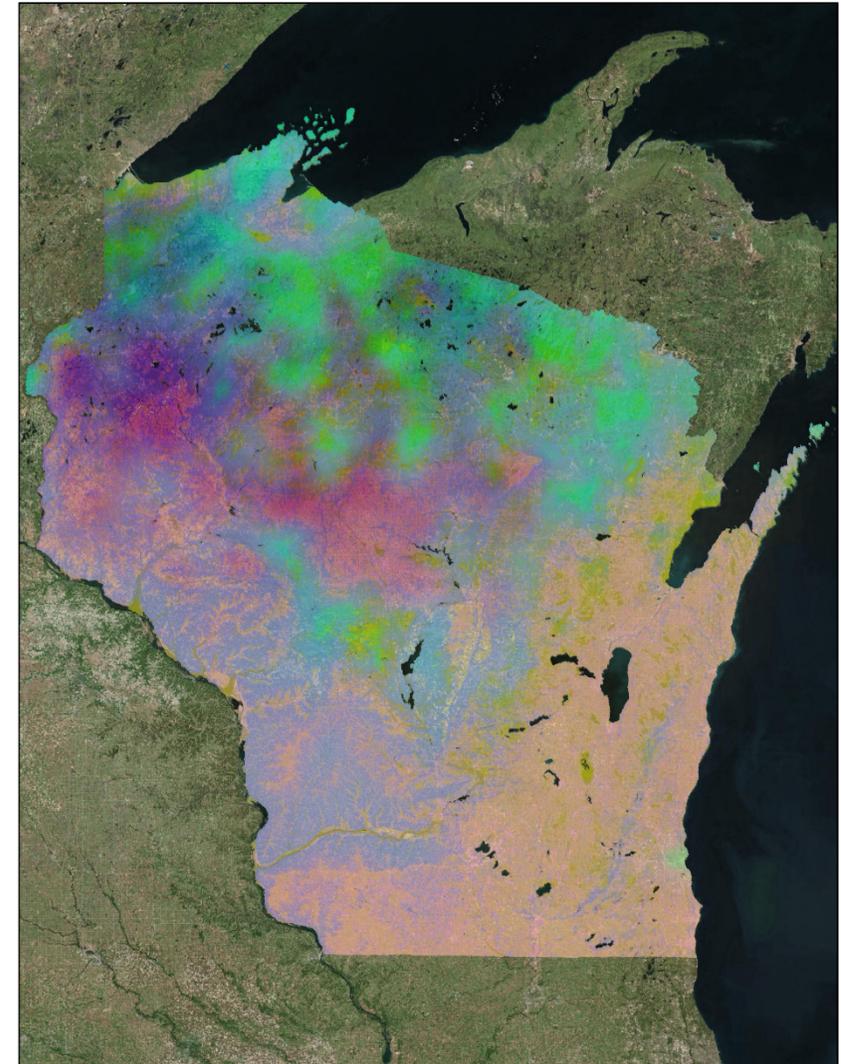
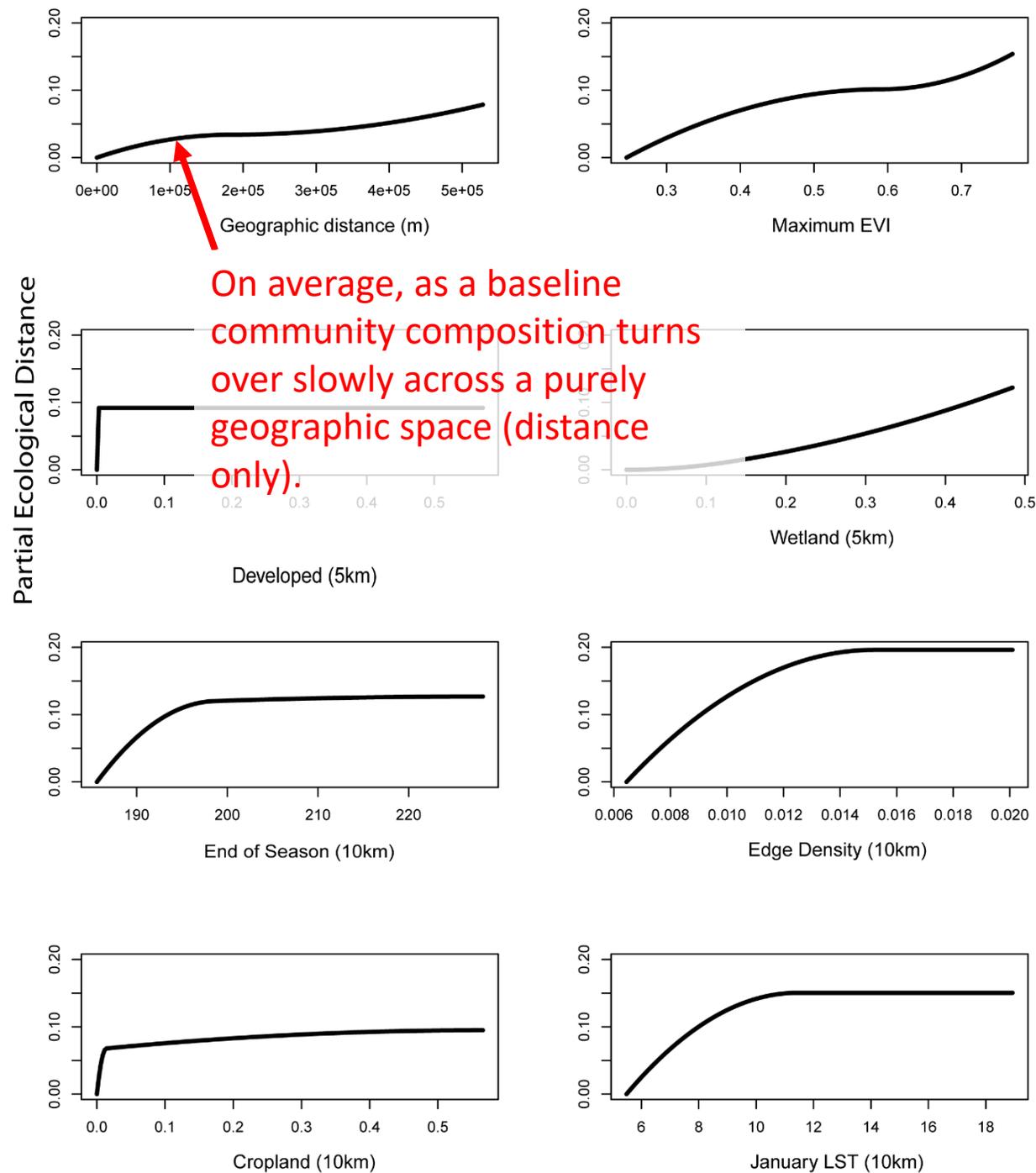
PCA of Dissimilarity Model of Composition based on geographic predictors

- PC1: Edge density (5km), EOS, landcover richness (10km), Jan. LST
- PC2: night lights and proportion developed
- PC3: core area

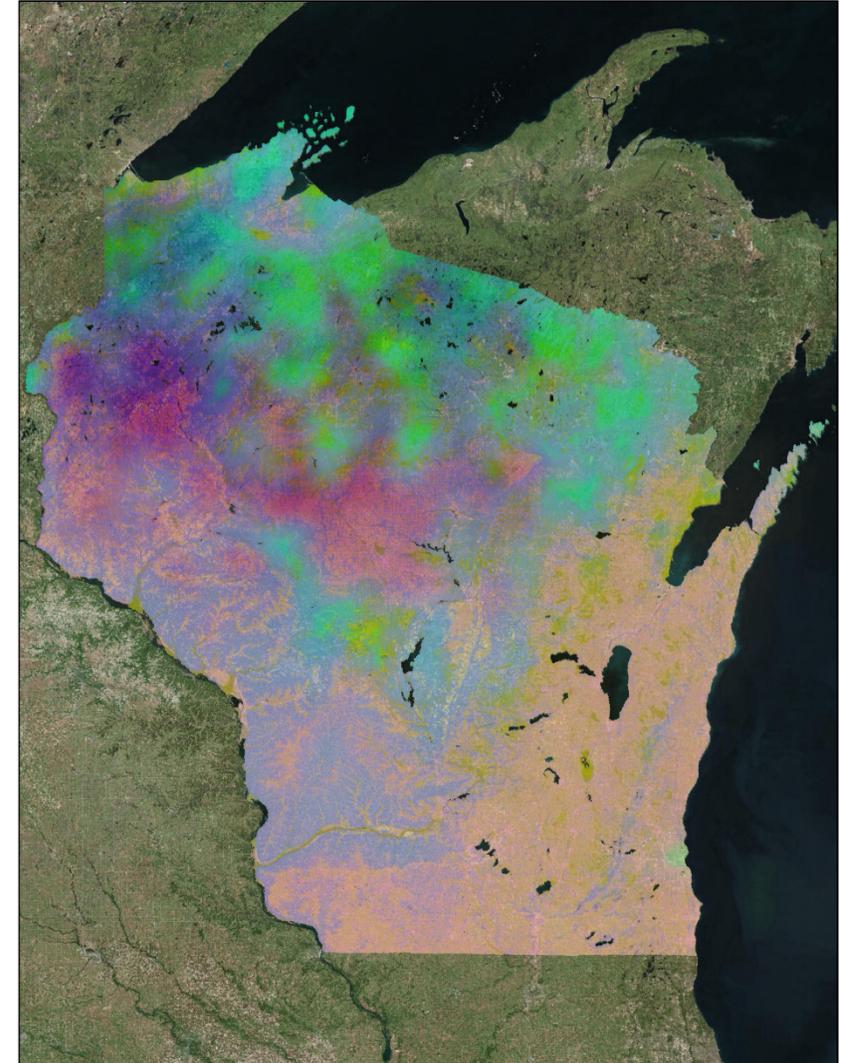
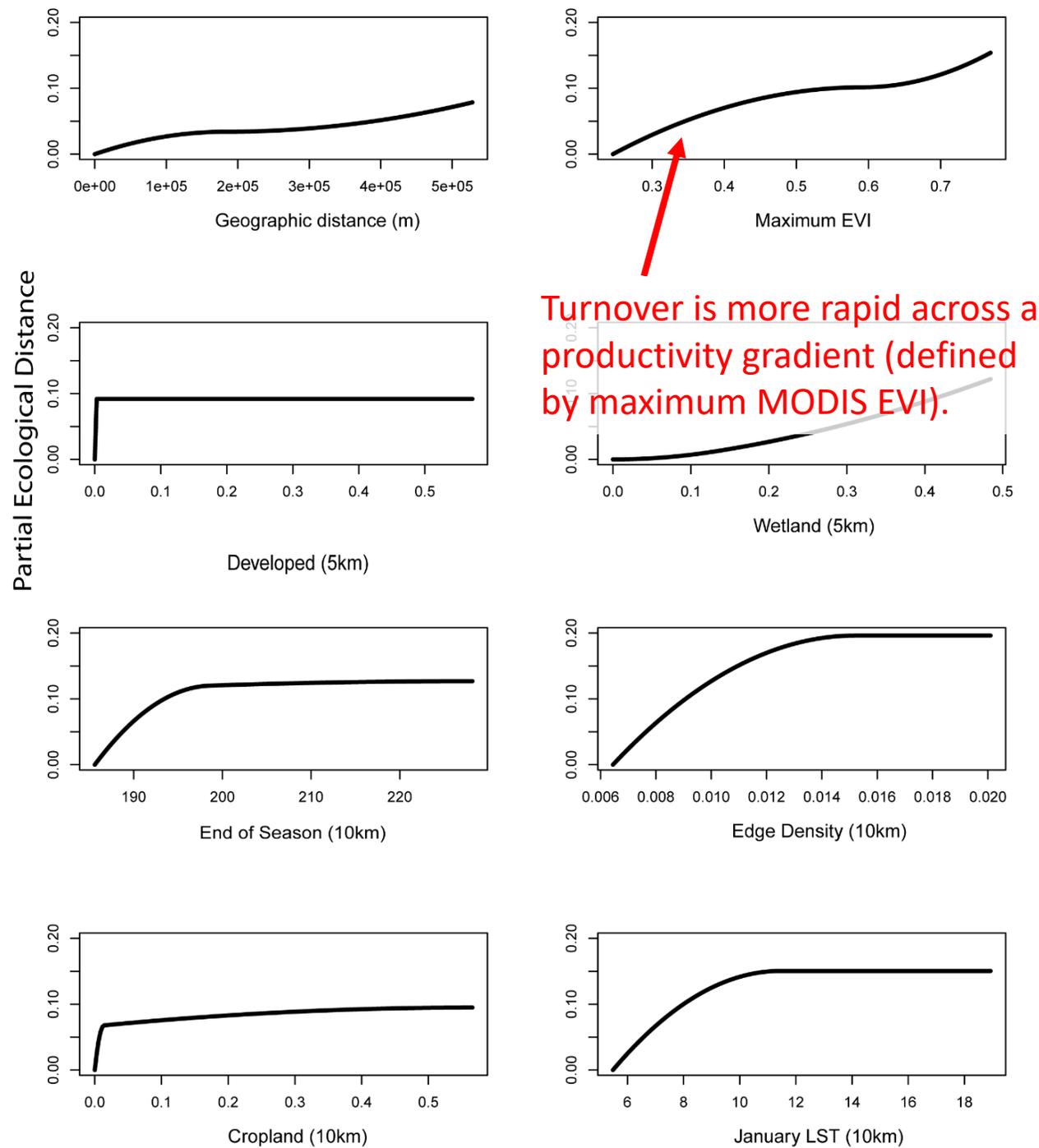
Terrestrial Animal Communities (visualized by first three principal components)



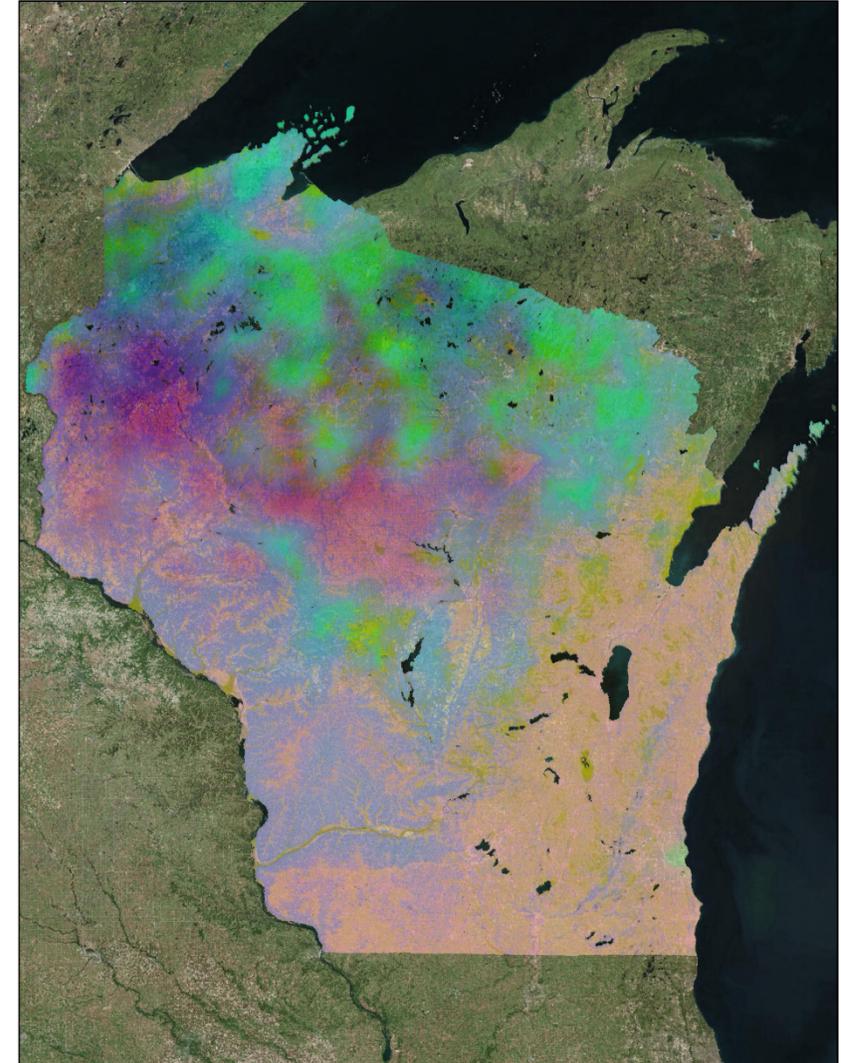
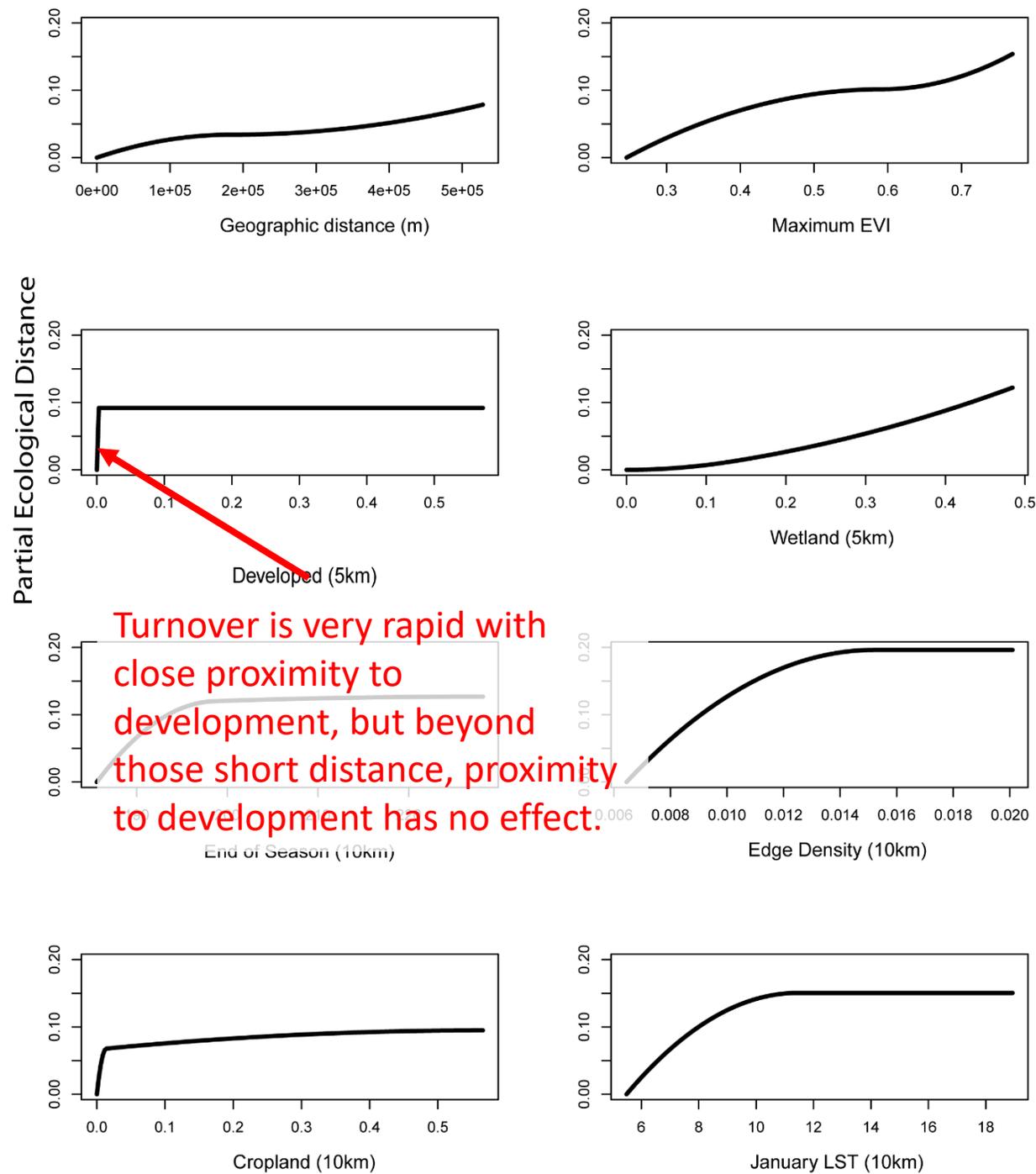
Terrestrial Animal Communities (visualized by first three principal components)



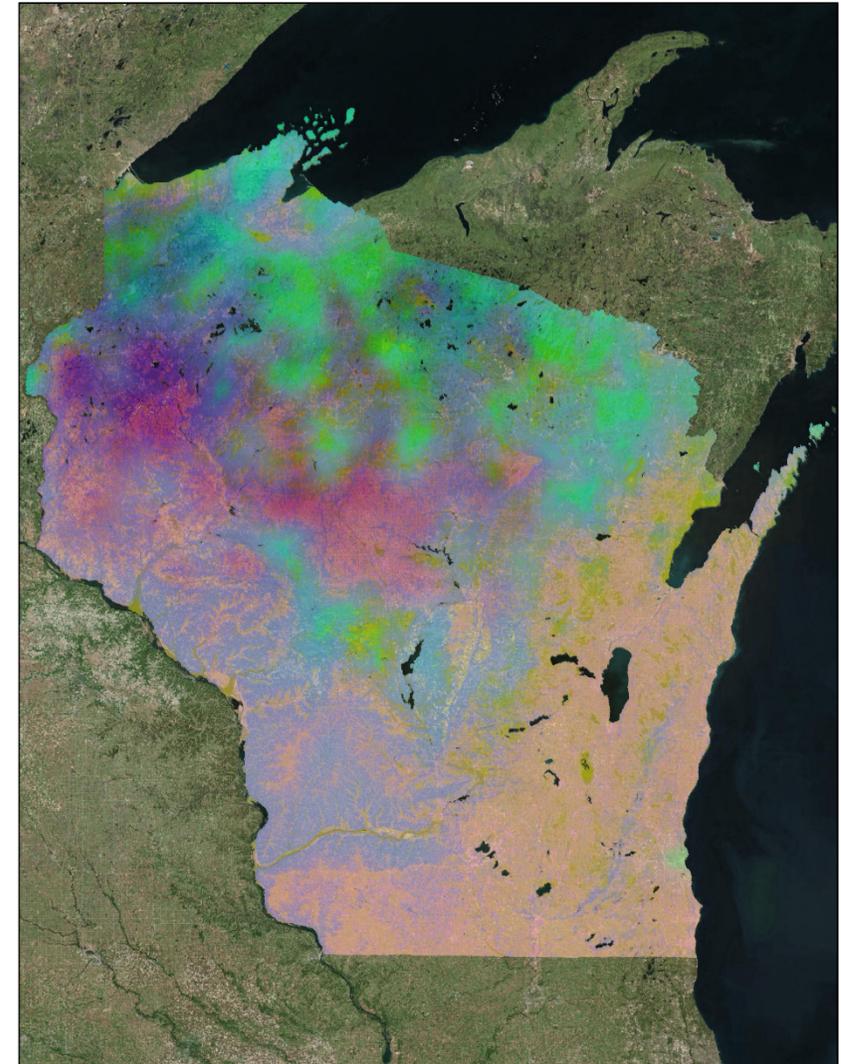
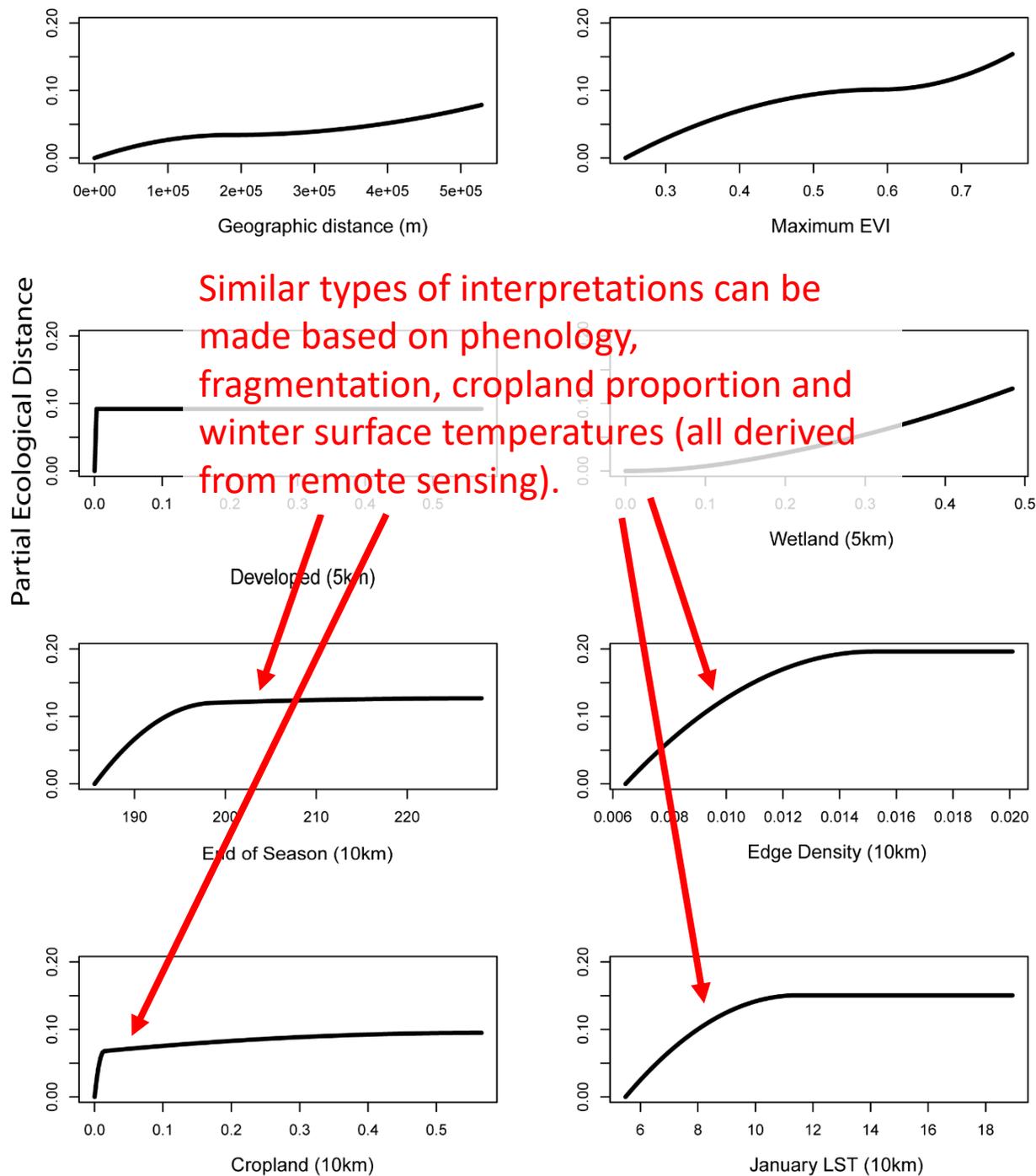
Terrestrial Animal Communities (visualized by first three principal components)

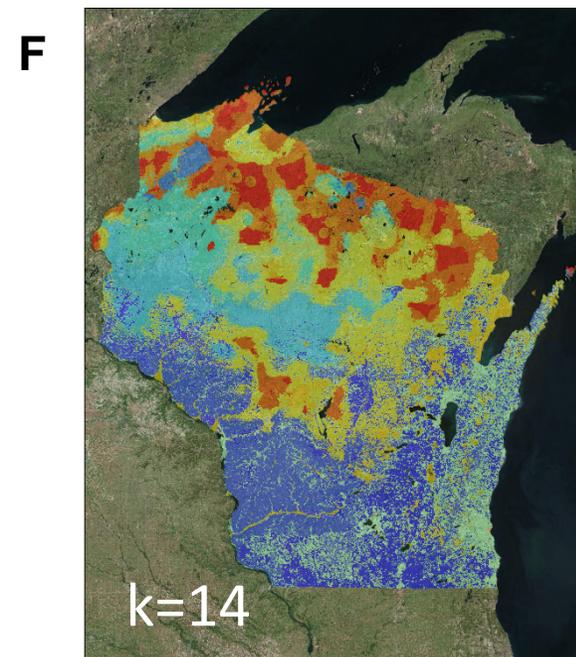
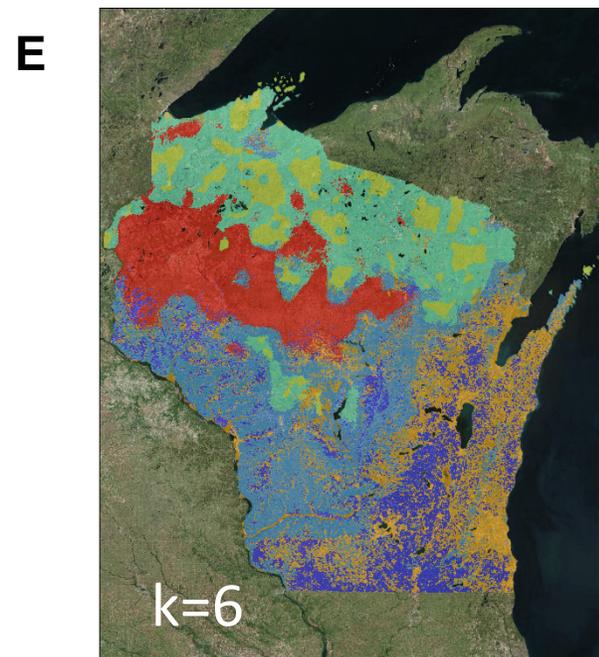
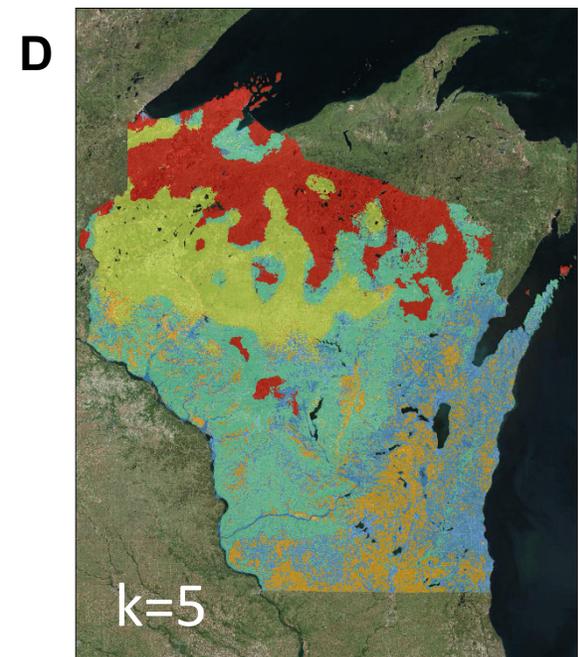
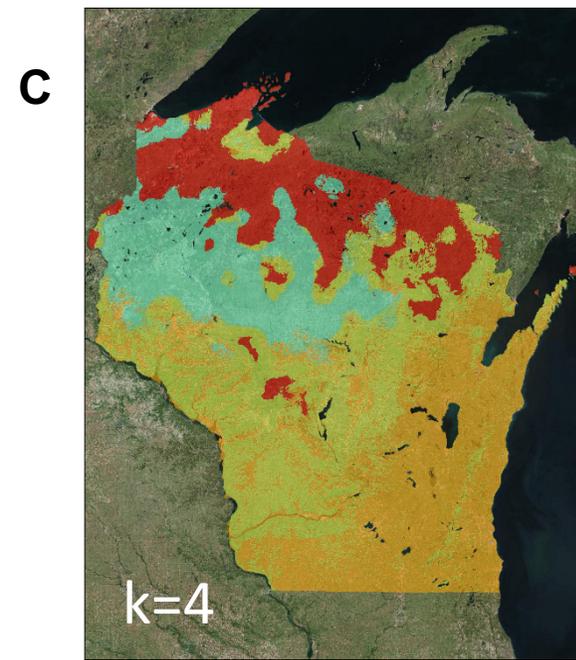
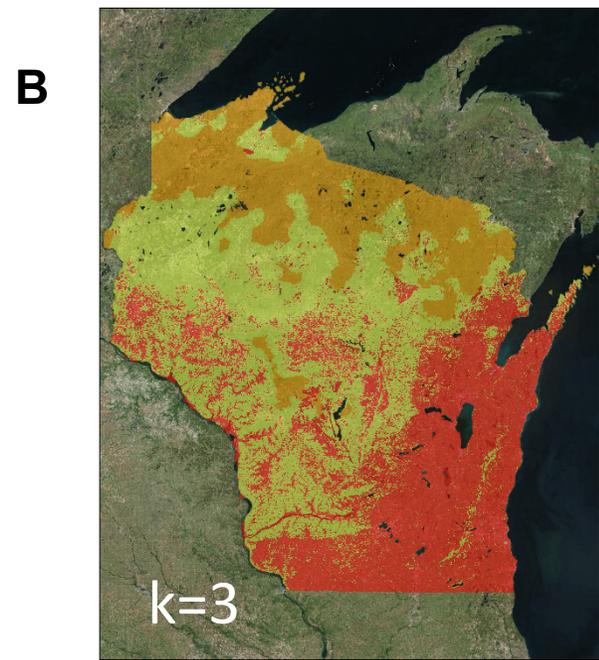
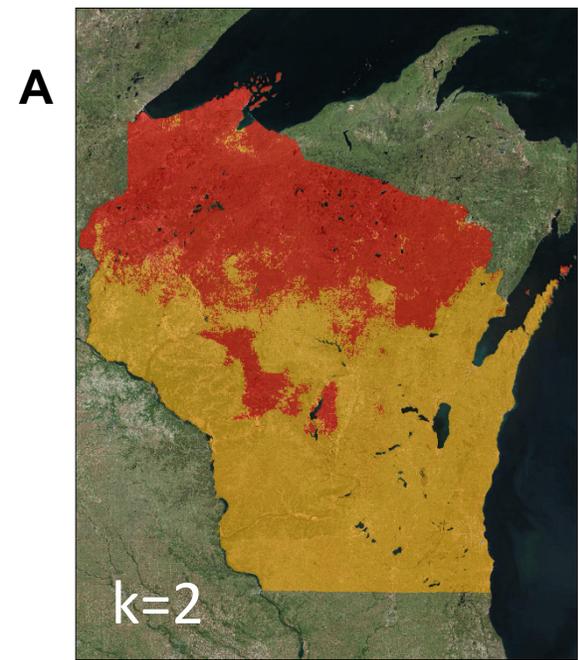


Terrestrial Animal Communities (visualized by first three principal components)



Terrestrial Animal Communities (visualized by first three principal components)

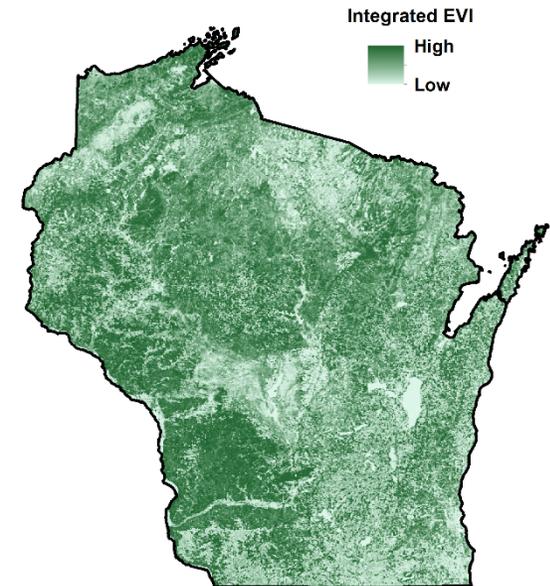
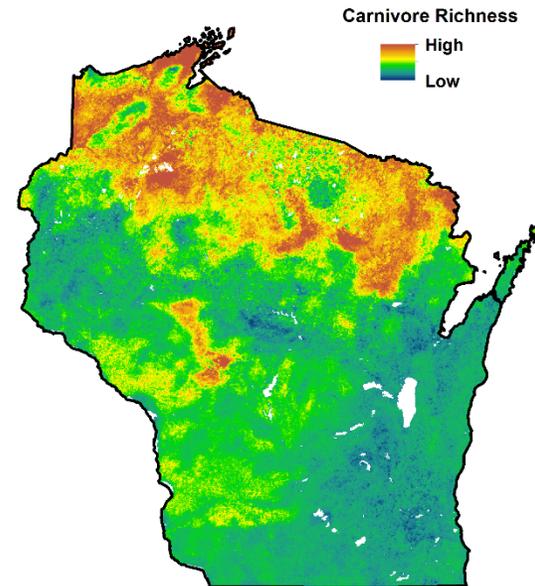
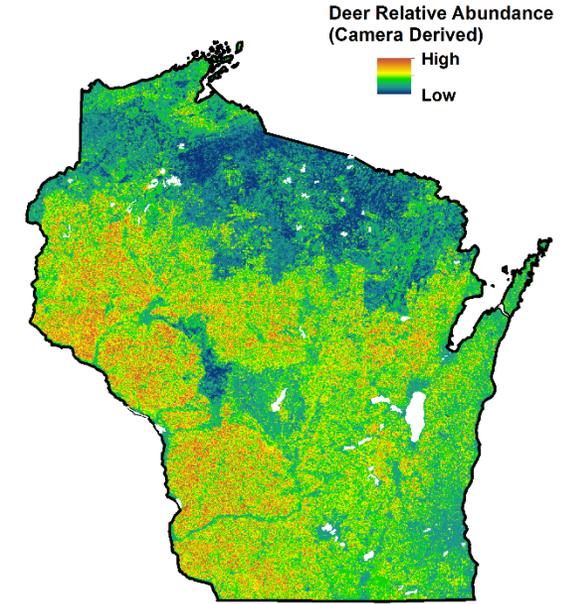
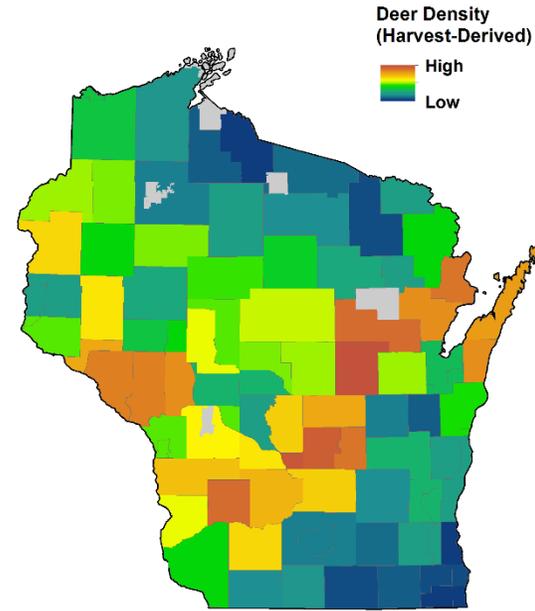


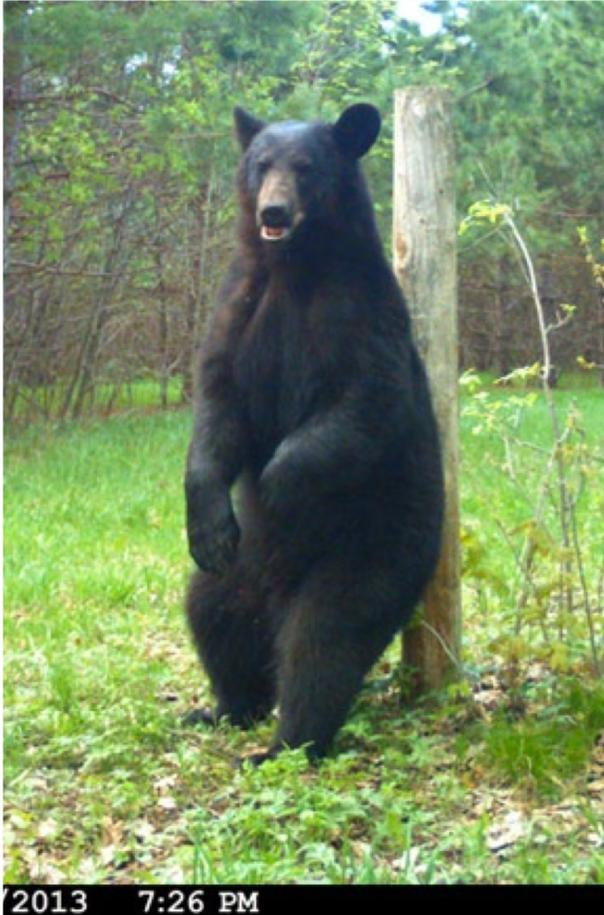


Use predictions on previous slides with k-means clustering to identify distinct animal communities (best fitting cluster number is 14 in panel F).

Occupancy

John Clare's work:
How do these patterns
relate to *behavior*?

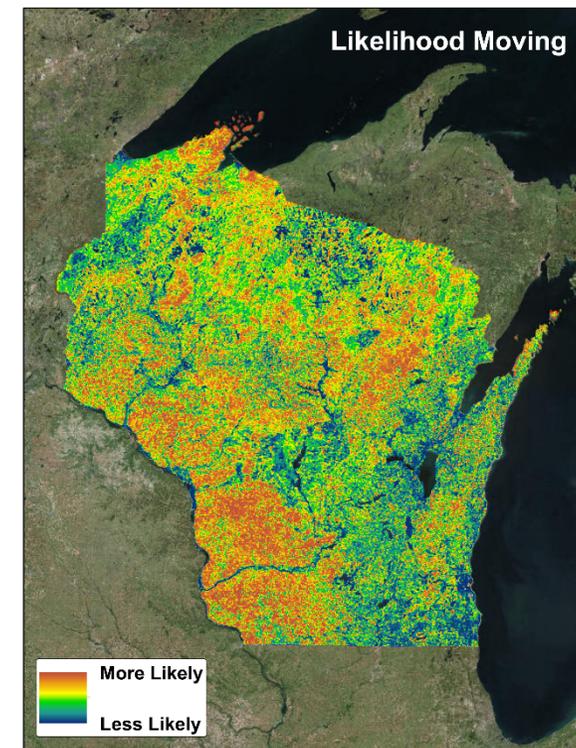
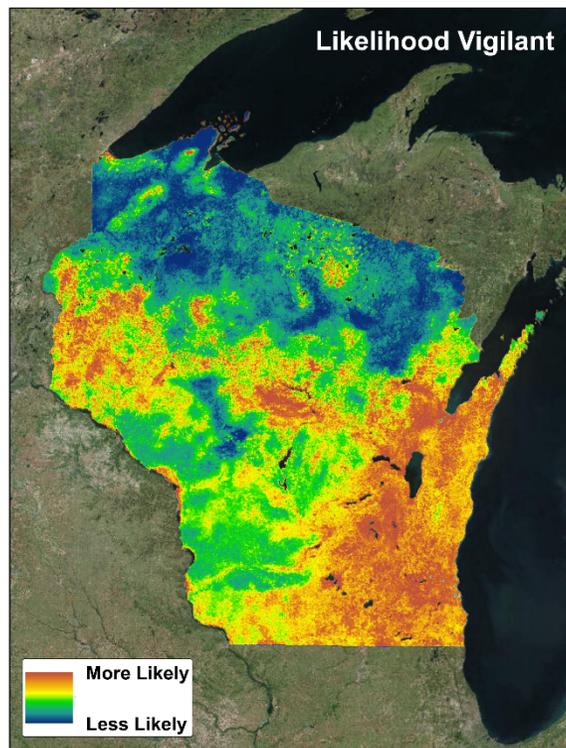
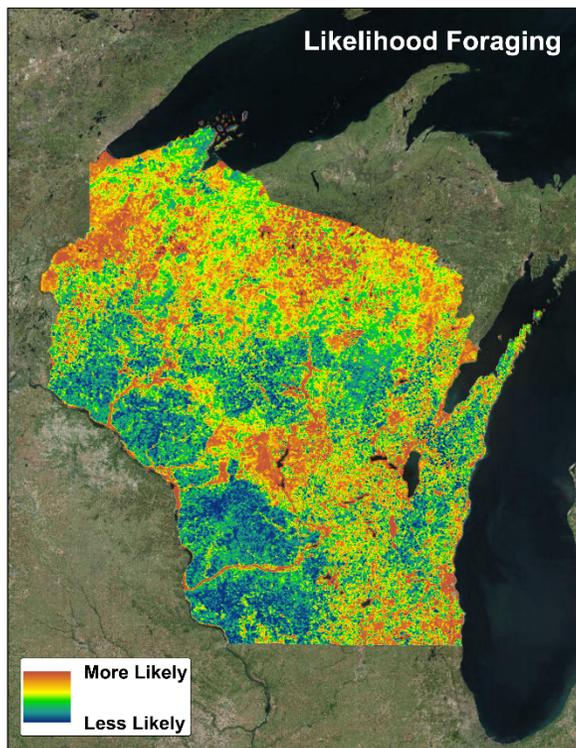




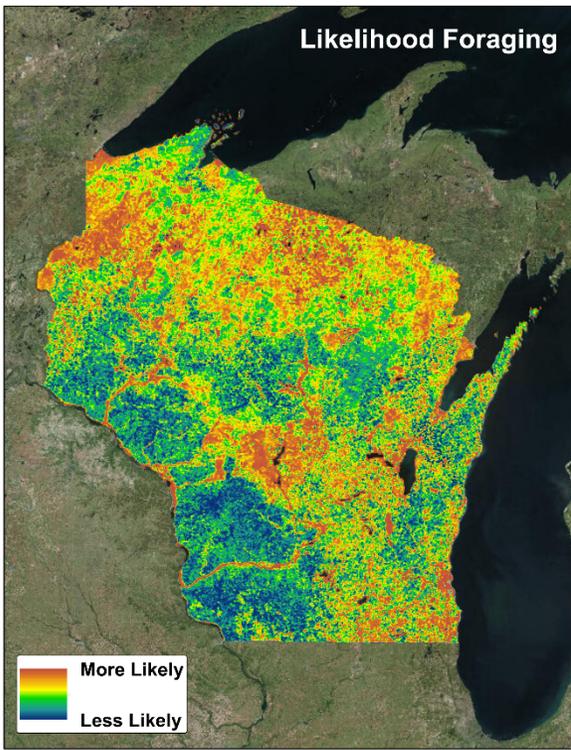
3) Behavior

What drives animal behavior?

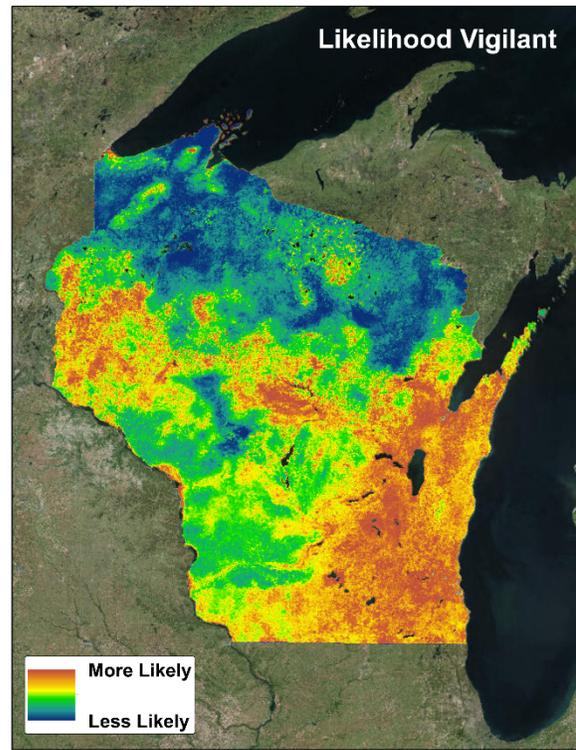
- Remote sensing measurements may be predictive of animal activity (e.g., vegetation productivity, landscape context)
- Predator density also influences behavior



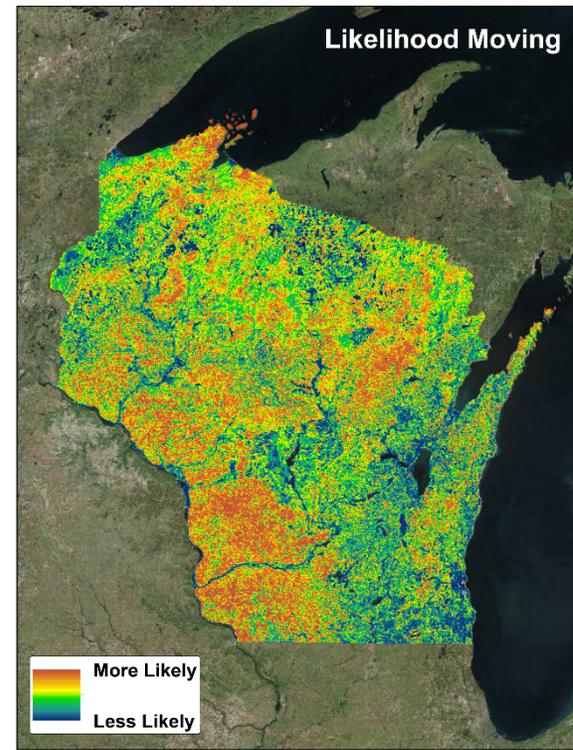
Likelihood Foraging



Likelihood Vigilant



Likelihood Moving



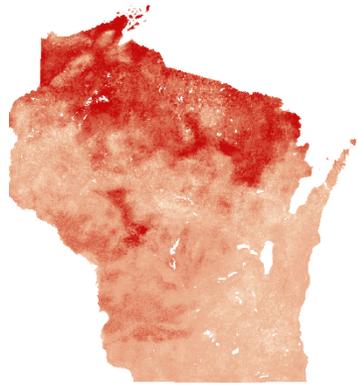
Integrated predictions across the hour (but holding the time of day constant) reveals distinct trade-offs in the activity budgets for deer in different areas.
 Note: prediction requires marginalizing across some “unpredictable” variables (e.g., no raster available) or using spatial products derived from related inputs (i.e., distribution of predators predicted using same data sets).

Static Inputs

Integrated EVI

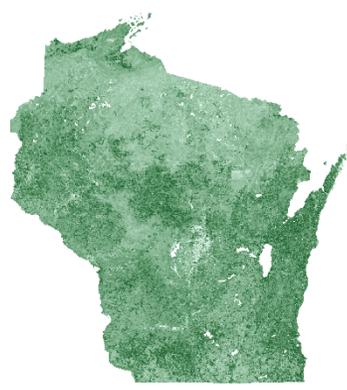


Predator Spp. Richness



Dynamic Inputs

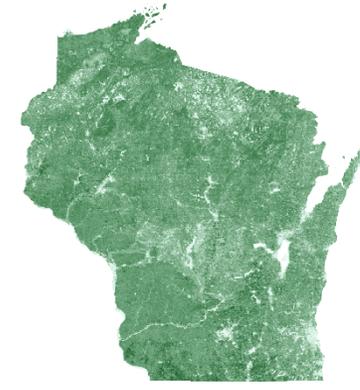
End of Growing Season Relative to Current Date



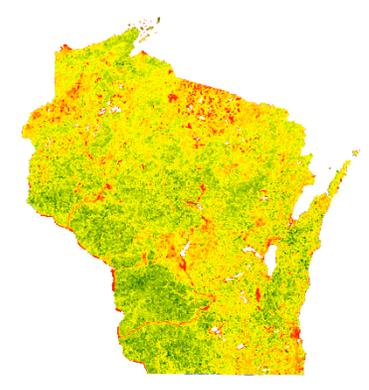
Peak Productivity Relative to Current Date



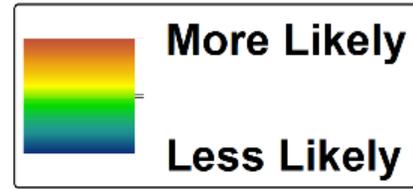
Daily EVI



Daily EVI Relative to Surroundings



Likelihood Foraging

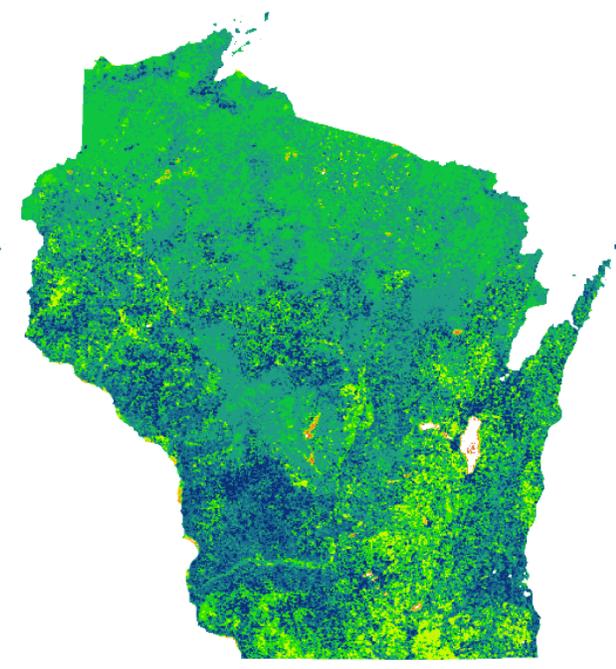
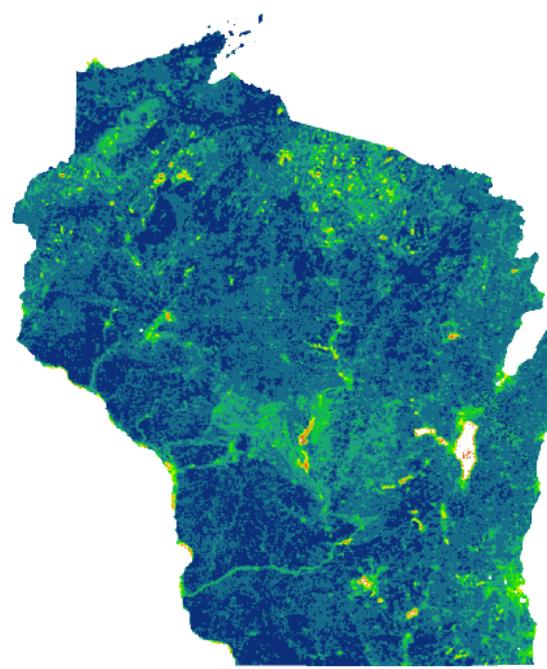
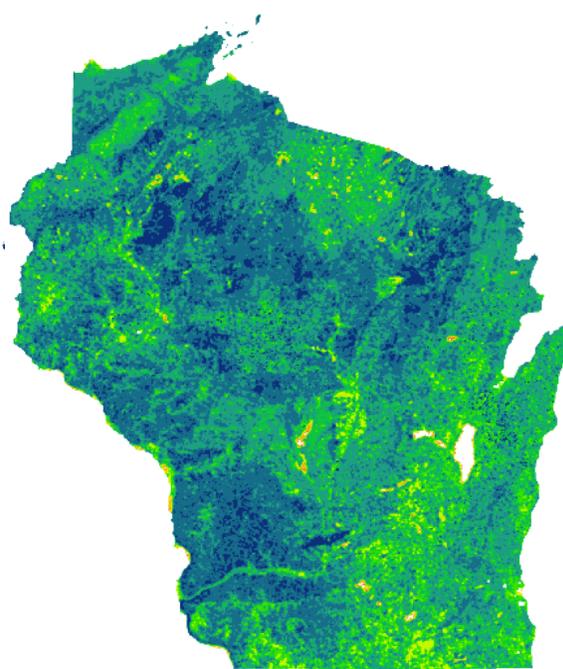
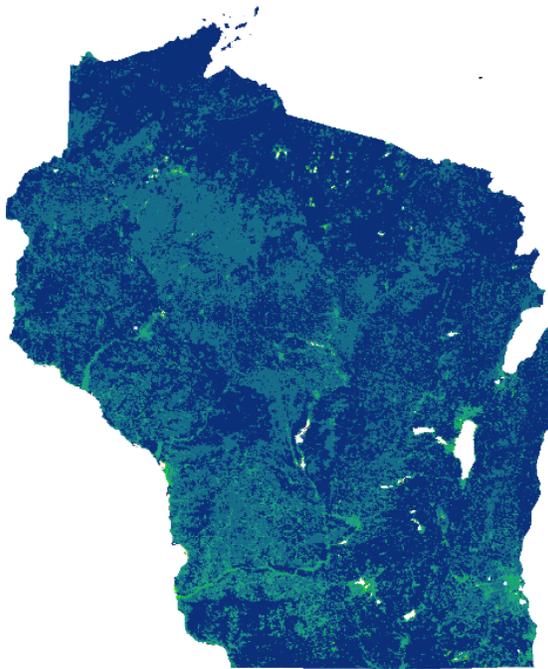


January 15, 2017

May 30, 2017

July 15, 2017

November 3, 2017



EVI:



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

Funding

#NNX14AC36G

#NNX16A061H



Other Contributors:

Christina Locke

Jennifer Stenglein

Vivek Malleshappa

Young Lee

Partners











