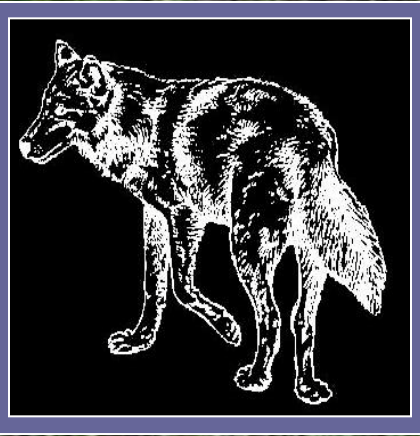
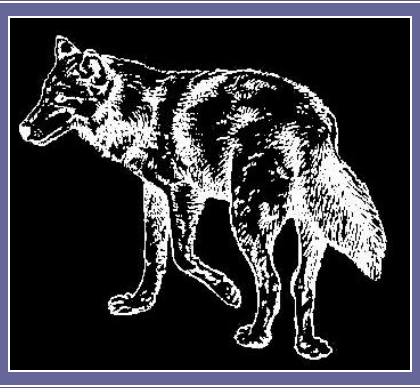


Trophic Cascades in Great Lakes Wolves

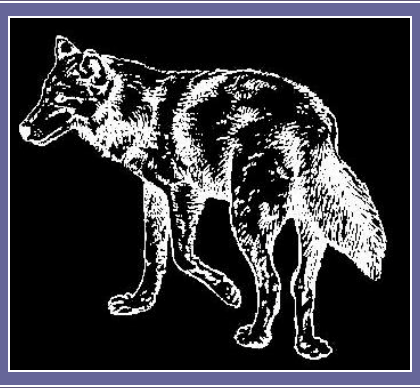
Tom Rooney, Ramana Callan,
Krystle Bouchard, and Nate Nibbelink



Summary of two research projects

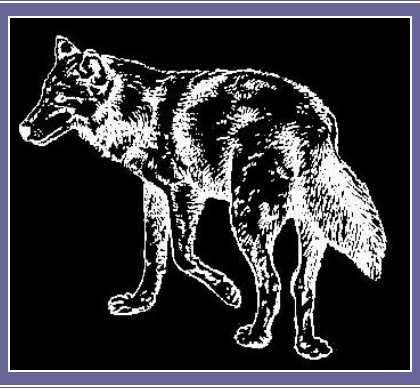
Ramana Callan, PhD
University of Georgia

Krystle Bouchard, MS
Wright State University



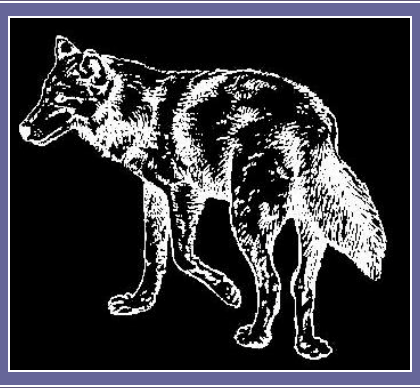
Wisconsin's Understory Plant Communities

- Local losses in plant species diversity
- Regional recruitment failure of conifers
- N. WI White-tailed deer populations
  - pre-settlement: < 10/mi^2
  - current: 10-40/mi^2

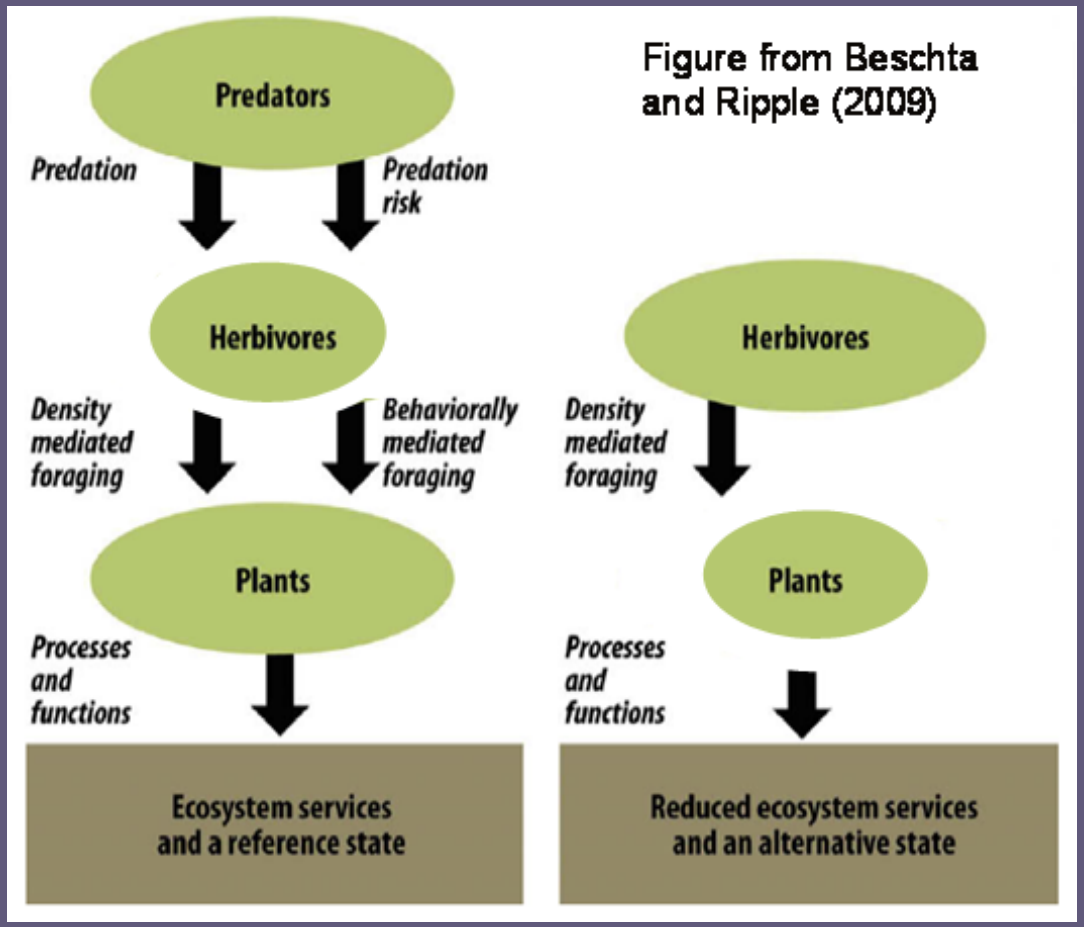


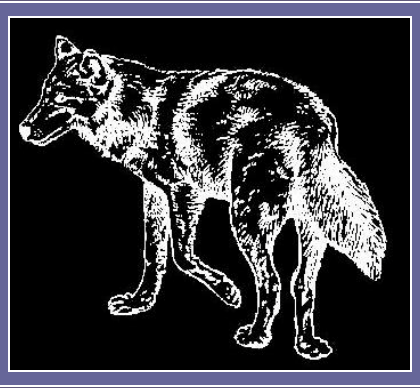
Wisconsin's Wolves

- Predicted to contribute to the conservation of regional biodiversity
- Through direct impacts on white-tailed deer, wolves are predicted to trigger additional indirect impacts on plant communities



Wolves and Trophic Cascades





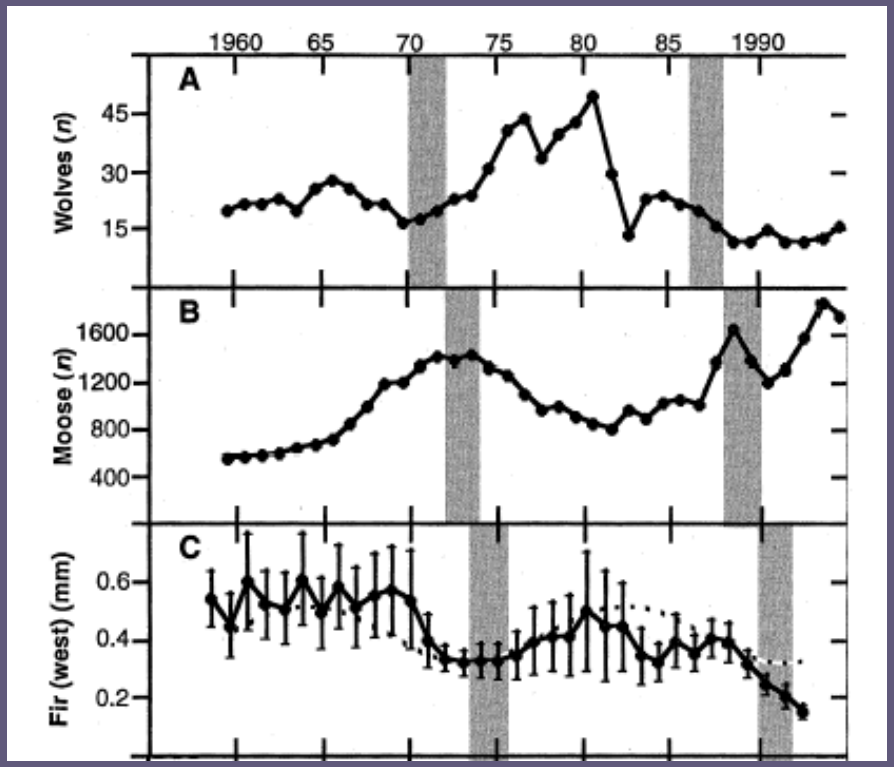
Wolves and Trophic Cascades

Predators can indirectly influence plants by:

- Predation: Density-mediated indirect interactions (Death Effects)
- Predation Risk: Trait-mediated indirect interactions

  →**Behaviorally mediated trophic cascades (Fear Effects)**

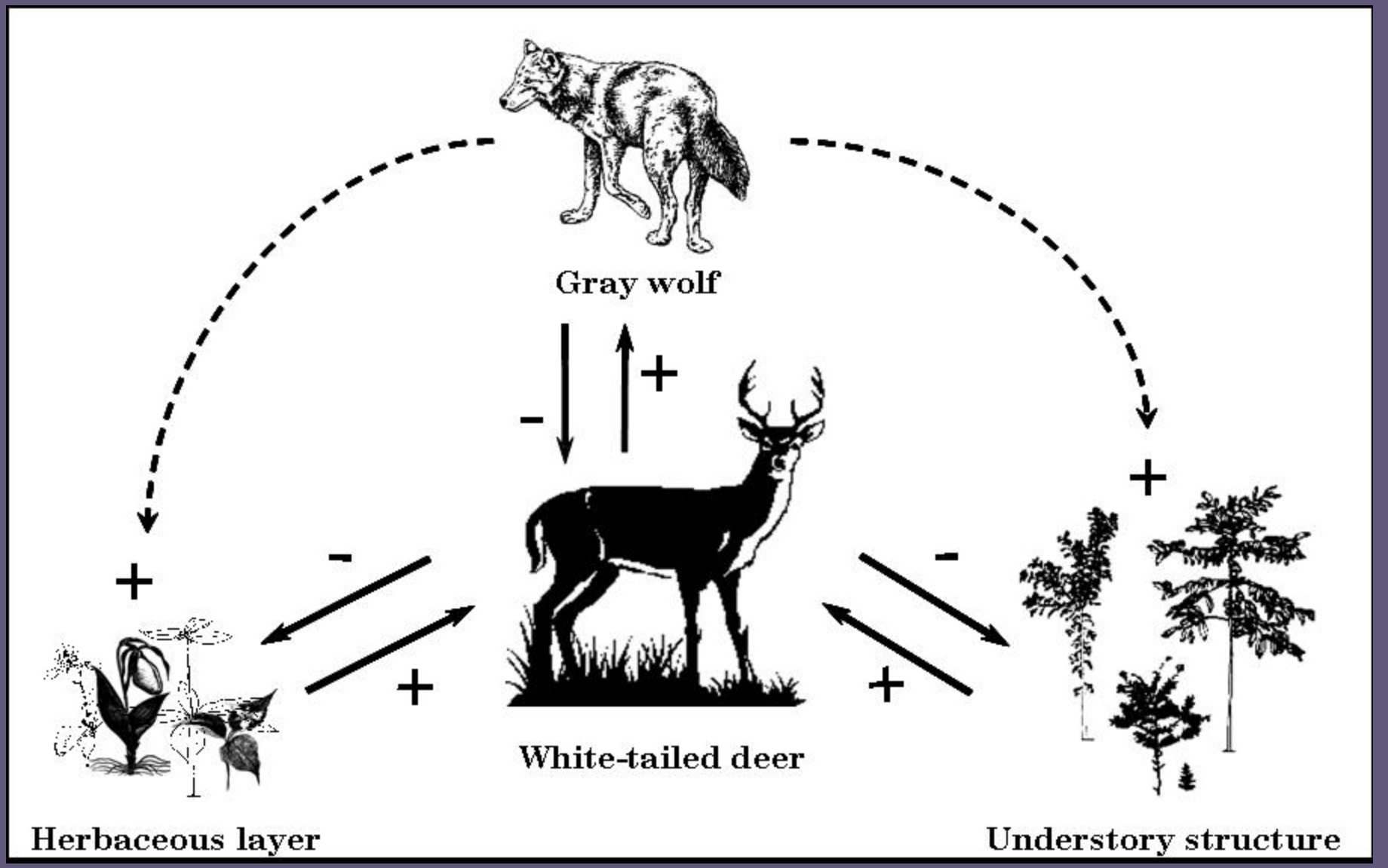
Wolf-moose-balsam fir system on Isle Royale

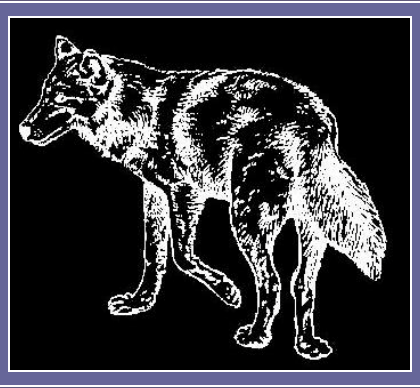


McLaren and Peterson 1994

(Photo credit: Michigan Technological University)

Trophic interactions in Wisconsin forests





Wolves and white-tailed deer

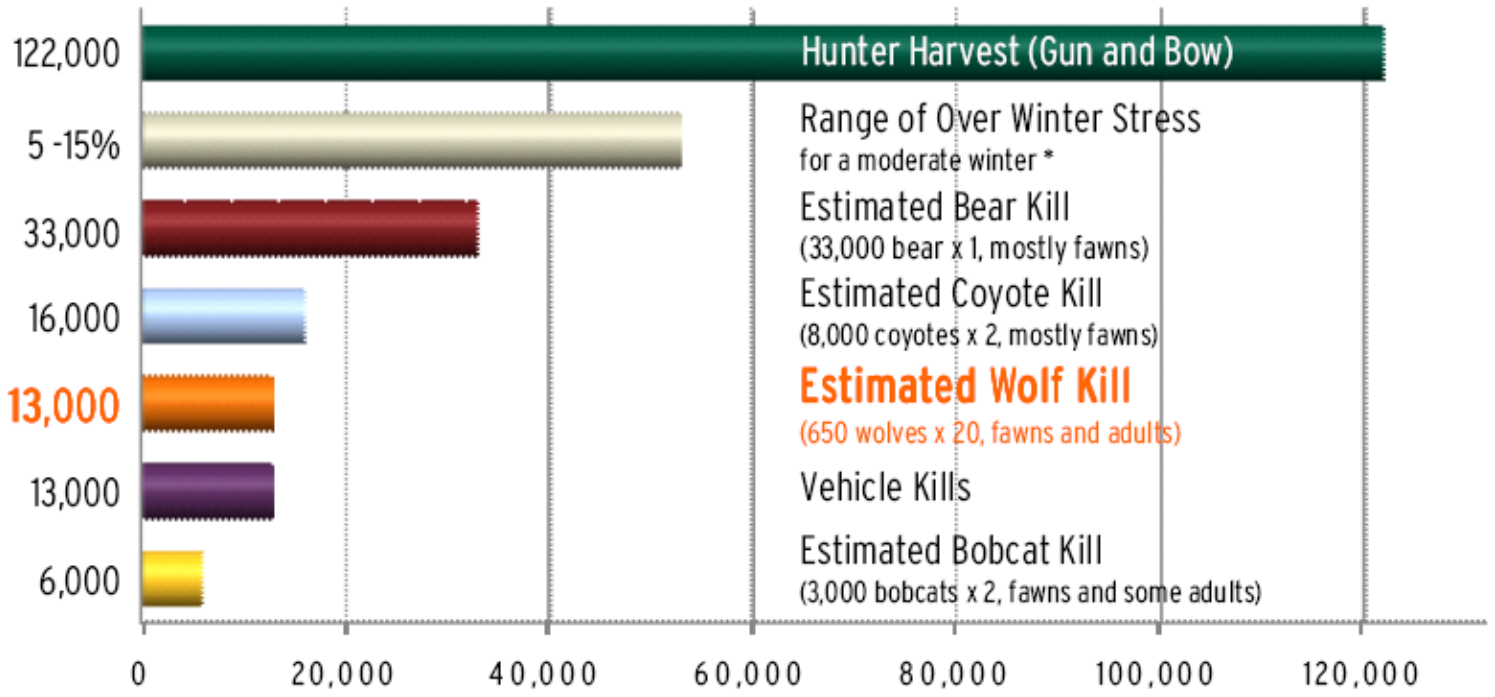
- 400,000 deer; 690 wolves

  regional Death Effects unlikely
- Distribution of deer in MN found to be at margins of wolf territories → **buffer zones between packs act as refugia**

  Death and Fear Effects possible
- Wolves are predicted to alter foraging behavior by white-tailed deer (*i.e.* deer increase vigilance and movement)

  Fear Effects possible

Deer Mortality in Wisconsin's Northern and Central Forests

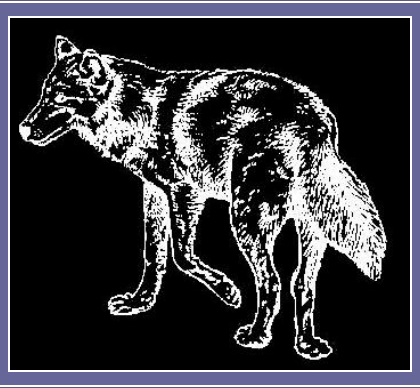


Source: Wisconsin Department of Natural Resources

* the range estimate is based on 5-15% of the 2009 winter standing deer herd for a moderate winter.

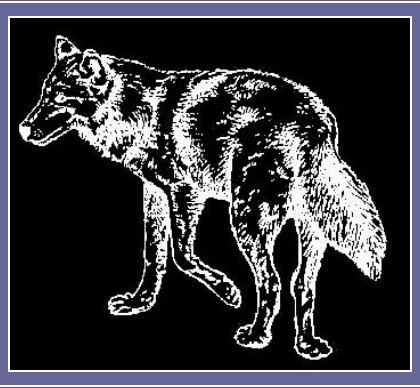
Callan: Northern white cedar wetlands

- High Plant Species Diversity
- Historically used by deer as winter “yards”



Objective

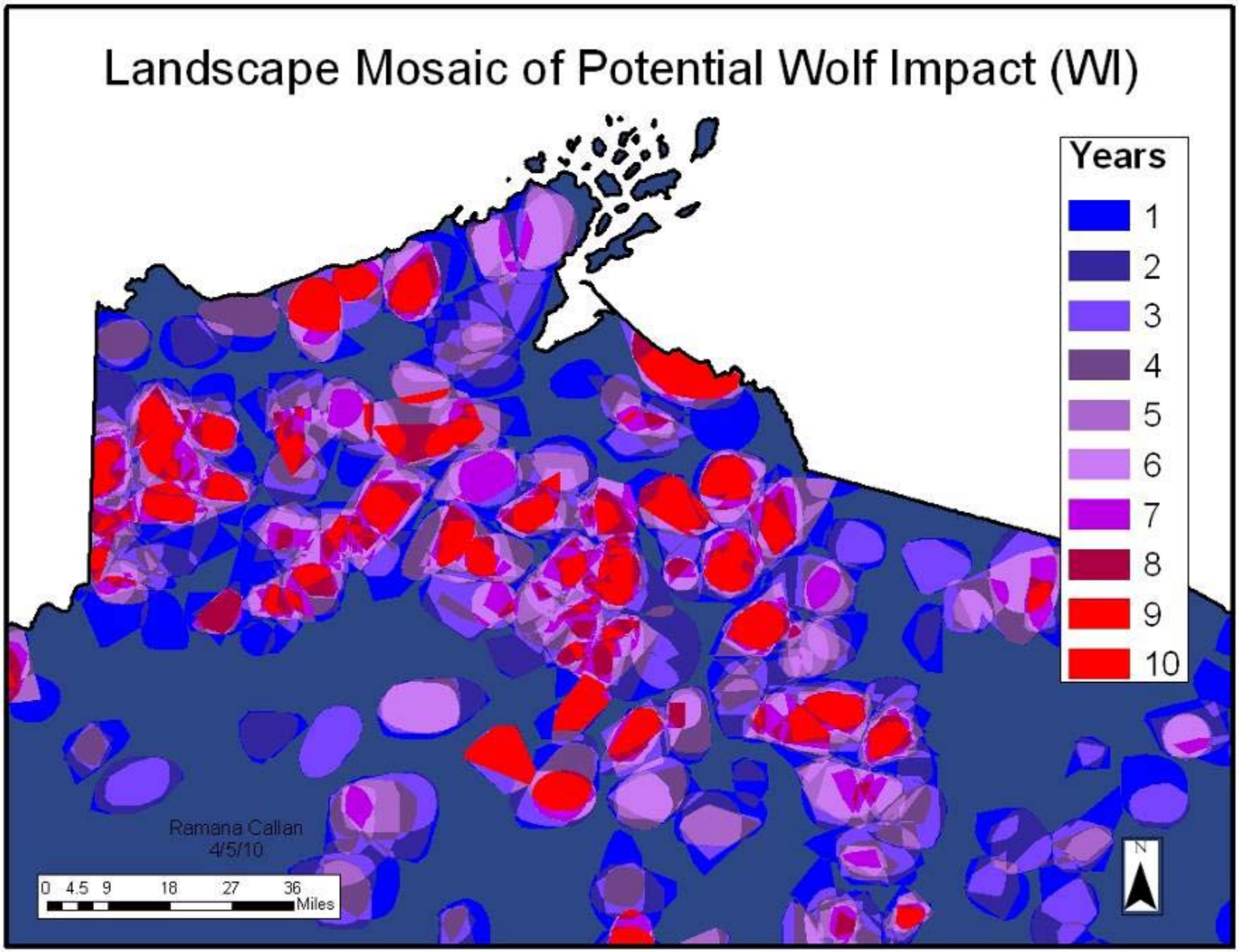
Detect and characterize differences in vegetation between areas occupied by wolves and areas unoccupied by wolves



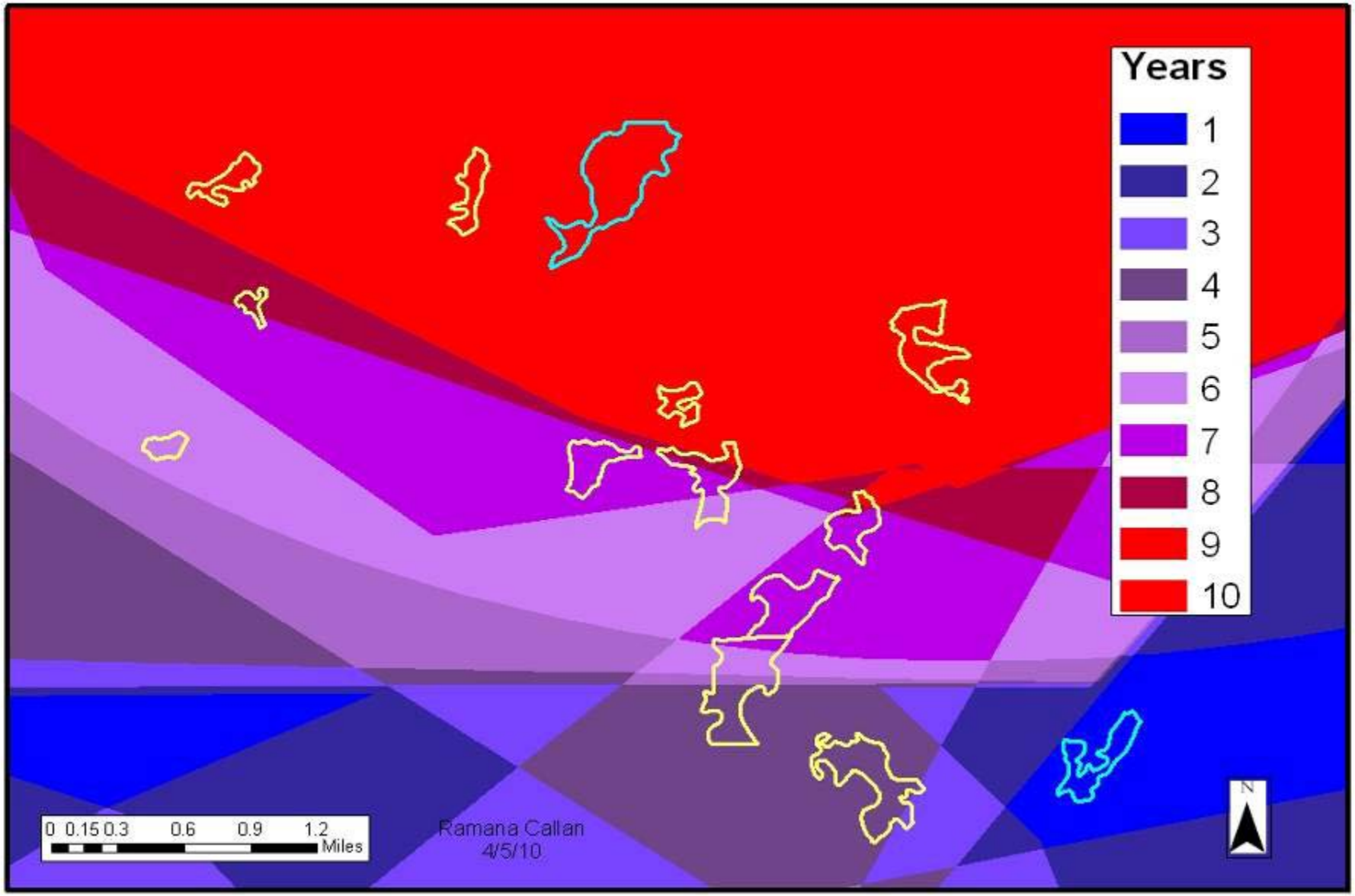
Experimental Approach

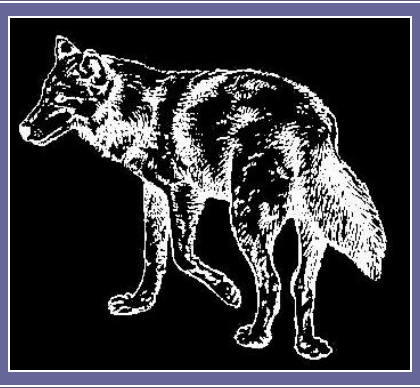
Overlay Wisconsin DNR wolf territory data

- characterize “high wolf impact areas” (8-10 years of wolf occupancy) and “low wolf impact areas” (0-3 years of wolf occupancy)


Landscape Mosaic of Potential Wolf Impact (WI)
Years
1
2
3
4
5
6
7
8
9
10
Ramana Callan
4/5/10
0 4.5 9 18 27 36
Miles
N

Cedar Stand Site Selection





Research Questions

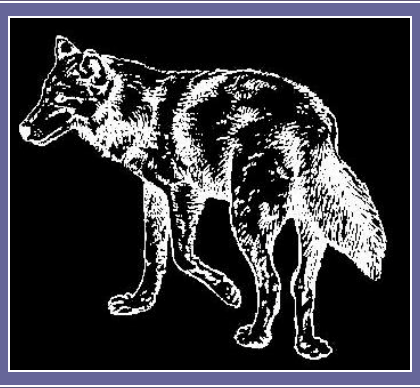
(1) Is plant species richness higher in white cedar wetlands occupied by wolves?

- species richness by vegetation growth form:

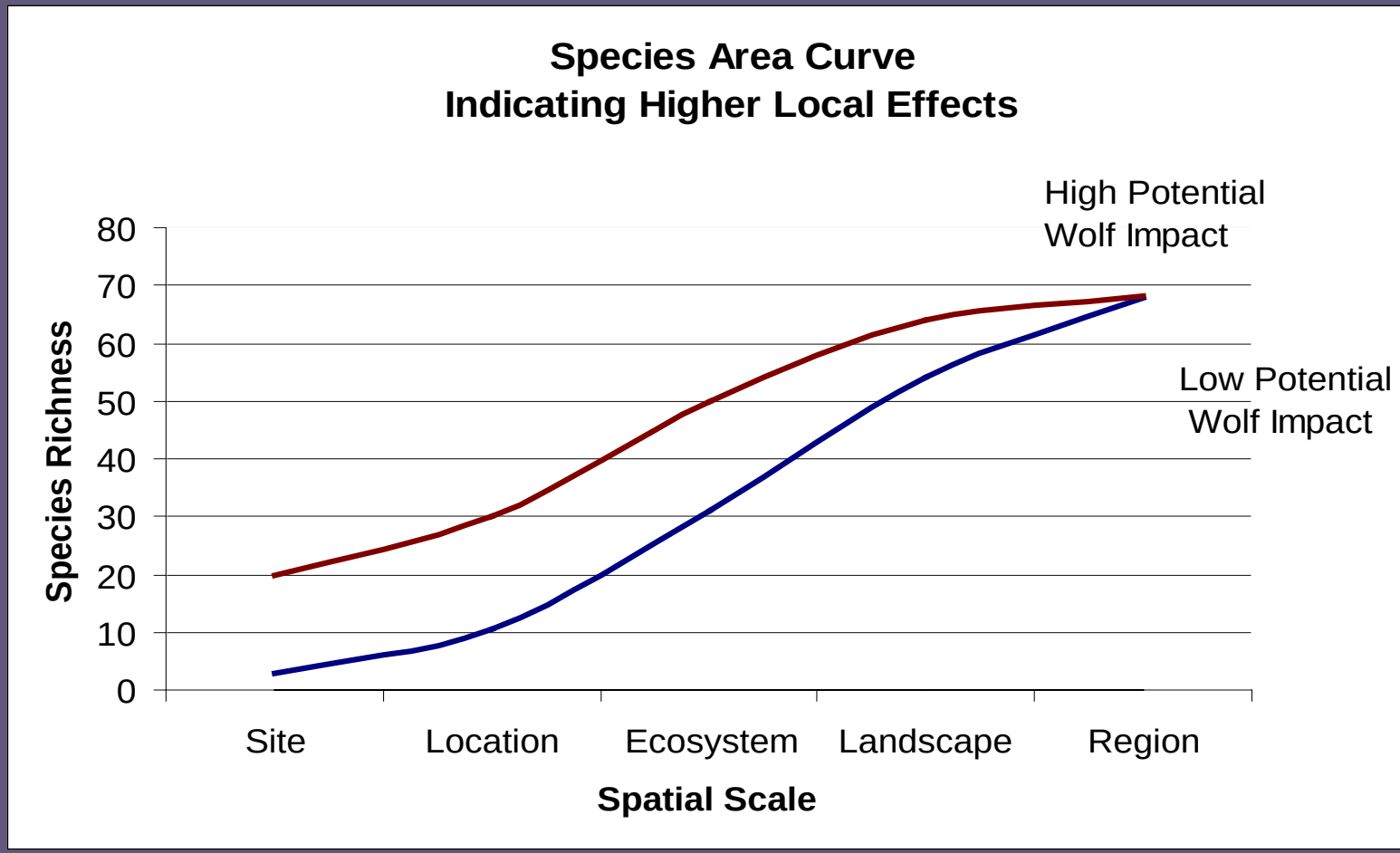
Tree, Shrub, Forb, Fern, Grass

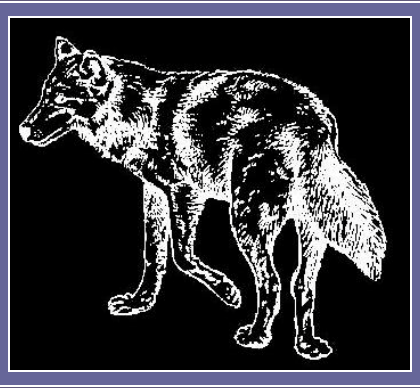
(2) At what scale are these differences detectable?

- 0.01m², 0.1m², 1m², 10m², 100m², 1,000m²



Hypothesis: Spatial Scale

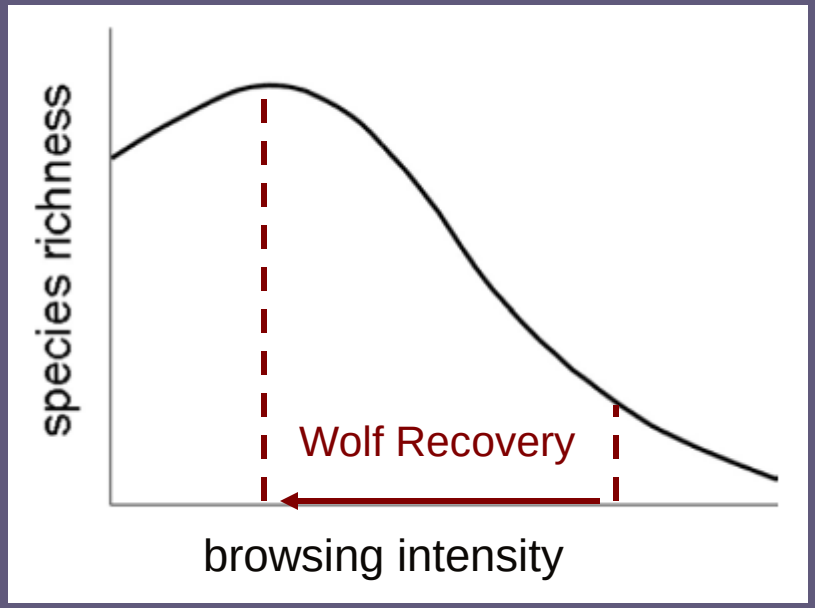


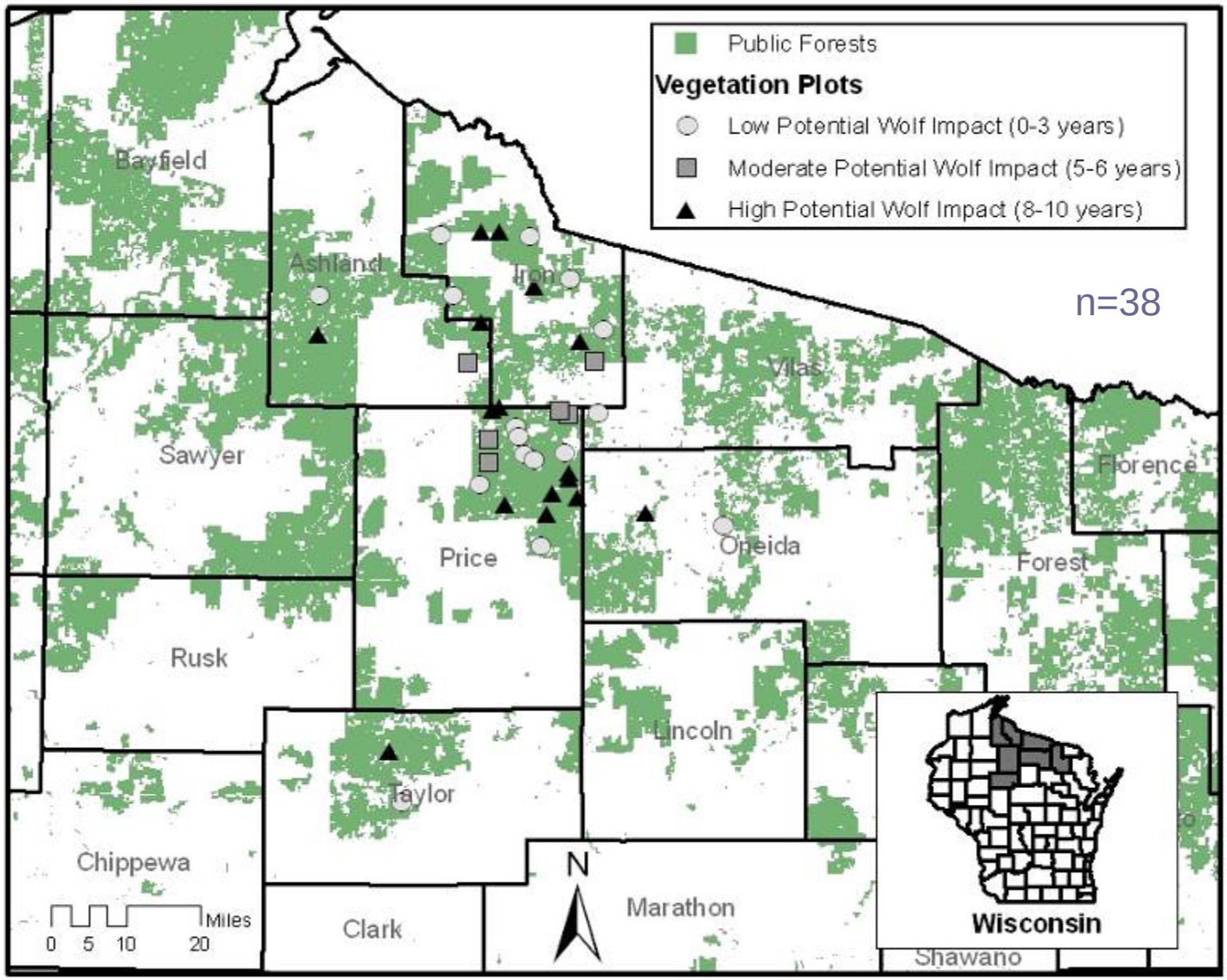


Hypotheses: Vegetation Growth Forms

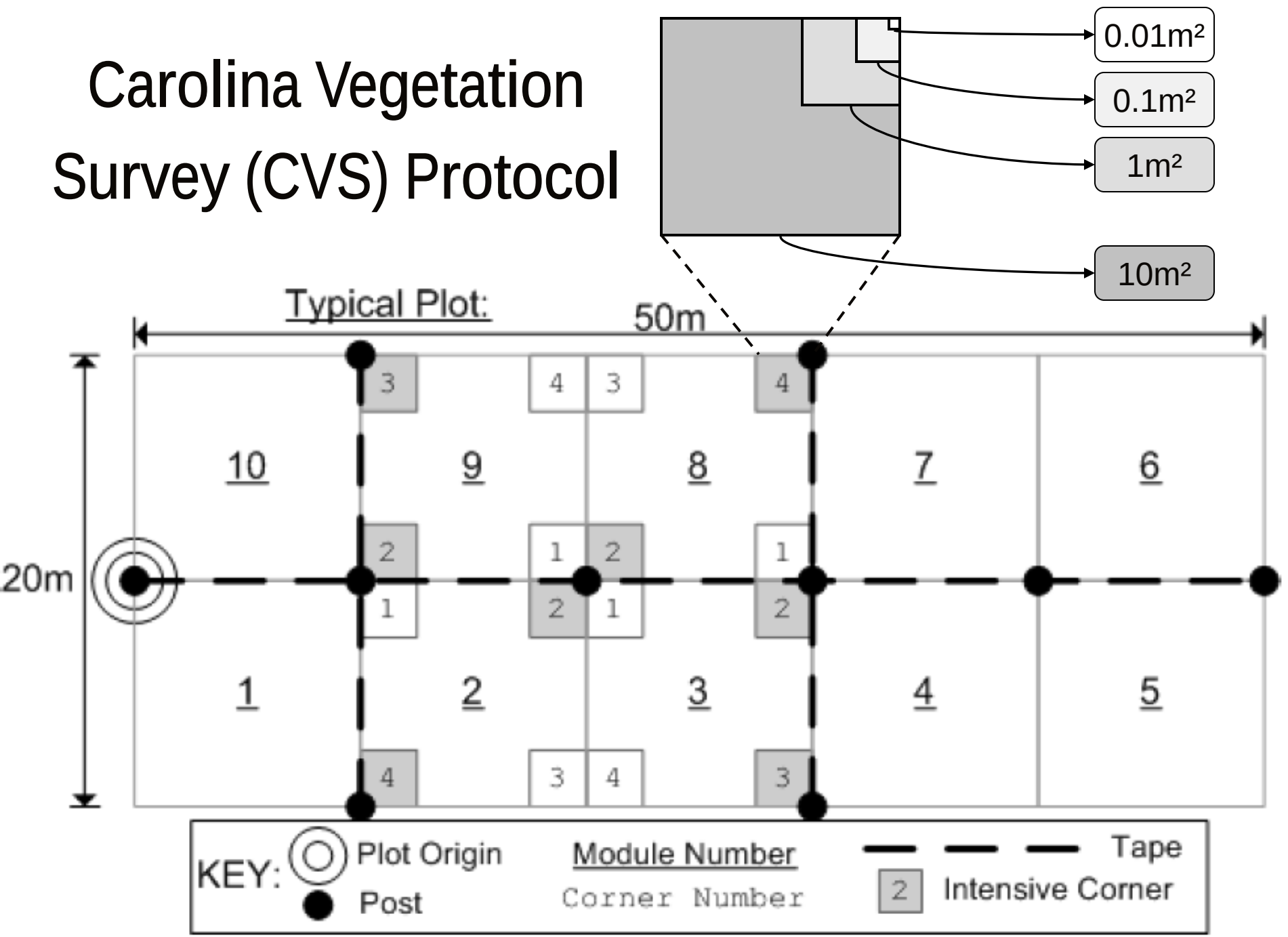
High Impact Wolf Areas should display:

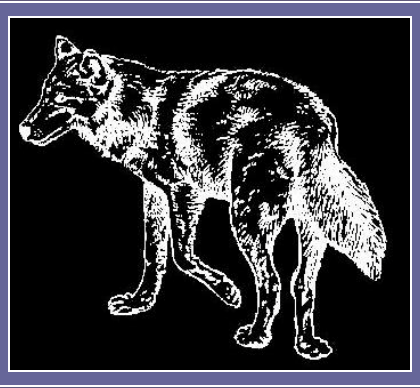
1) ≈ **Tree species richness** and % cover
2) ↑ **Shrub and Forb** species richness
3) ↓ **Grass and Fern %** cover




Public Forests
Vegetation Plots
Low Potential Wolf Impact (0-3 years)
Moderate Potential Wolf Impact (5-6 years)
High Potential Wolf Impact (8-10 years)
n=38
Bayfield
Ashland
Iron
Vilas
Sawyer
Florence
Price
Oneida
Forest
Rusk
Lincoln
Taylor
Chippewa
Clark
Marathon
Shawano
N
Miles
0 5 10 20
Wisconsin

Carolina Vegetation Survey (CVS) Protocol

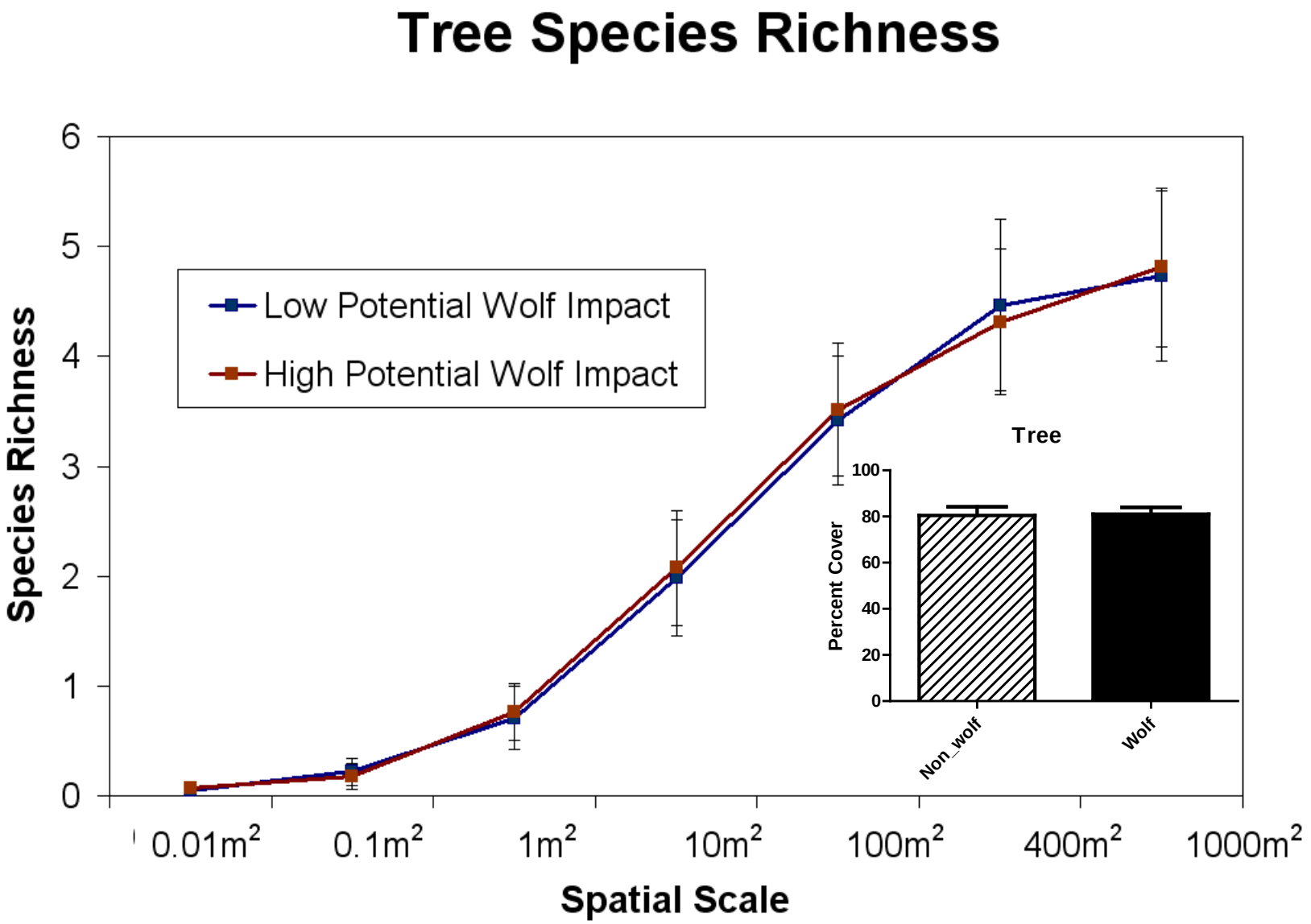




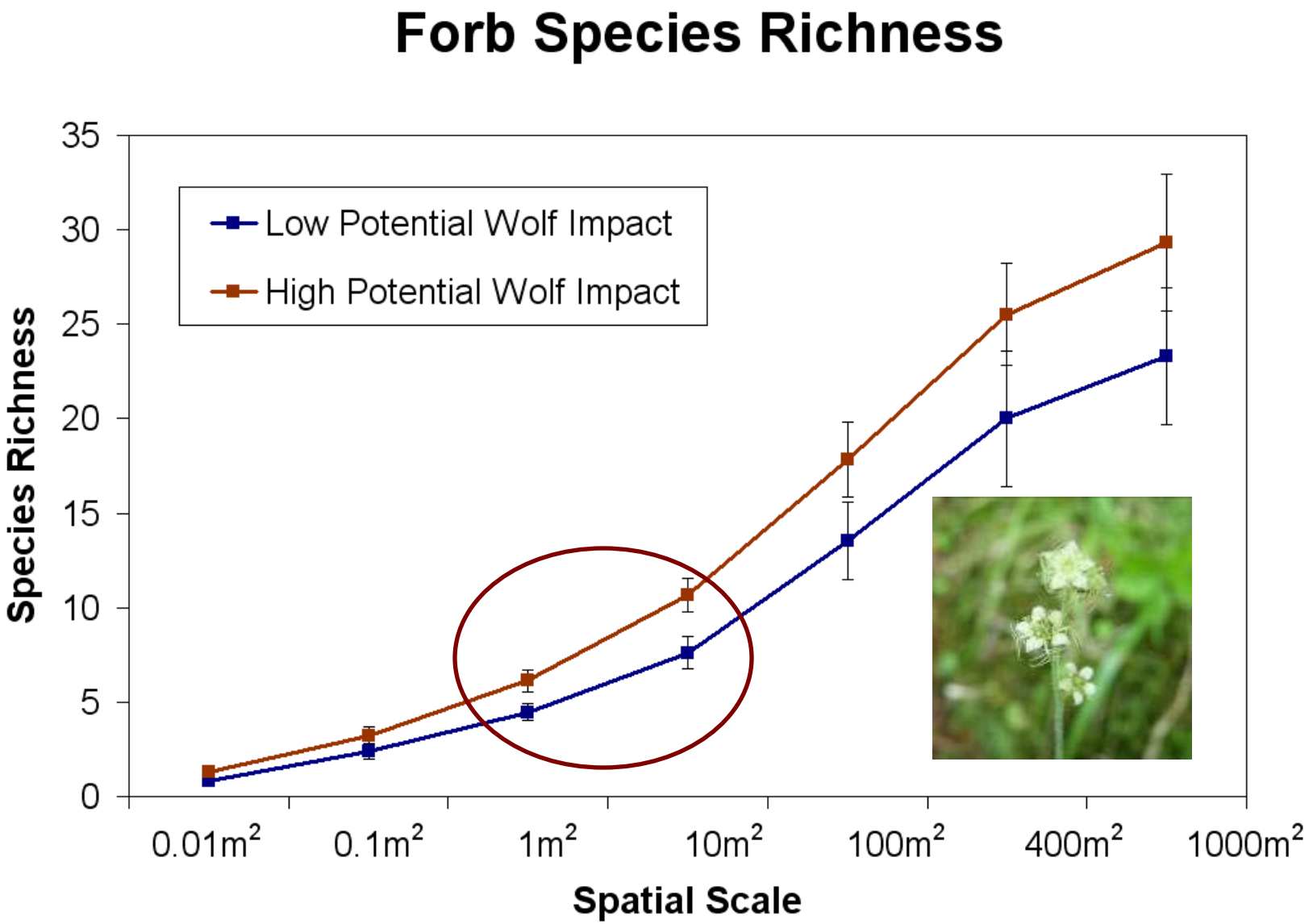
Results: Biodiversity of white cedar wetlands

Trees	23
Shrubs	31
Forbs and Vines	100
Ferns and Fern allies	17
Sedges	16
Grasses and Rushes	8
Non-natives	4

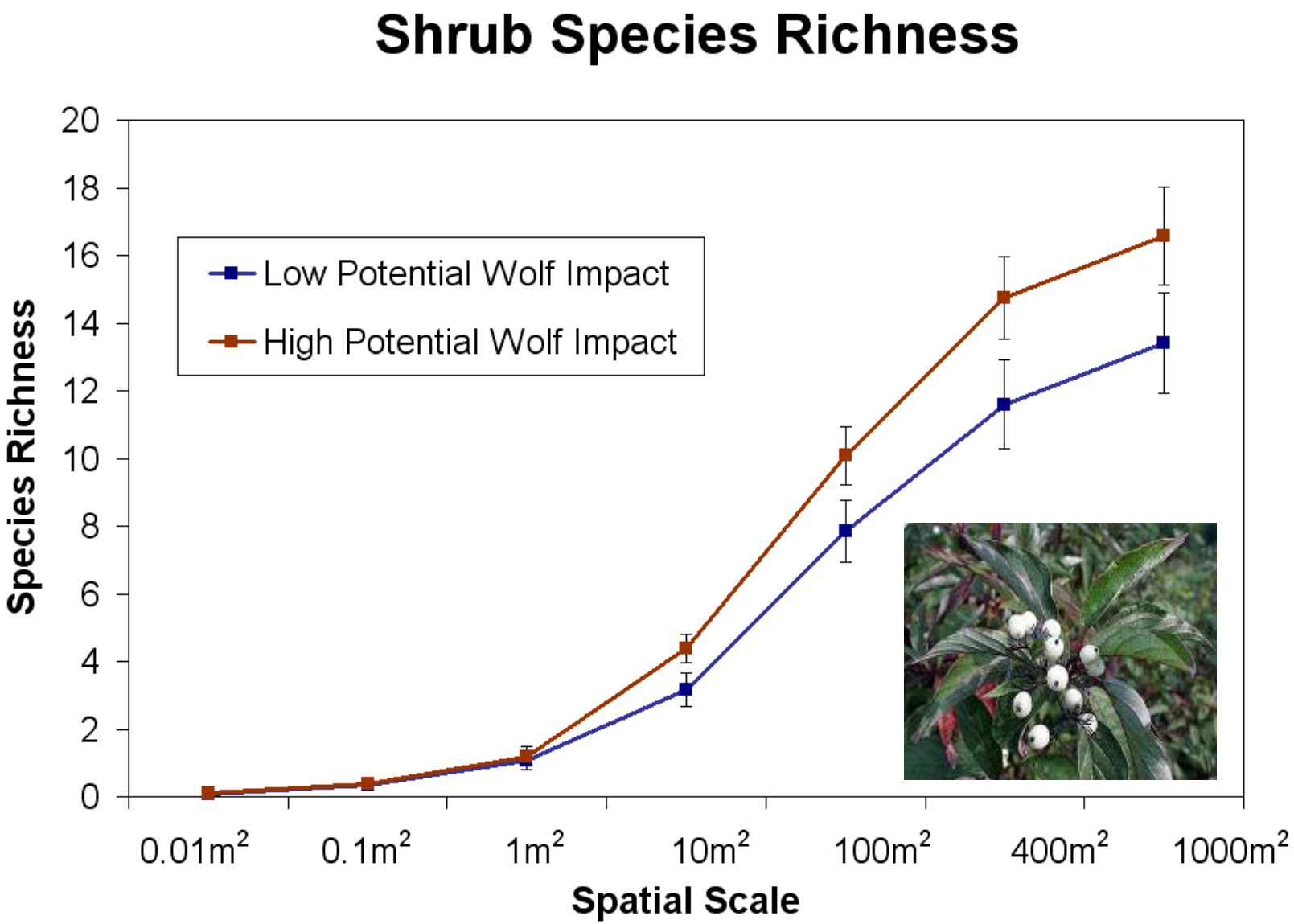
Hypothesis 1 Supported: ≈ Tree species richness and % cover



Hypothesis 2 Supported: ↑ Forb & Shrub richness in wolf areas

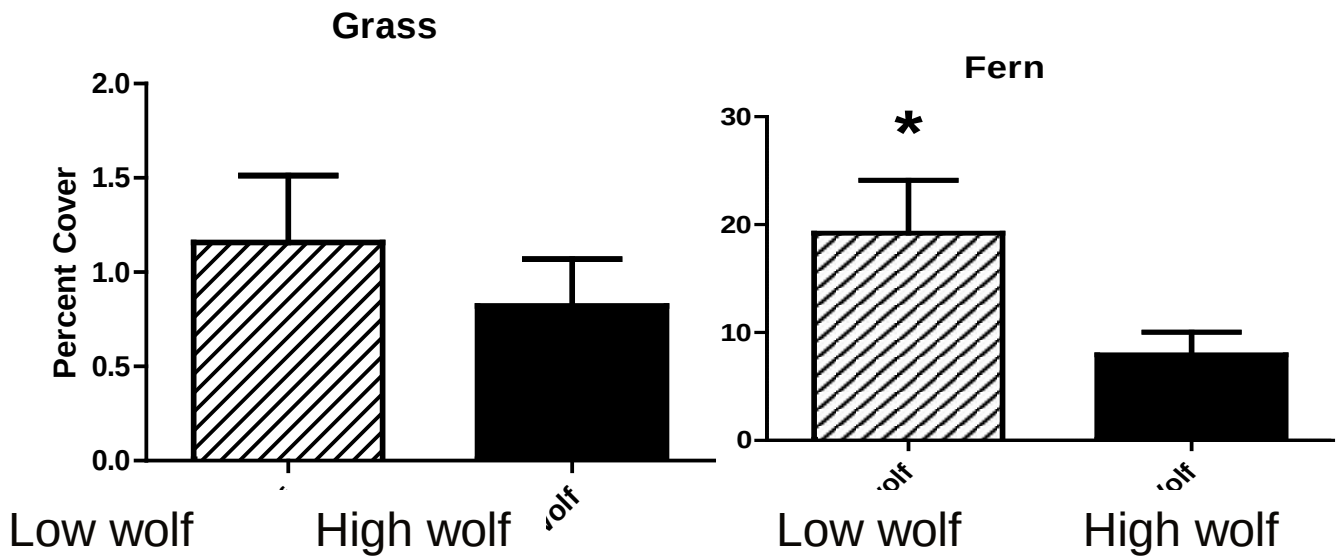


Hypothesis 2 Supported: ↑ Forb & Shrub richness in wolf areas



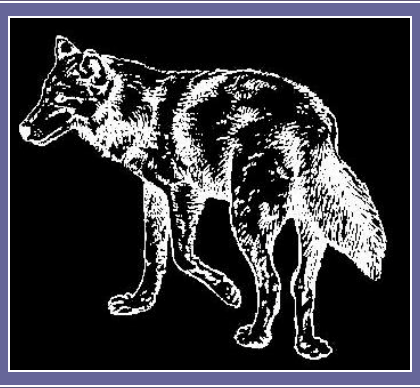
Results: Percent Cover

Hypothesis 3 Partially Supported: ↓ Grass and Fern % cover in high wolf impact areas



Low wolf impact area

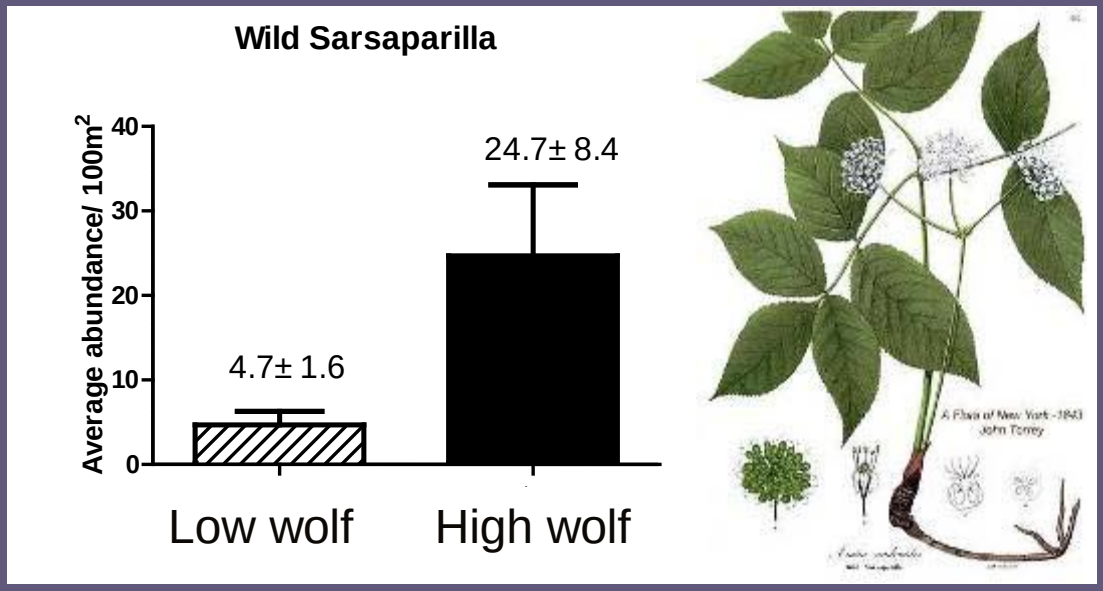
High wolf impact area



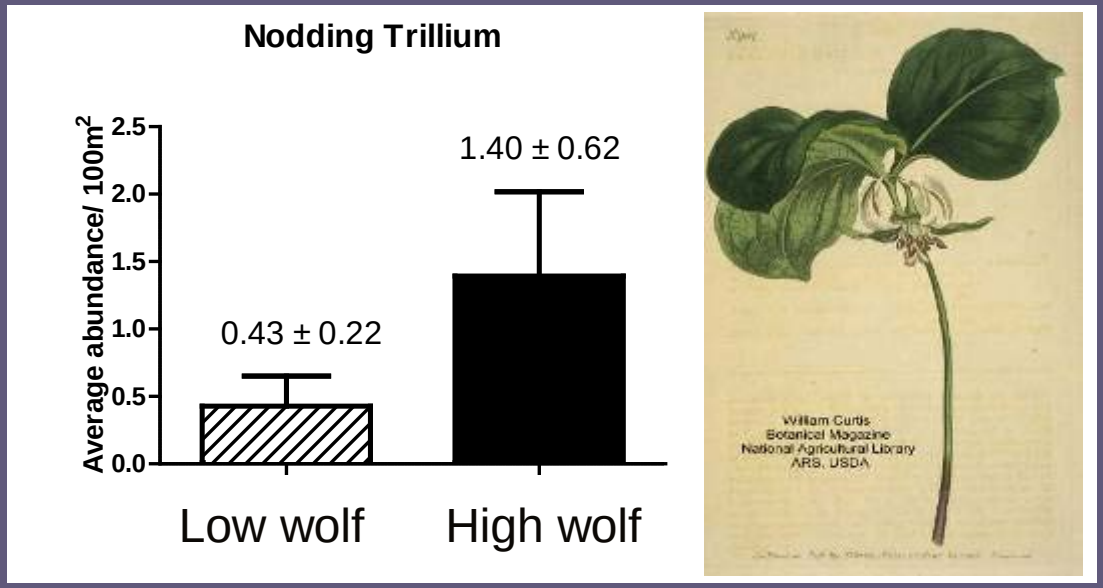
Response of browse-sensitive species in low and high wolf impact areas

Results: Select sensitive species

Wild sarsaparilla
(Aralia nudicaulis)

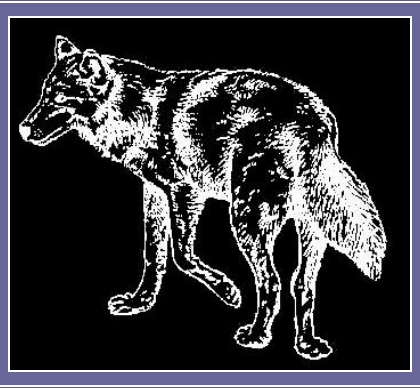


Nodding trillium
(Trillium cernuum)



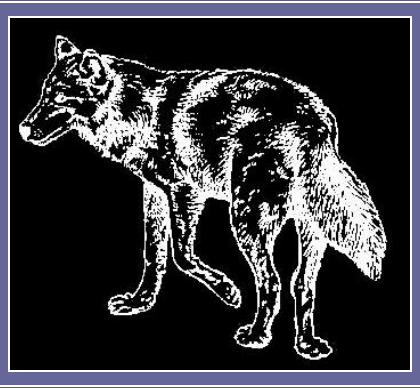
Bouchard: Upland forest wildflowers

- Focus on 3 deer browse indicator species



Objective

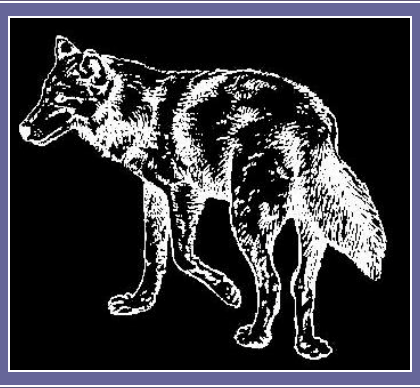
Detect and characterize differences in vegetation across a wolf recolonization gradient



Research Questions

(1) Does indicator plant size increase with time since wolf recolonization?

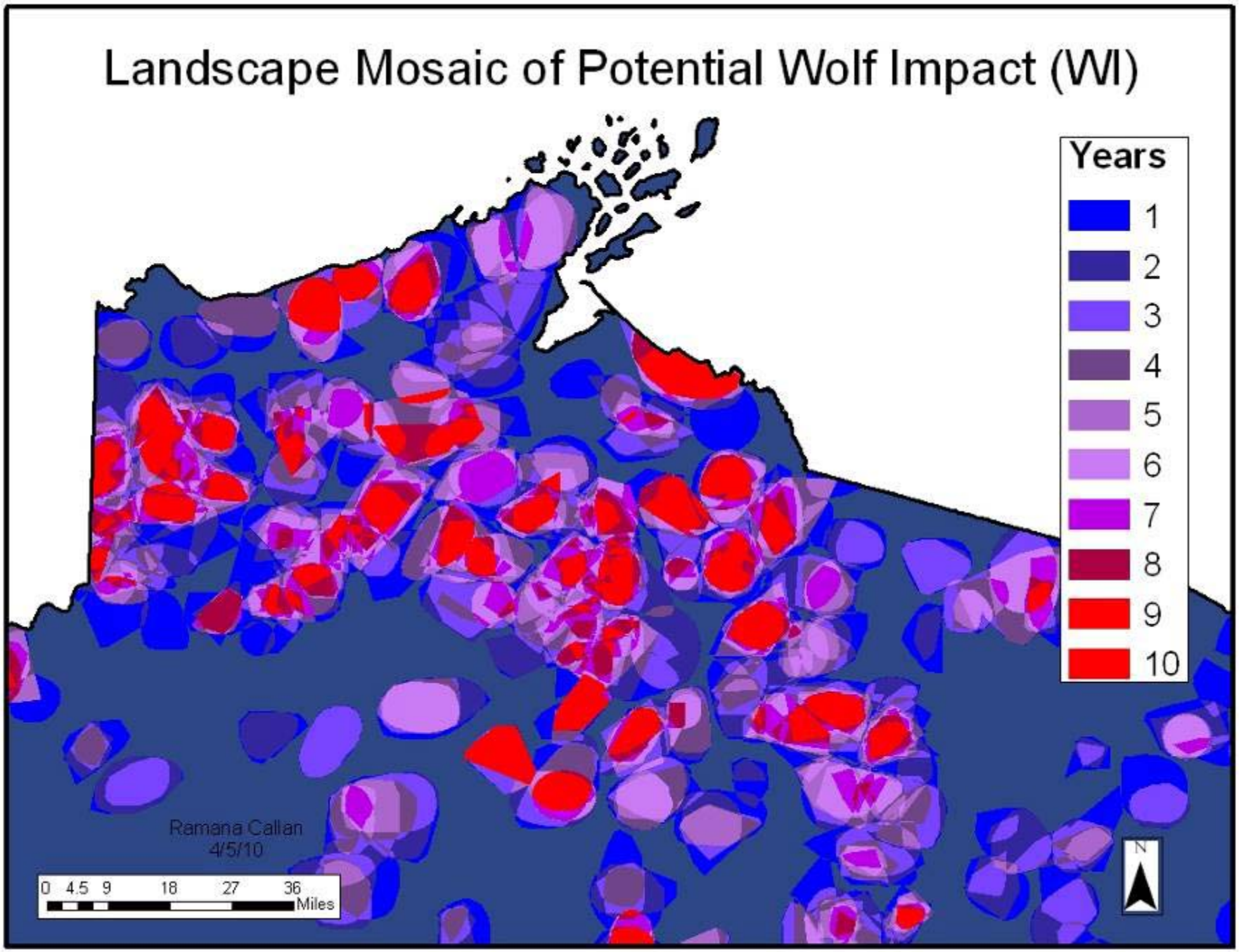
(2) How long does it take before wolf effects become detectable?

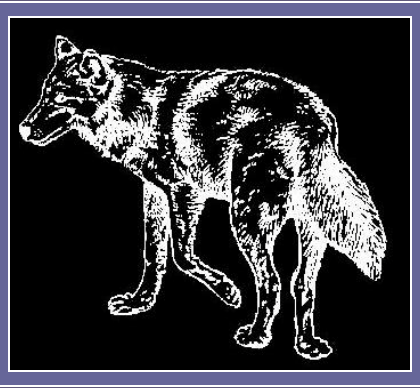


Experimental Approach

(1) Overlay Wisconsin DNR wolf territory data
   - wolves present 12-13 years
   - wolves present 4-6 years
   - wolves absent

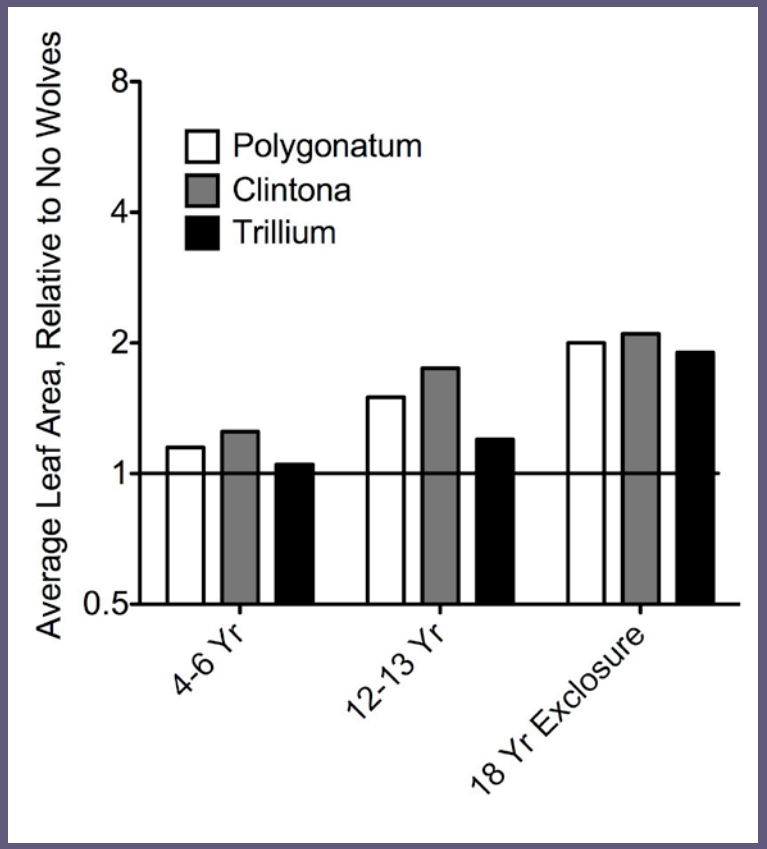
(2) Sites on national and state forest land; matched stand types (mature forest)

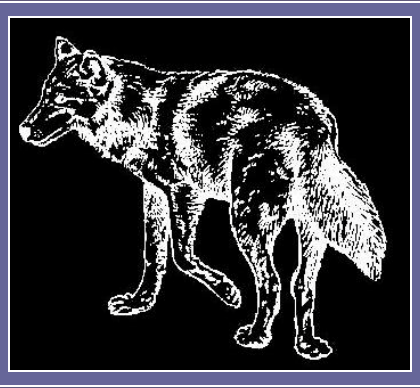

Landscape Mosaic of Potential Wolf Impact (WI)
Years
1
2
3
4
5
6
7
8
9
10
Ramana Callan
4/5/10
0 4.5 9 18 27 36
Miles
N



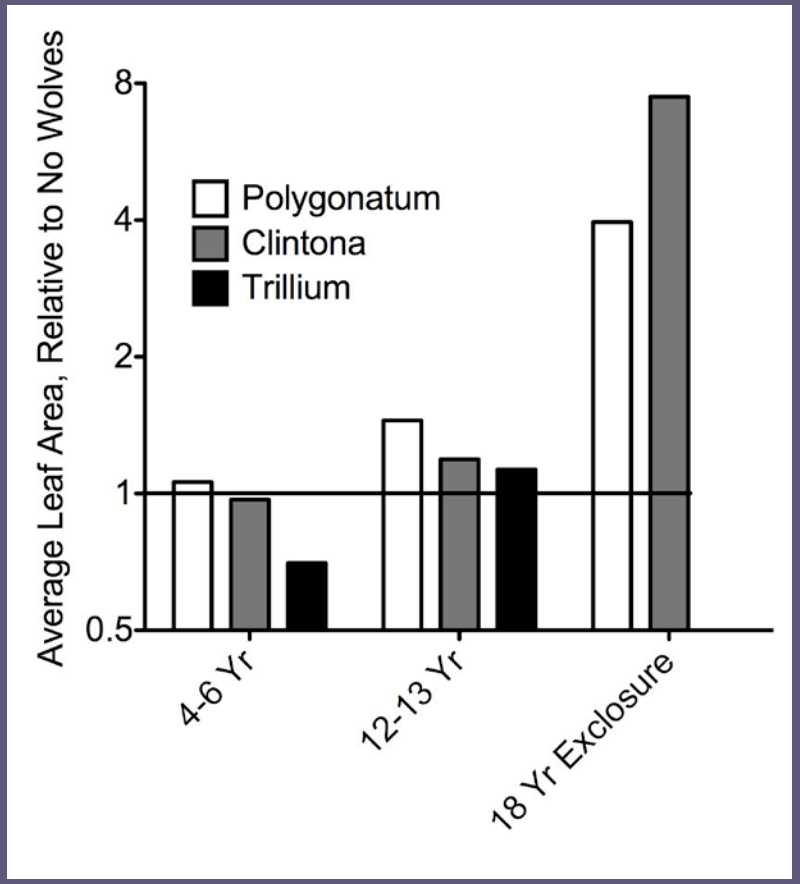
Hypothesis: Plant Size

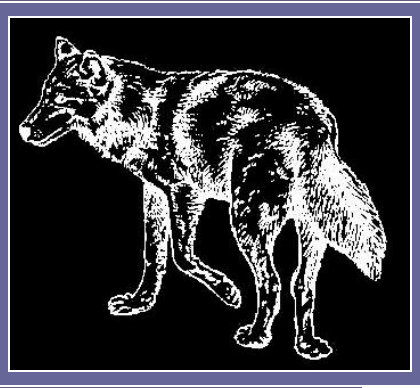
(1) Mean indicator plant size increase with time since wolf recolonization, but does not resemble “deer-free” exclosures



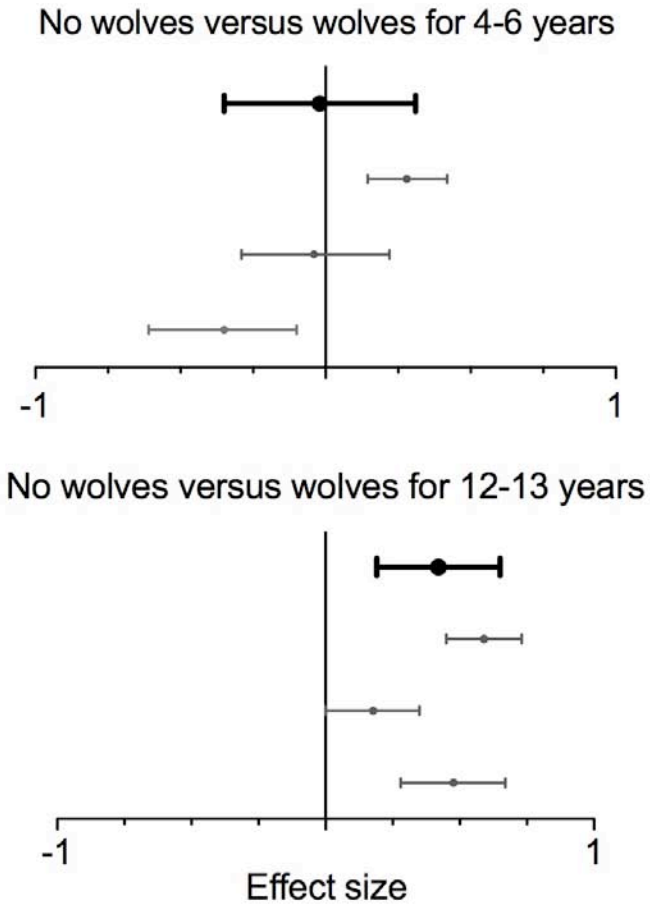


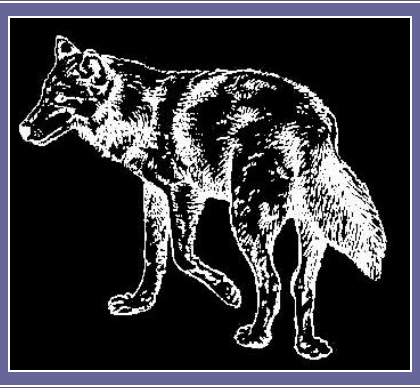
Results: Mixed Effects After 4-6 Years, Consistent Effects After 12-13 Years





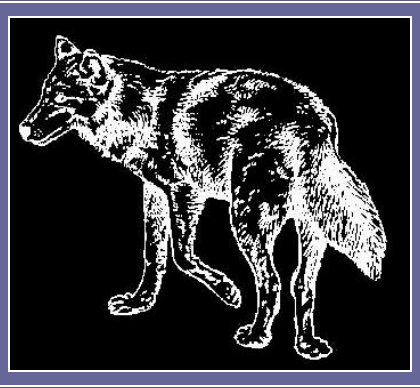
Results: Mixed Effects After 4-6 Years, Consistent Effects After 12-13 Years





Summary of Results

- Species richness of forbs and shrubs was greater in high wolf impact areas and evident at specific scales:
  - » $1m^2$-$10m^2$ for forbs
  - » $10m^2$-$400m^2$ for shrubs
- % cover of ferns was lower in high wolf impact areas
- Browse indicator species reveal reduced browsing pressure in high wolf impact areas



Summary of Results

- In forests and forested wetlands, trophic cascades:
  - Exist
  - Are subtle
  - Require about a decade before they are apparent
  - Do not resemble “deer free” conditions
  - Might become more pronounced with time

Acknowledgements

Collaborators

Adrian Wydeven, Jane Wiedenhoeft (Wisconsin DNR)

Corey Raimond and Clare Frederick (Field Assistants)

Warren Keith Moser (Forest Service)