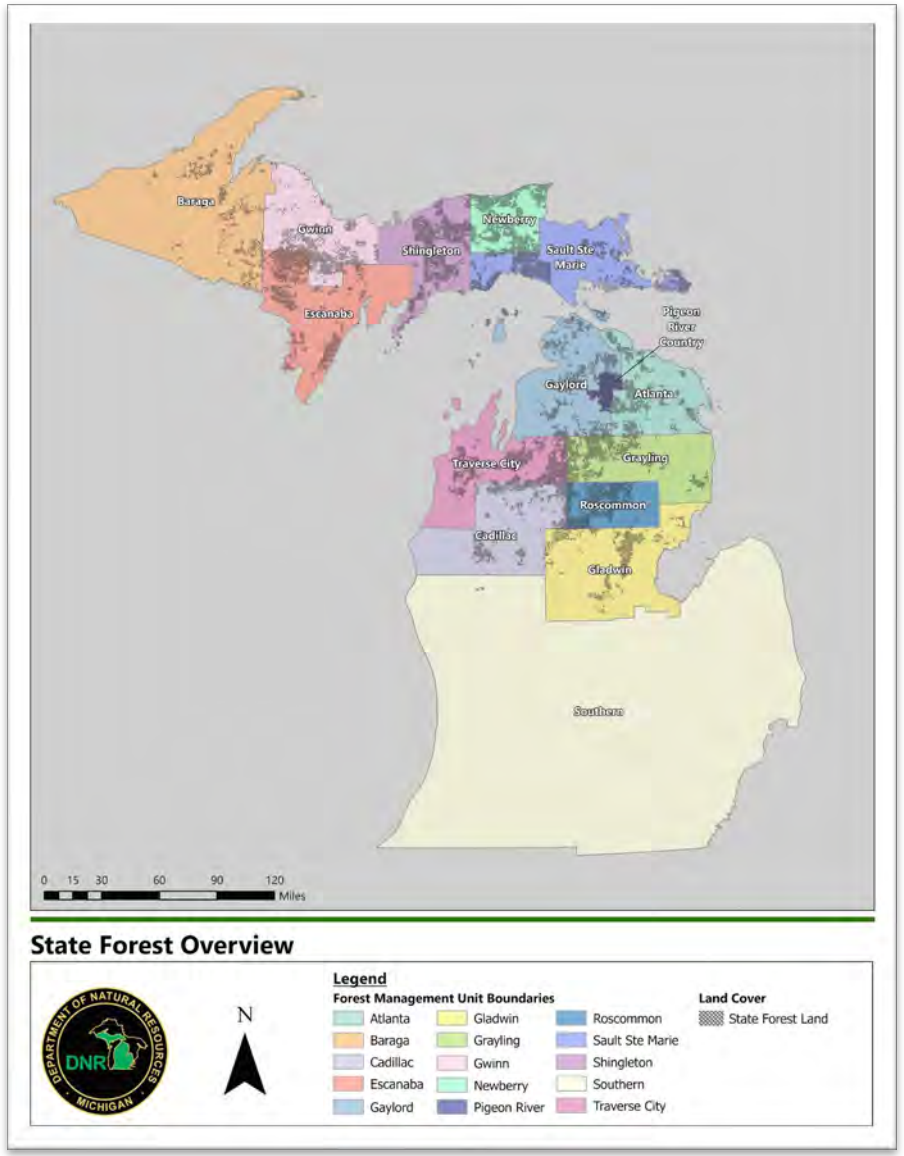
State Forest Management Plan

Topics

- Our team
- Legal authority
- Co-management
- What's new in this plan
- Lines of effort
- Plan organization and structure
- Review period
- Questions



Our Team

Forest Resources Division (FRD)

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Legal Authority

- NREPA - Act 451 of 1994 - Part 525
- Requires a management plan for:
  - Stable, long-term, sustainable timber supply
  - Promote and encourage outdoor recreation, tourism, and the forest products industry
  - Incorporate biodiversity conservation goals
  - Identify environmentally sensitive areas
  - Identify forest treatments to maintain and sustain healthy, vigorous forests and quality wildlife habitat

451-1994-III-2-4-MISCELLANEOUS-TOPICS-525 - PART 525 SUSTAINABLE FORESTRY ON STATE FORESTLANDS (324.52501...324.52511)

Section 324.52501 - Definitions.

Section 324.52502 - Management of state forest; manner; duties of department.

Section 324.52503 - Forestry development, conservation, and recreation management plan.

Section 324.52504 - Harvest and sale of timber; deposit of proceeds into forest development fund; report.

Section 324.52505 - Third-party certification that forestry standards satisfied; report.

Section 324.52506 - Report.

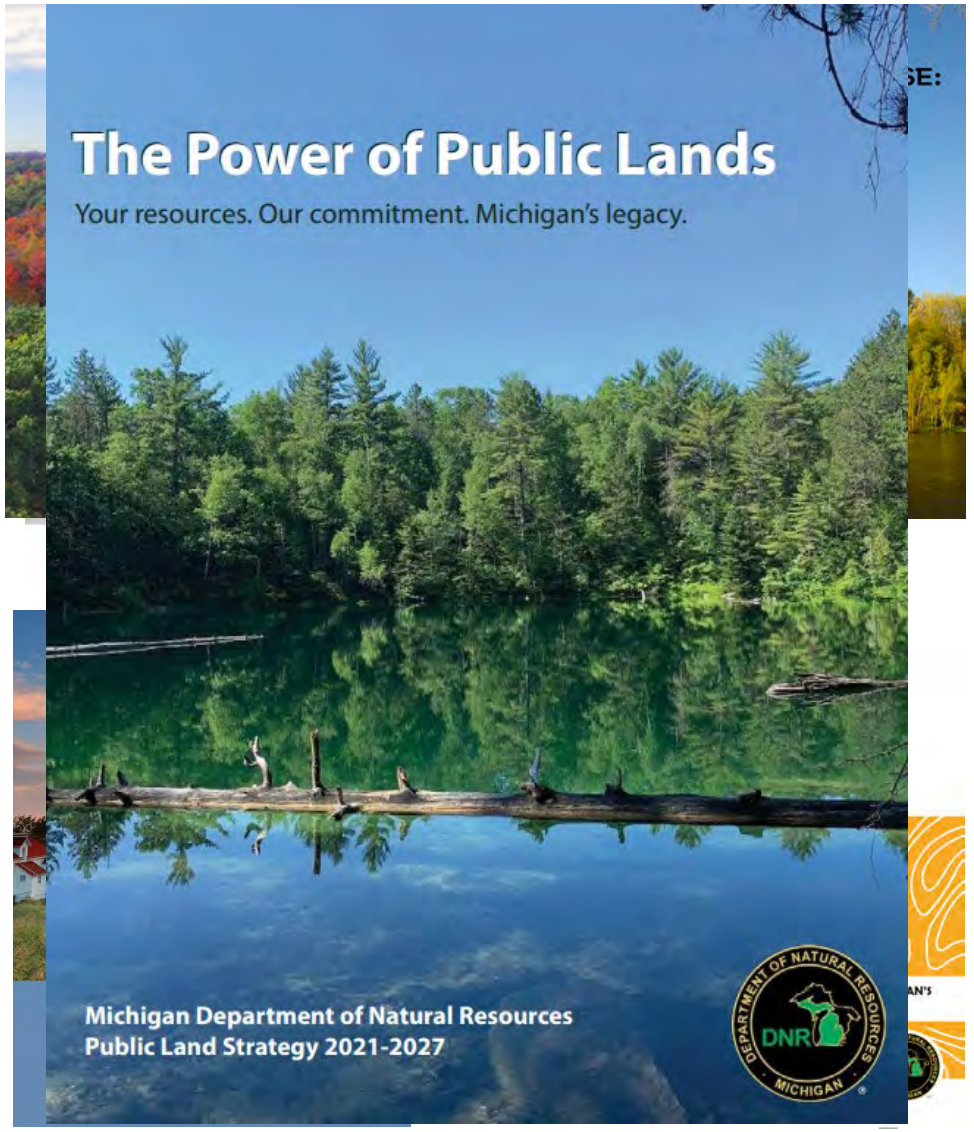
Section 324.52511 - Repealed. 2004, Act 123, Eff. Dec. 31, 2011.

Co-management of the State Forest

- First implemented in 1946 when State Game Areas and State Forests were merged in the northern 2/3 of the State
- Forest Resources Division is the land administering division for the State Forest
- Forest Resources Division and Wildlife Division are jointly responsible for developing the management plans and providing management guidance
- Recreation management on the State Forest has transitioned to Parks and Recreation Division over the last 15 years
- Parks and Recreation Division and Fisheries Division provide guidance through the compartment review process

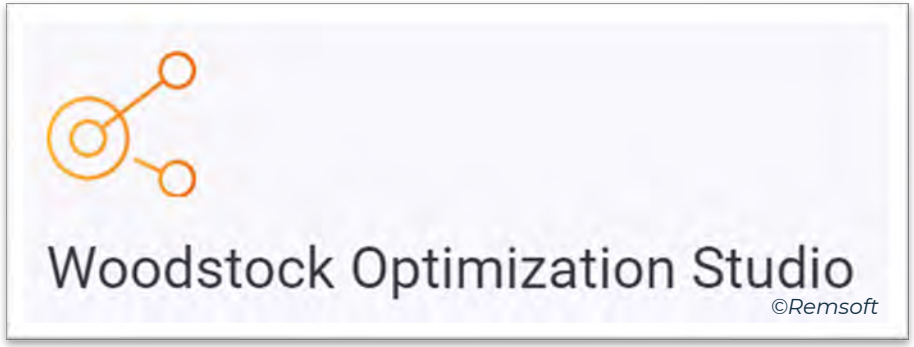
What's new in the 2024 SFMP

- Improved alignment with other plans
  - DNR Land Strategy
  - Forest Action Plan
  - Wildlife Action Plan
  - Statewide Comprehensive Outdoor Recreation Plan
  - Trails Plan
  - Division Strategic Plans



What's new in the 2024 SFMP

- Robust planning and optimization analytics platform
- Ensures long term sustainability of timber resources and wildlife habitat
- Integrated forest covertype and wildlife habitat management
- Projects future conditions given different management scenarios

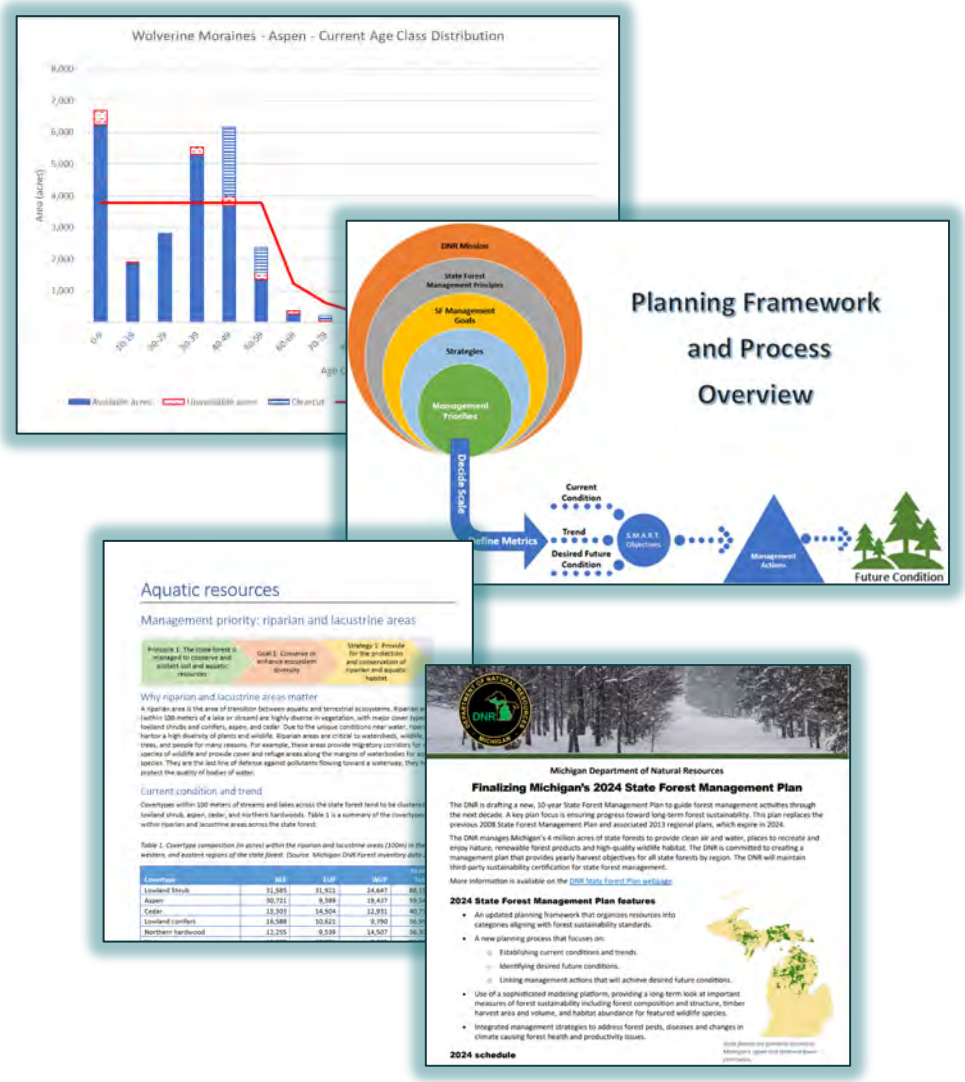


What's new in the 2024 SFMP

- Long term sustainability objectives drive short term harvest levels
- Integrated forest covertype and wildlife habitat management
- Reduced # of management areas down to 35
- Combined 4 existing plans into 1
- Integration of climate smart management direction in each management priority

Lines of Effort

SFMP Model	Scenario Development	Preferred Management Scenario
Planning Framework	Planning Process	Desired Future Conditions
Writing the Plan	Statewide and Regional Management Priorities	Management Areas
Engagement	Internal Collaboration	External Consultation



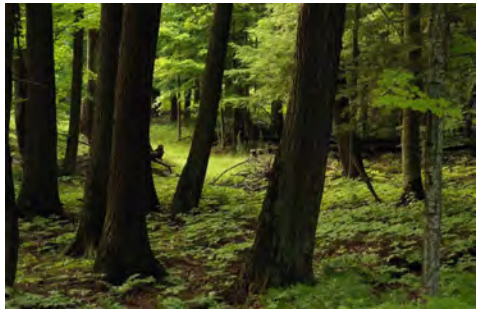
Modeling Effort

Forest Inventory

Management Strategies

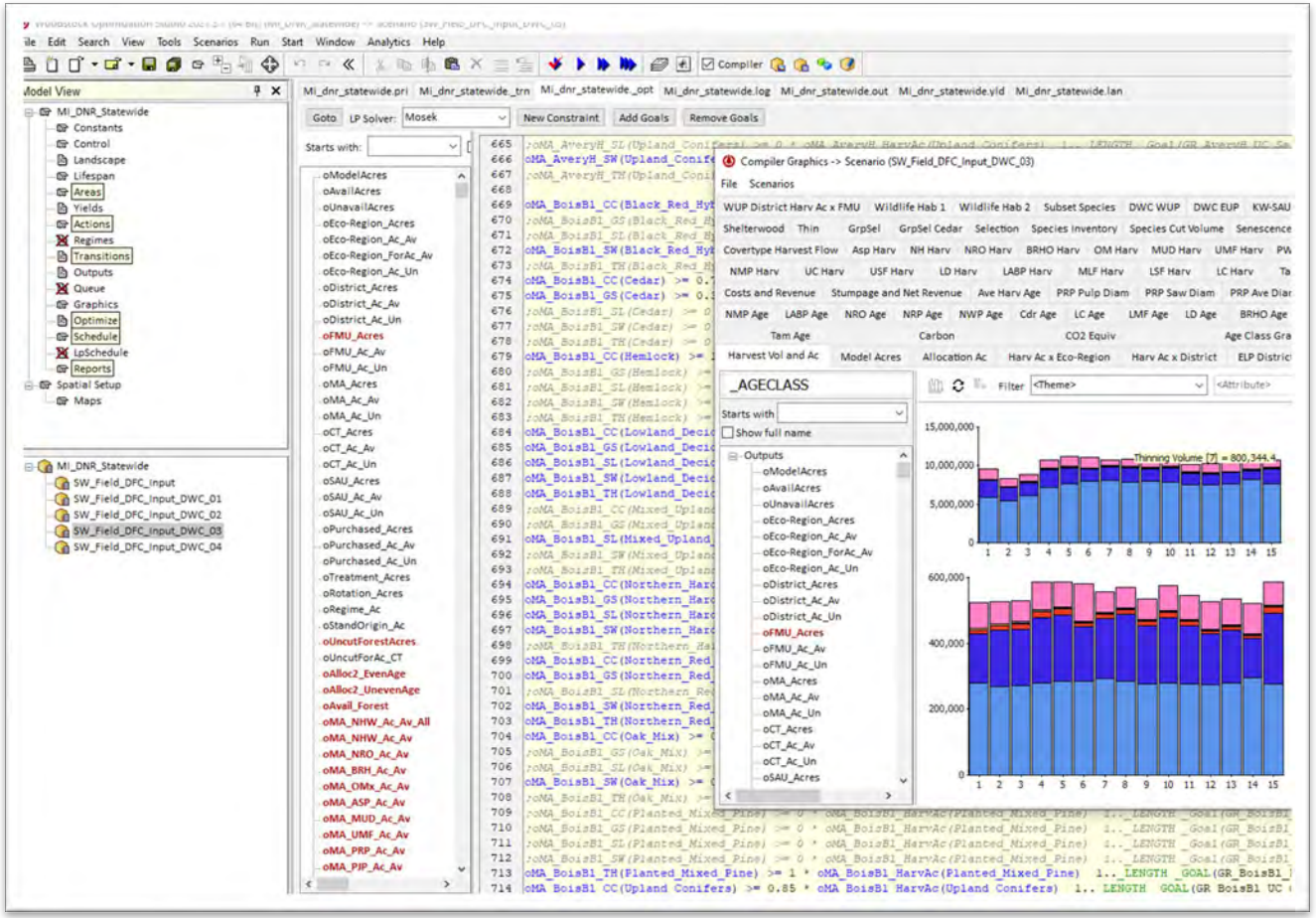
Timber and Wildlife Habitat Goals

SFMP Model



Modeling Effort - Overview

- Future forest conditions
  - Age, covertype, basal area
- Landscape habitat abundance
  - Featured species potential habitat
  - Forest diversity matrix
- 10-year projected harvest levels
  - Management areas
  - Special analysis units



Modeling Effort – Landscape Habitat Conditions (LHC)

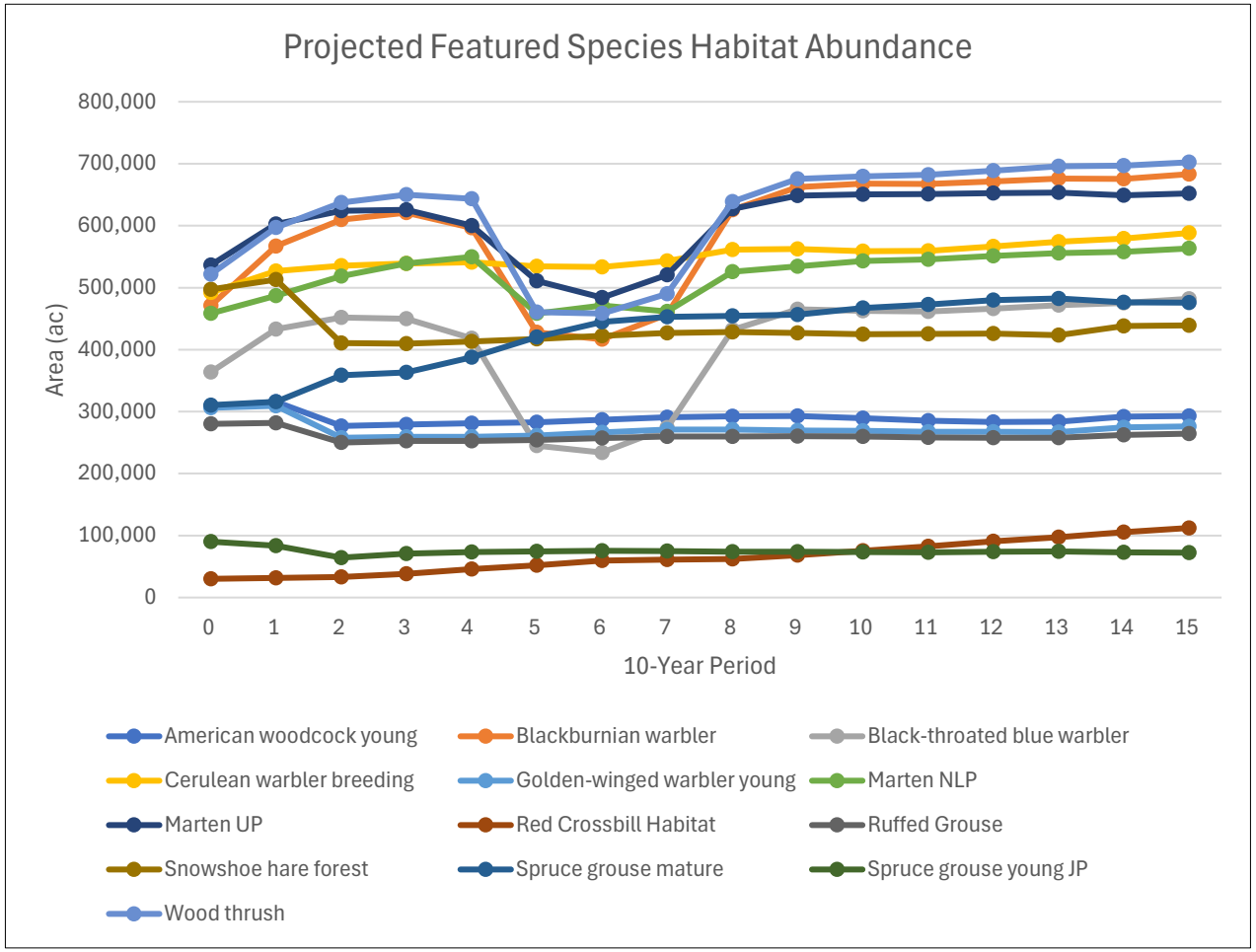
- Broad habitat conditions that are aggregates of covertypes and conditions
- LHCs are of primary management importance
- May be underrepresented at a large scale through standard management
- Outputs were created to track LHCs in scenarios

Table 1. State forest featured species and their associated landscape habitat conditions.

Feature species (Habitat niche if specified)	Young Forest	Mature Forest	Interior Forest	Mast	Mesic Conifer	Big Trees	Natural Disturbance	Openings	Mature Forests: Dense Understory	Mature Forests: Open Understory
Kirtland's warbler	X	--	X	--	--	--	--	--	--	--
Ruffed grouse	X	--	--	--	--	--	--	--	--	--
Elk	X	--	--	X	--	--	--	X	--	--
Snowshoe hare	X	--	--	--	--	--	--	--	--	--
American marten	--	X	X	--	X	X	--	--	--	--
Cerulean warbler	--	X	X	--	--	X	--	--	X	--
Blackburnian warbler	--	X	X	--	X	X	--	--	--	X
Black-throated blue warbler	--	X	X	--	--	X	--	--	X	--
Wood thrush	--	X	--	--	--	--	--	--	--	X
Red crossbill (conifer forest)	--	X	--	--	--	X	--	--	--	X
White-tailed deer	--	X	--	X	--	--	--	--	--	--
Black-backed woodpecker	--	--	--	--	--	--	X	--	--	--
Sharp-tailed grouse	--	--	--	--	--	--	--	X	--	--
Wild turkey	--	--	--	X	--	--	--	X	--	--
Golden-winged warbler	--	--	--	--	--	--	--	X	--	--
American woodcock	X	--	--	--	--	--	--	X	--	--
Black bear	--	--	--	X	--	--	--	--	--	--
Spruce grouse (conifer forest)	X	X	--	--	--	--	--	--	X	--

Modeling Effort – Featured Species Habitat

- Model outputs were created to represent the amount of habitat conditions that exist for each species (typically nesting / breeding)
- Enabled us to track habitat abundance over time for each species in each MA in every scenario
- Able to set goals or constraints for each species when necessary (Special Analysis Units)



Modeling Effort - Special Analysis Units

- Grouse Enhanced Management System
- Elk Management Plan
- Pigeon River Country – Concept of Management
- Kirtland's Warbler Management Plan
- Deer Wintering Complexes

Modeling Effort - Deer wintering Complexes (DWC)

Deer Winter Range Goal:

- Sustainably manage shelter and food resources on deer winter range to reduce overwinter deer population fluctuations by:
  - Maintaining or enhancing conifer shelter thereby facilitating deer movement to obtain food and avoid predation
  - Providing high quality food adjacent to shelter

Modeling Effort - Deer wintering Complexes (DWC) Goals

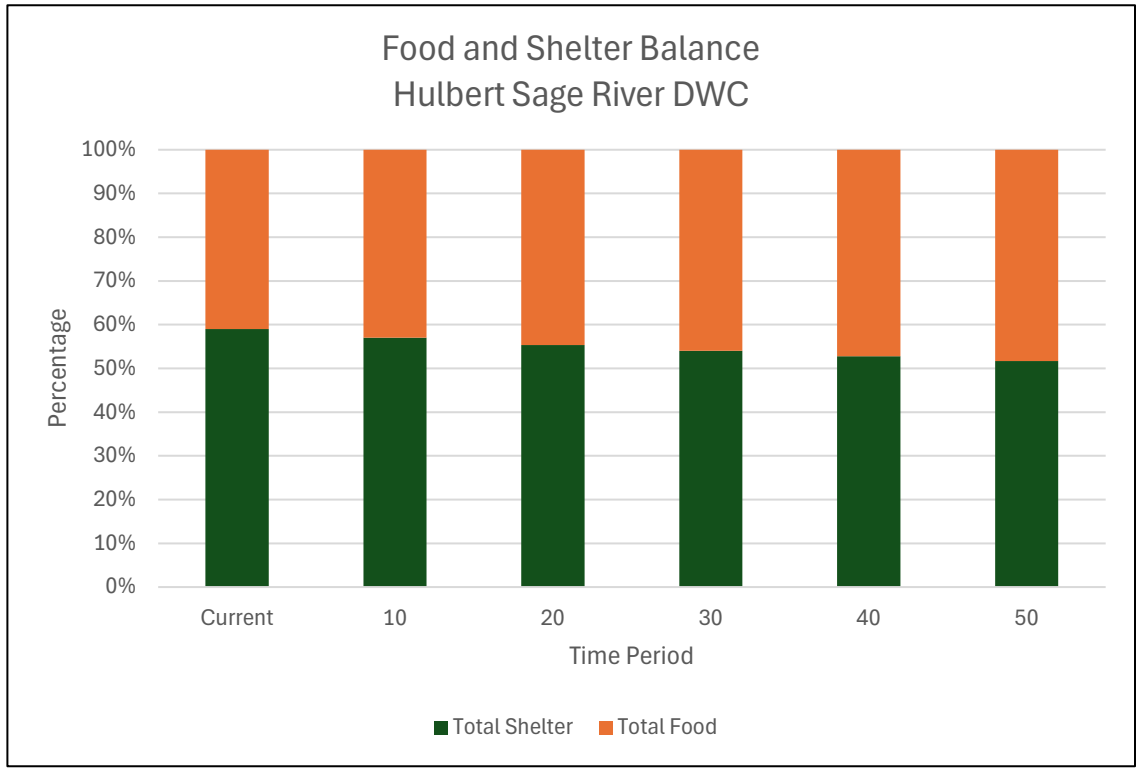
Deer Wintering Complex Goals:

- Balance the area of cover types that provide food and shelter across the DWC over time
- Maintain a sustainable condition within each DWC where:
  - Functional food is always available
  - Functional shelter is always available

Modeling Effort - Deer wintering Complex (DWC)

Balancing the area of cover types that provide food and shelter across the DWC over time:

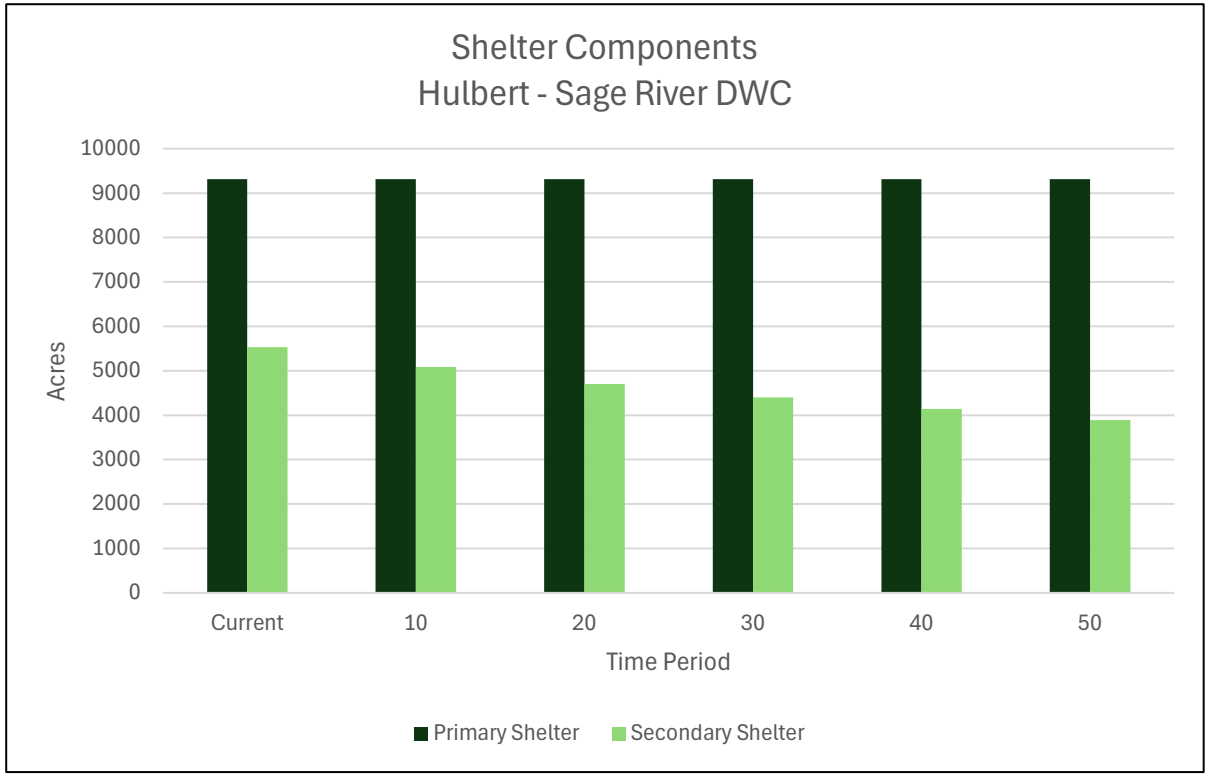
- Achieved by harvesting stands and encouraging them to transition to other cover types as they regenerate
- Natural or artificial regeneration



Modeling Effort - Deer wintering Complexes (DWC)

Maintaining cover types that provide functioning shelter:

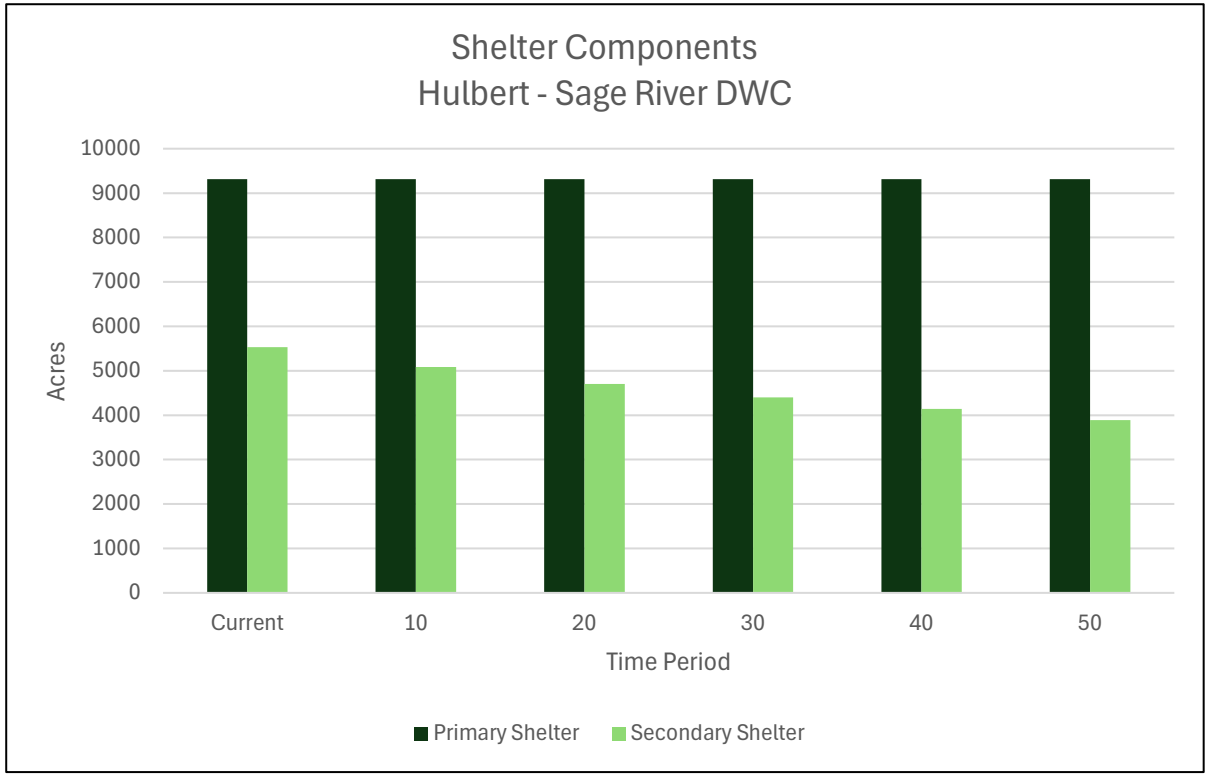
- Primary shelter cover types
  - Cedar
  - Hemlock
- Dominated by long-lived tree species
- Difficult to regenerate when managed
- No active management projected in the SFMP within DWCs



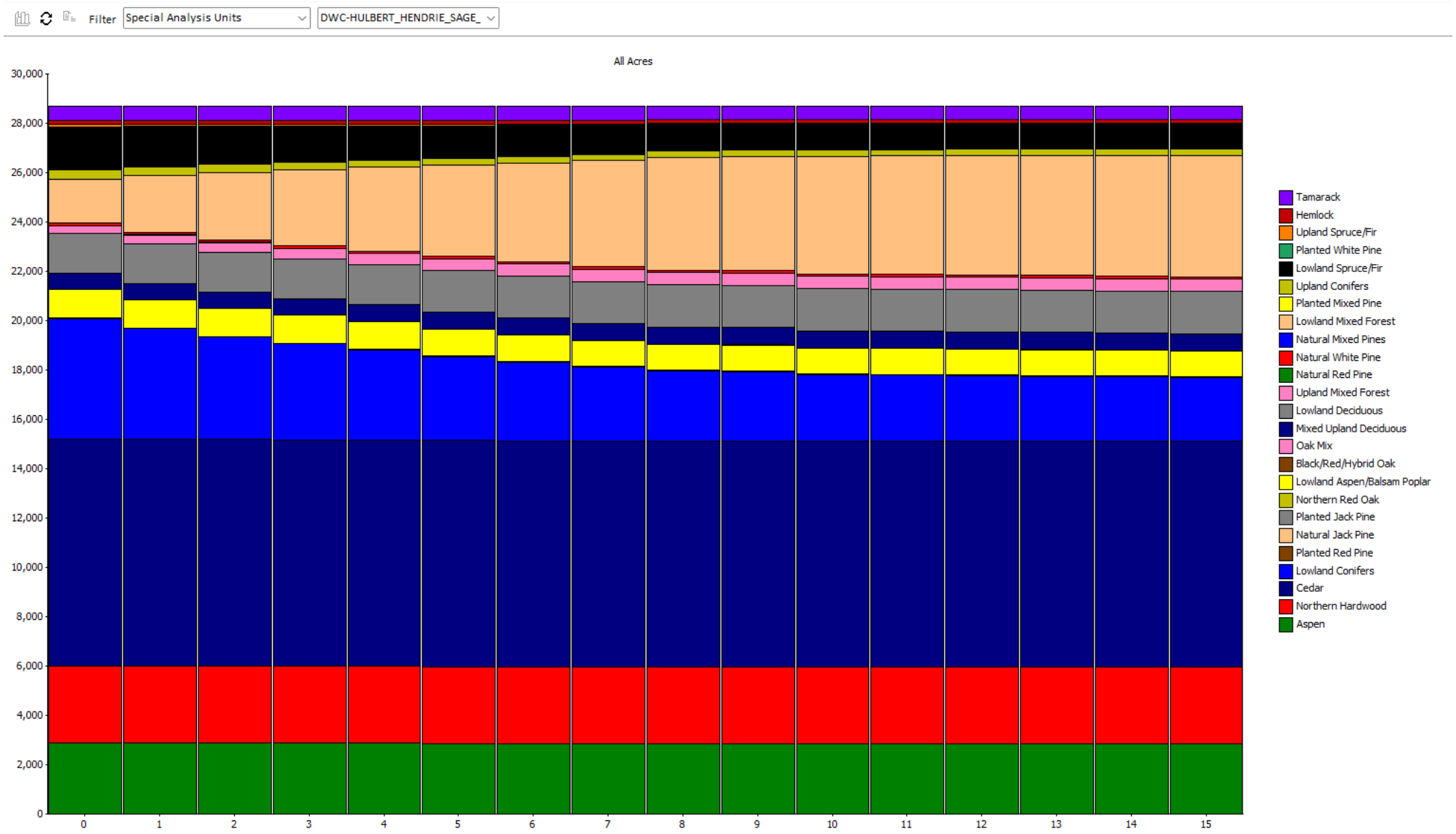
Modeling Effort - Deer wintering Complexes (DWC)

Maintaining cover types that provide functioning shelter:

- Secondary shelter
  - Lowland Spruce / Fir
  - Lowland Conifer
- Contain shorter lived tree species (80 – 150-year life span)
- Management is necessary to maintain in healthy condition
- Can be converted to food when deciduous species are mixed in

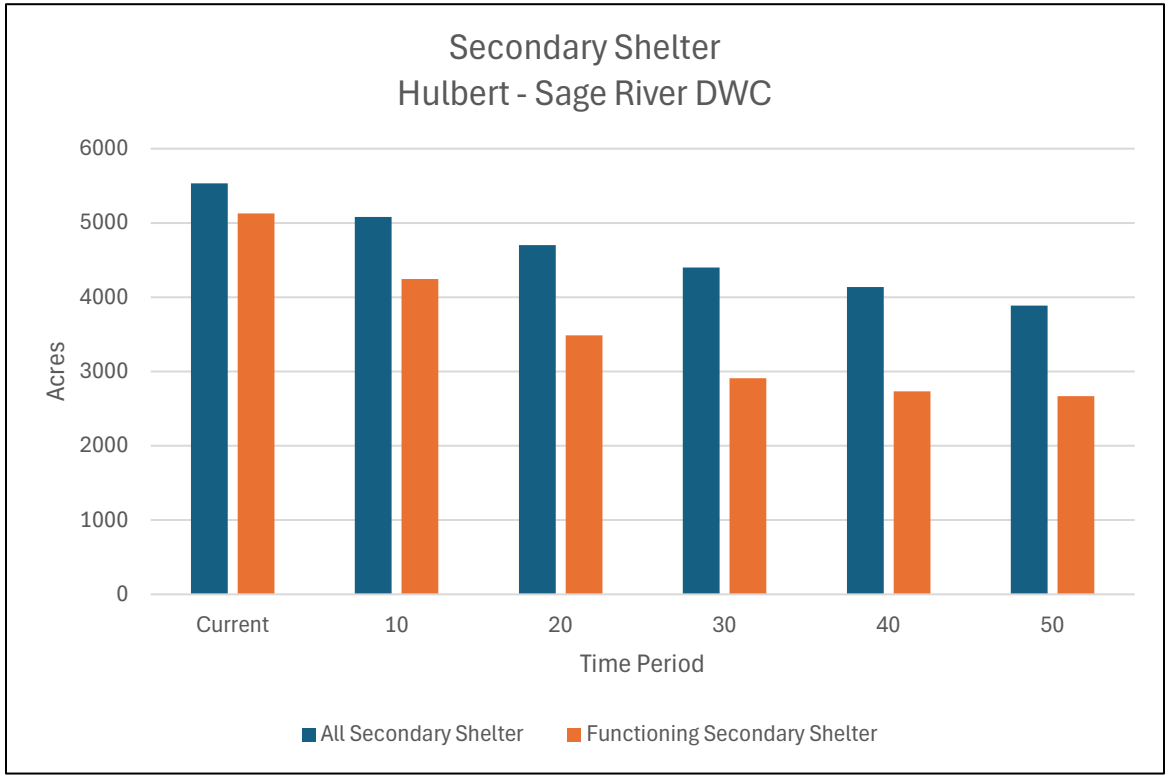


Cover type conversions



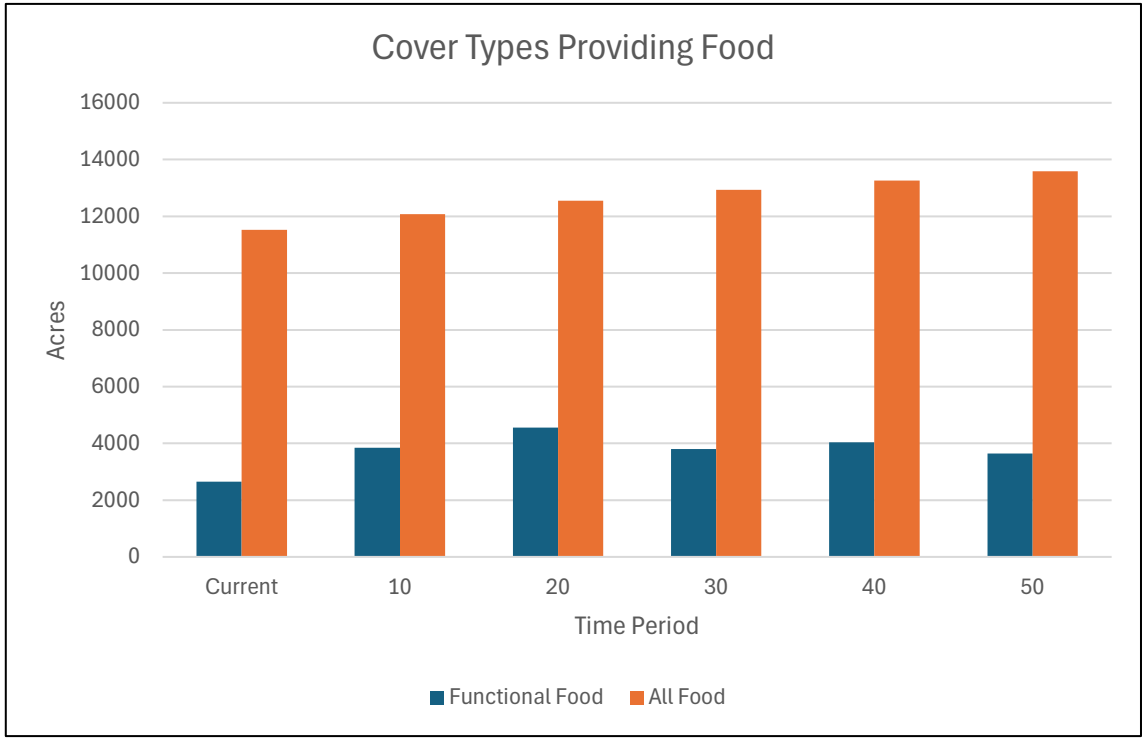
Modeling Effort - Deer wintering Complexes (DWC)

- Secondary Shelter Management
- Actively managed using area regulation principles
- 75 – 90% of all secondary shelter remains as functional shelter during management

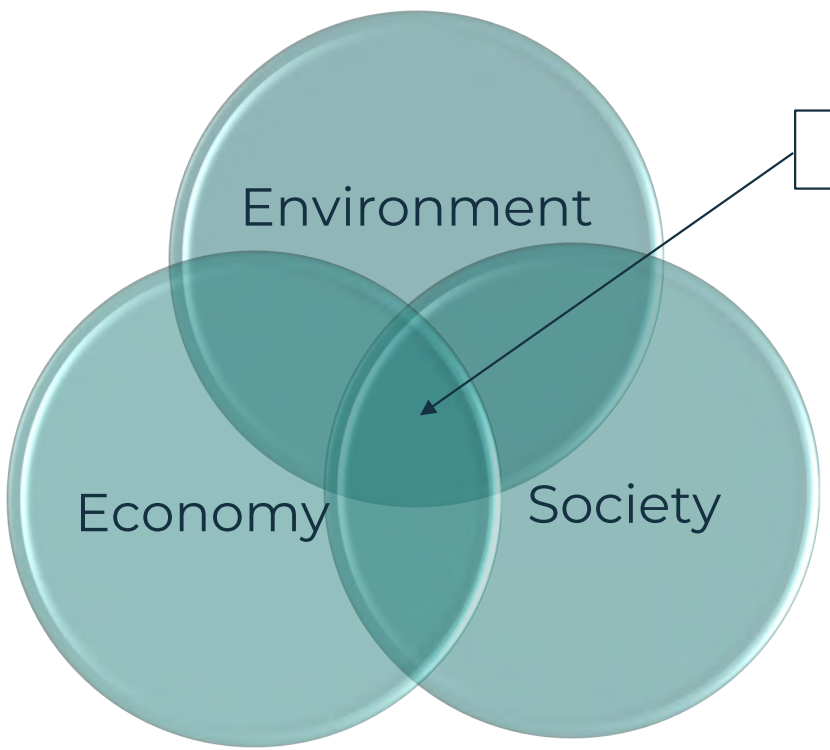


Modeling Effort - Deer wintering Complexes (DWC)

- Cover types providing food
  - Aspen
  - Northern Hardwoods
  - Lowland Mixed Forest
- Actively managed using area regulation principles
- 20-30 % is providing functional food at any time

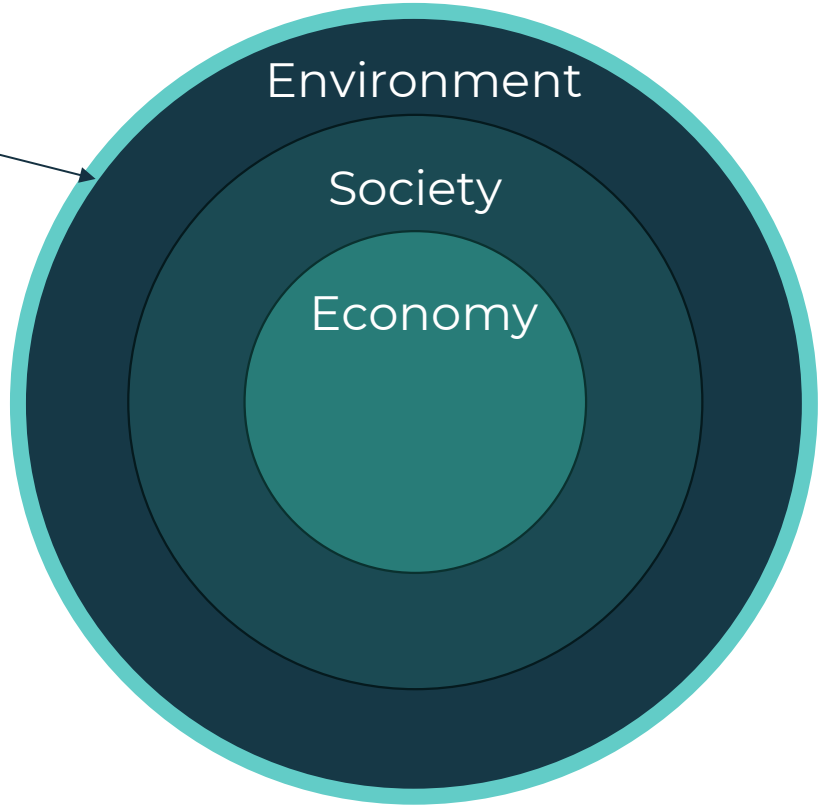


Planning Framework Effort



Old model – weak sustainability

Sustainability



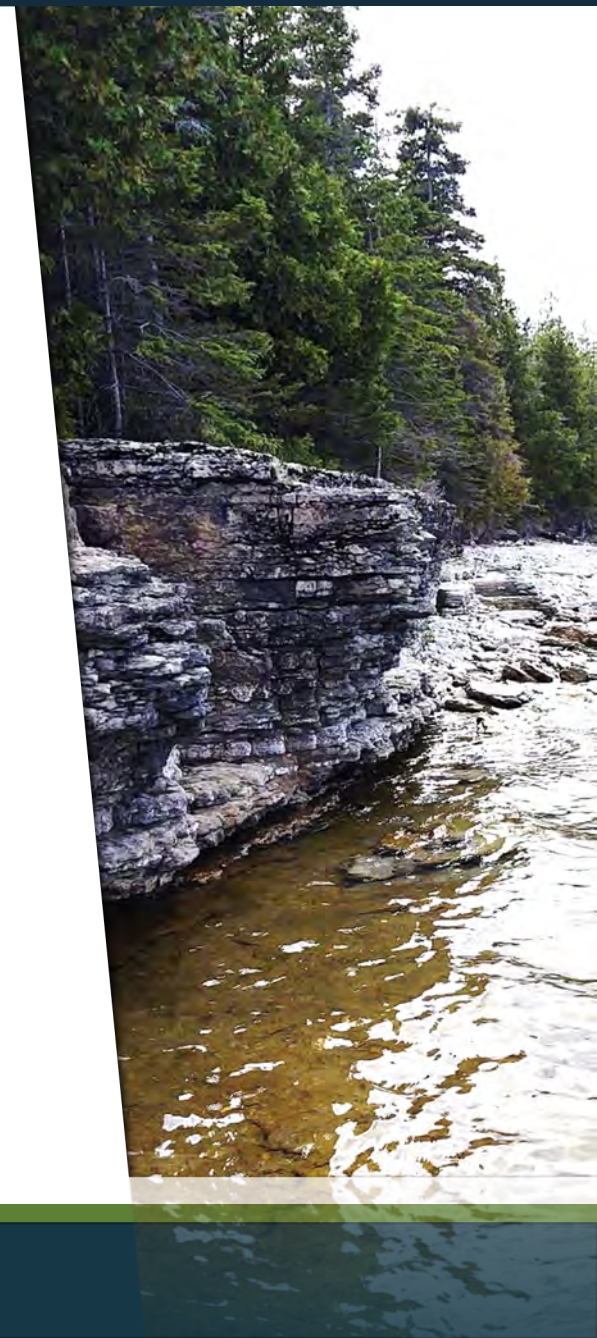
New model – strong sustainability

Planning Framework Effort

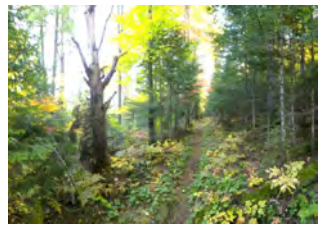
Established 7 Management Principles that are aligned with **Montreal Process Criterion & Indicator Framework** for measuring **progress toward forest sustainability**.

The state forest is managed to…

1. conserve or enhance biological diversity.
2. maintain productive capacity.
3. promote ecosystem health and vitality.
4. conserve and protect soil and aquatic resources.
5. provide opportunities for social and economic benefits.
6. respond to a changing climate.
7. protect cultural and historic resources.

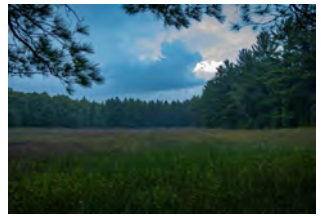


Our mission: We are committed to the conservation, protection, management, use and enjoyment of the state's natural and cultural resources for current and future generations.

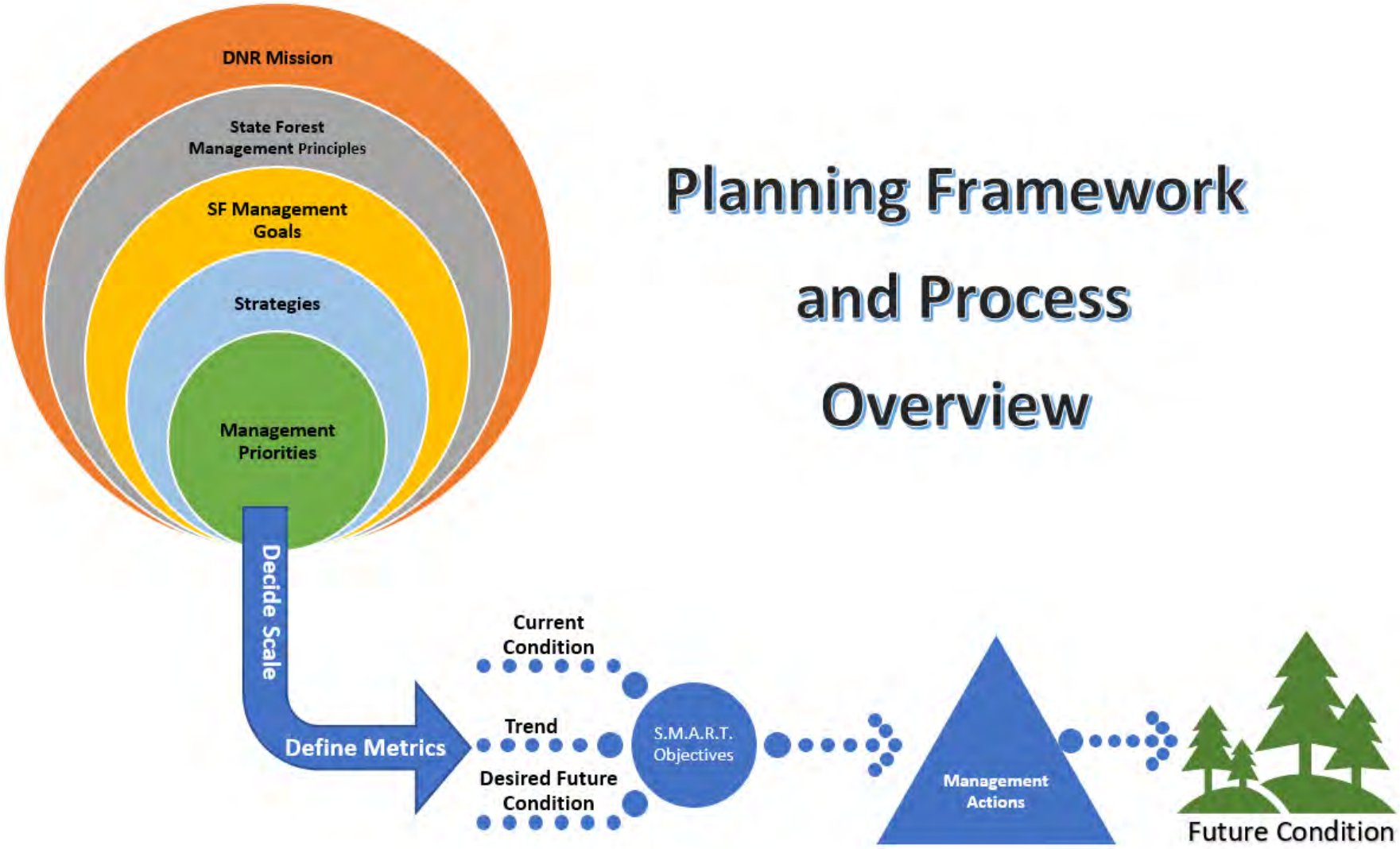






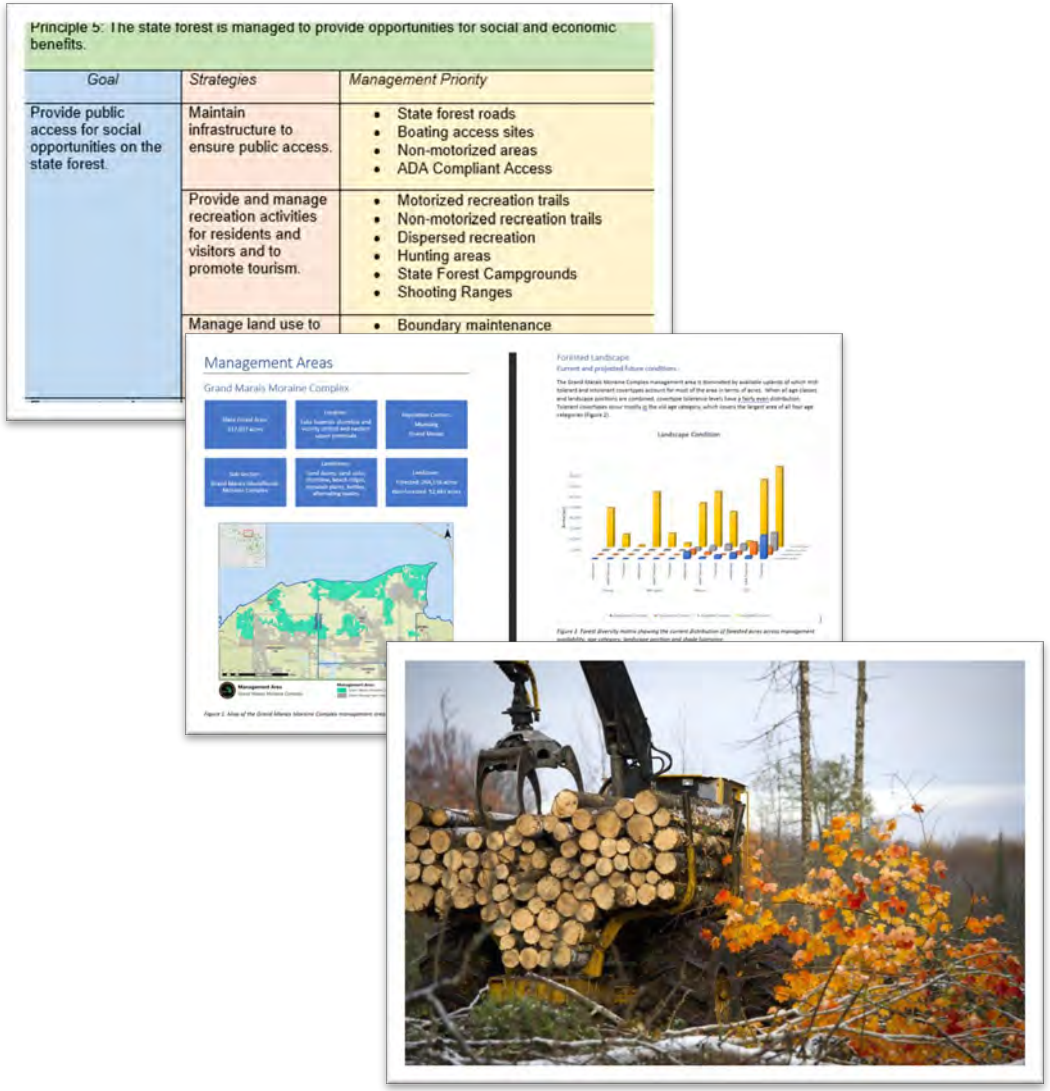



Planning Framework and Process Overview



Writing Effort

- Transition from planning framework to topic-based plan organization
- Managing at different scales
  - Section 3: Statewide and regional management priorities
  - Section 4: Landscape level covertype and habitat management goals at the management area level and special analysis units

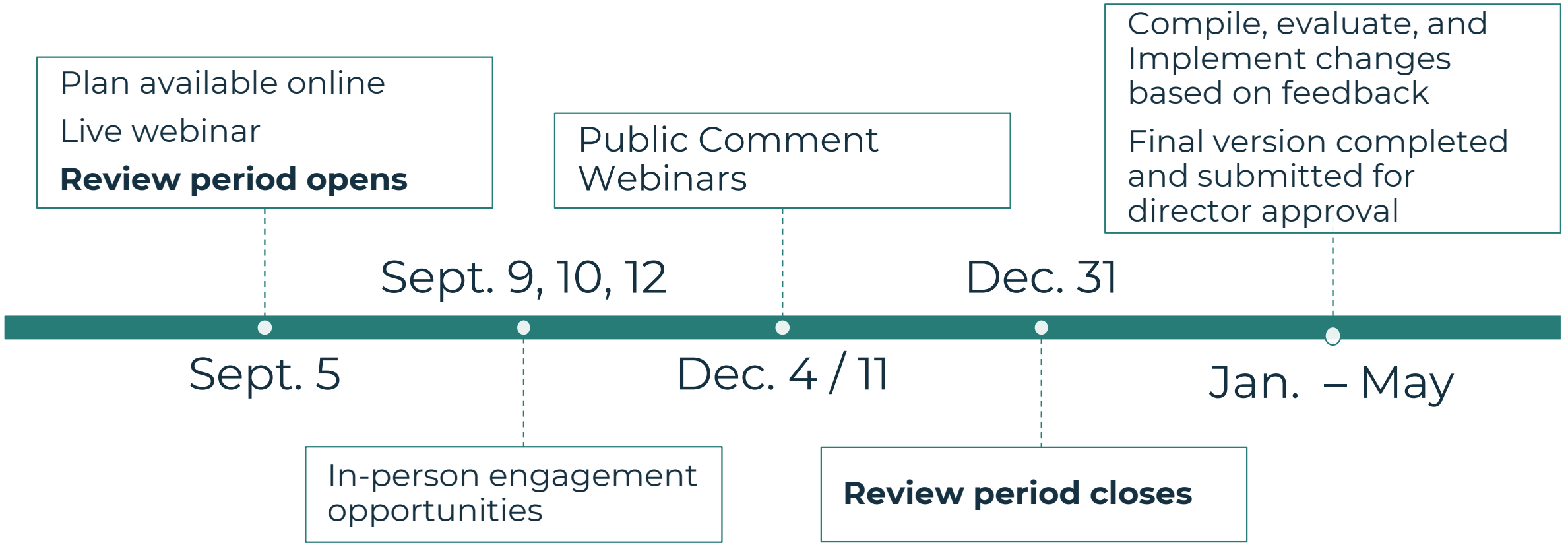


Plan Organization & Structure

Executive Summary

1. Introduction
2. State Forest History
3. Statewide and Regional Planning
4. Management Area Planning
5. Special Analysis Units
6. Implementation
7. Monitoring and Revision
8. Glossary
9. References
10. Appendices

Looking Ahead



Providing Input

Email us at: ForestPlanComments@Michigan.gov

More Info at: State forest planning (michigan.gov)


Thank you!

Bottlenecks, barriers, and opportunities: sustaining mesic and lowland conifers on an ever-changing landscape

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Michigan Technological University

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Michigan Technological University

ecosystem Science Center

Outline

- Context
- Eastern Hemlock
  - Historic and contemporary status
  - Research findings
- Northern White-cedar
  - Historic and contemporary status
  - Research findings
- Synthesis and implications for management

Context

- In deep snow regions, migration to mesic and lowland conifer stands is essential for white-tailed deer to survive harsh winter conditions
- Deer migratory traditions are learned and vary regionally and seasonally in response to snow depth
- Eastern hemlock and northern white-cedar are our premier winter cover species and provide shelter and high-quality forage
- The winter bottleneck is considered a primary driver of survival and fawn recruitment

" Upper Peninsula. Gradual steady increase for the past 20 years, with many local variations. **Half the yards browsed out**, with frequent starvation, by 1938."

A Survey of Over-Populated Deer Ranges in the United States. Aldo Leopold, Lyle K. Sowls and David L. Spencer. The Journal of Wildlife Management , Apr., 1947, Vol. 11, No. 2 (Apr., 1947), pp. 162-177

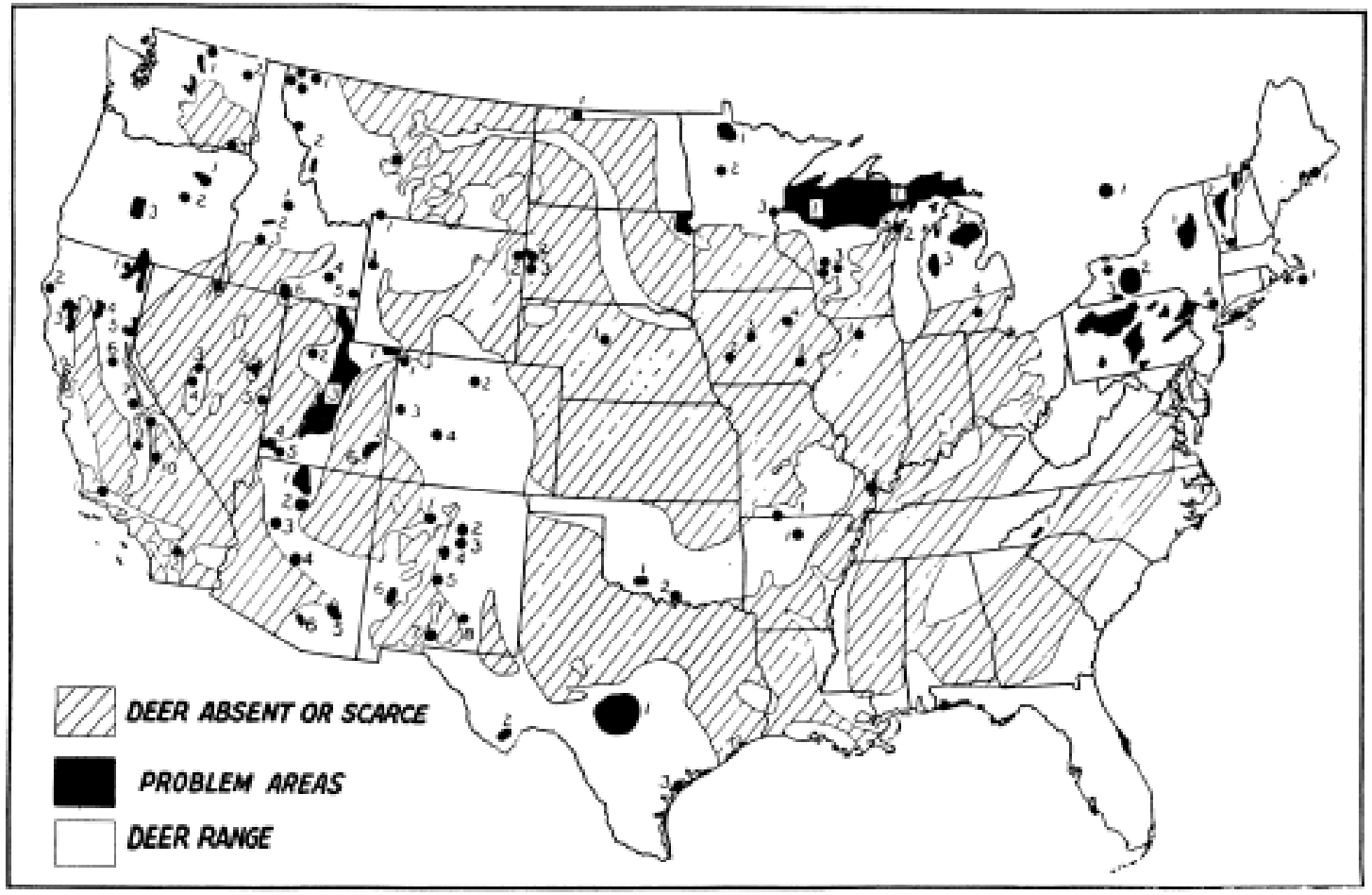
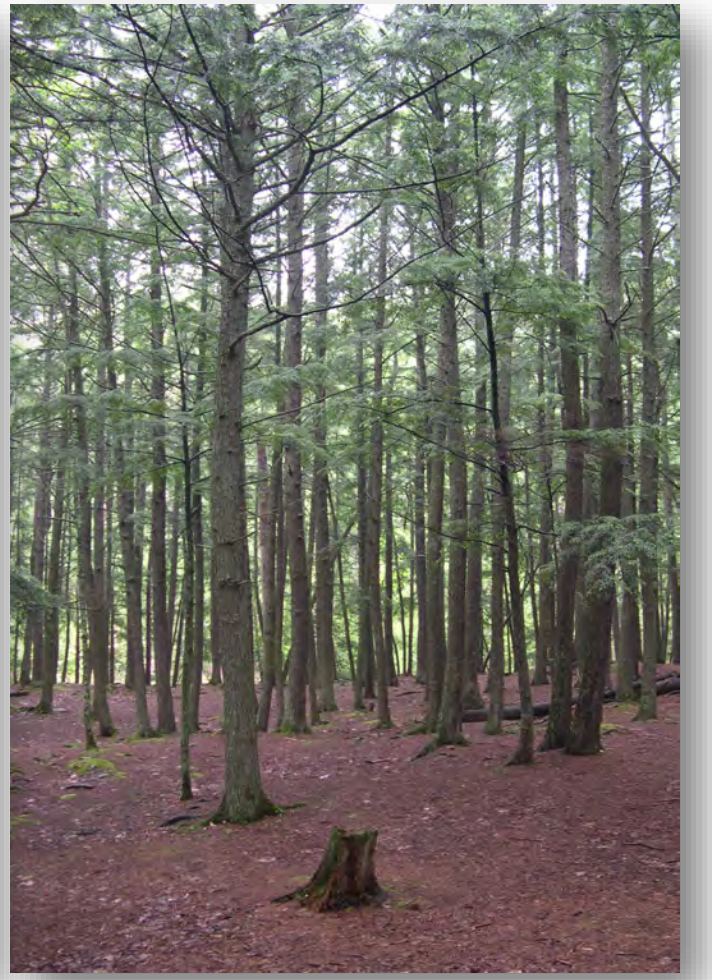
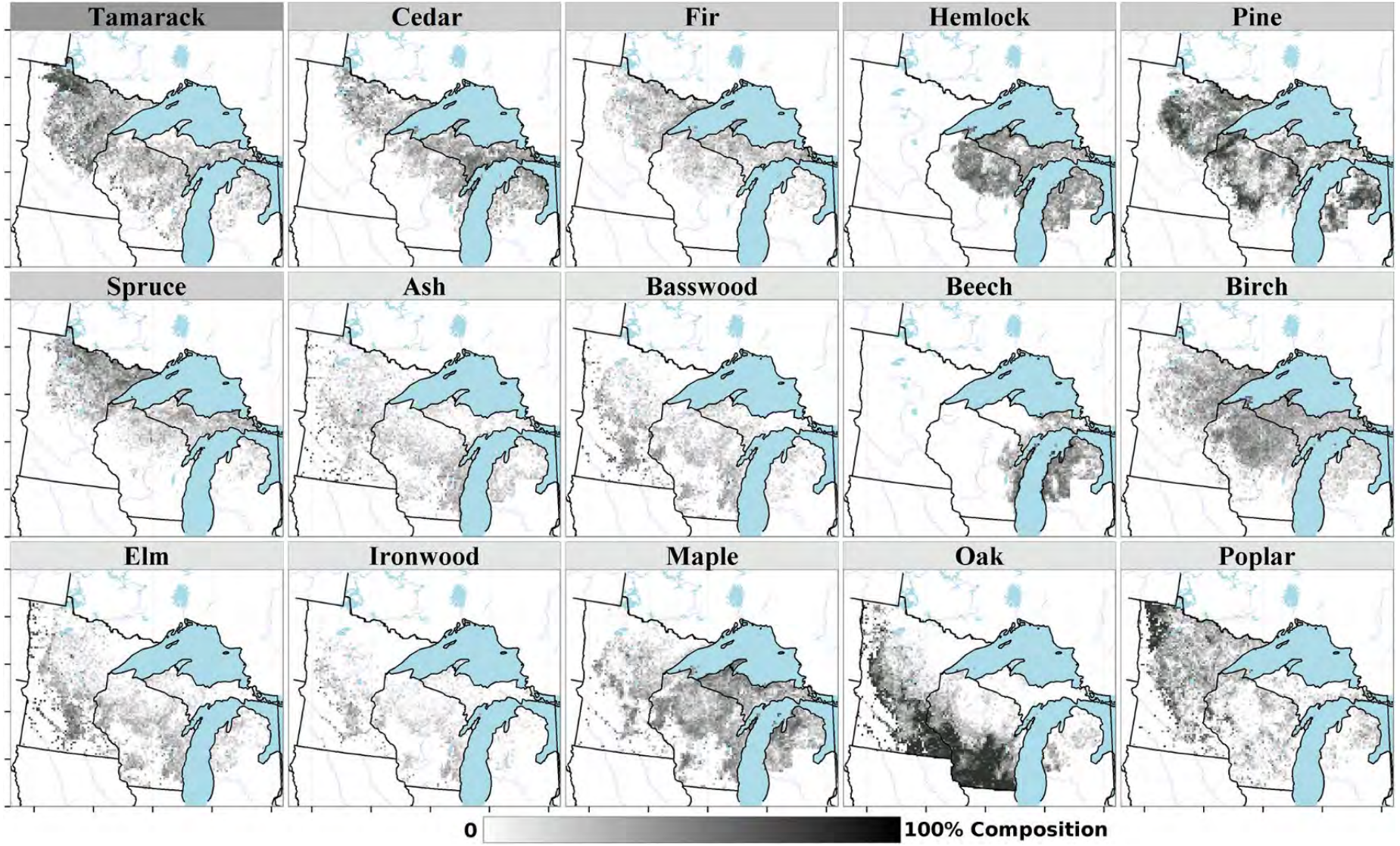


FIG. 1.—Areas in which over-populations of deer now exist or have existed in the recent past. Numbers refer to case histories.

Eastern hemlock



Public Lands Survey *c.* 1832-1907

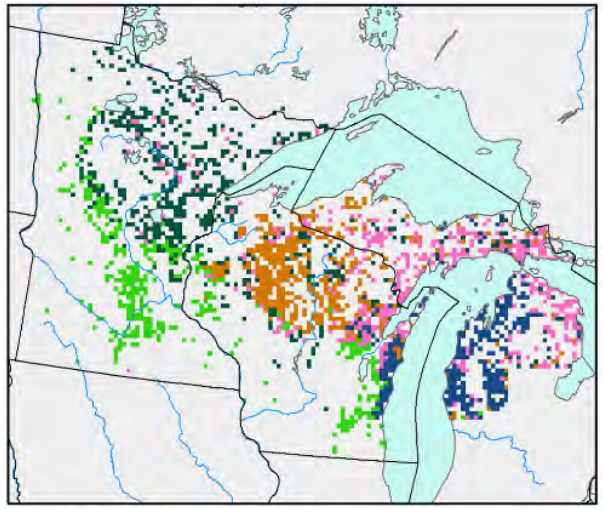


Novel and Lost Forests in the Upper Midwestern United States, from New Estimates of Settlement-Era Composition, Stem Density, and Biomass
Simon J. Goring ,David J. Mladenoff,Charles V. Cogbill,Sydne Record,Christopher J. Paciorek,Stephen T. Jackson,Michael C. Dietze,Andria Dawson,Jaclyn Hatala Matthes,Jason S. McLachlan,John W. Williams
Published: December 9, 2016
https://doi.org/10.1371/journal.pone.0151935

Forest Inventory & Analysis *c.* 2007-2011

On the two primary forest types where it occurred in the Public Lands Survey, hemlock declined by 90.7 and 84.3 %, respectively.

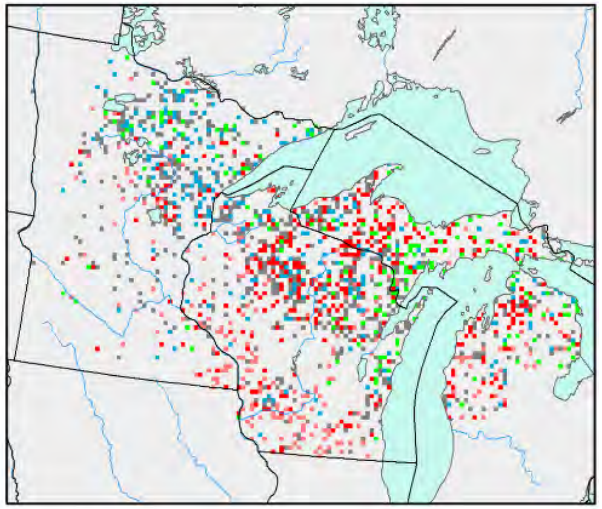
Lost forests



Legend

- Tamarack-Pine-Birch-Spruce-Poplar
- Cedar-Hemlock-Pine
- Elm-Oak-Basswood-Ironwood
- Hemlock-Birch-Maple
- Beech-Hemlock-Maple

Novel forests



Legend

- Cedar-Maple-Ash
- Poplar-Maple-Ash
- Ash-Maple-Cedar-Birch
- Oak-Maple
- Maple-Poplar-Spruce

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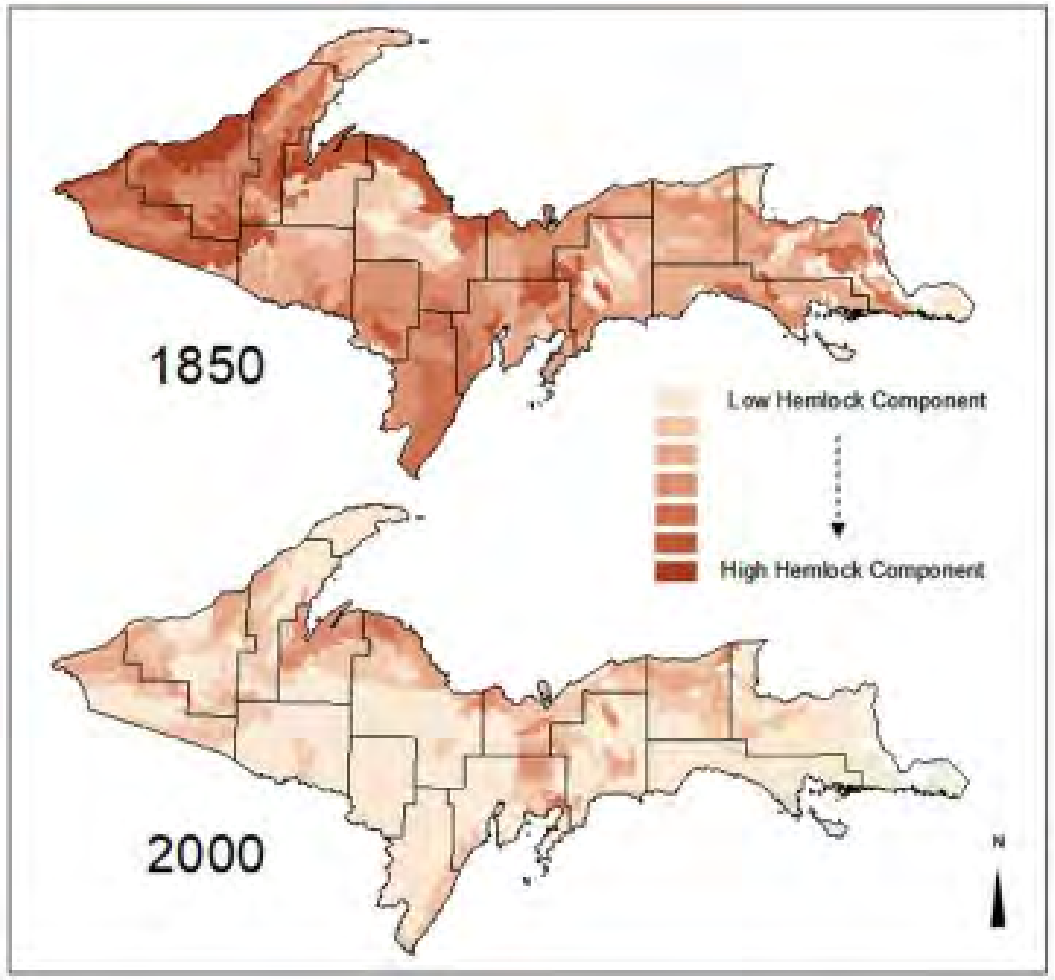
Changes in the Upper Peninsula



https://content.govdelivery.com/attachments/MIDNR/2023/12/20/file_attachments/2725189/Factors%20Limiting%20Deer%20Abundance%20in%20the%20Upper%20Peninsula%20Report.pdf

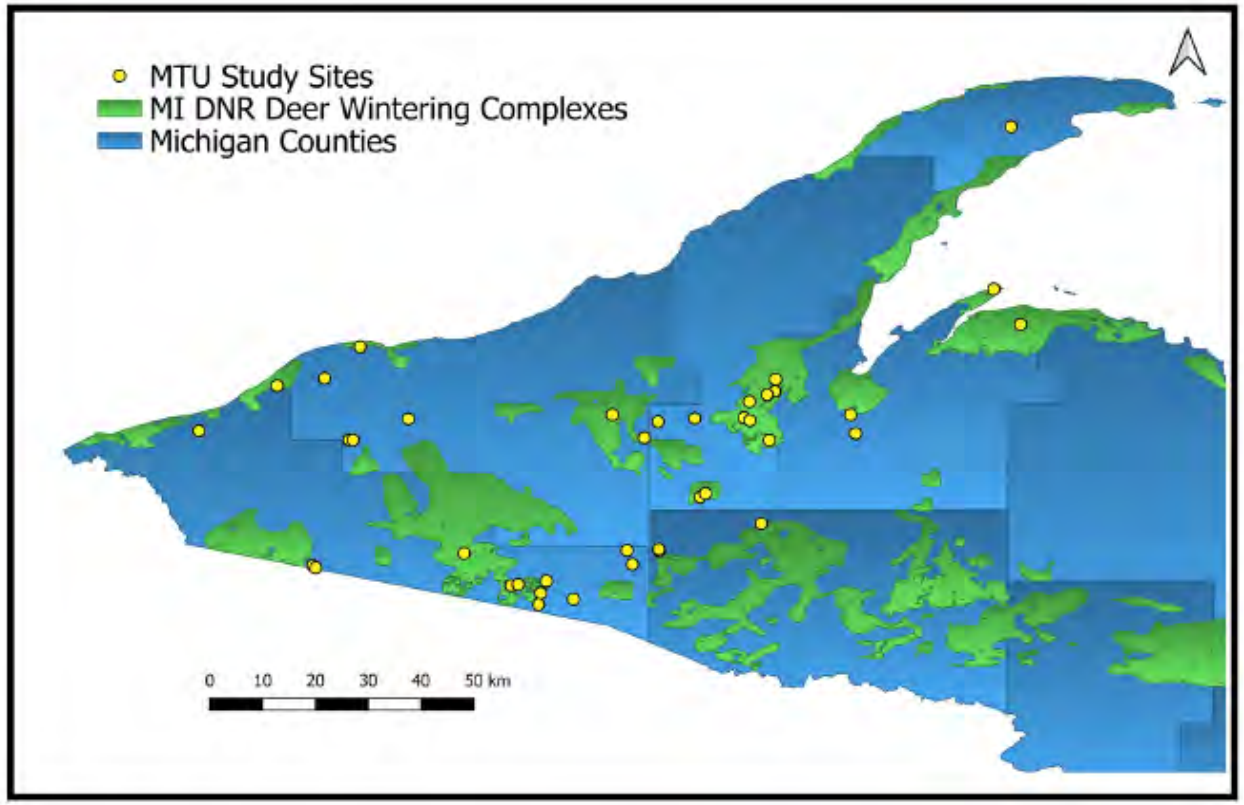
"In the 1850's, hemlock was widespread and the third most common tree species in the Upper Peninsula. Hemlock now comprises less than 1% of forestland, declining over 97% from an area of 4.7 million acres to little more than 100,000 acres, most of which occurs in the Upper Peninsula."

(Albert L.. Digital Representations of Tree Species Range Maps from Atlas of United States Trees. USGS November 2006; Mark MacKay. Unpublished Analysis of GLO and FIA data by LTA 2006. Michigan DNR; Mark MacKay. Forest History of the WUP Ecoregional Plan 2006)

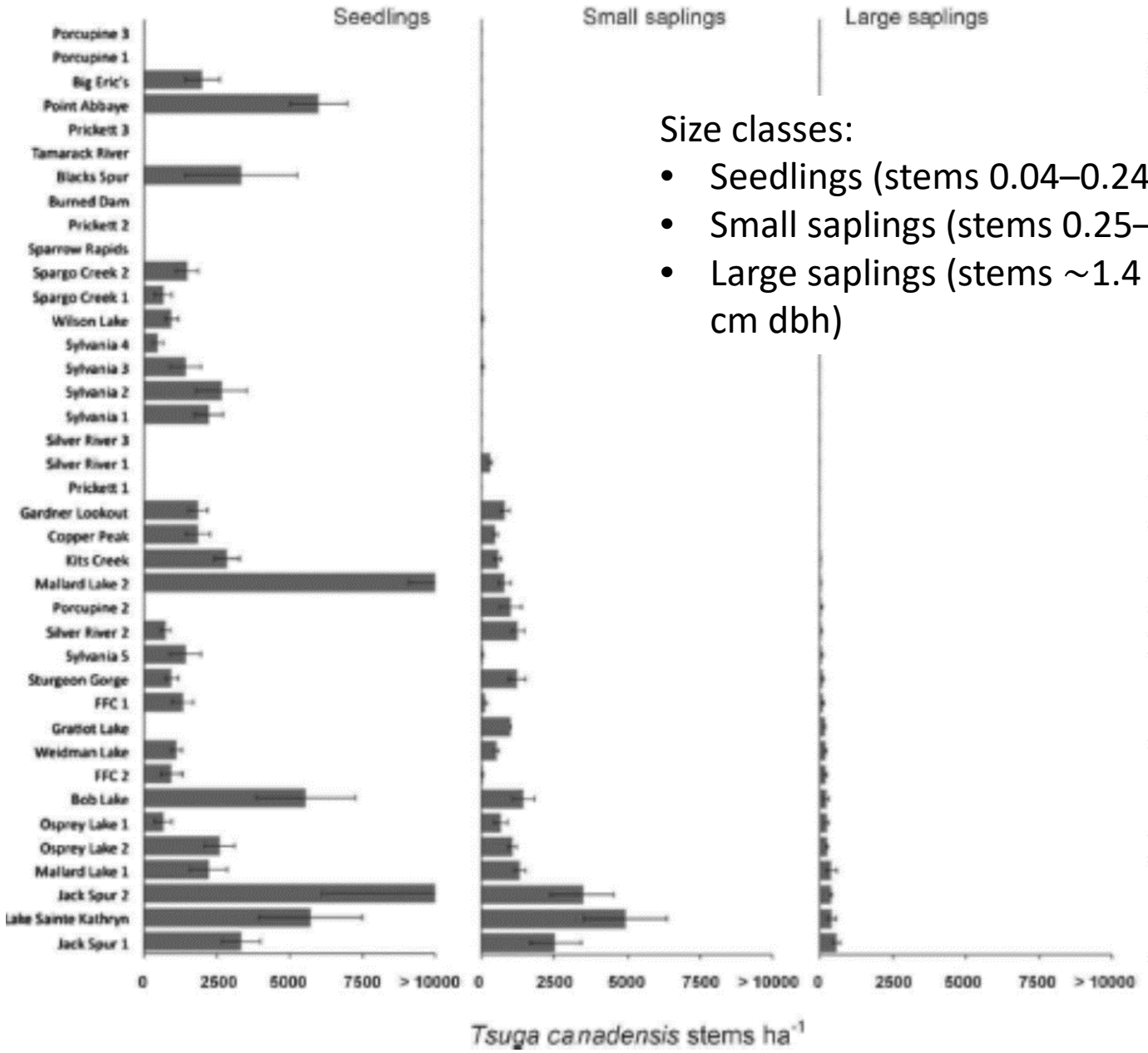
A protracted decline

- Major decline late 1800s to early 1900s
  - "cutover", land clearing, and wildfires
- Continued gradual decline
- Regeneration failures common since at least the 1940s
- A challenging species to reliably regenerate
  - Life history traits
  - Contemporary and historic bottlenecks
  - Legacy effects

Monitoring deer use and vegetaion changes in hemlock stands in the western Upper Peninsula



- Study established in 2005
- 39 randomly selected relict hemlock stands
- Annual pellet surveys and periodic vegetation surveys



Size classes:

- Seedlings (stems 0.04–0.24 m tall)
- Small saplings (stems 0.25–1.4 m tall)
- Large saplings (stems ~1.4 m in ht to tall cm dbh)

Regeneration dynamics in remnant Tsuga canadensis stands in the northern Lake States: Potential direct and indirect effects of herbivory. Jill C. Witt and Christopher R. Webster. 2010. Forest Ecology and Management 260: 519-525. https://doi.org/10.1016/j.foreco.2010.05.007

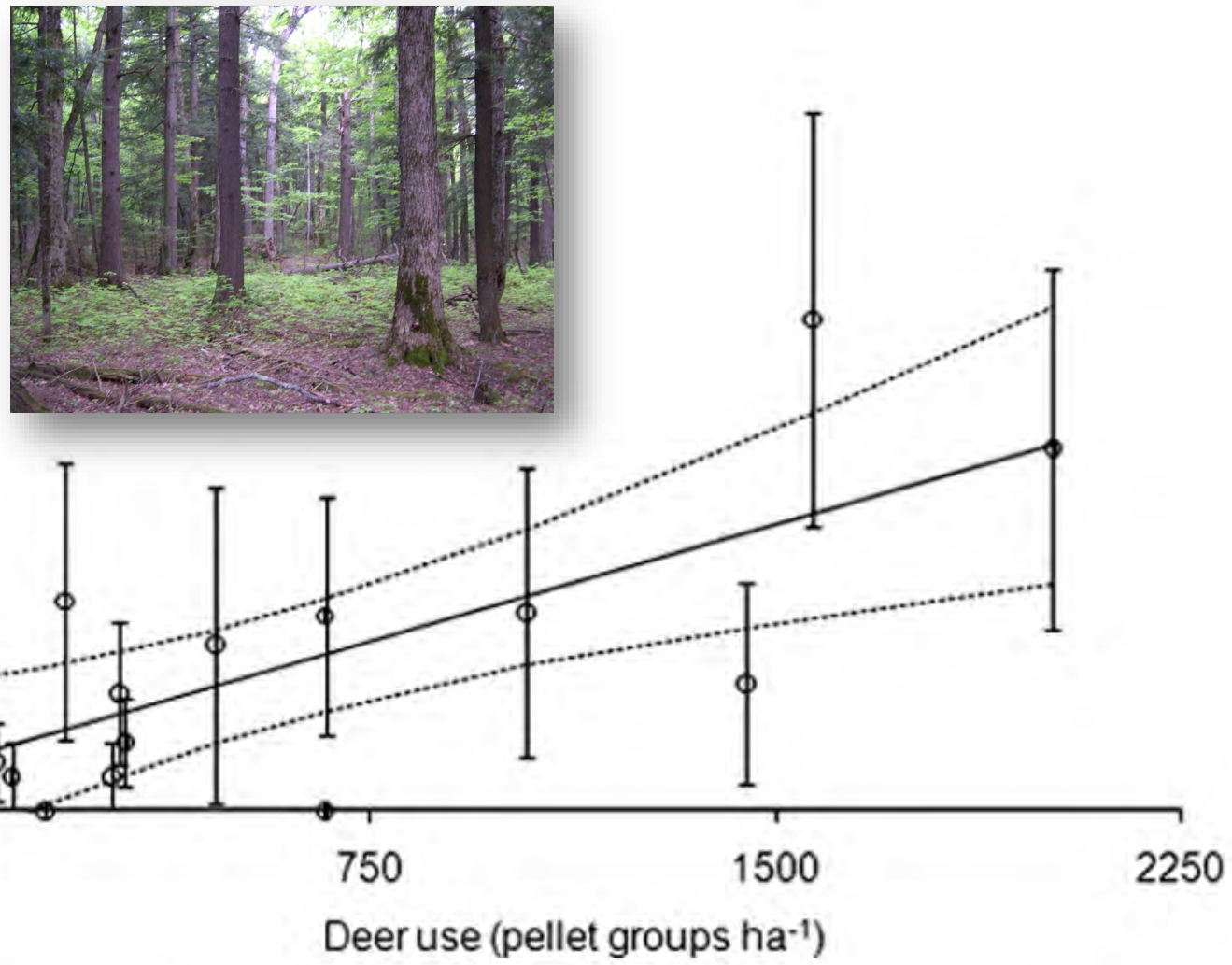
Deer use: 3-yr average 457 ± 486 pellet groups ha^{-1}, with some stands > 2200 pellet groups ha^{-1} yr^{-1}

Table 1
Parameter estimates for our best-fit model of *Tsuga canadensis* abundance for seedling, small sapling, and large sapling size classes using a generalized linear modeling framework. All variables in models were significant ($p < 0.05$). Numbers in parentheses are 95% confidence intervals for the parameter estimates.

Model covariates	*Tsuga canadensis*		
	Seedlings (0.04–0.24 m height)	Small saplings (0.25–1.4 m height)	Large saplings (~1.4 m height–4.0 cm dbh)
Intercept	1.211 (0.832)	8.690 (2.588)	−5.026 (1.047)
Tsuga canadensis seedlings		0.012 (0.005)[a]	
Tsuga canadensis small saplings			0.475 (0.002)[b]
Acer saccharum basal area	−0.804 (0.133)[a]		
Stand basal area	−0.045 (0.015)	−1.256 (0.403)[a]	
White-tailed deer pellet groups ha^{-1}		−0.056 (0.018)[a]	
Stand area			−0.036 (0.012)
Stand elevation	0.003 (0.001)		0.005 (0.002)

[a] Variable was square root transformed.
[b] Variable was natural log transformed.

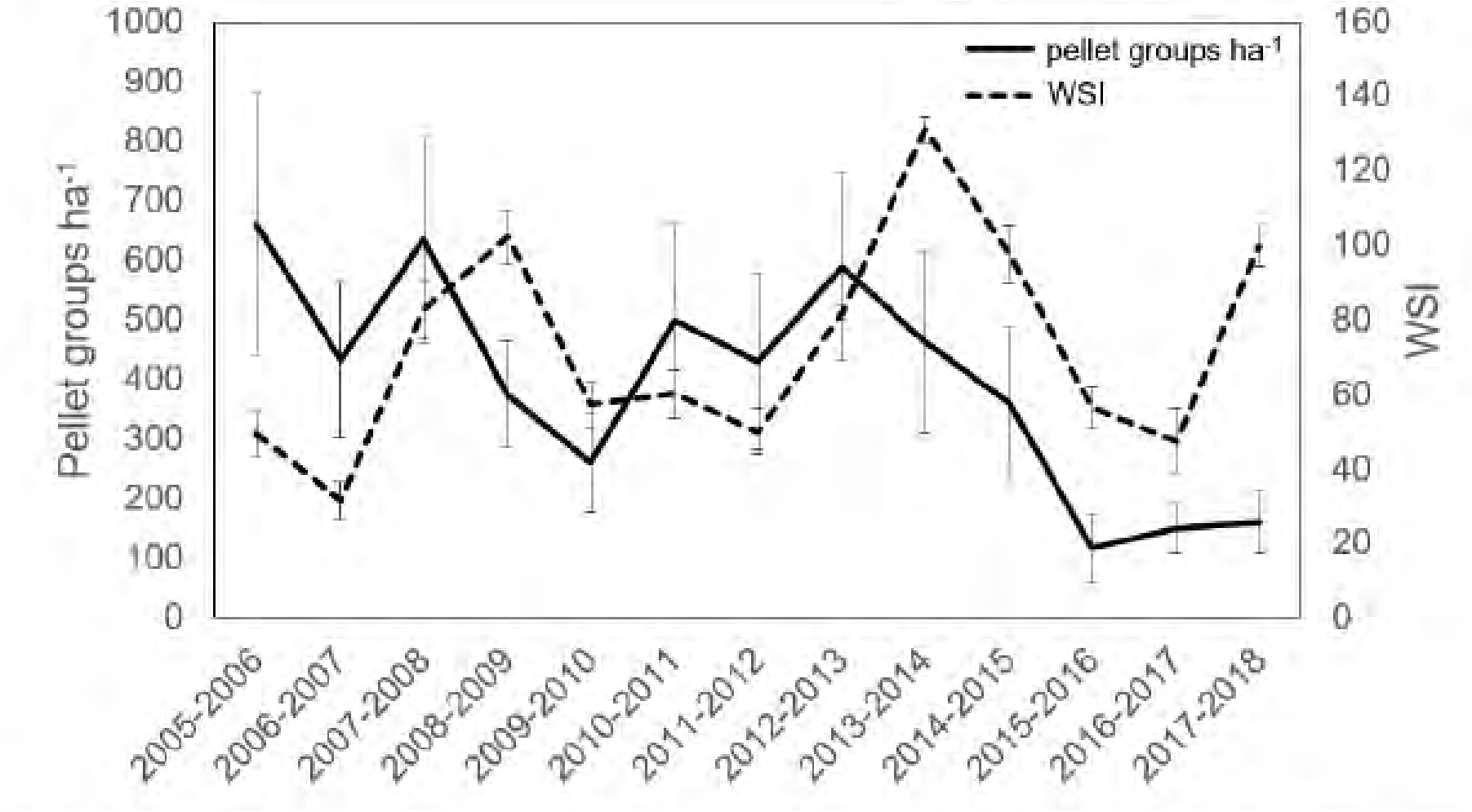
Regeneration dynamics in remnant Tsuga canadensis stands in the northern Lake States: Potential direct and indirect effects of herbivory. Jill C. Witt and Christopher R. Webster. 2010. Forest Ecology and Management 260: 519-525. https://doi.org/10.1016/j.foreco.2010.05.007



Use is high enough in some stands that there is a substantial nitrogen fertilization effect, which likely favors maple and deciduous species over hemlock in the regeneration layer

- Murray et al. 2014. Ecosystems 17:1002-1013. https://link.springer.com/article/10.1007/s10021-014-9796-y

Ungulate winter habitat selection as a driver of herbaceous-layer heterogeneity in northern temperate forests. Jensen, N. R., C. R. Webster, J. C. Witt, and J. B. Grant. 2011. Ecosphere 2(6):art67. doi:10.1890/ES10-00189.1



Subset of 15 stands revisited for vegetation surveys in 2015. WSI = number of days with snow depth ≥ 18 inches plus number of days temperature ≤ 0° F

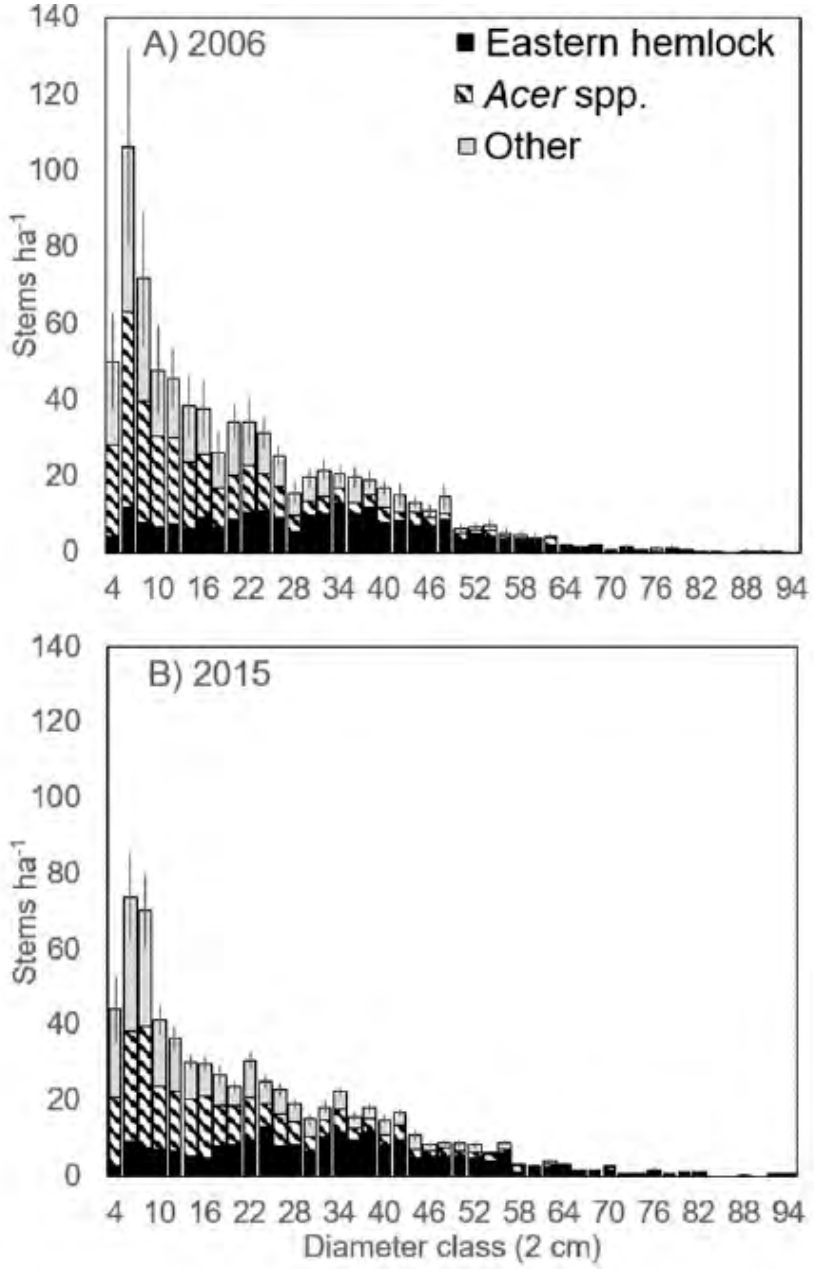
Press-Pulse Odocoileus Virginianus Herbivory in Relict Tsuga Canadensis Stands in the Western Upper Peninsula of Michigan, USA. Grace L. Parikh and Christopher R. Webster. 2019. Forests10(6), 496; https://doi.org/10.3390/f10060496

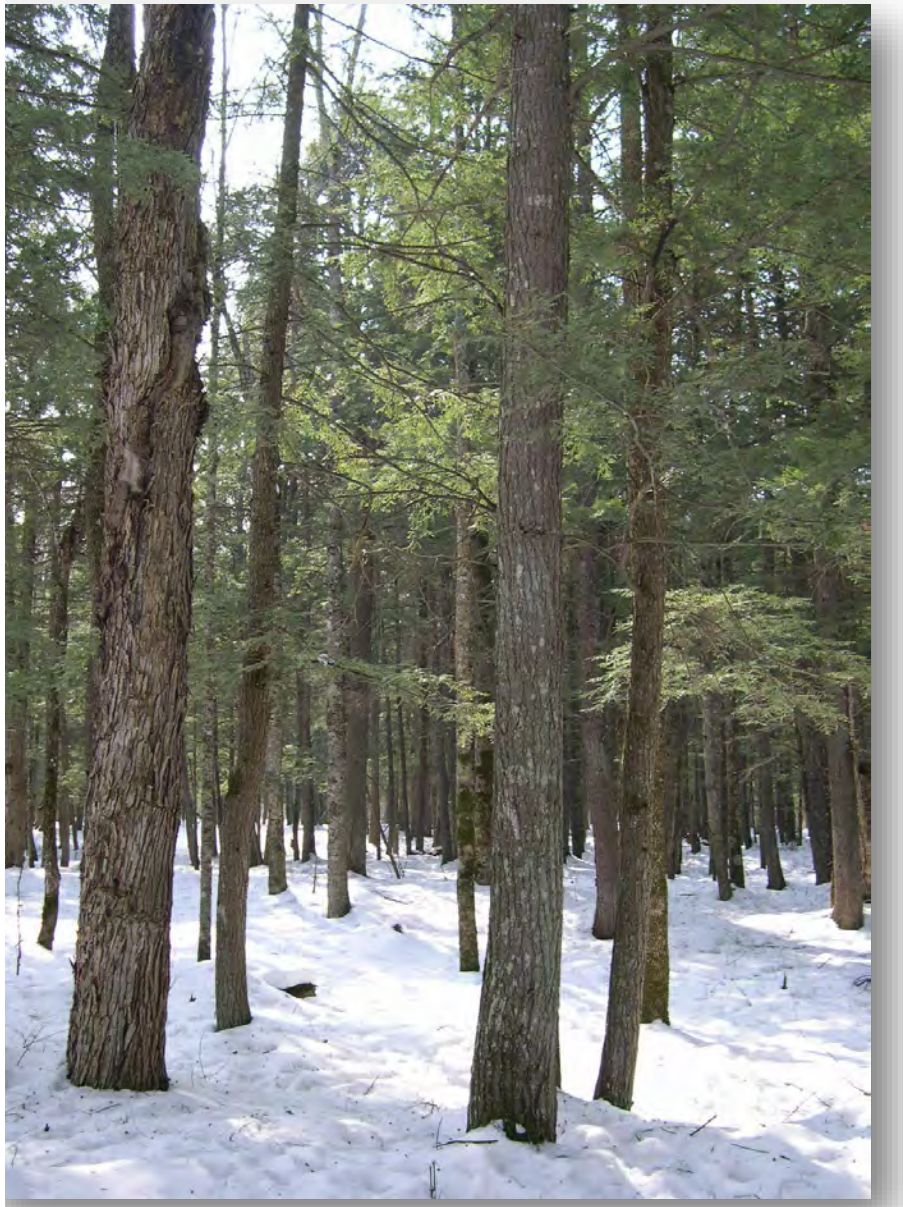
Table 2. Absolute densities of woody regeneration in 15 *Tsuga canadensis* stands in the western Upper Peninsula of Michigan. Densities were compared using a generalized linear mixed model framework. Negative binomial distributions were used for all analyses.

Scientific Name	Common Name	Stems ha^{-1} 2007	Stems ha^{-1} 2015	% Change	*p*-Value
Small regeneration (0.04–0.24 m height)					
Abies balsamea L.	Balsam fir	632 ± 323	1088 ± 439	72%	0.07
Acer rubrum L.	Red maple	4989 ± 691	20527 ± 5721	311%	<0.001
Acer saccharum Marshall	Sugar maple	4768 ± 712	27534 ± 9851	477%	0.007
Betula alleghaniensis Britton	Yellow birch	286 ± 140	455 ± 262	59%	0.60
Tsuga canadensis L. Carrière	Eastern hemlock	1163 ± 486	924 ± 440	−21%	0.06
	Other hardwood*	1358 ± 634	2868 ± 1828	111%	0.04
	Other conifer†	49 ± 34	291 ± 192	490%	0.04
	Total (no maple)	3488 ± 989	5626 ± 1889	61%	0.03
Medium regeneration (0.25 m–1.4 m height)					
Abies balsamea L.	Balsam fir	436 ± 130	105 ± 34	−68%	<0.001
Acer rubrum L.	Red maple	438 ± 166	248 ± 116	−43%	0.08
Acer saccharum Marshall	Sugar maple	2648 ± 1291	290 ± 144	−79%	<0.001
Betula alleghaniensis Britton	Yellow birch	255 ± 205	92 ± 39	−55%	0.63
Tsuga canadensis L. Carrière	Eastern hemlock	371 ± 122	195 ± 58	−44%	0.006
	Other hardwood	1258 ± 590	556 ± 213	−56%	<0.001
	Other conifer	89 ± 37	74 ± 19	−17%	0.53
	Total (no maple)	2409 ± 767	898 ± 277	−63%	0.005
Large regeneration (>1.4 m height–4 cm dbh)					
Abies balsamea L.	Balsam fir	181 ± 100	104 ± 44	−42%	0.02
Acer rubrum L.	Red maple	43 ± 14	68 ± 29	58%	0.22
Acer saccharum Marshall	Sugar maple	209 ± 75	172 ± 110	−18%	0.05
Betula alleghaniensis Britton	Yellow birch	77 ± 46	44 ± 20	−42%	0.06
Tsuga canadensis L. Carrière	Eastern hemlock	88 ± 63	55 ± 32	−38%	0.15
	Other hardwood	97 ± 65	180 ± 122	86%	<0.001
	Other conifer	7 ± 4	17 ± 11	133%	0.08
	Total (no maple)	450 ± 210	401 ± 150	−11%	0.55

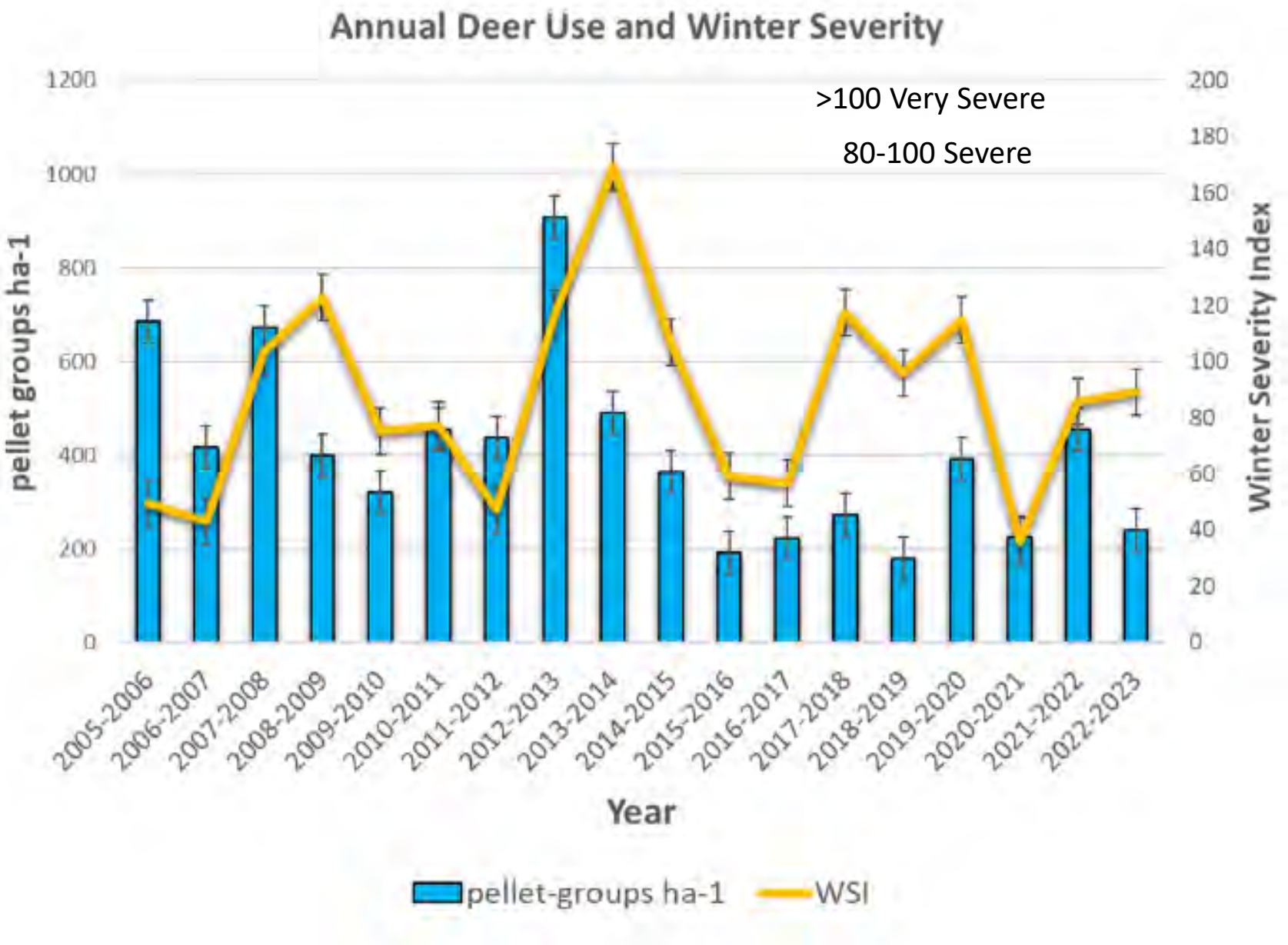
Note: means are reported ± 1 standard error. * Species in the "other hardwood" category were *Betula papyrifera* Marshall, *Fraxinus americana* L., *Fraxinus nigra* Marshall, *Ostrya virginiana* (Mill.) K. Koch, *Populus grandidentata* L., *Populus tremuloides* L., *Prunus spp.* L., *Quercus rubra* L., *Salix spp.* L., *Tilia americana* L., and *Ulmus americana* L. † Species in the "other conifer" category were *Picea glauca* (Moench) Voss, *Picea mariana* (Mill.), *Pinus strobus* L., and *Thuja occidentalis* L.

Press-Pulse Odocoileus Virginianus Herbivory in Relict Tsuga Canadensis Stands in the Western Upper Peninsula of Michigan, USA. Grace L. Parikh and Christopher R. Webster. 2019. Forests 2019, 10(6), 496; https://doi.org/10.3390/f10060496

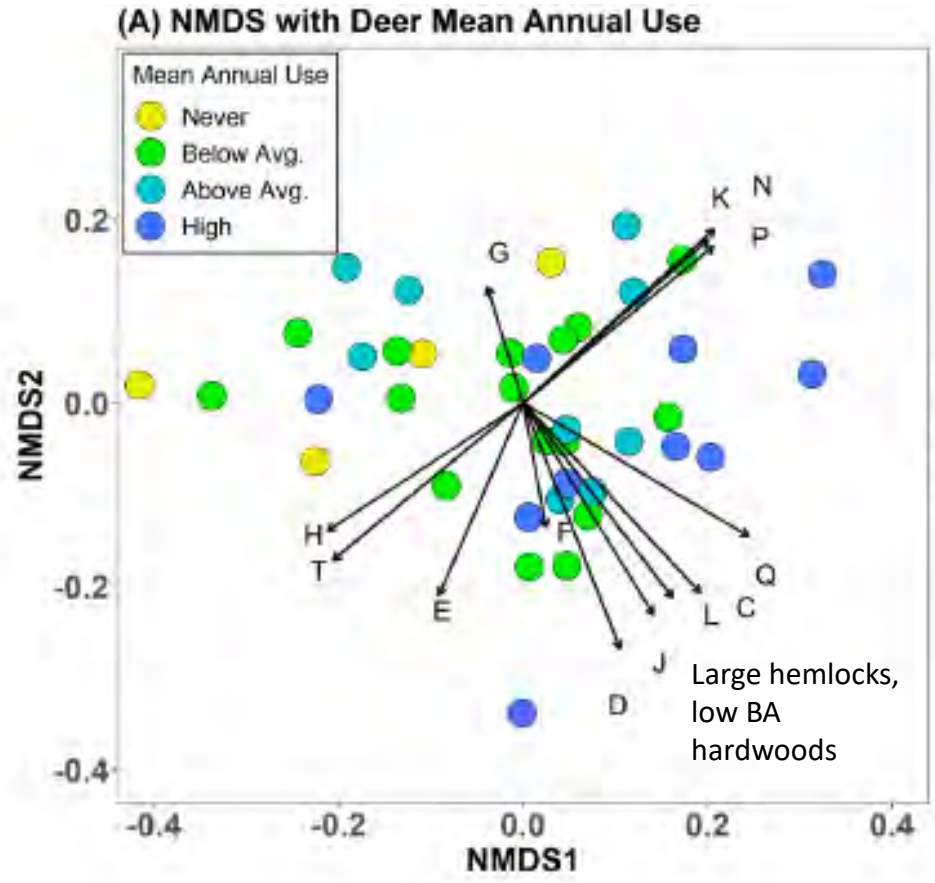


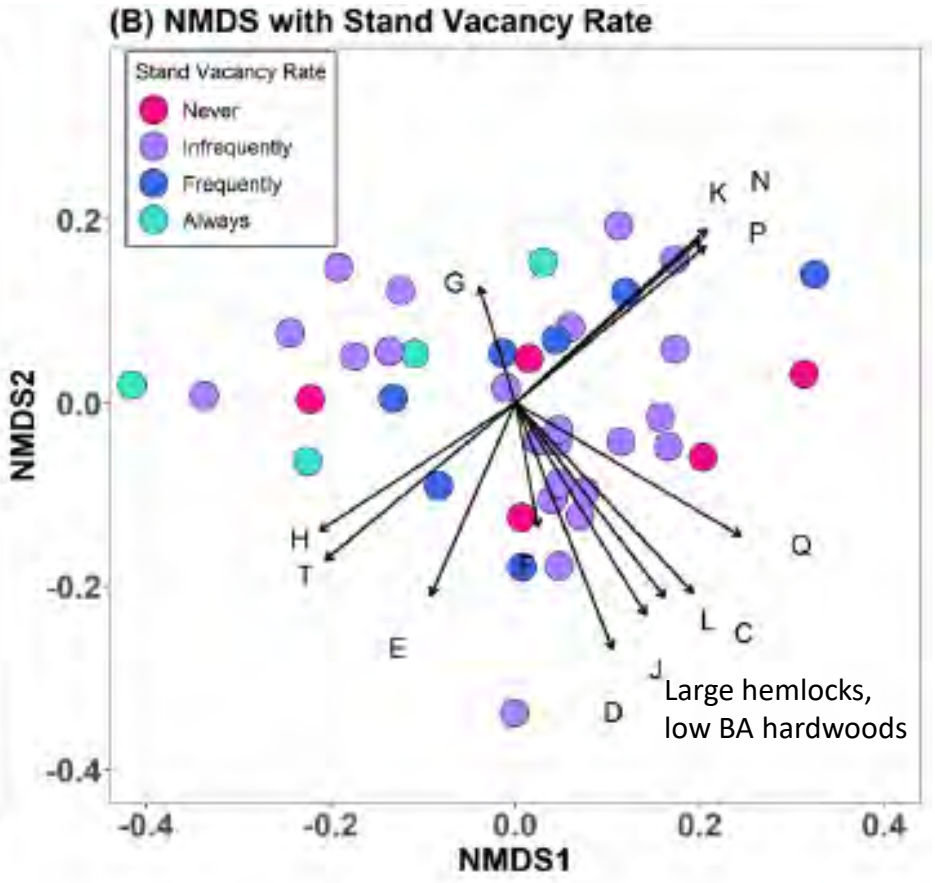


Press-Pulse Odocoileus Virginianus Herbivory in Relict Tsuga Canadensis Stands in the Western Upper Peninsula of Michigan, USA. Grace L. Parikh and Christopher R. Webster. 2019. Forests 2019, 10(6), 496; https://doi.org/10.3390/f10060496



White-Tailed Deer in a Winter-Wonderland: Long-term Deer Yard Use and Methodological Considerations for Ungulate Fecal DNA Metabarcoding. Ottino, Melanie A. Michigan Technological University ProQuest Dissertations & Theses, 2023.30815225.





White-Tailed Deer in a Winter-Wonderland: Long-term Deer Yard Use and Methodological Considerations for Ungulate Fecal DNA Metabarcoding. Ottino, Melanie A. Michigan Technological University ProQuest Dissertations & Theses, 2023.30815225.

Table 2.3. Indicator species analysis correlating stand structural variables with levels of deer use and occupancy in 39 winter yarding sites. Indicators were only included if p <0.10, and Group denotes class with the Deer Use Estimate.

Deer Use Estimate	Structural Variable	Group	p-value
Mean Annual Use	Hemlock Crown Spread Ratio	Never	0.040*
	Deciduous Basal Area	Never	0.025*
Vacancy Rate	Hemlock Crown Spread Ratio	Always	0.083
	Hemlock Height	Never	0.076
	Hemlock Crown Width	Never	0.050*
	Deciduous Basal Area	Always	0.030*
Simplified Vacancy Rate	Hemlock dbh	>50% Occupied	0.066
	Hemlock Basal Area	>50% Occupied	0.061
	Hemlock Crown Length	>50% Occupied	0.022*
	Hemlock Crown Width	>50% Occupied	0.021*
	Stand Tree Per Hectare	>50% Vacant	0.021*
	Hemlock Height	>50% Occupied	0.016*
Use Variability	Coniferous Basal Area	Low Variability	0.028*

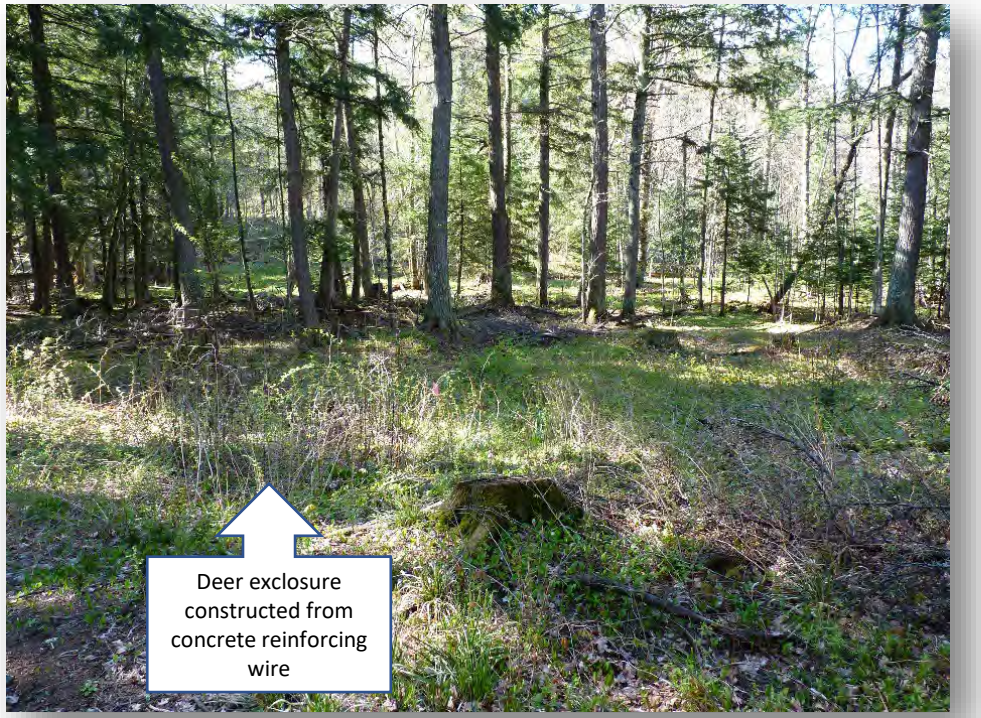
*Denotes significant p-values (<0.05)

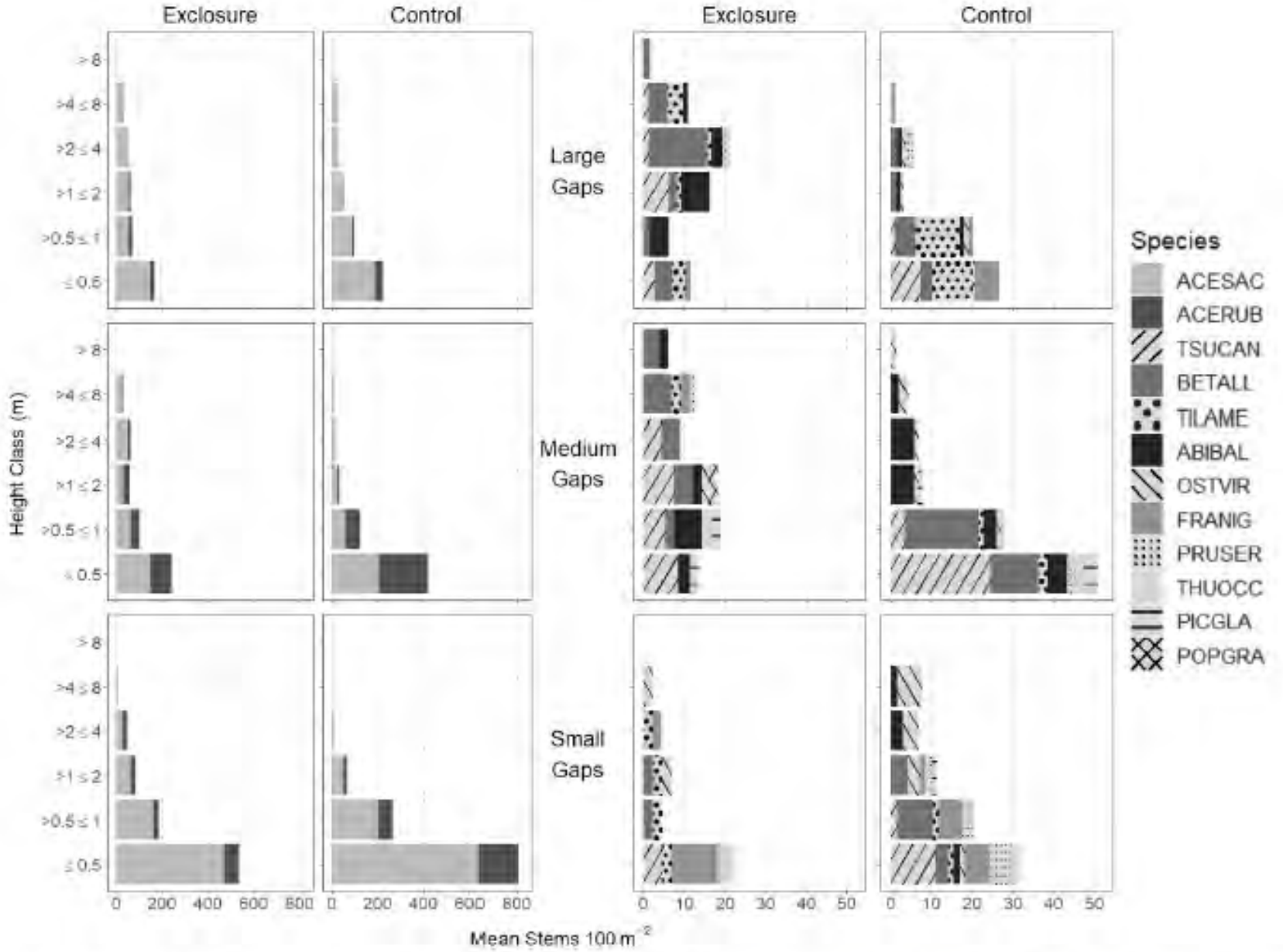
Elevation and isolation are also important correlates with winter habitat selection (Witt et al. 2012. Canadian Journal of Zoology https://doi.org/10.1139/z2012-065)

White-Tailed Deer in a Winter-Wonderland: Long-term Deer Yard Use and Methodological Considerations for Ungulate Fecal DNA Metabarcoding. Ottino, Melanie A. Michigan Technological University ProQuest Dissertations & Theses, 2023.30815225.

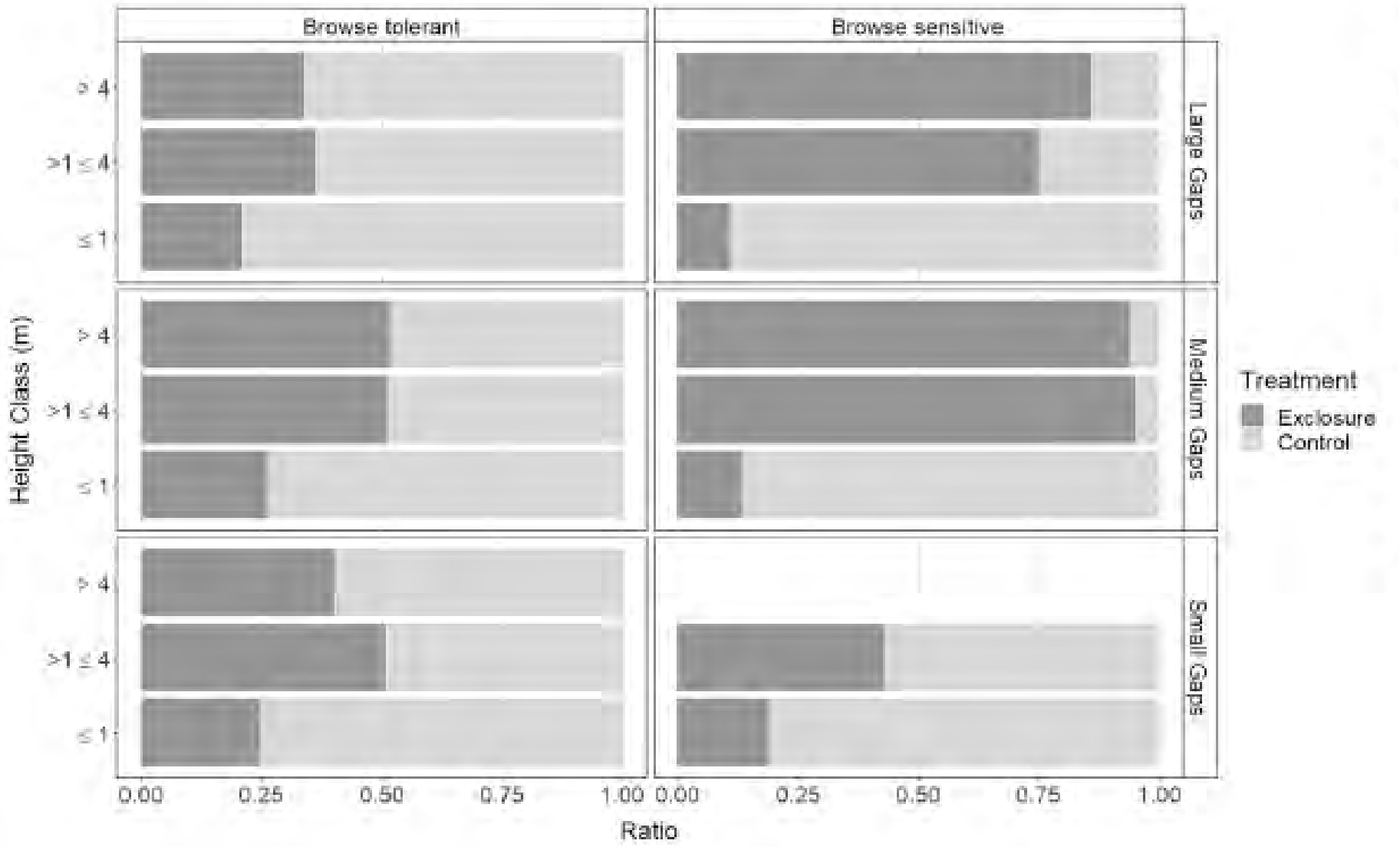
Hemlock regeneration in silvicultural openings

- Established winter 2002/03 at the MTU Ford Forest
- 20 small harvest openings (gaps) with small deer exclosures
  - Opening size classes: 50-150 m^2, 151-250 m^2, 251-450 m^2





Influence of deer herbivory on regeneration dynamics and gap capture in experimental gaps, 18 years post-harvest. Matthew S. VanderMolen and Christopher R. Webster. 2021. Forest Ecology and Management 501, 119675 https://doi.org/10.1016/j.foreco.2021.119675



Influence of deer herbivory on regeneration dynamics and gap capture in experimental gaps, 18 years post-harvest. Matthew S. VanderMolen and Christopher R. Webster. 2021. Forest Ecology and Management 501, 119675 https://doi.org/10.1016/j.foreco.2021.119675


NOT DEPARTMENT OF NATURAL RESOURCES MATERIAL
Northern white cedar forests are important culturally, and for habitat, timber products, and ecosystem services


Cedar can live to be several hundred years old and is our longest-lived U.P. tree species. Oldest cedar found are over 1,400 years old - Fayette Cliff Cedars
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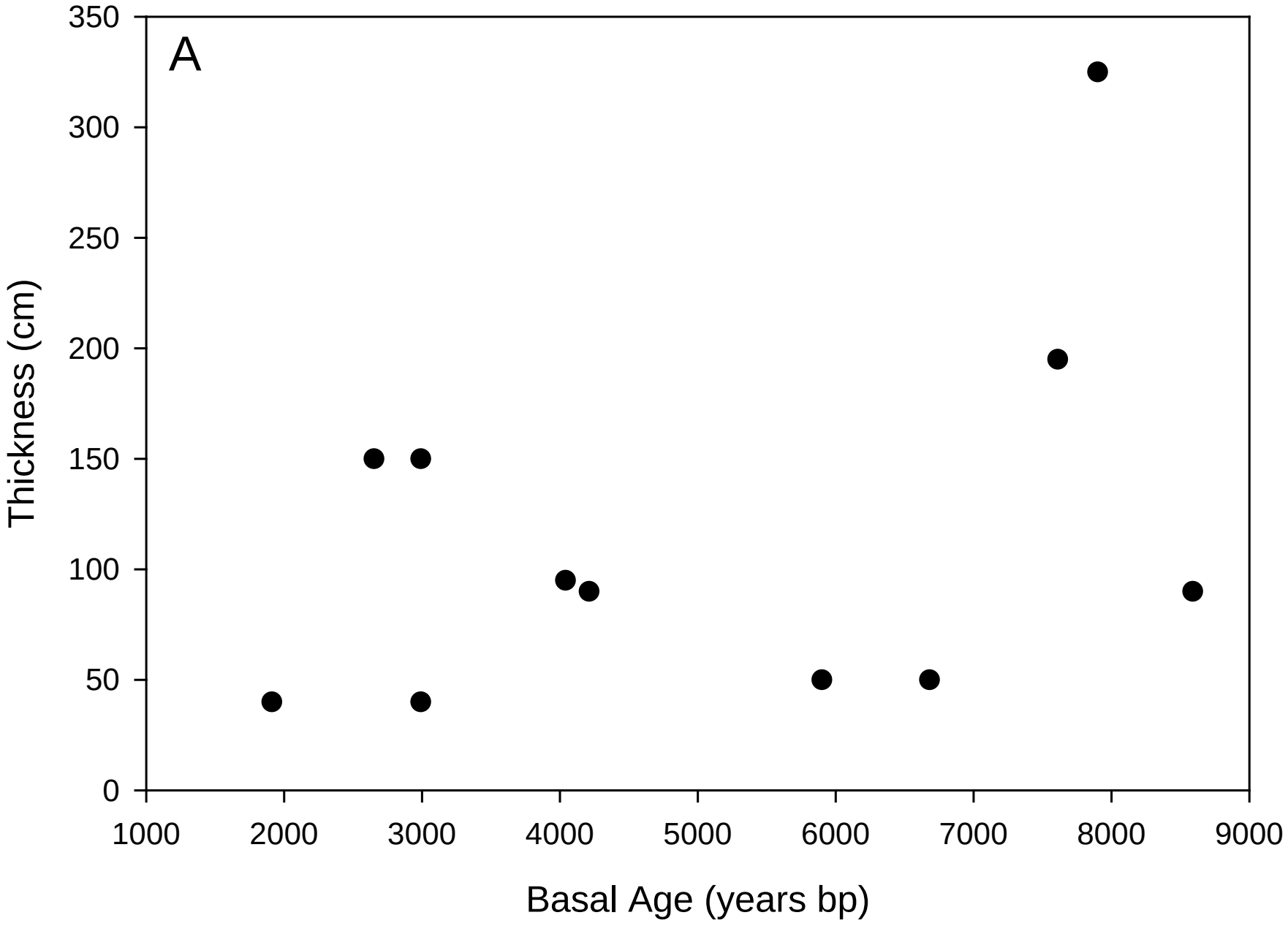
How old are cedar swamps?



Long-term peat accumulation in temperate forested peatlands (*Thuja occidentalis* swamps) in the Great Lakes region of North America

C.A. Ott and R.A. Chimner

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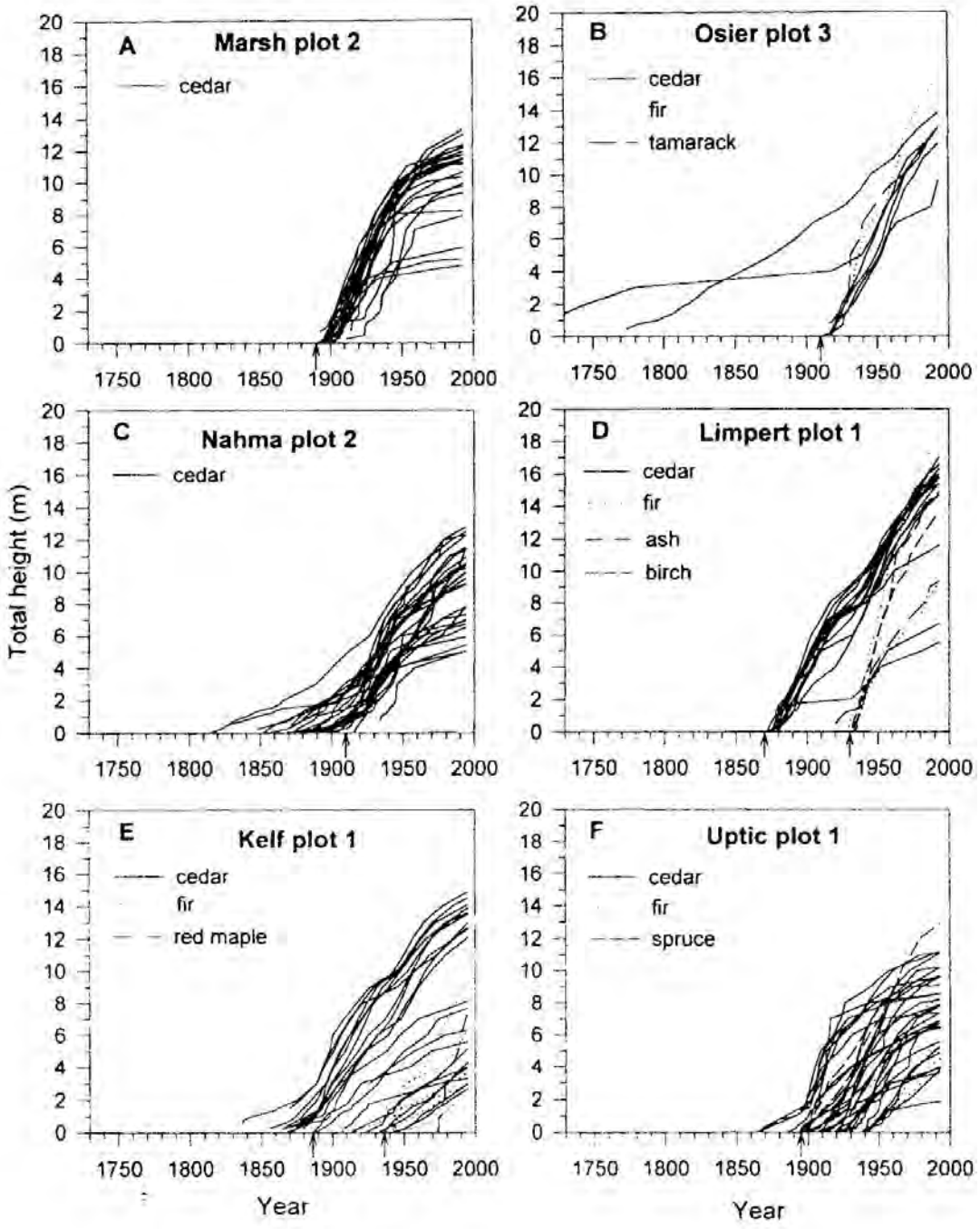
Mires and Peat, Volume 18 (2016), Article 01, 1–9, http://www.mires-and-peat.net/, ISSN 1819-754X
 DOI: 10.19189/MaP.2015.OMB.182

Most of the current cedar came in after large disturbance events (logging) between 1870 and 1935

However, there has been a problem regenerating cedar for over 75 years with only 3% of all cedar established after 1945



Heitzman et al. 1997

Michigan Department of Natural Resources

www.michigan.gov/dnr

REQUEST FOR PROPOSALS

MICHIGAN DEPARTMENT OF NATURAL RESOURCES
FOREST RESOURCES DIVISION

Celebrating 100 years

Fiscal year 2021
Application Deadline: March 12, 2021, 5:00 PM EST

The goal of this project is to quantitatively evaluate previous regeneration patterns and provide recommendations for additional research and management to the state of Michigan.

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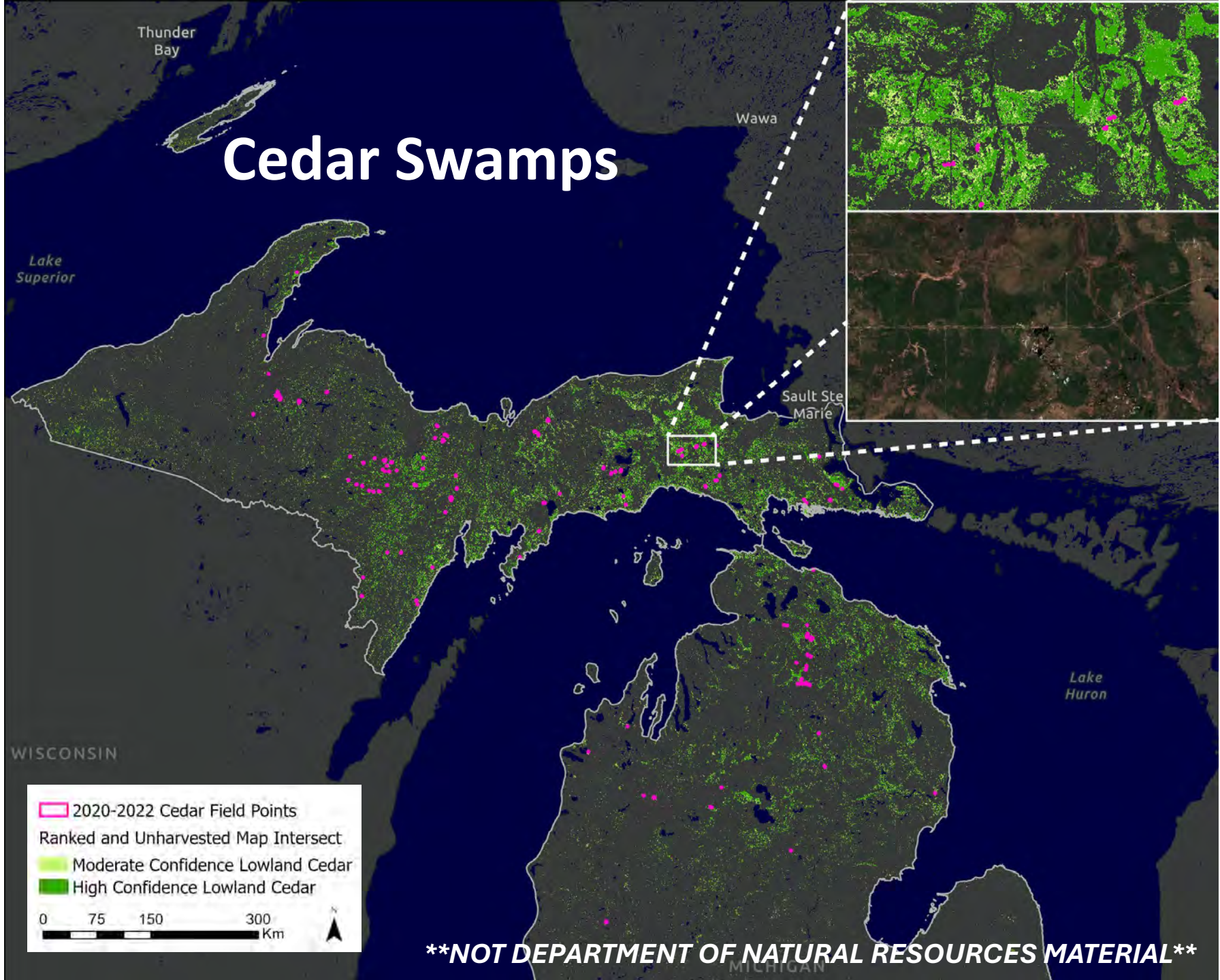
We sampled 128 harvested sites and 77 reference stands across N. Michigan to assess cedar regeneration after forest harvesting



Effect of Silviculture

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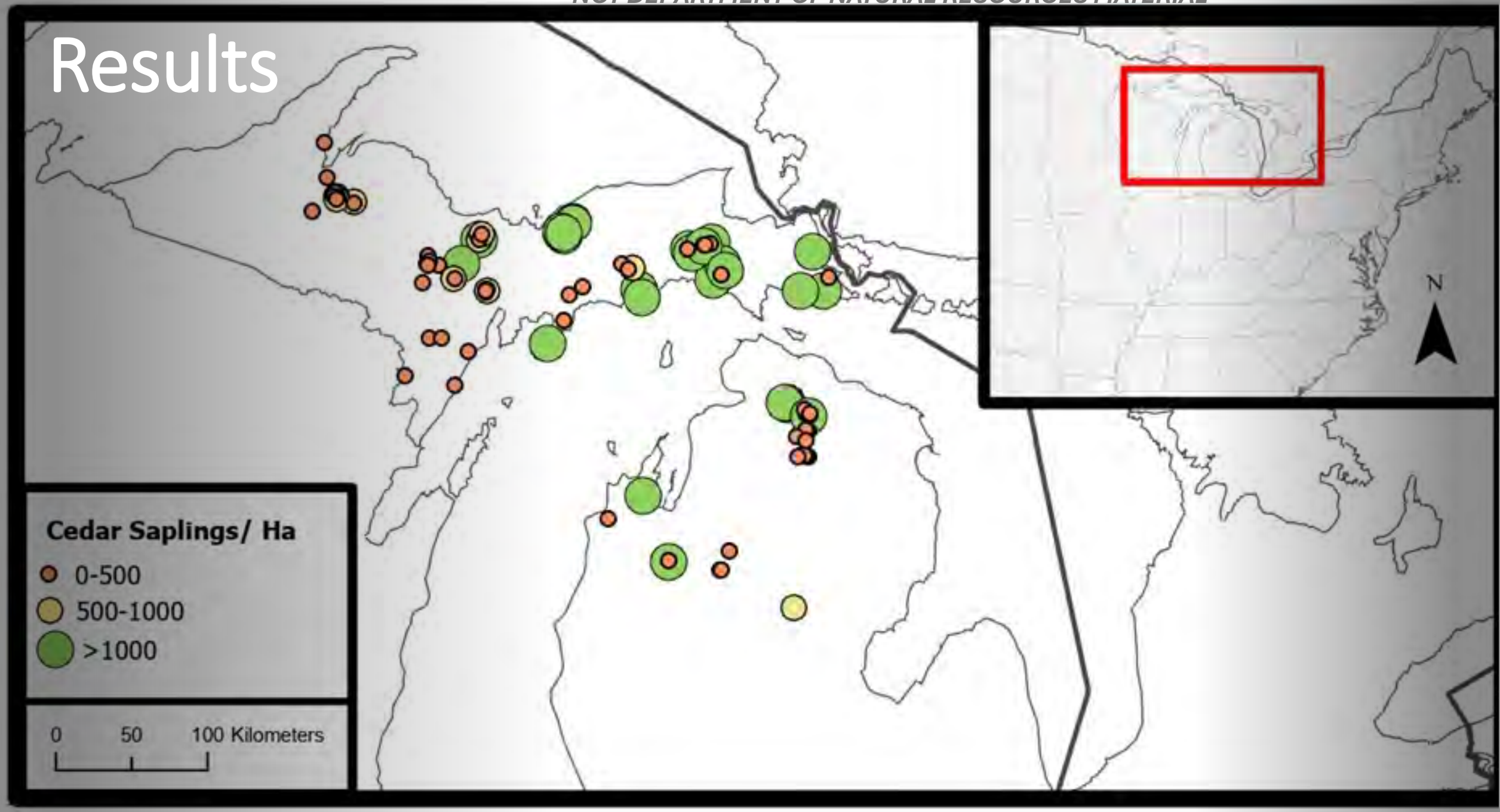
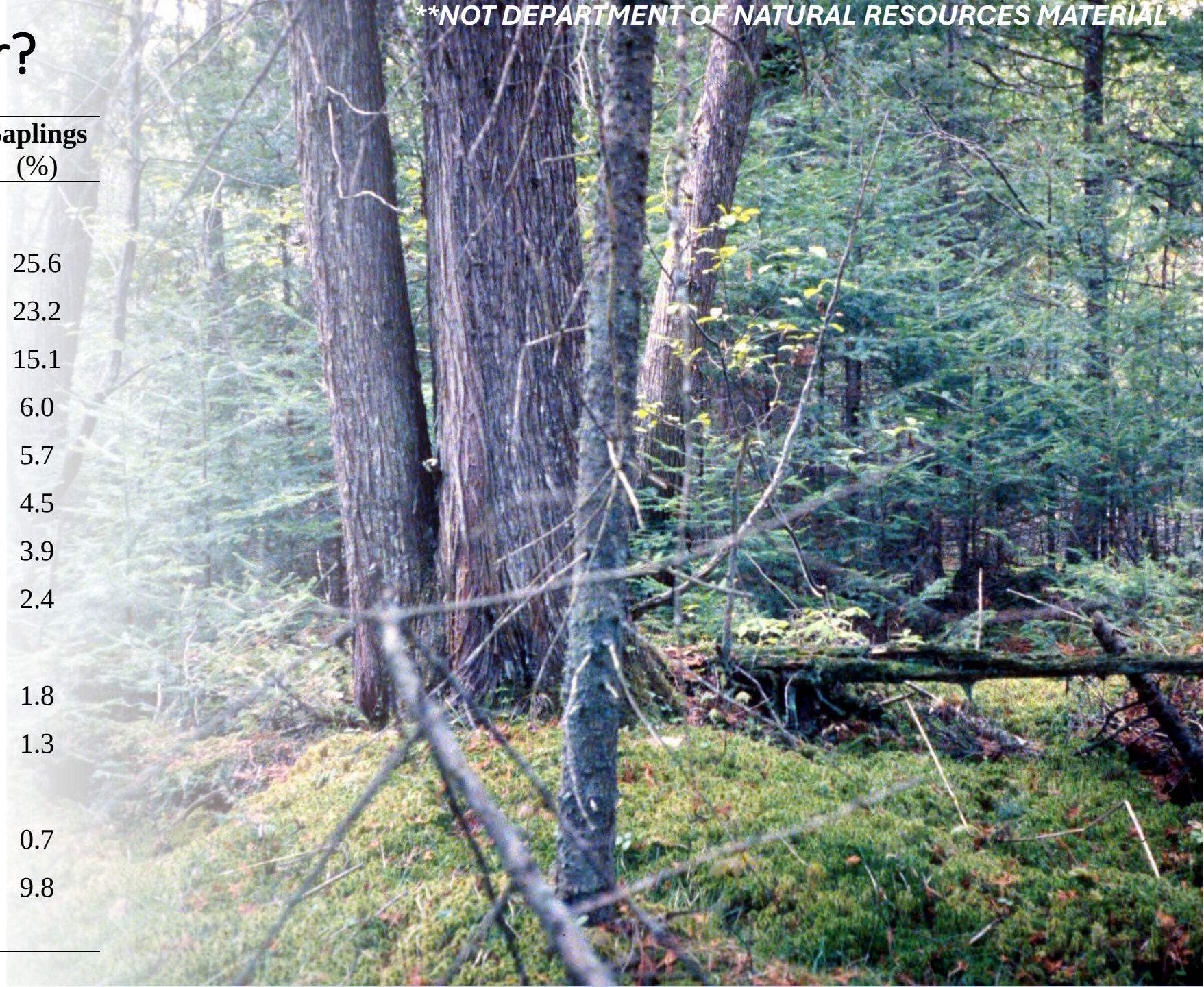
Results

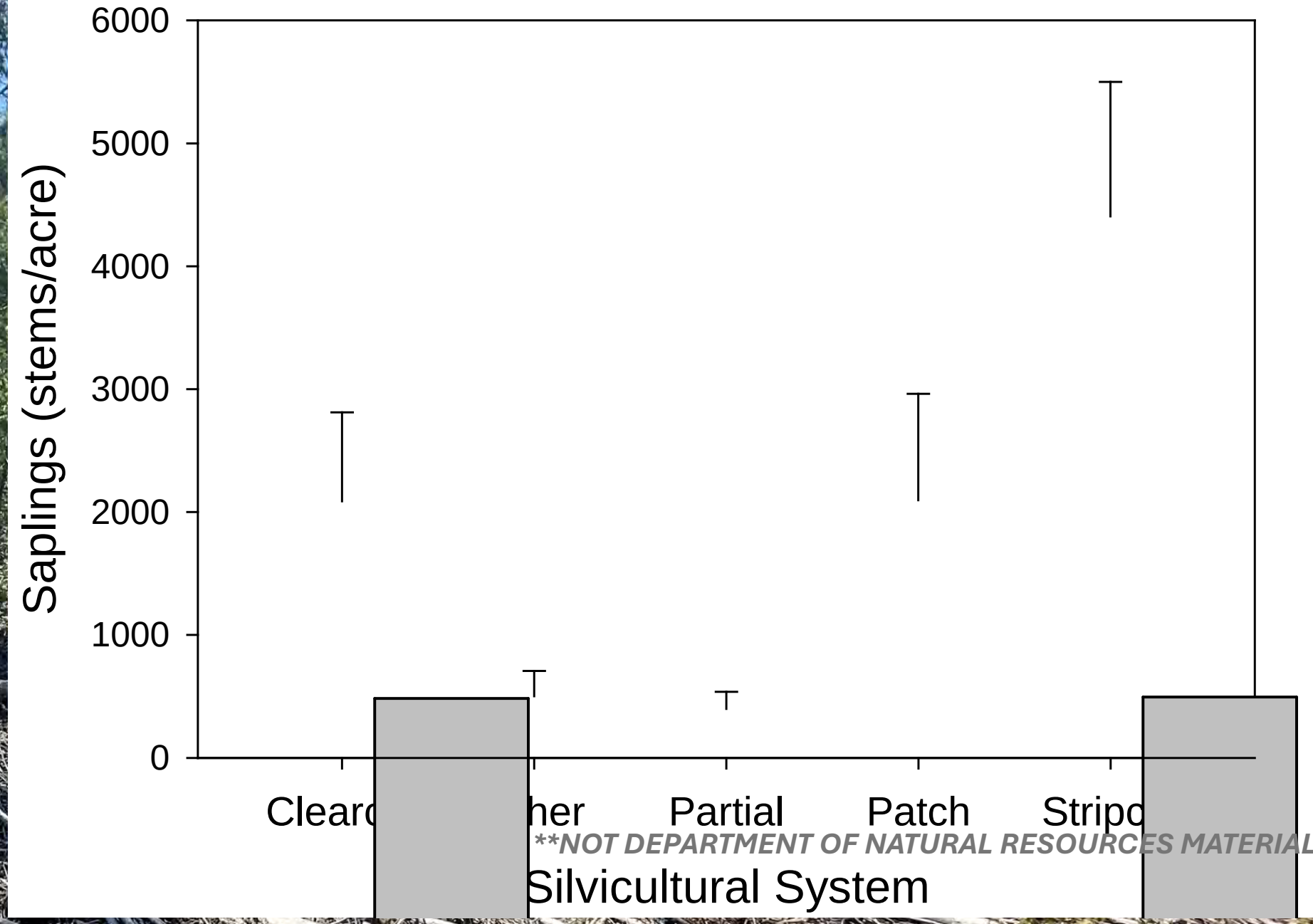


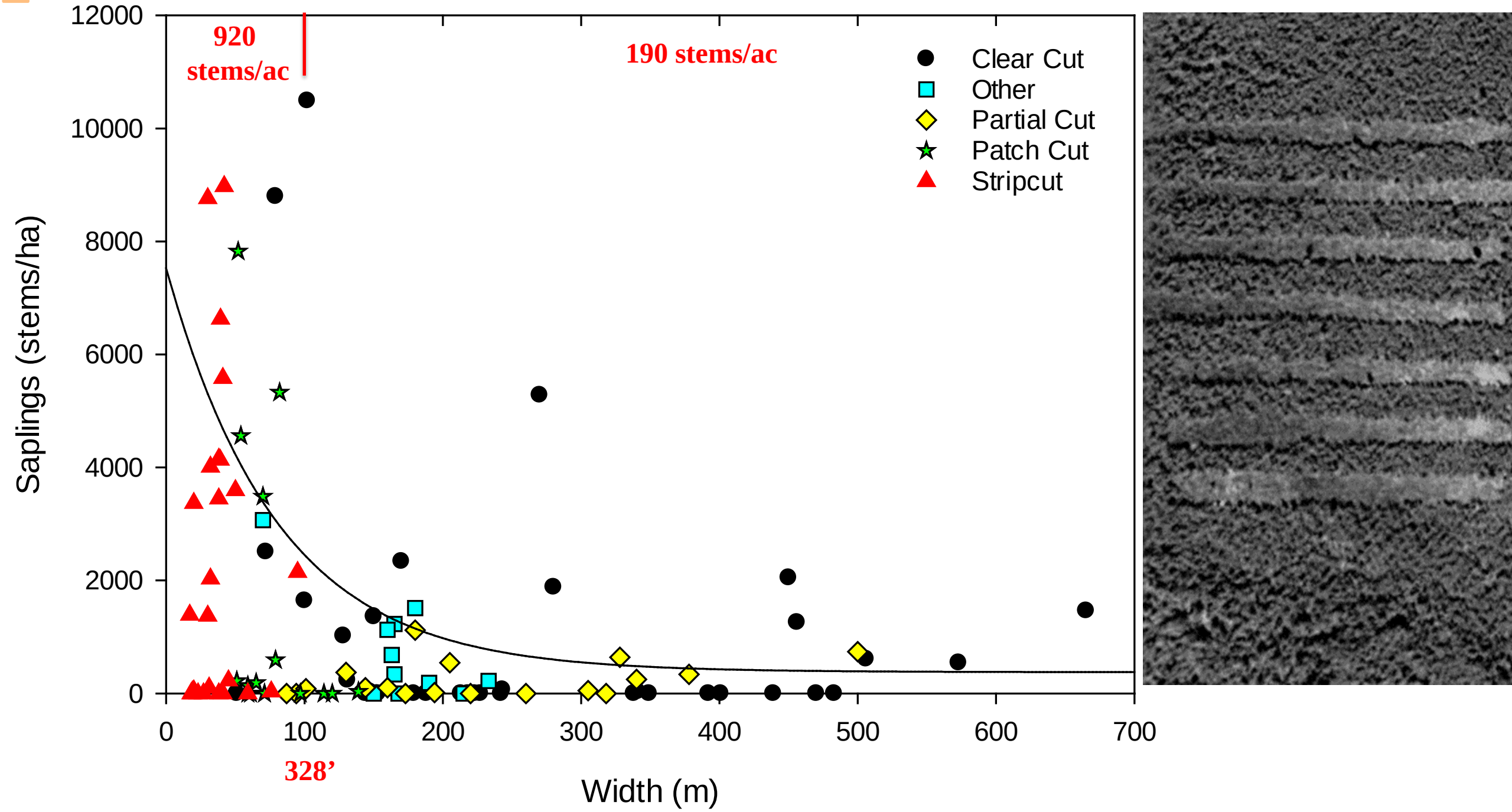
What Replaced Cedar?

Species	Saplings (stems/ha)	Saplings (%)
Alder (*Alnus incana* (L.*) ssp. rugosa*)	2168.1	25.6
Balsam Fir (*Abies balsamea*)	1964.2	23.2
Cedar (*Thuja occidentalis*)	1278.4	15.1
Red Maple (*Acer rubrum*)	503.3	6.0
Black Spruce (*Picea mariana*)	480.3	5.7
Black Ash (*Fraxinus nigra*)	379.4	4.5
Paper Birch (*Betula papyrifera*	326.4	3.9
Tamarack (*Larix laricina*)	206.8	2.4
Balsam Poplar *(Populus balsamifera)*	150.4	1.8
Aspen *(Populus tremuloides)*	107.3	1.3
Yellow Birch *(Betula alleghaniensis)*	62.4	0.7
Other (66 species)	831.3	9.8
Total	8458.5	



What is the effect of silviculture?





Wetlands Ecol Manage
https://doi.org/10.1007/s11273-024-09979-y

ORIGINAL PAPER

Characterizing northern white-cedar communities in harvested and unharvested lowland forests of Michigan, USA

Robin Michigiizhigookwe Clark · Christopher R. Webster · Laura S. Kenefic · Christel C. Kern · Rodney A. Chimner

Lowland Cedar

"Heavier cutting favor both alder invasion and balsam fir reproduction" Nelson, T. C. (1951). *A Reproduction Study of Northern White Cedar*.

Alder

Balsam Fir

Red Maple

Three Subtypes of Cedar Swamps

Cedar-Shrub Swamp

Cedar, Alder, Tamarack

Wettest sites, organic soils

Cedar-Conifer Swamp

Cedar, Balsam Fir, Black Spruce

organic soils

Cedar-Deciduous Swamp

Cedar, Red Maple, Black Ash, Yellow Birch

Wet Mineral Soils

How do deer influence cedar recruitment?

2008

****NOT DEPARTMENT OF NATURAL RESOURCES MATERIAL****

New Forests (2016) 47:73–86
DOI 10.1007/s11056-015-9483-7

CrossMark

Artificial microtopography and herbivory protection facilitates wetland tree (*Thuja occidentalis* L.) survival and growth in created wetlands

Laura C. Kangas[1] · Rose Schwartz[1] · Michael R. Pennington[2,3] · Christopher R. Webster[1] · Rodney A. Chimner[1]

2008

2023

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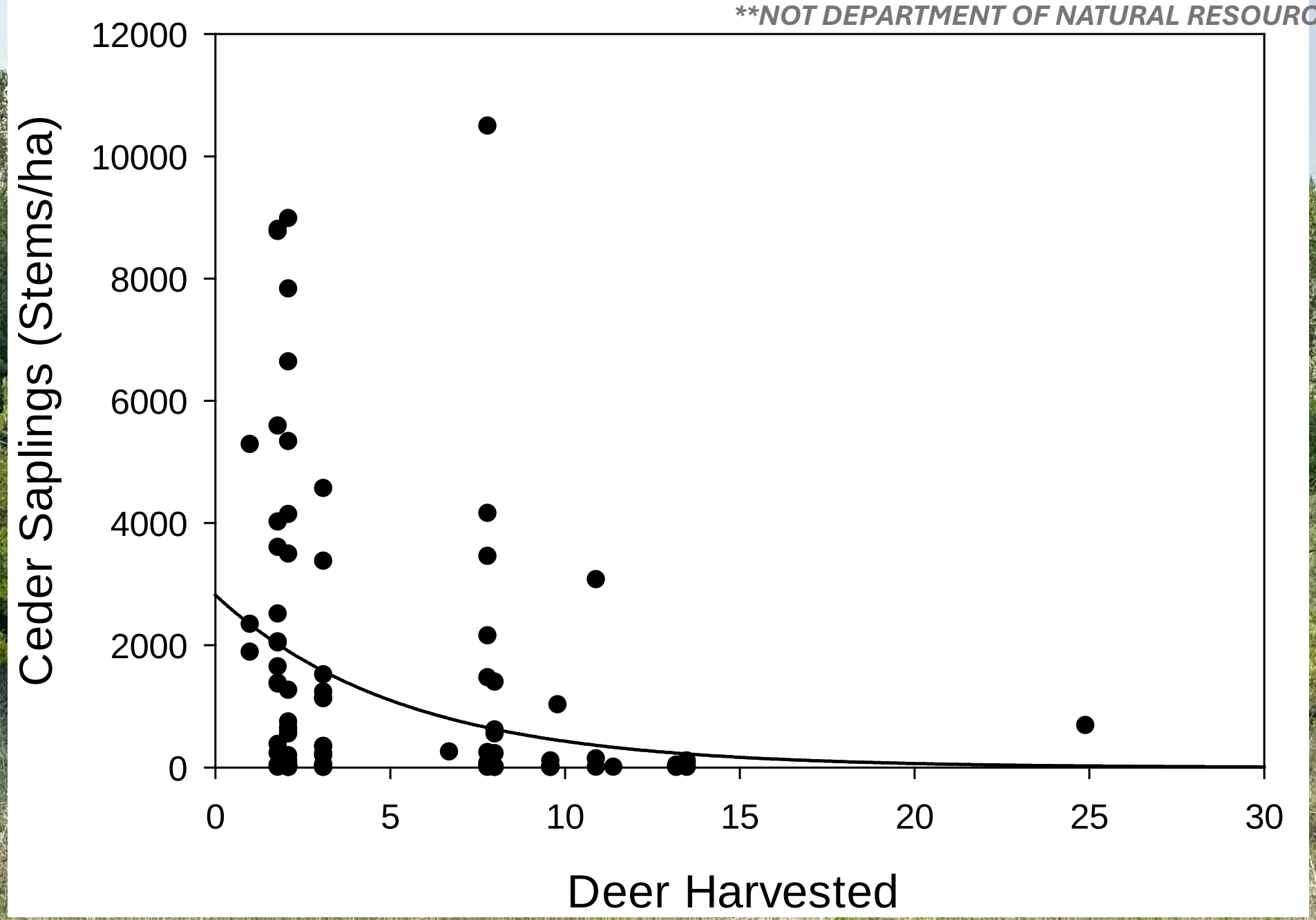

Used the 2022 online county harvest records

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<100 m ← Width of Cut → >100 m

Low ← Deer Herbivory → High

Cedar-deciduous

Cedar-conifer

Cedar-shrub

Successful Cedar Regeneration (~33%)

Cedar-deciduous

Cedar-conifer

Cedar-shrub

Original Cedar Swamp Subtypes

Red Maple

Balsam Fir

Alder

Unsuccessful Cedar Regeneration (~66%)

The next phase involves testing new silvicultural treatments, focusing on maintaining and improving long-term health and resilience of cedar stands on state lands for wildlife and forestry values

- Restore cedar back on the landscape after conversion
- Improve cedar regeneration in cedar stands with a lack of age-class diversity

Synthesis and implications for management

- A tightening winter bottleneck, legacy effects, and time lags
  - A dilemma for deer, hemlock, cedar, managers, and the public alike
- A sustained effort focused on restoration, rehabilitation, and conservation is needed
  - Challenging, but …
    - We can regenerate these species if we tailor our methods based on local bottlenecks and a better understanding of their silvics/life history traits
  - Given the value of older stands with large trees as winter habitat
    - Prudent to prioritize conservation of high-quality stands and focus restoration and rehabilitation efforts on degraded stands
    - Recognize non-commercial nature of maintaining high quality winter habitat
  - Long-term commitment

Acknowledgements

- Michigan Department of Natural Resources Wildlife Division
- Michigan Department of Natural Resources Forestry Division
- Michigan Department of Transportation
- United States Forest Service
- McIntire-Stennis Cooperative Forestry Research Program
- Ecosystem Science Center, Michigan Technological University
- College of Forest Resources and Environmental Science, Michigan Technological University
- A host of collaborators, students, technicians, and public and private land stewards

Michigan Natural Resources Commission

Deer Habitat, Nutrition, and Northern Hardwoods

Dr. Gary J. Roloff
Department of Fisheries and Wildlife
Michigan State University

Not Department of Natural Resources Work Product

Who is Dr. Roloff?

- ~20 years MSU
  - Forest – wildlife relationships
- ~11 years at Boise Cascade Corporation
- Hunt, fish and trap
- Appreciation for non-consumptive uses of natural resources

Not Department of Natural Resources Work Product

Main Message

- Year-round (not just winter) habitat condition is critical to deer population dynamics. We have observed signs of potential habitat limitations on summer range in forest-dominated portions of Michigan.

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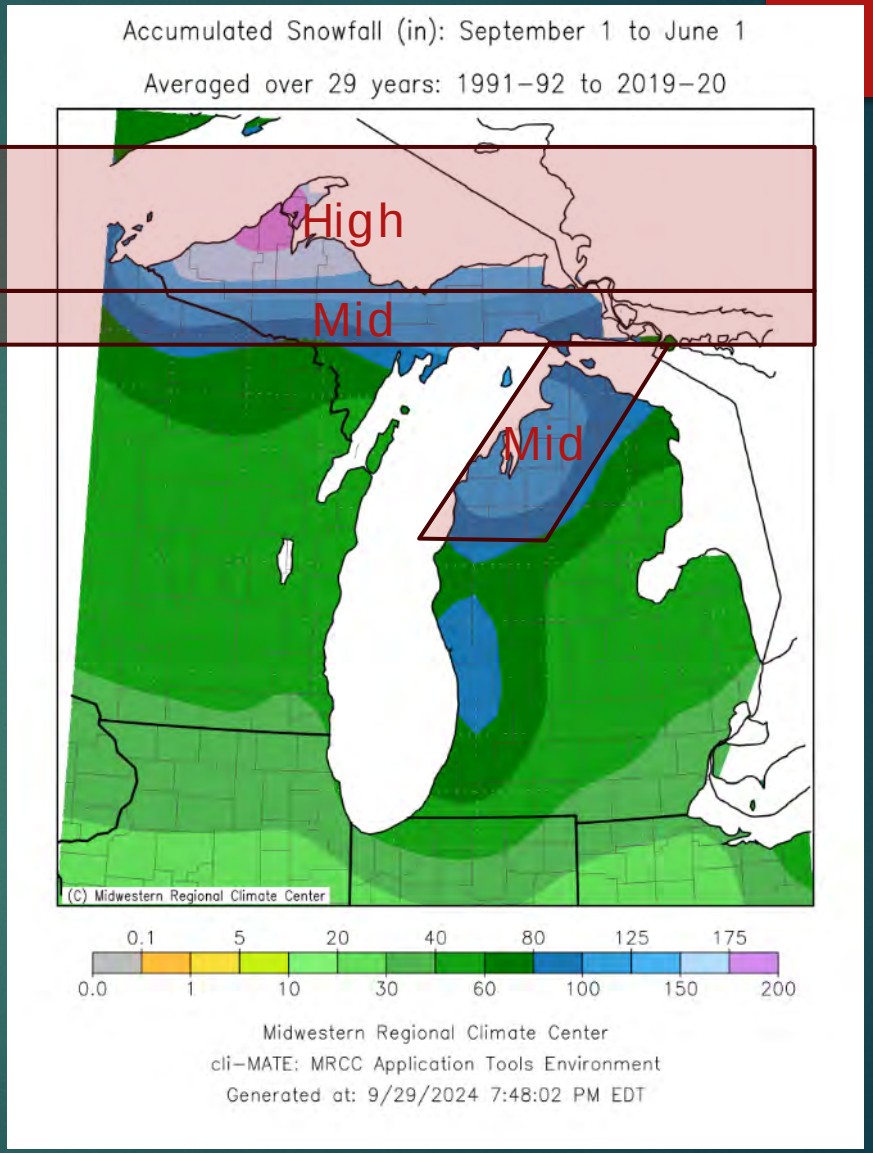
Winter is King



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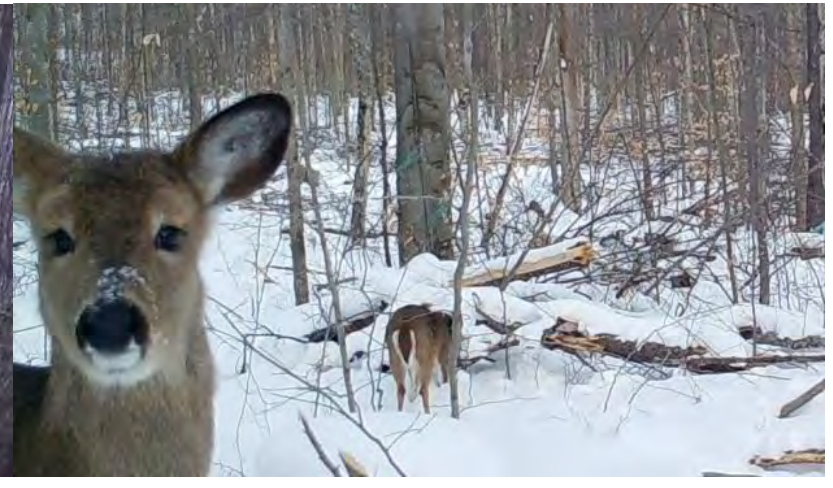
Nutrition

- Nutrition (not just food) is critical (arguably the most critical)



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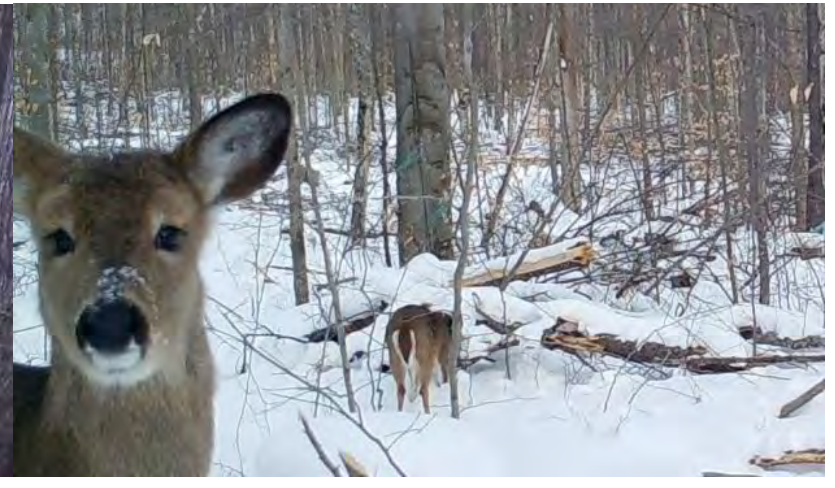
Nutrition and does

- Good nutrition…
  - Does during development years more likely to produce and raise healthy fawns
  - Does annually produce more fawns



Evidence

- Mule deer (Bishop et al. 2010; Wildlife Monographs)
  - *"We documented food limitation in the Uncompahgre deer population because survival of fawns and adult females increased considerably in response to enhanced nutrition."*
- Mule deer (Robinette et al. 1973; Journal of Wildlife Management)
  - *"…associated with this improved nutrition were increases in deer weights, productivity, and antler size; earlier dates for breeding and fawning and possibly antler velvet shedding; and a decline in fawn mortality during the first week postpartum."*
- Elk (Cook et al. 2010; Wildlife Monographs)
  - *"…our data suggest that limiting effects of summer-autumn nutrition on populations may be greater than often assumed, perhaps greater than those during winter in some ecosystems, …"*

…among others

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Evidence (continued)

Table 1. Relation of autumn nutritional level to deer reproductive patterns.

	High Nutrition	Low Nutrition
Does examined	27	22
Does not bred	0	2
Does bred but unproductive	3	1
Fawns produced	47	21
Litters (1:2:3 fawns)	2:21:1	17:2:0
Fawns per doe	1.74	0.95
Fawns per pregnant doe	1.96	1.11
Male fawns	16*	13*
Female fawns	29	6
Percent males	35.6	68.4

* One set of twins could not be sexed.

JOURNAL ARTICLE

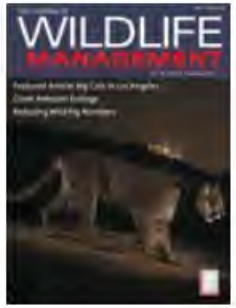
Reproduction Studies on Penned White-Tailed Deer

Louis J. Verme

The Journal of Wildlife Management

Vol. 29, No. 1 (Jan., 1965), pp. 74-79 (6 pages)

Published By: Wiley



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Annual Cycle of Deer Nutrition

	SPRING	SUMMER	Fall	Winter
Bucks	Rebuild muscle (Protein), support antler growth (Ca, P)			
Does	Rebuild fat and muscle; supporting fetus (Protein, Carbs)			
Both	Sodium			

*Third trimester is critical to fawn survival.
*Nutritional condition of forage understudied.

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Annual Cycle of Deer Nutrition

	SPRING	SUMMER	Fall	Winter
Bucks	Rebuild muscle (Protein), support antler growth (Ca, P)	Antler growth (Protein, Ca, P)		
Does	Rebuild fat and muscle; supporting fetus (Protein, Carbs)	Nursing (pass Protein and energy to fawn)		
Both	Sodium	Parasite loads		

New browse early
Herbs, shrubs, tree leaves

*For does, most demanding period.

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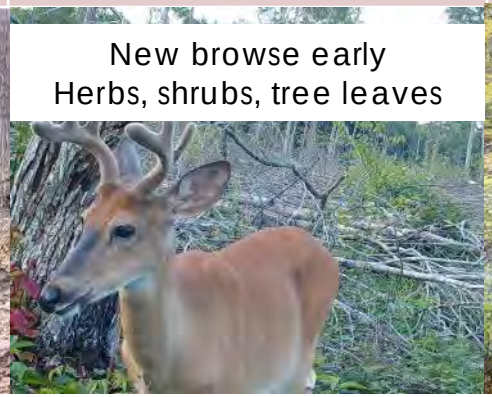
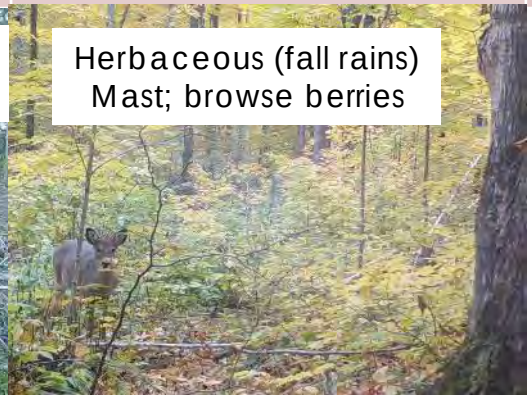
Annual Cycle of Deer Nutrition

	SPRING	SUMMER	Fall	Winter
Bucks	Rebuild muscle (Protein), support antler growth (Ca, P)	Antler growth (Protein, Ca, P)	Rut; low fat reserves will result in muscle burn	
Does	Rebuild fat and muscle; supporting fetus (Protein, Carbs)	*Nursing (pass Protein and energy to fawn)	Build enough fat to hold through winter and support fetus	
Both	Sodium	Parasite loads	Fats and carbs	





*For bucks, most demanding period.

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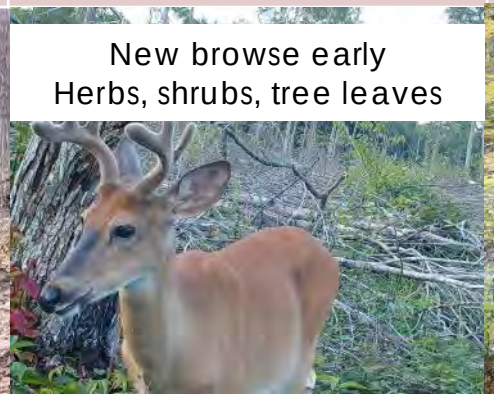
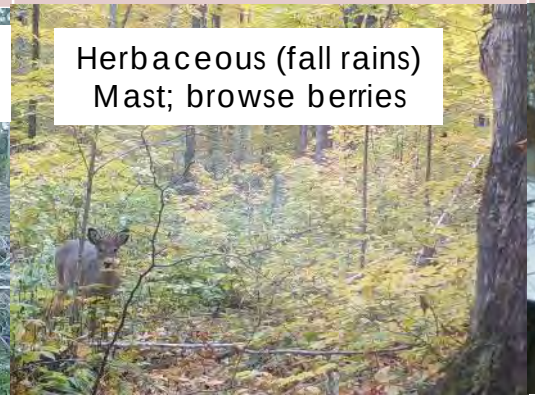
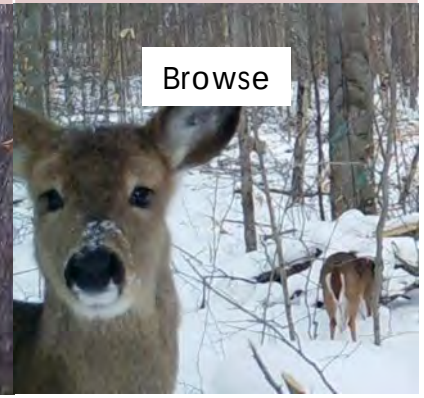
Annual Cycle of Deer Nutrition

	SPRING	SUMMER	Fall	Winter
Bucks	Rebuild muscle (Protein), support antler growth (Ca, P)	Antler growth (Protein, Ca, P)	Rut; low fat reserves will result in muscle burn	"Recover" from rut
Does	Rebuild fat and muscle; supporting fetus (Protein, Carbs)	*Nursing (pass Protein and energy to fawn)	Enough fat to hold through winter and support fetus	Support self and fetus
Both	Sodium	Parasite loads	Fats and carbs	Survive

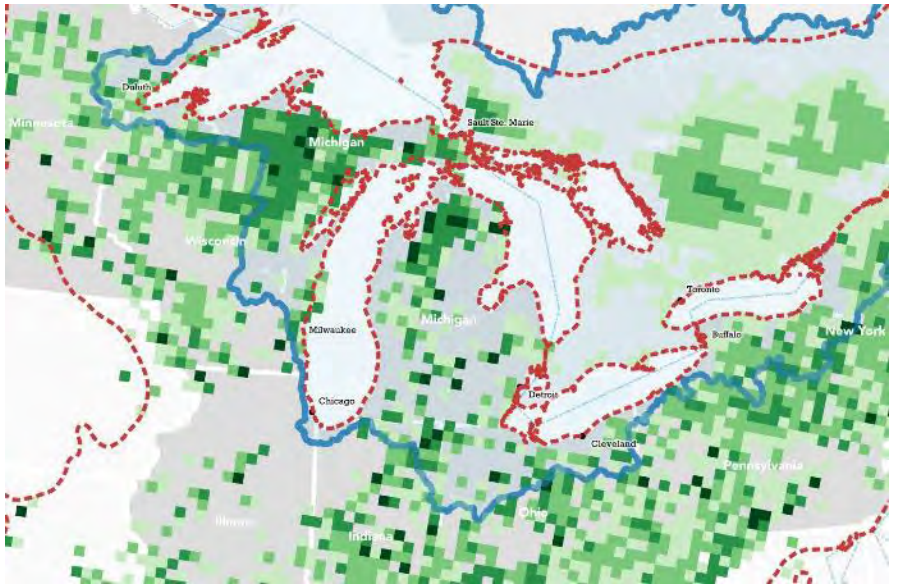






Northern Hardwoods Forests

- ~5 million ac in state
  - With oak associates, makes up about 19% of state forest lands



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Condition of northern hardwoods

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What occurs in the browse zone?

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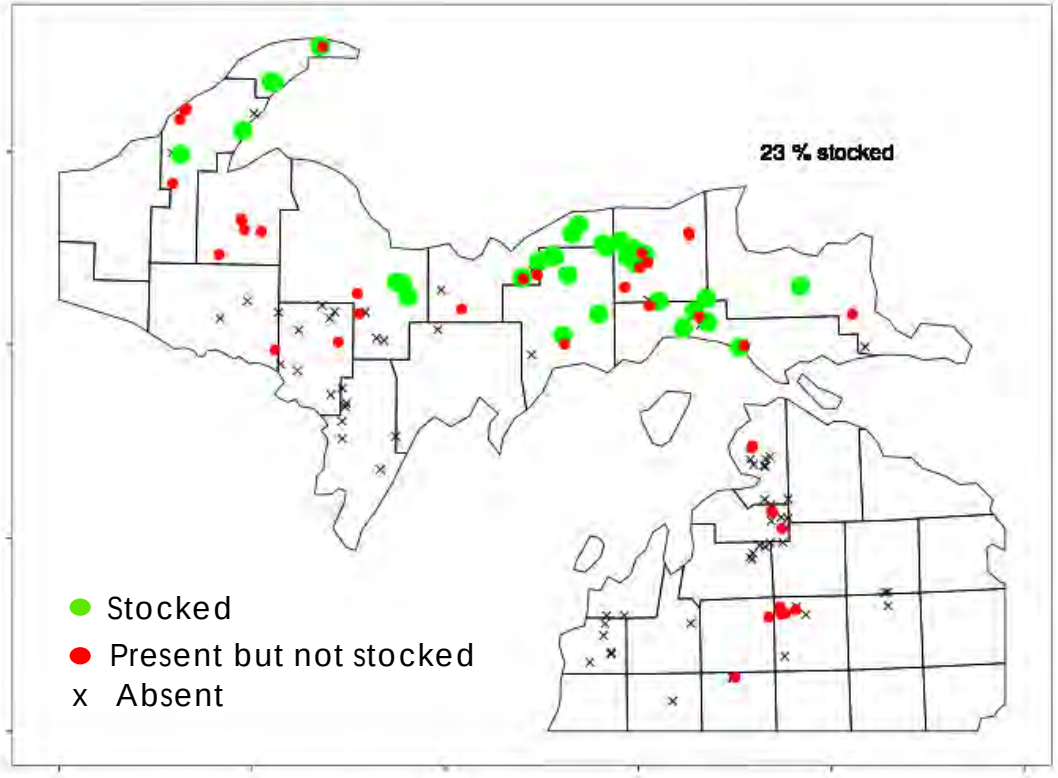
Highly desirable browse

- Current Conditions (understory vegetation plots)



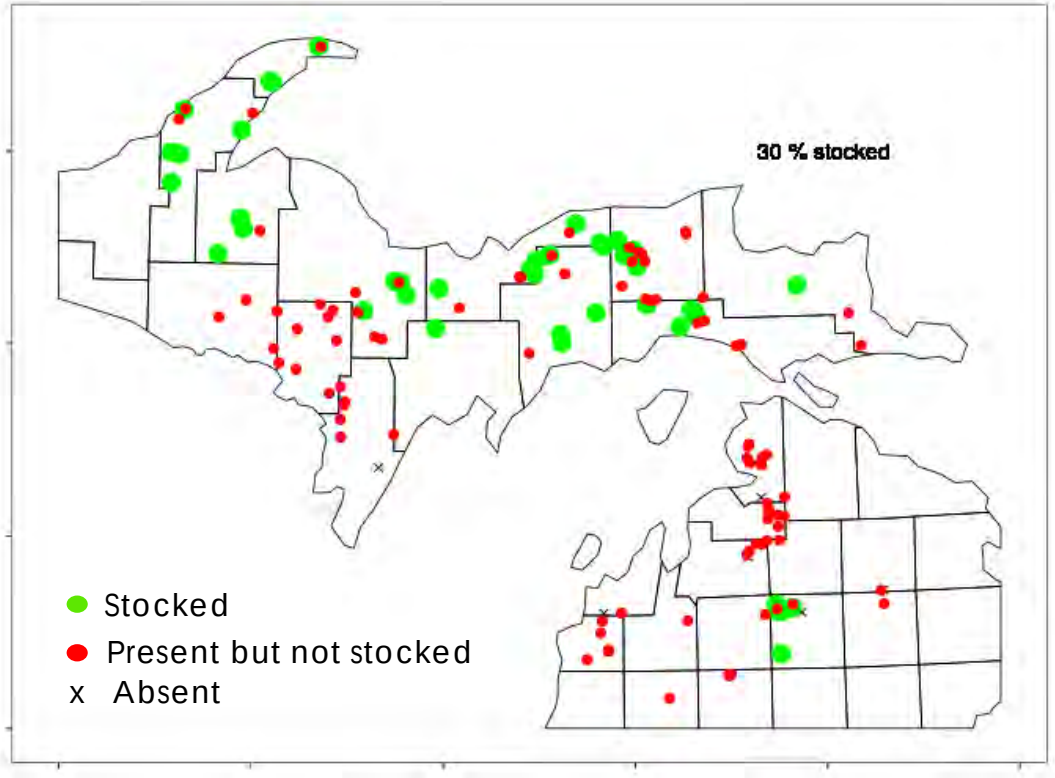
Sites with >171 stems/ac of “highly desirable” browse species

- American elm
- Hemlock
- White cedar
- Paper birch
- Red maple
- Red oak
- Yellow birch

Source: https://walterslab.shinyapps.io/stockingtool/

Highly and moderately desirable browse

- Current Conditions (understory vegetation plots)



Sites with >171 stems/ac of “highly and moderately” desirable deer browse species

- American elm
- Hemlock
- White cedar
- Paper birch
- Red maple
- Red oak
- Yellow birch

- Black cherry
- Sugar maple
- Aspens

Source: https://walterslab.shinyapps.io/stockingtool/

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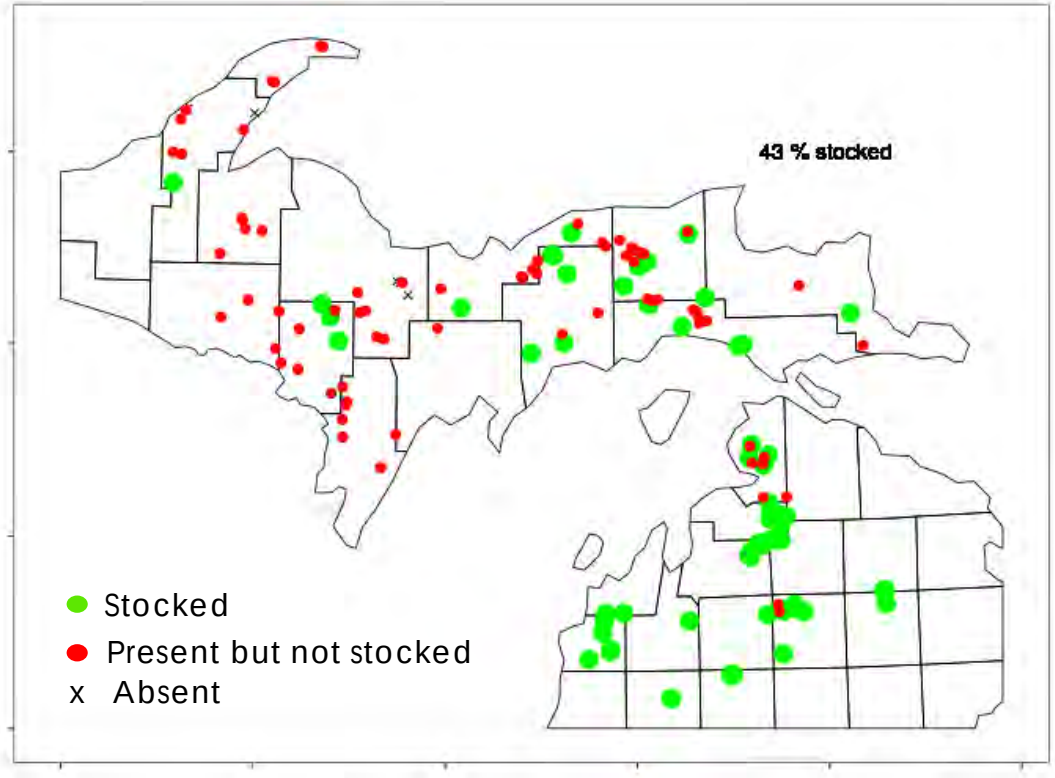
Low desirability browse

- Current Conditions (understory vegetation plots)



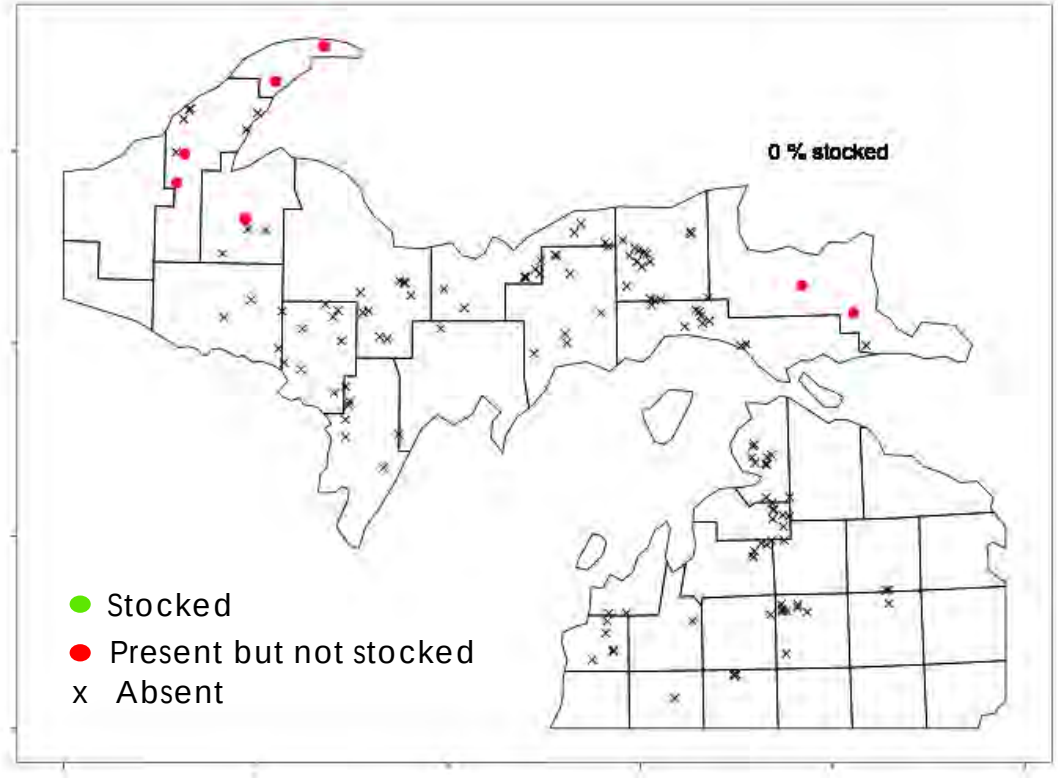
Sites with >171 stems/ac of “low desirability” browse species

- Beech
- Ash
- Ironwood
- Red pine

Source: https://walterslab.shinyapps.io/stockingtool/

Oaks

- Current Conditions (understory vegetation plots)



Sites with >171 stems/ac of oak species
- Red oak
- White oak

Source: https://walterslab.shinyapps.io/stockingtool/

Nutrition deficient?

- What if forest dominated* landscapes in Michigan are nutrition deficient?
  - Rotation-aged red pine
  - Rotation-aged jack pine
  - Mature northern hardwoods (5 million ac)
    - Desirable browse should be abundant
    - Mast producing trees occurring and recruiting
    - Complex vegetation structure

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Annual Cycle of Deer Nutrition

	SPRING	SUMMER	Fall	Winter
Bucks	Rebuild muscle (Protein), support antler growth (Ca, P)	Antler growth (Protein, Ca, P)	Rut; low fat reserves will result in muscle burn	"Recover" from rut
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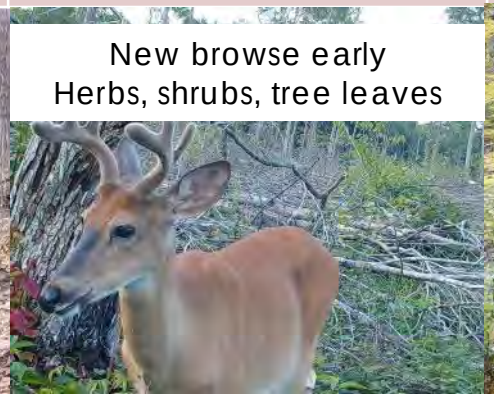
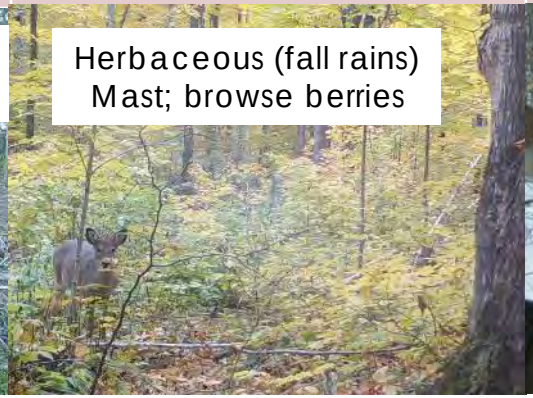
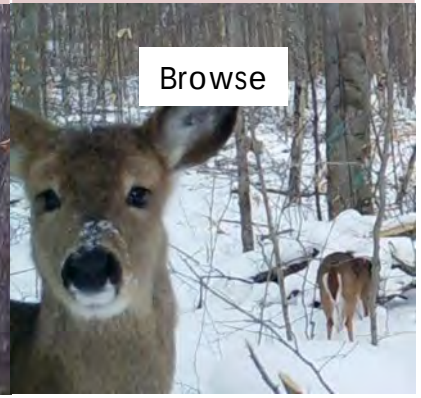
Both	Sodium	Parasite loads	Fats and carbs	Survive







Recommendations

Better understand nutritional aspects of summer habitat, particularly in forest dominated landscapes where deer numbers seem low

In areas where more deer are desired and the forests can handle increased browse pressure, FRD and WD work to improve quality of regenerating forest conditions

In areas where abundant deer are restricting regeneration of desirable forest conditions, reduce deer populations

Thank you

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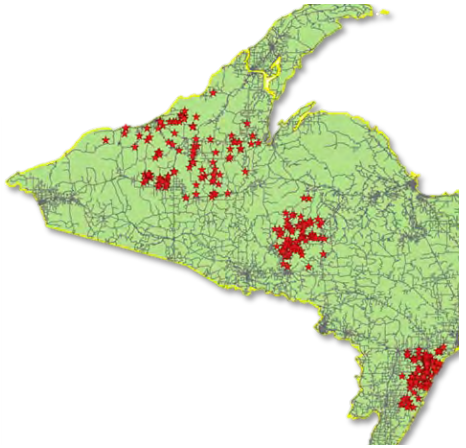
White-tailed Deer Predation in the Upper Peninsula of Michigan

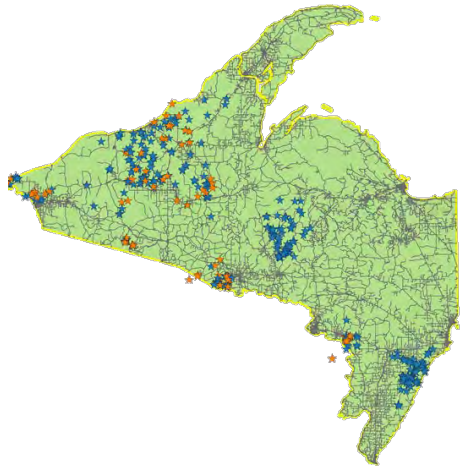
Jerrold L. Belant, Dean E. Beyer, Jr., and Tyler R. Petroelje

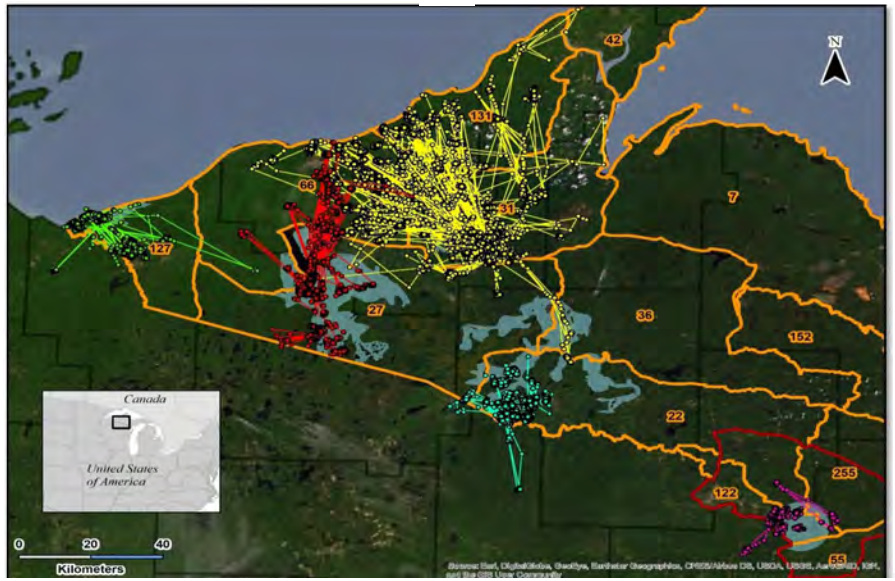
NRC Wildlife Committee
10 October 2024

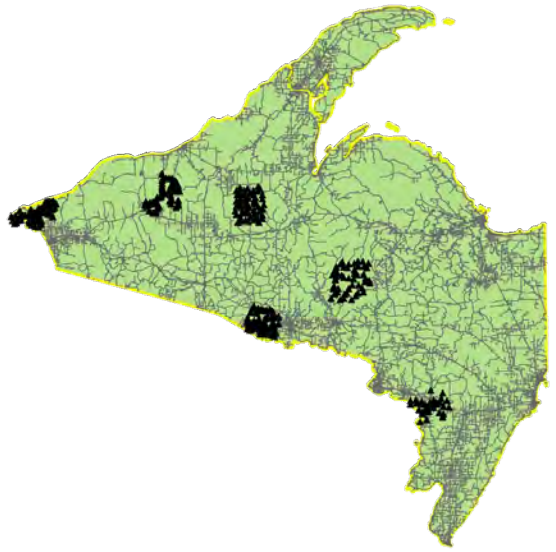
Data: collared deer sample sizes

- 423 adult females
- 365 newborn fawns
- 158 winter fawns (~7 months old)
- 96 adult males
- 1,042 total deer

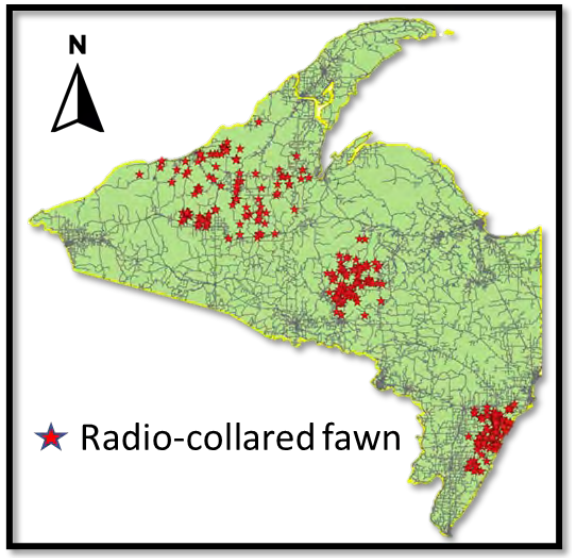




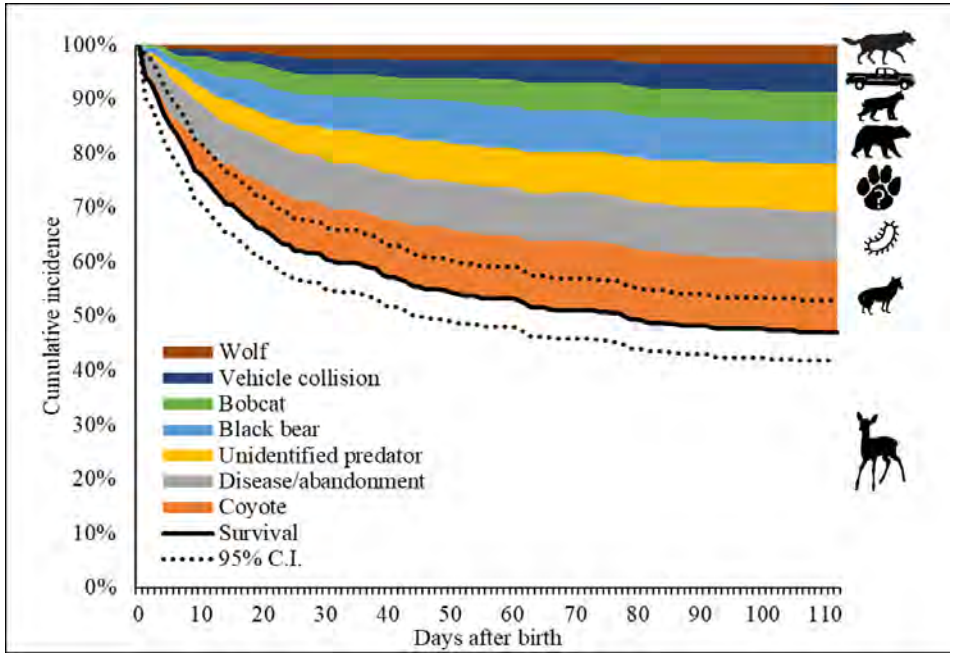


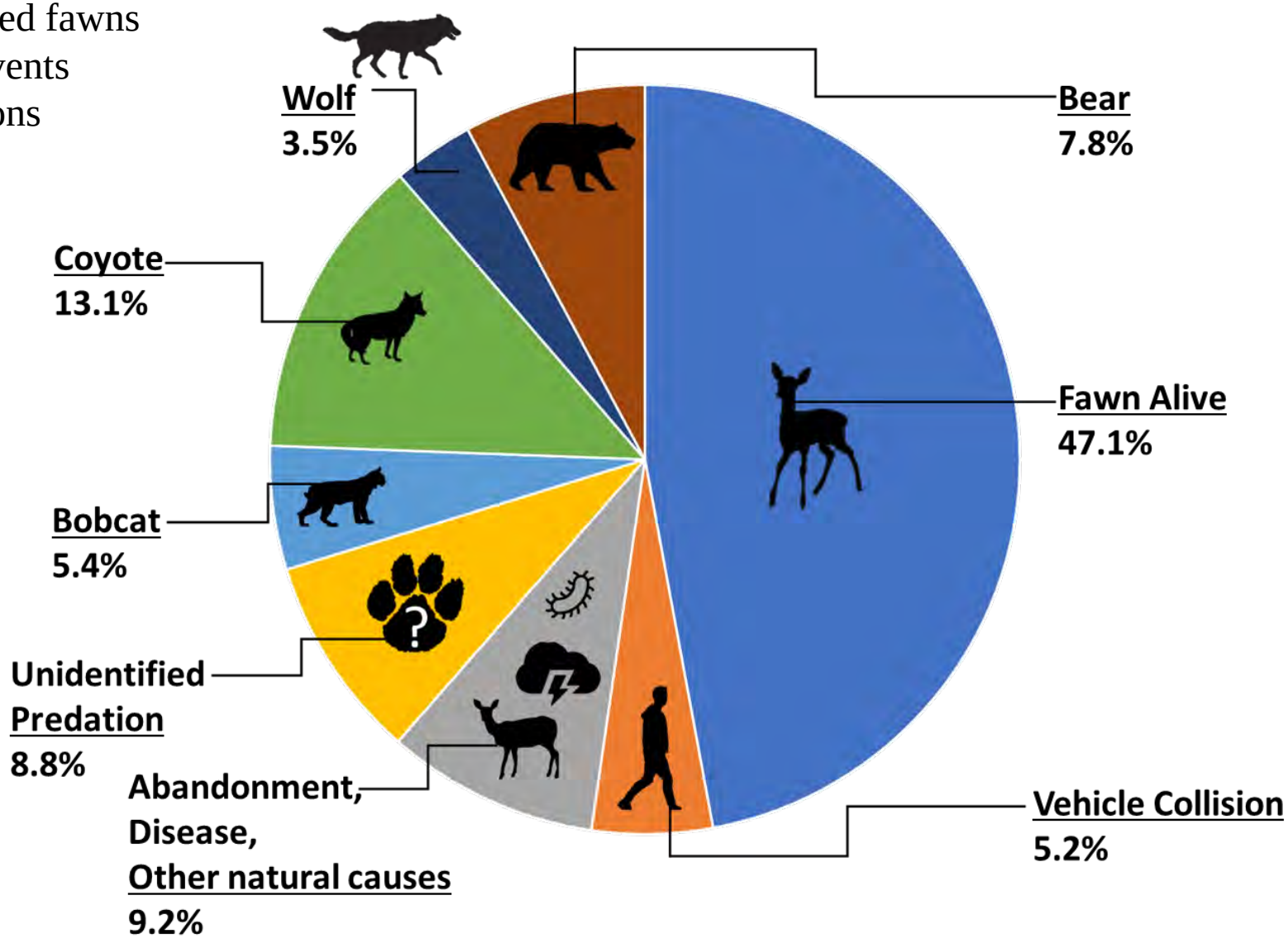


Fates of white-tailed deer fawns, 16 weeks post-birth



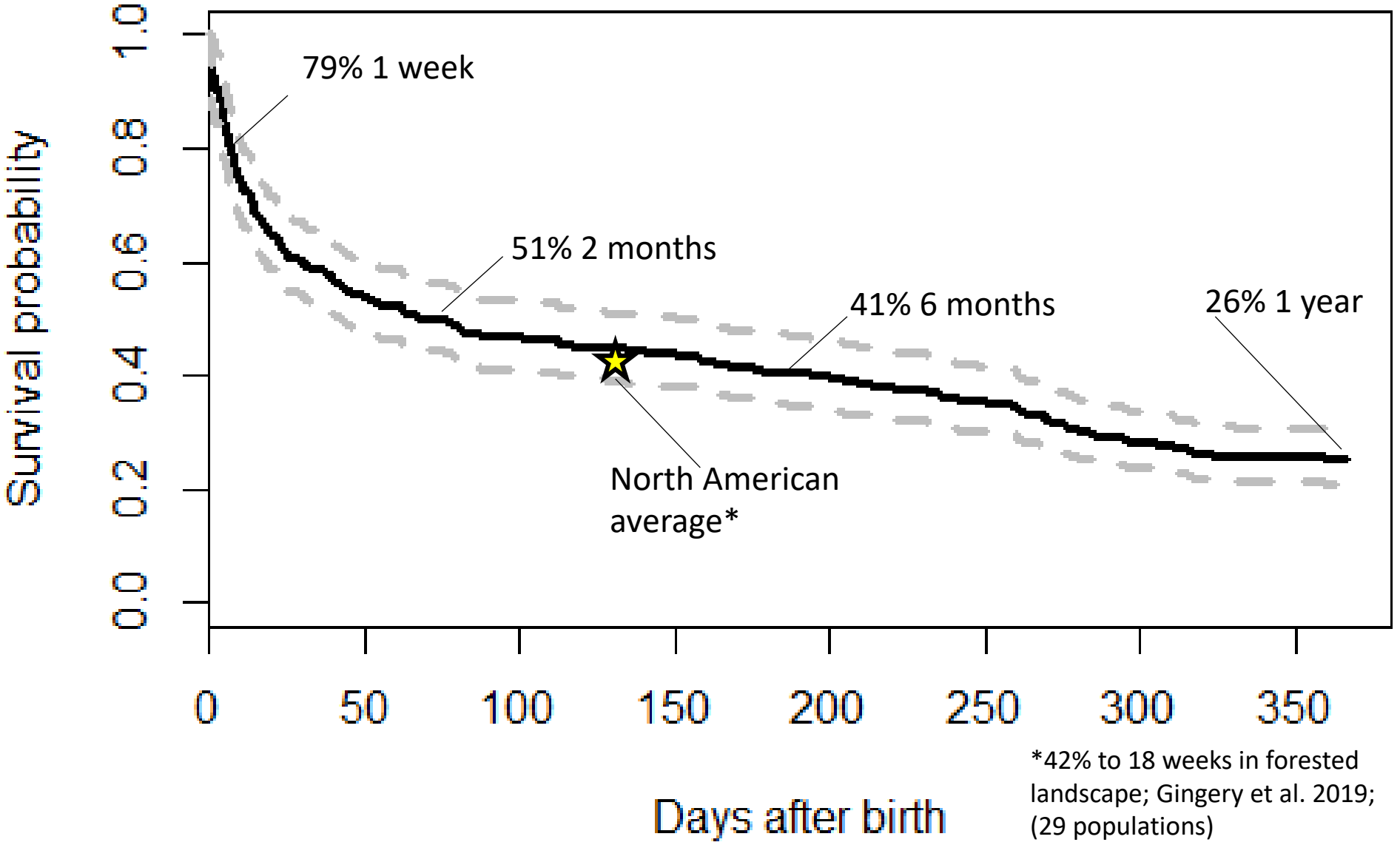
- 363 radio-collared fawns
- 166 mortality events
- 12 wolf predations





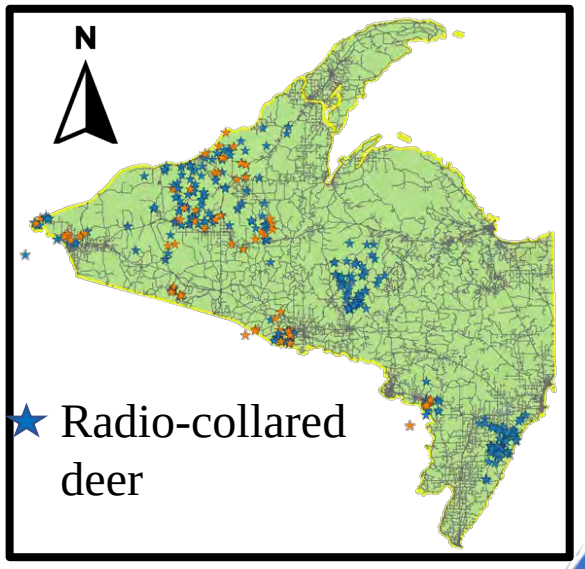
Fawn survival

- 365 newborn fawns
- 158 winter captured fawns

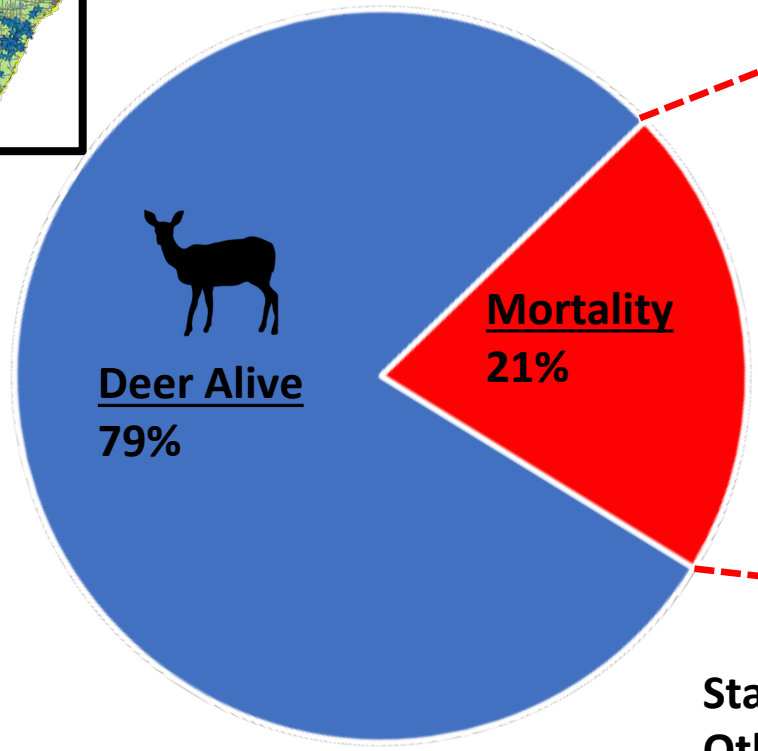


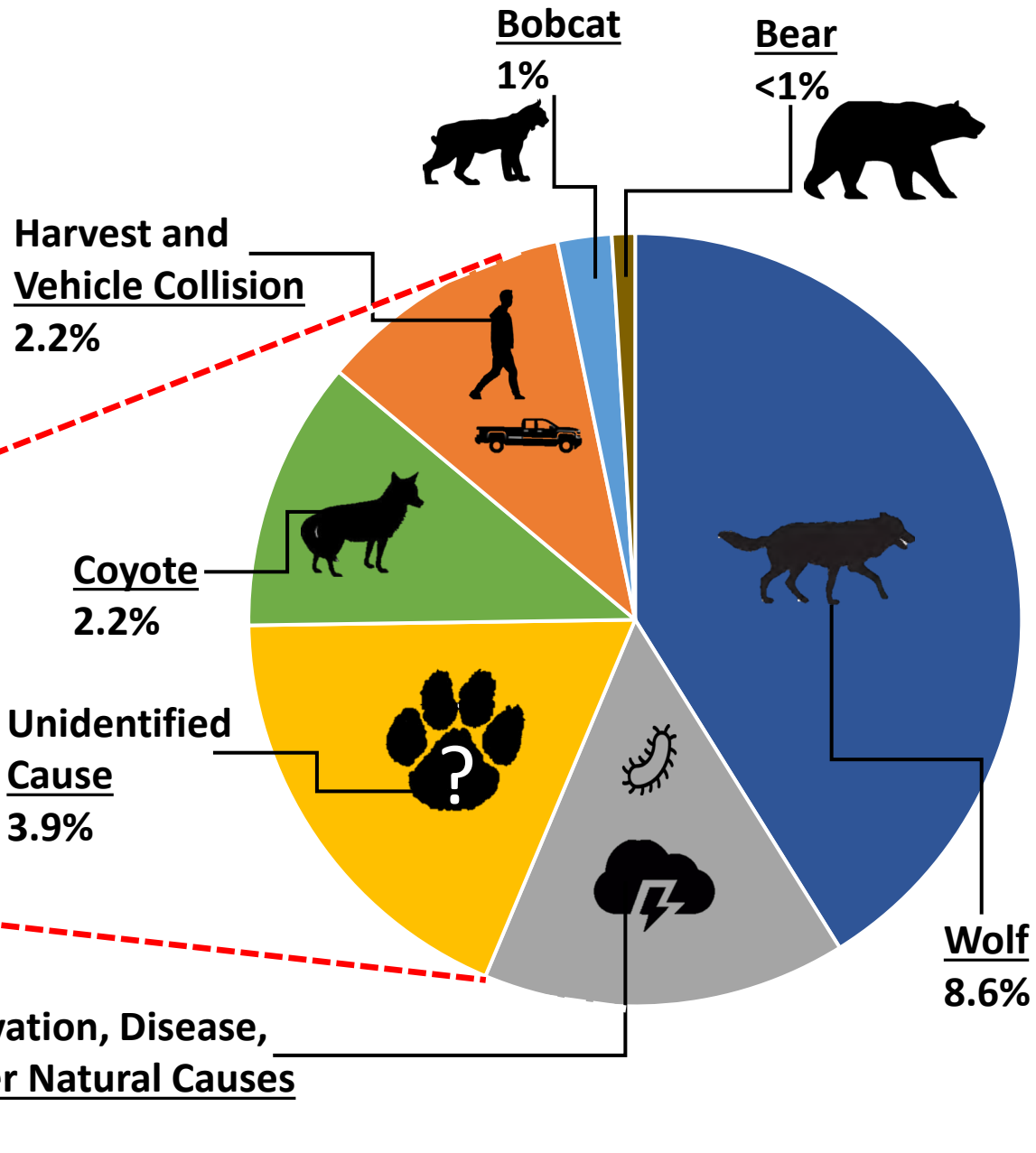
*42% to 18 weeks in forested landscape; Gingery et al. 2019; (29 populations)

Annual fates of adult female white-tailed deer

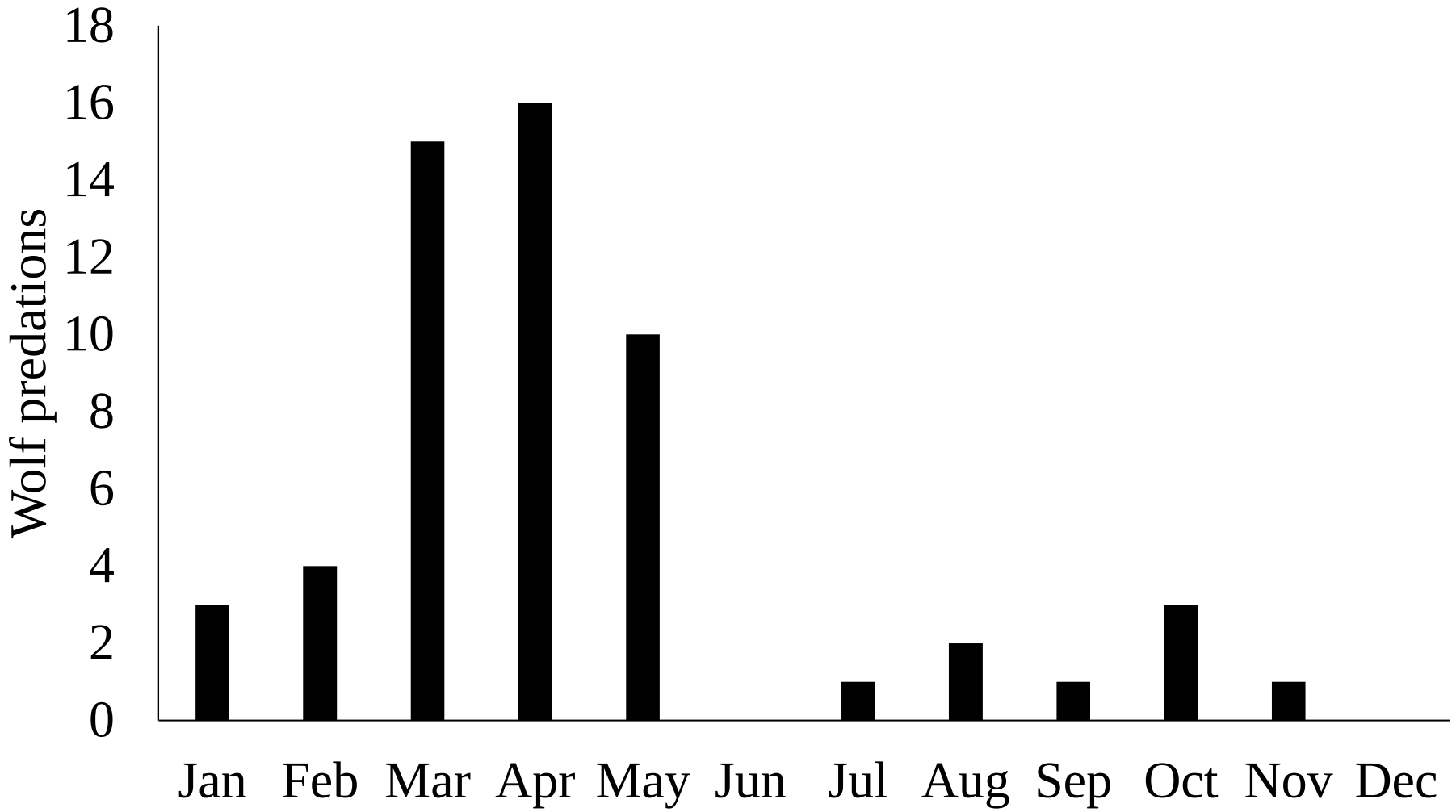


- 423 radio-collared deer
- 600 deer-years
- 175 mortality events
- 56 wolf predations

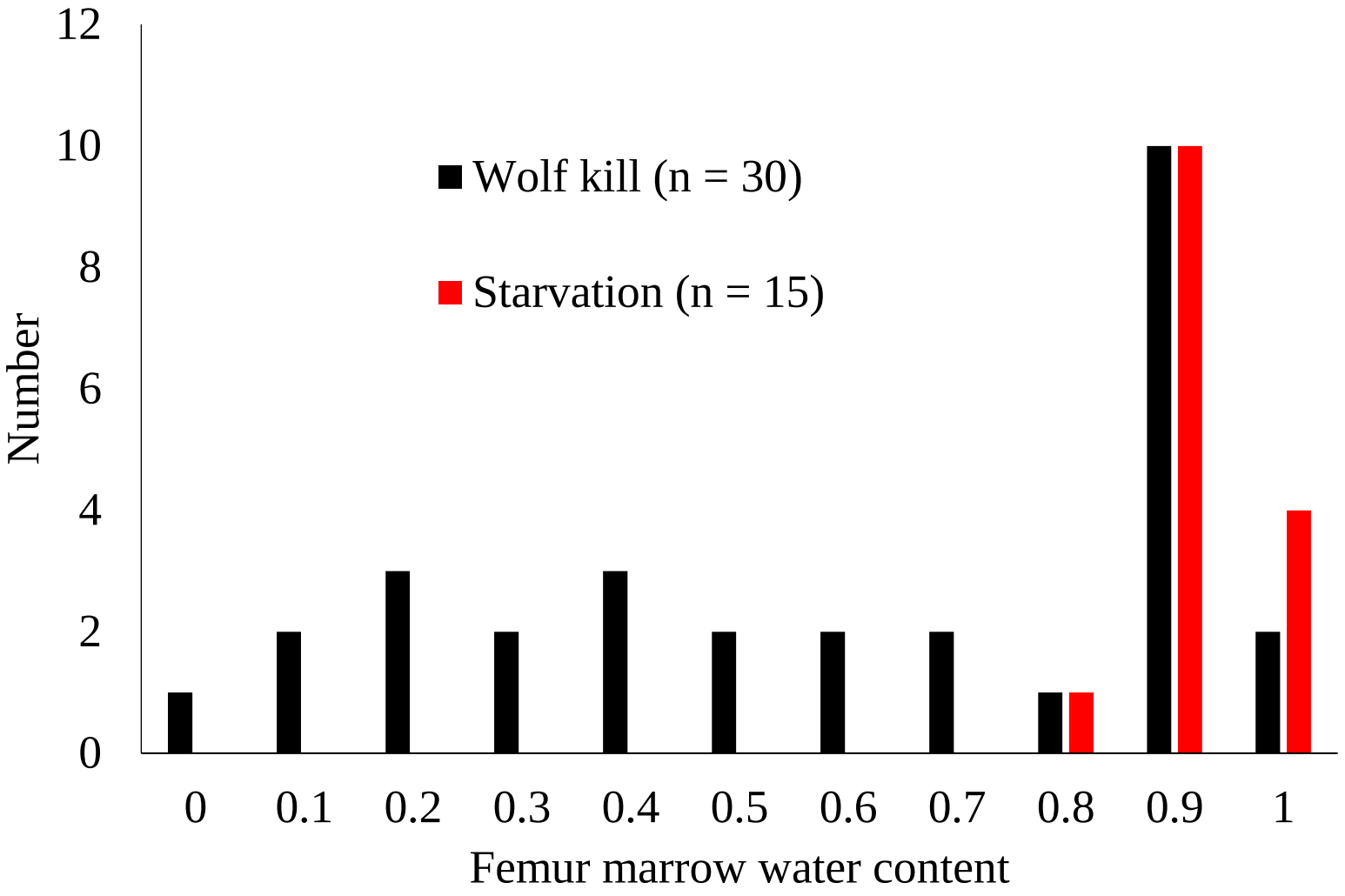


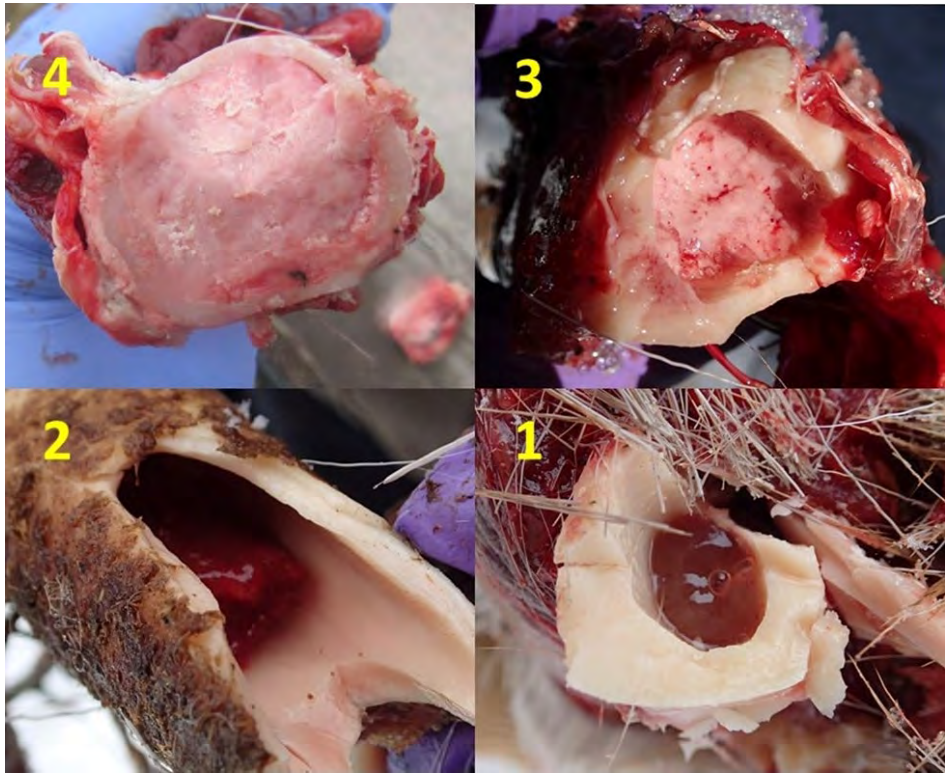


Timing of wolf predations on adult female deer

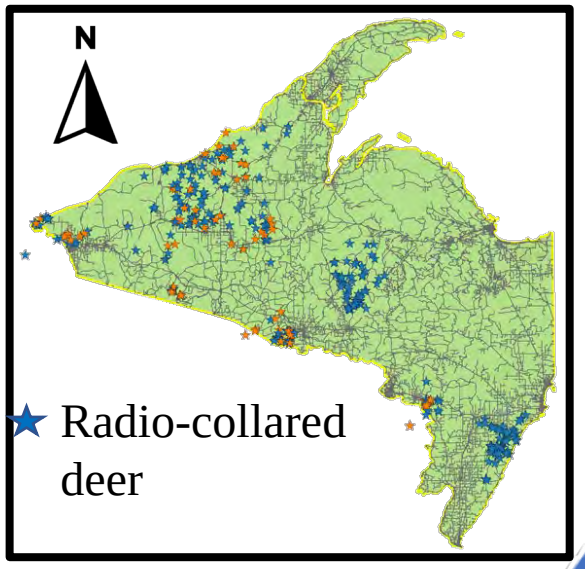


Nutritional condition of adult female deer killed by wolves





Annual fates of adult female white-tailed deer



- 423 radio-collared deer
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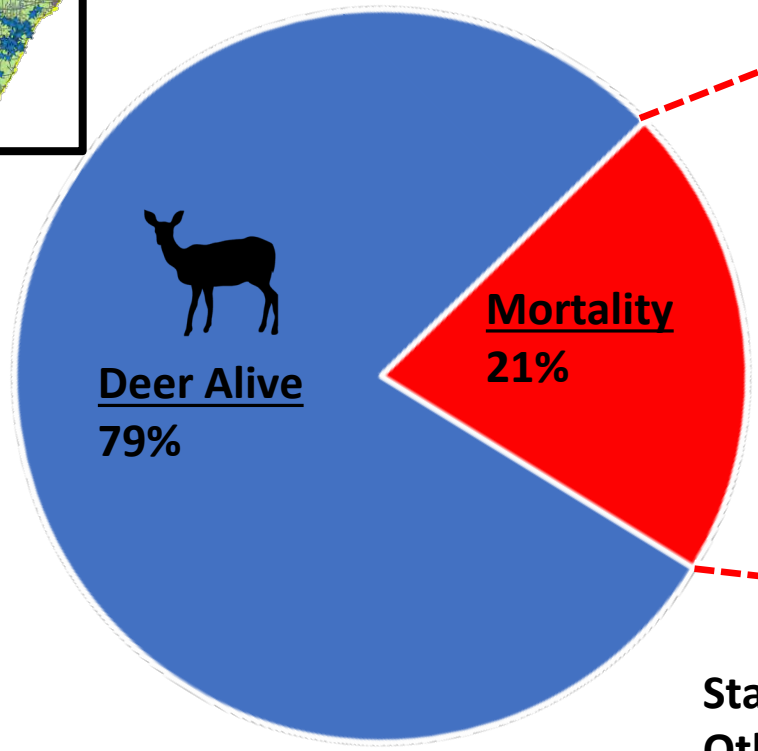
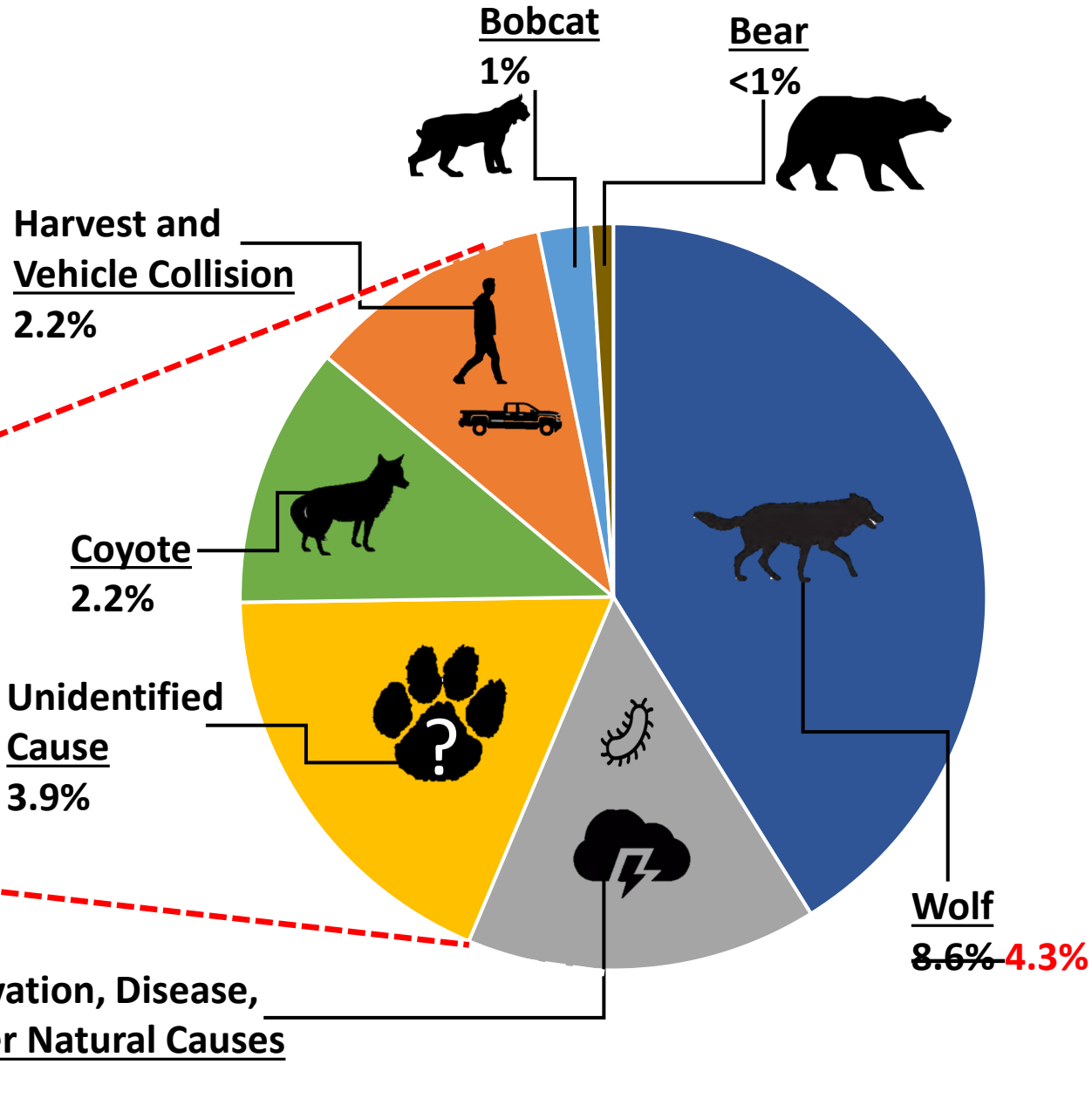
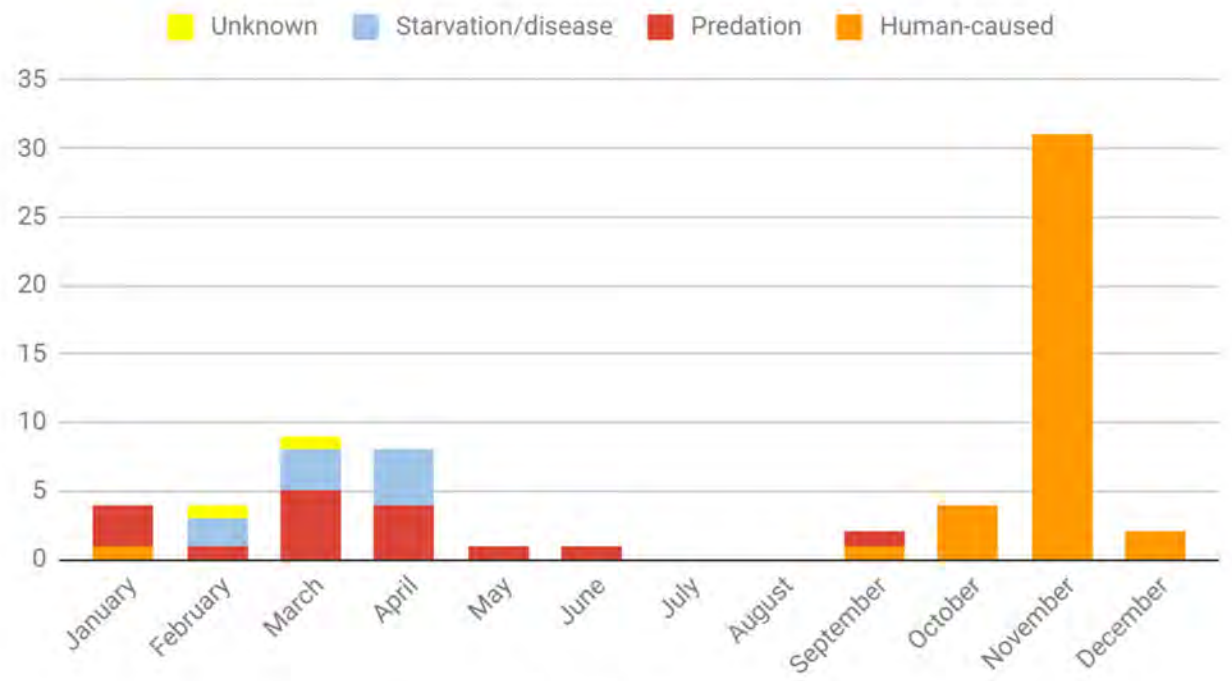




Adult male mortality

96 adult males monitored (2018-2020)
- 60 mortalities
  - 81.7% hunting
    - 5.0% Other human
  - 13.3% wolf predation
    - 0% coyote



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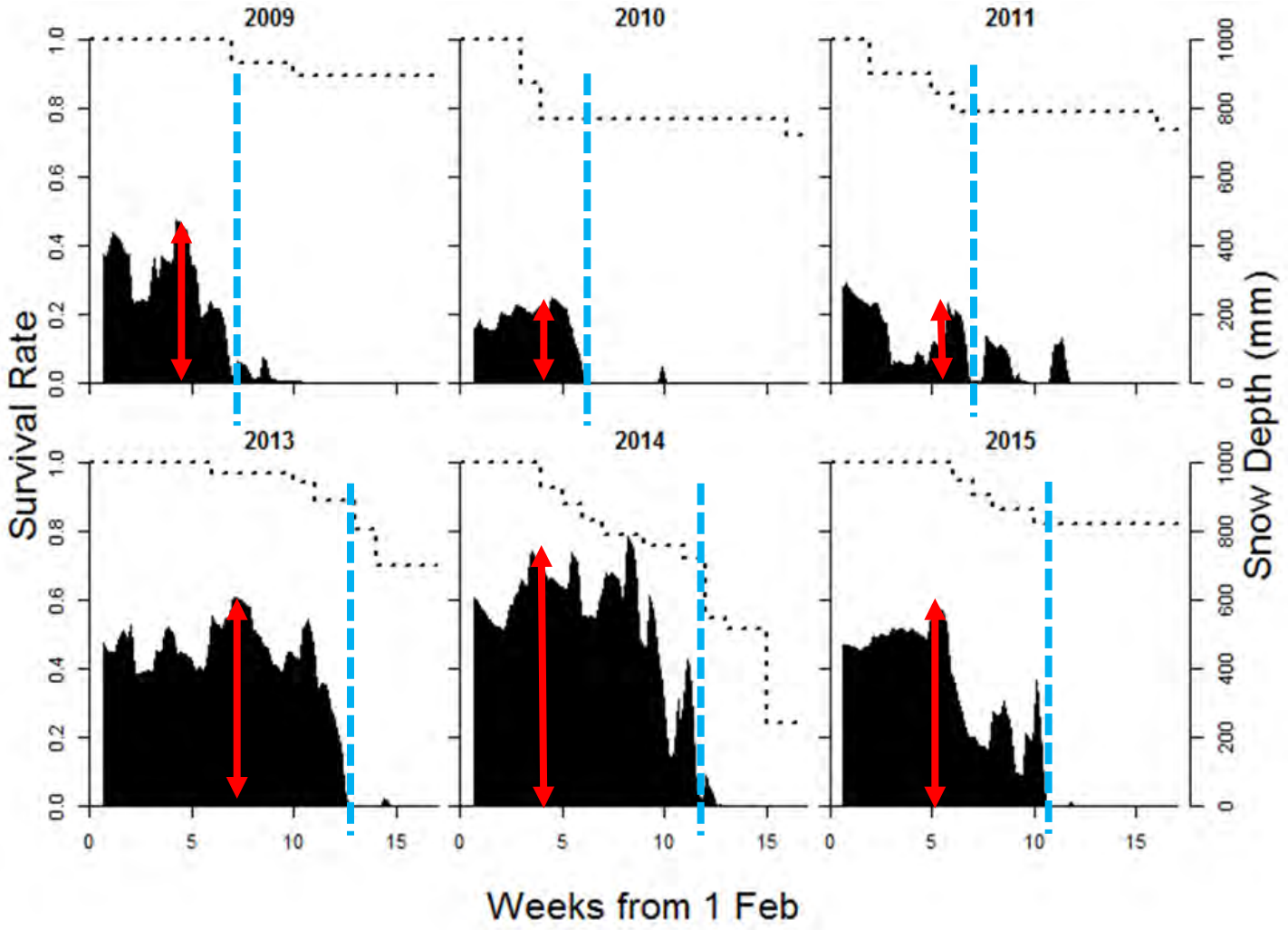
Adult female survival – winter weather

Covariate	Coeff	SE	Z	*P*	Risk effect per unit increase	Scaled and centered coeff
Body mass (kg)	−0.840	0.331	−2.54	0.011	↓ 11.9%	-0.84
Cumulative winter severity index	0.914	0.302	3.03	0.003	↑ 1.7%	-0.91
Cumulative snow free days	−1.719	0.551	−3.12	0.002	↓ 7.2%	**-1.72**
Body mass:time	0.062	0.035	1.77	0.077	NA	NA

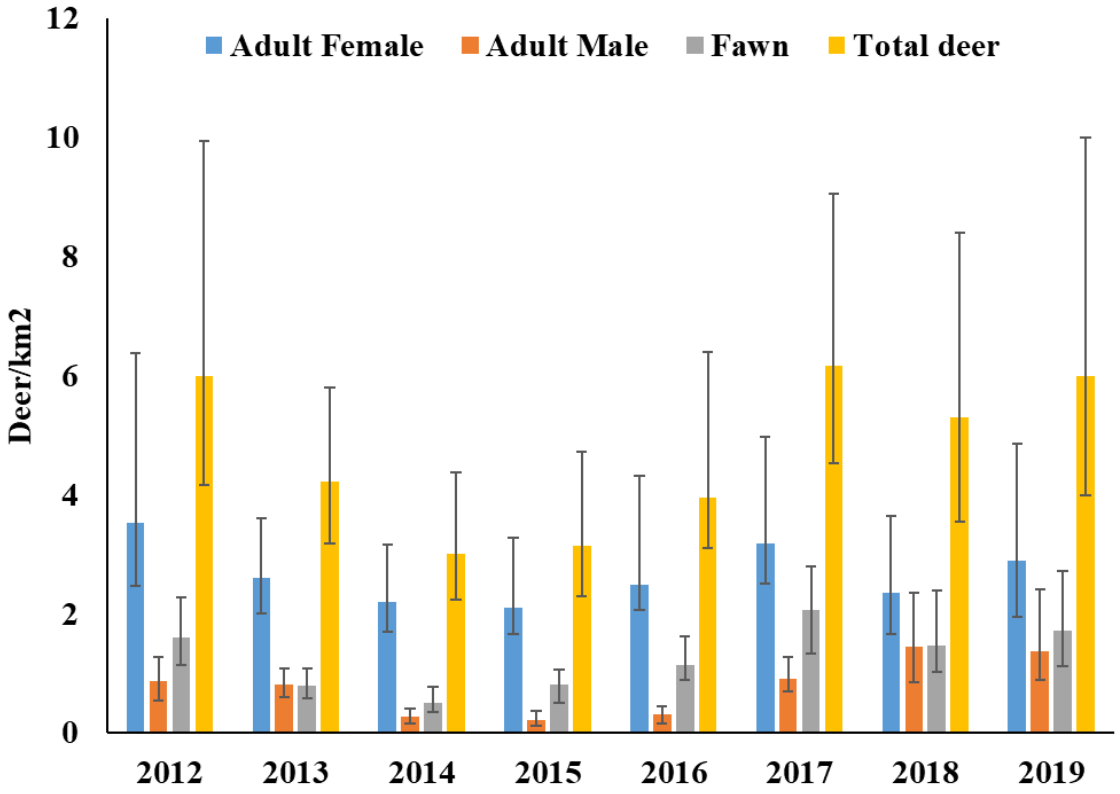
Adult female survival – winter weather

Magnitude of snow cover

Timing of spring snow melt



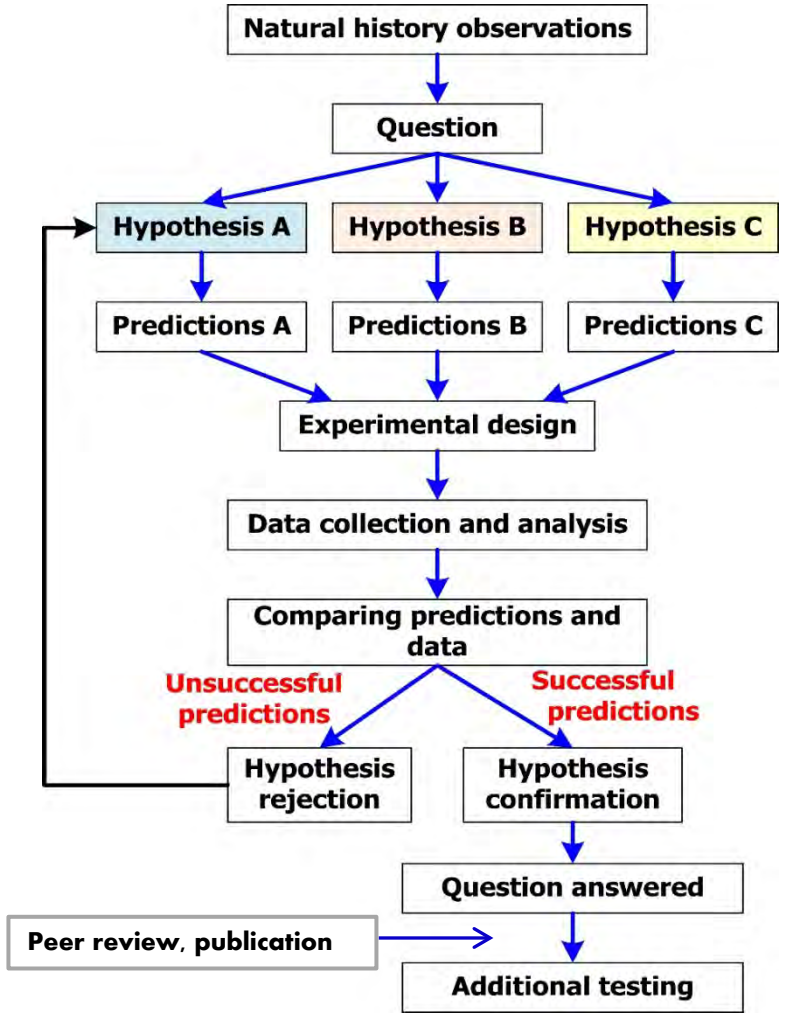
Deer abundance – mid-snowfall area



Aspect dominance

Aspect dominance

What science is….



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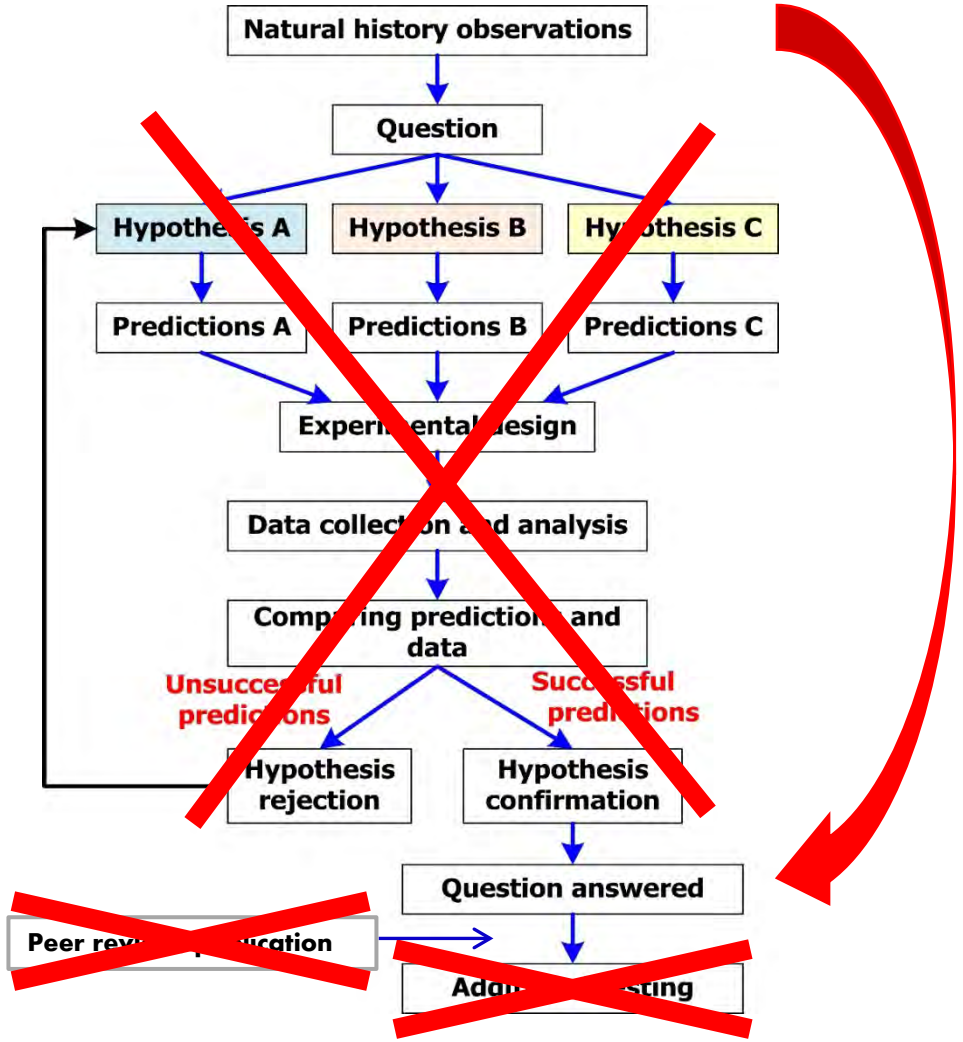
…and is not



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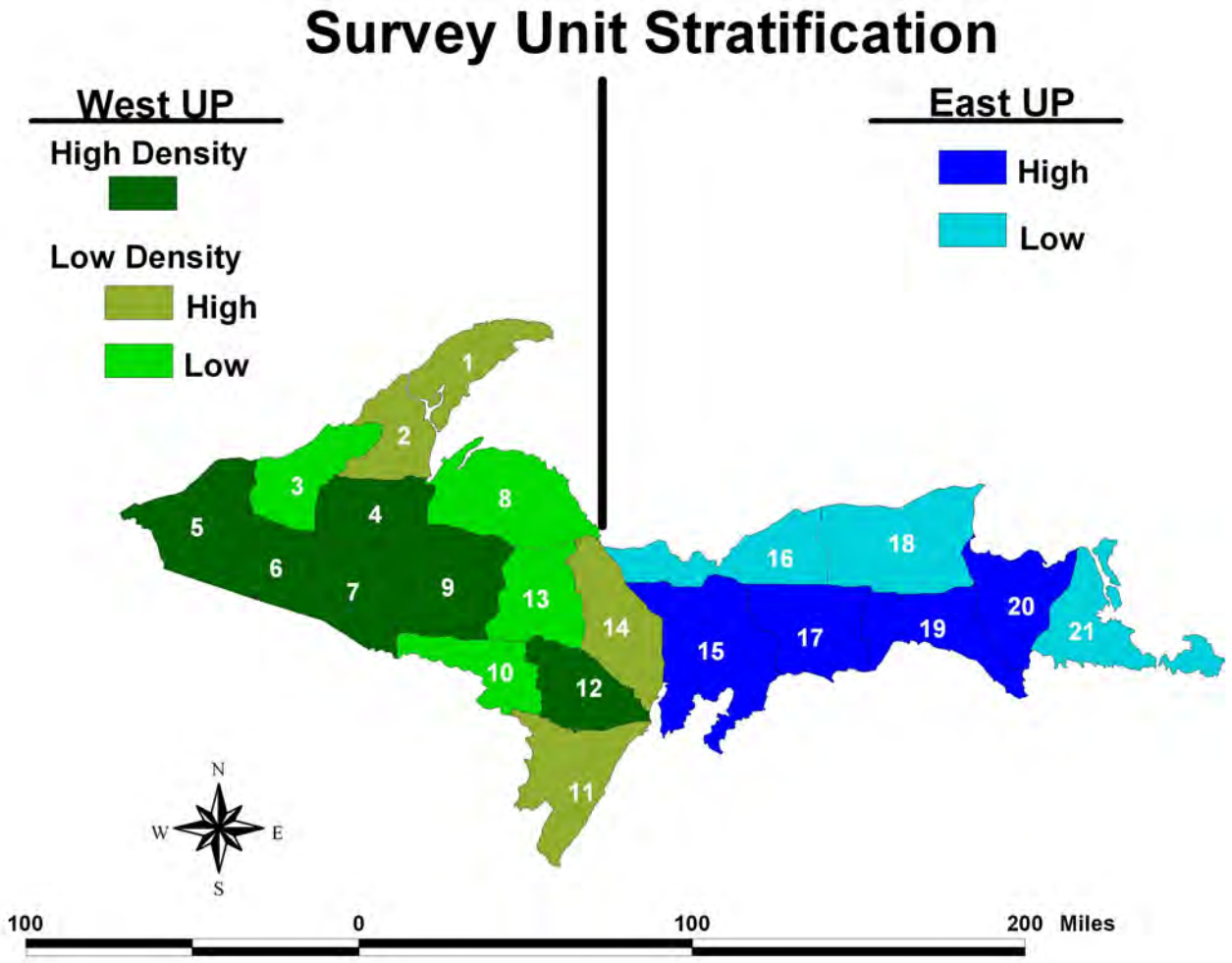
Developing a cost-effective technique to estimate wolf abundance in Michigan

Tyler Petroelje, MI DNR; Jerrold Belant, MSU; Dean Beyer, Jr., MSU; Brian Roell, MI DNR; Ken Kellner, MSU; Matt Nelson, MSU

Minimum Count: Wolf Population Index

- Why during winter?
  - High pack cohesion
  - Relatively easy detection
- Track Surveys
  - 60% of UP biennially
  - Travel by truck or snowmobile
  - Intensive & extensive search for wolf tracks and sign



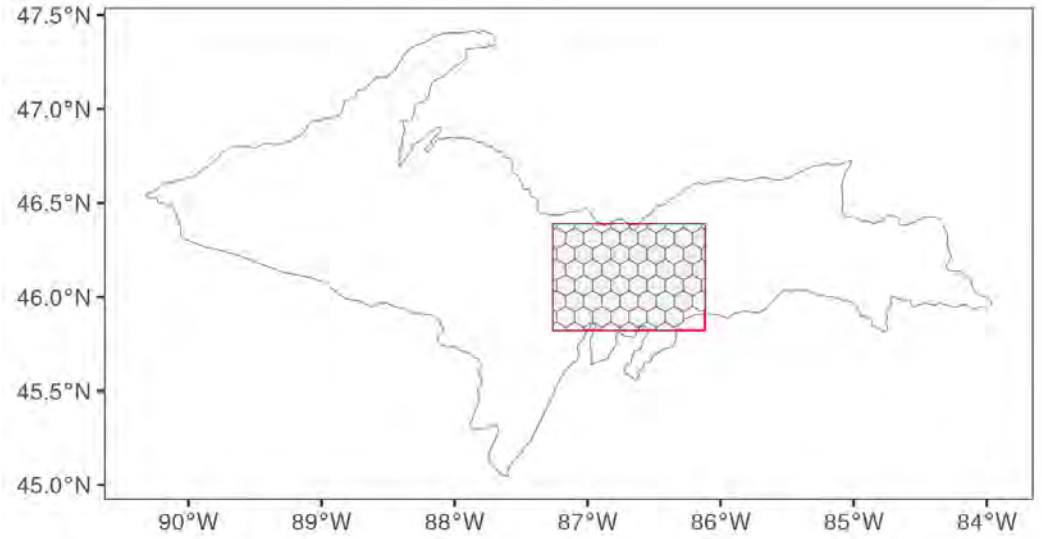
Background/Need for Wolf Abundance Project

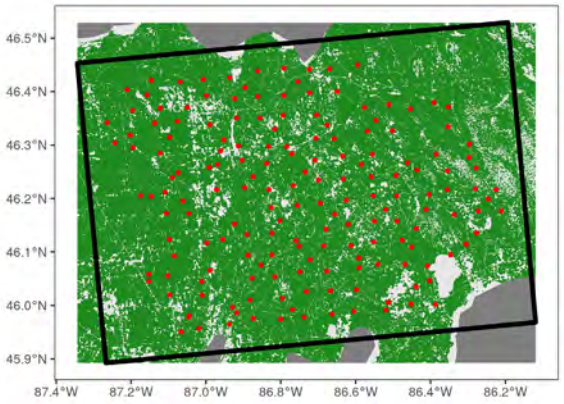
- Current minimum count requires significant effort to provide index of abundance
  - As wolf density has increased more time is needed to discern adjacent packs
  - Does not account for imperfect detection
  - Does not provide an abundance estimate with confidence intervals

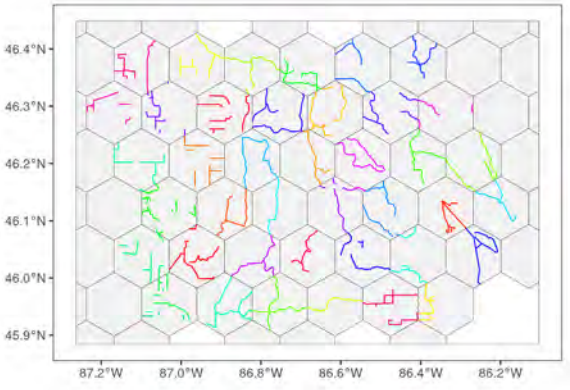
- Proposed wolf abundance project to research alternatives to estimate wolf abundance (2022-2027)
    - Increase precision
    - Decrease cost

2022 Pilot Surveys

- Feasibility study
- Pilot of 40 cells
  - 100 km^2 (~62 mi^2)
- 2 Surveys
  - A. Camera Survey
    - 200 cameras; 1 camera / 20 km^2 (~12.5 mi^2)
  - B. Occupancy track survey
    - 756 miles; average 19 miles/cell

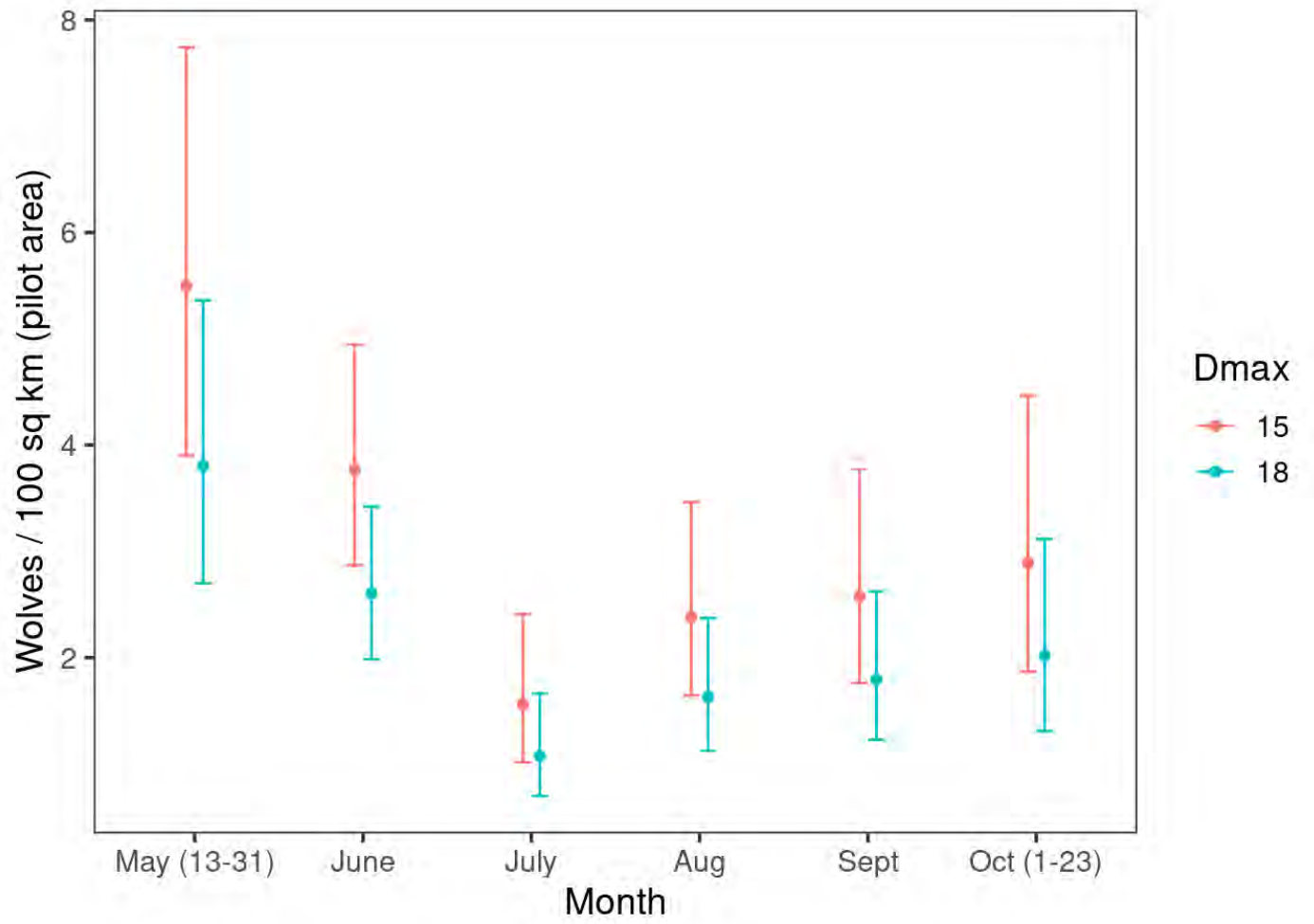


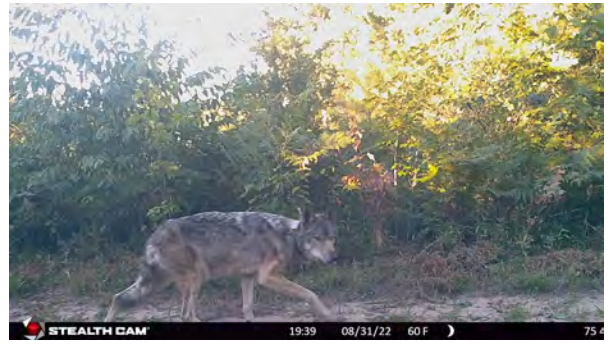




2022 Pilot Camera Survey

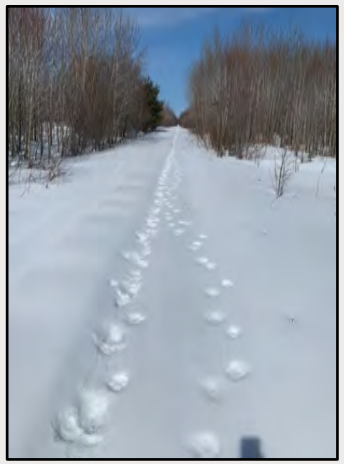
- 171 cameras detected 1,490 unique observations
- Detection probability likely driven by species life history
- Need to deploy cameras year-round for direct comparison to track surveys
- Need to assess detection year-round to select period of greatest precision for estimate

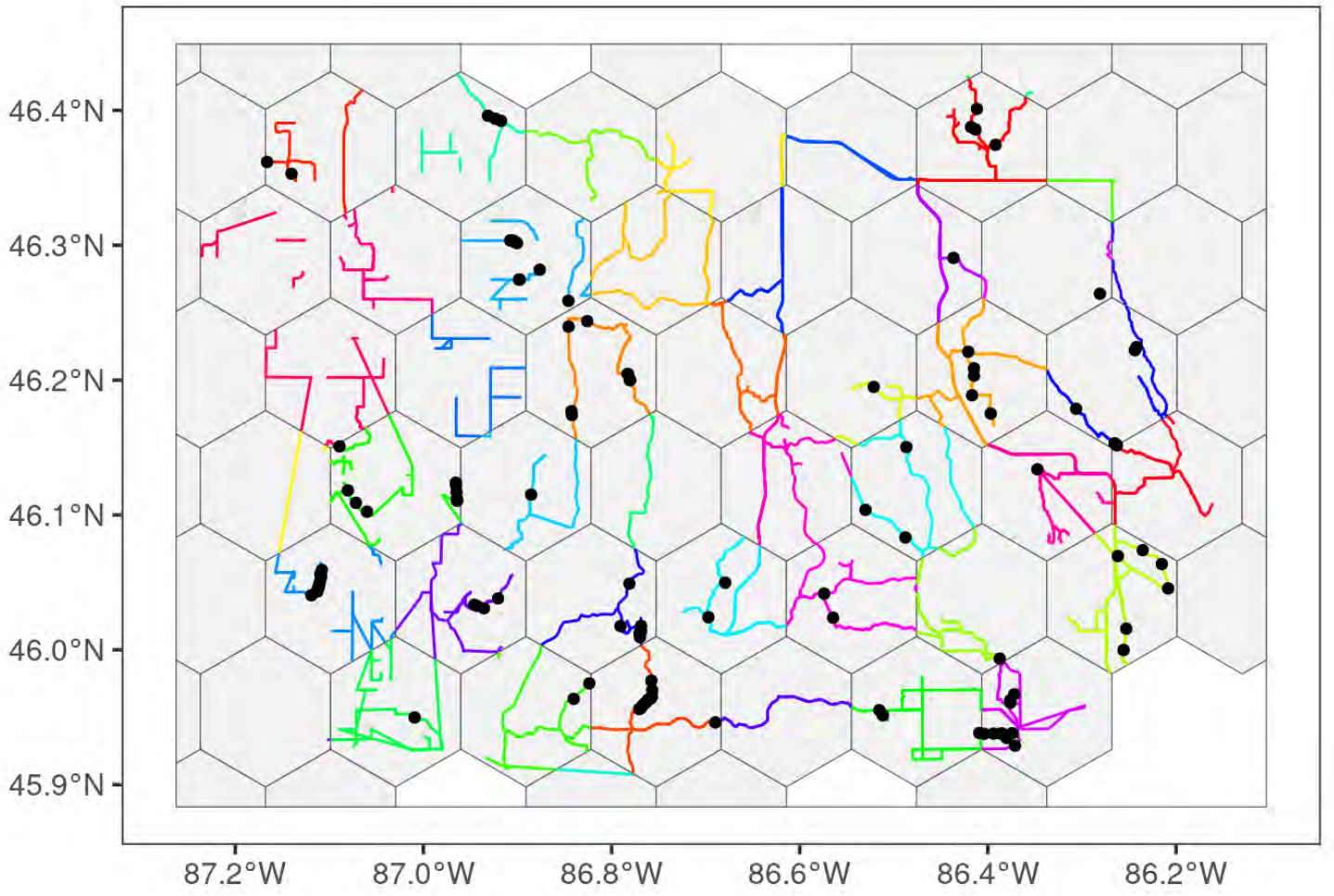




2022-2023 Pilot Snow Track Survey

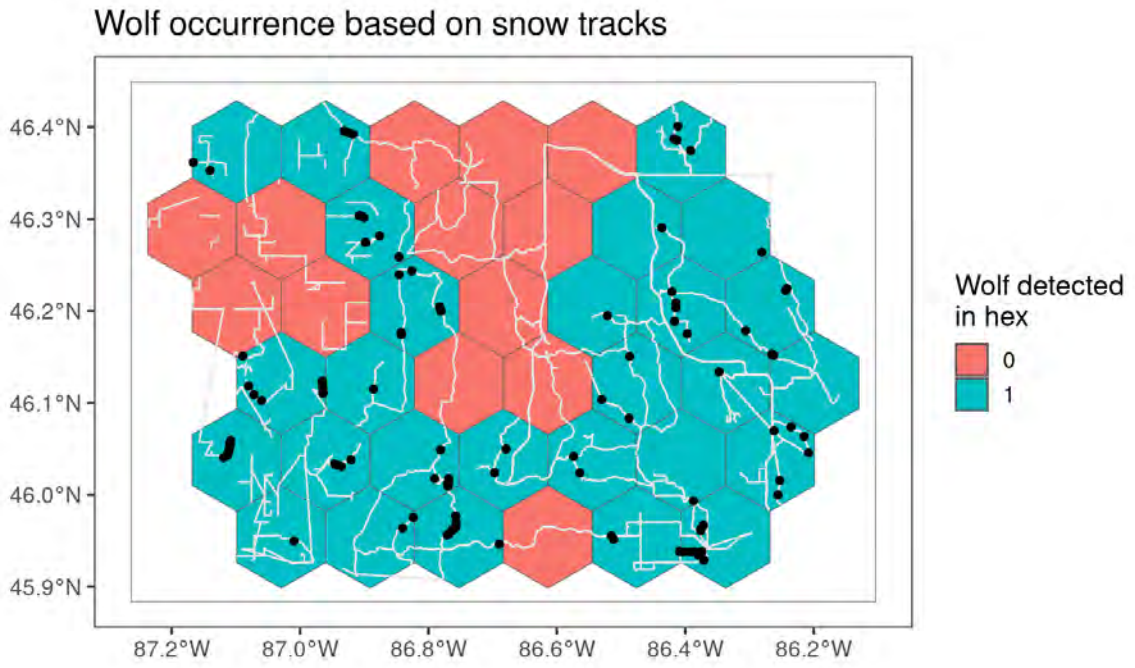
- 2,268 miles driven
- 119 observations of wolf tracks
- Challenges in scaling up survey
  - Time consuming
  - Low detection
  - Weather dependent

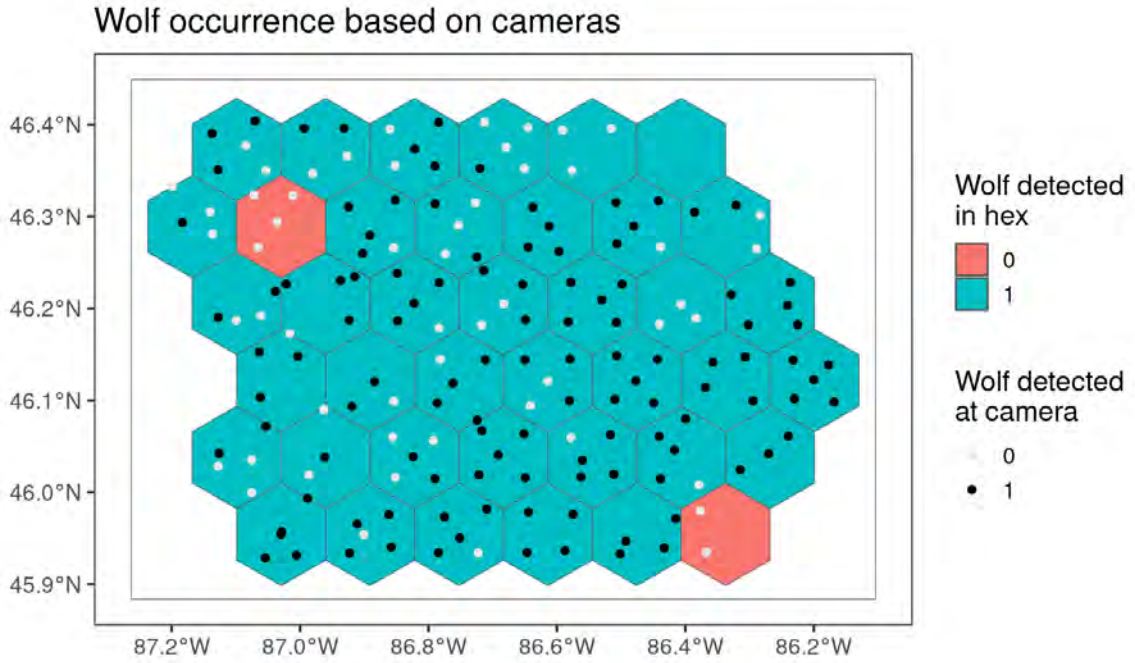




2022 Pilot Surveys: Lessons Learned

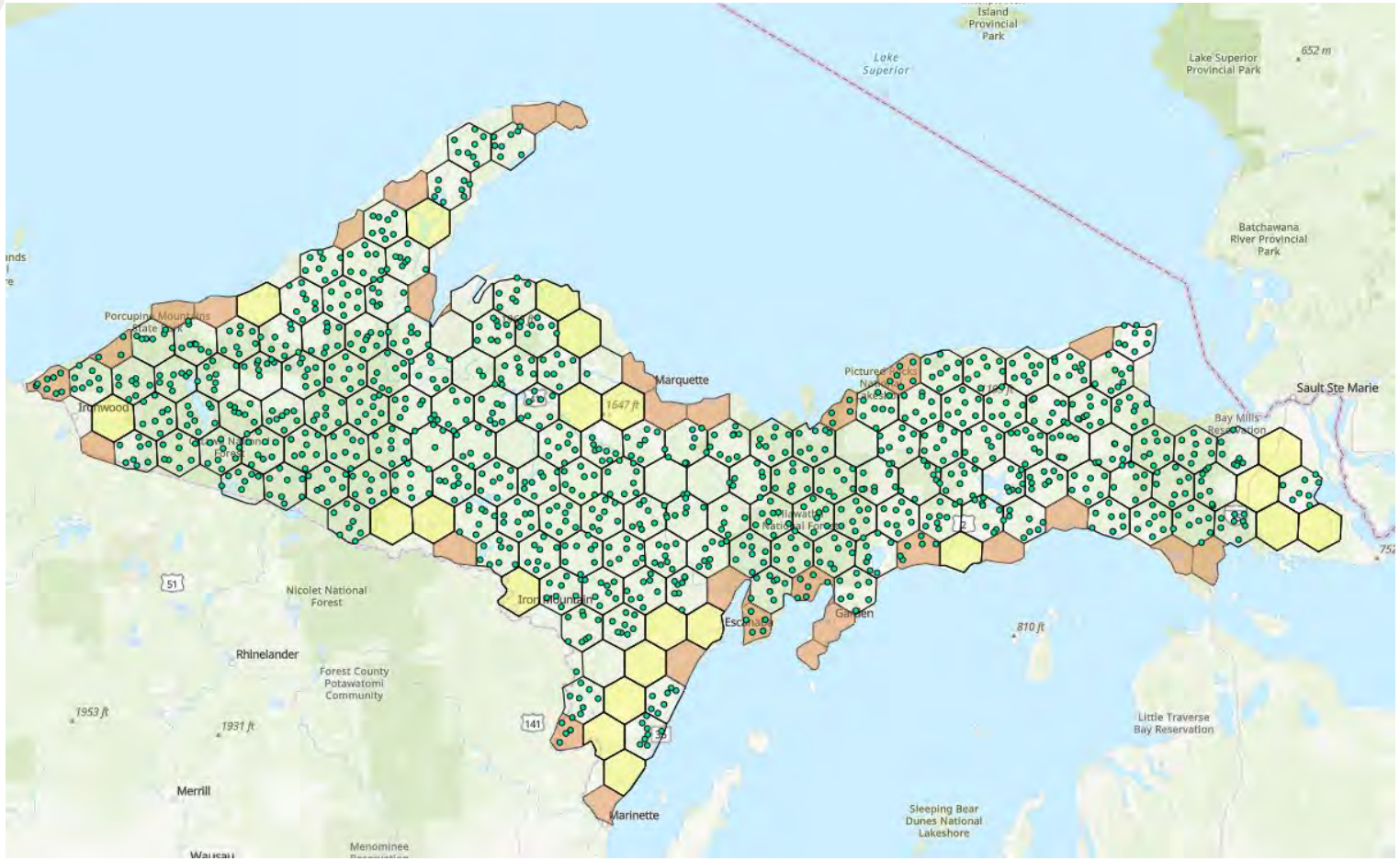
- Greater occupancy estimated from camera surveys
- 3 visits vs. 120 ‘visits’
  - 119 vs. 1,490 unique detections
- Not feasible to scale up occupancy-based track surveys
- Year-round camera surveys should provide good detection for comparison





Peninsula-wide deployments

- July-October 2023
  - 159 cells with cameras
  - 1,230 cameras deployed
- Some cells excluded due to size/ownership
  - 22 partial cells
  - 21 cells mostly private ownership
- Currently collecting data from 1st annual deployment



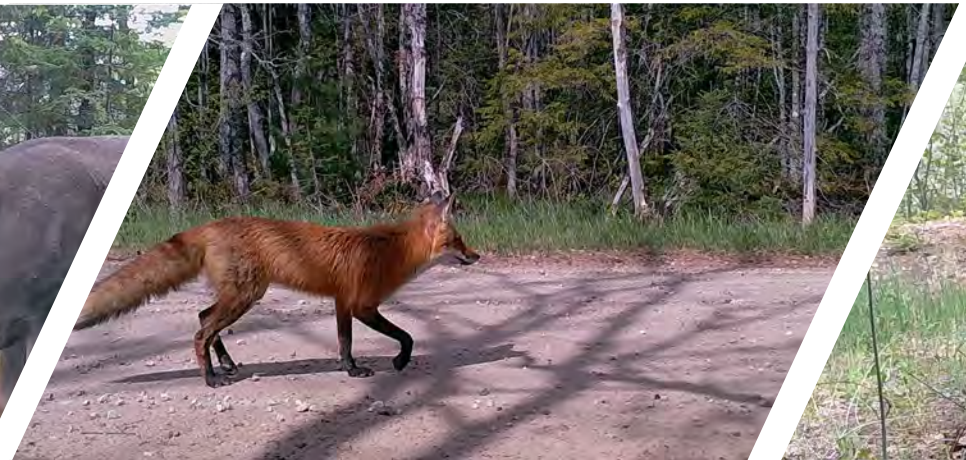
Wolf Abundance Project – Next steps

- 2024-2026
  - Cameras deployed in summer 2023, revisited in 2024, 2025, and 2026
  - Photo analysis using AI
  - Generate U.P. wide wolf abundance estimate
  - Annual reports available to public
  - Public facing website with interactive results
- 2027 and beyond
  - Final report to compare efficacy of wolf monitoring techniques
  - Potential to continue full camera deployment to monitor wolves



Potential monitoring strategy for other wildlife species

White-tailed deer, moose, bobcat, black bear, red fox, gray fox, coyote, turkey

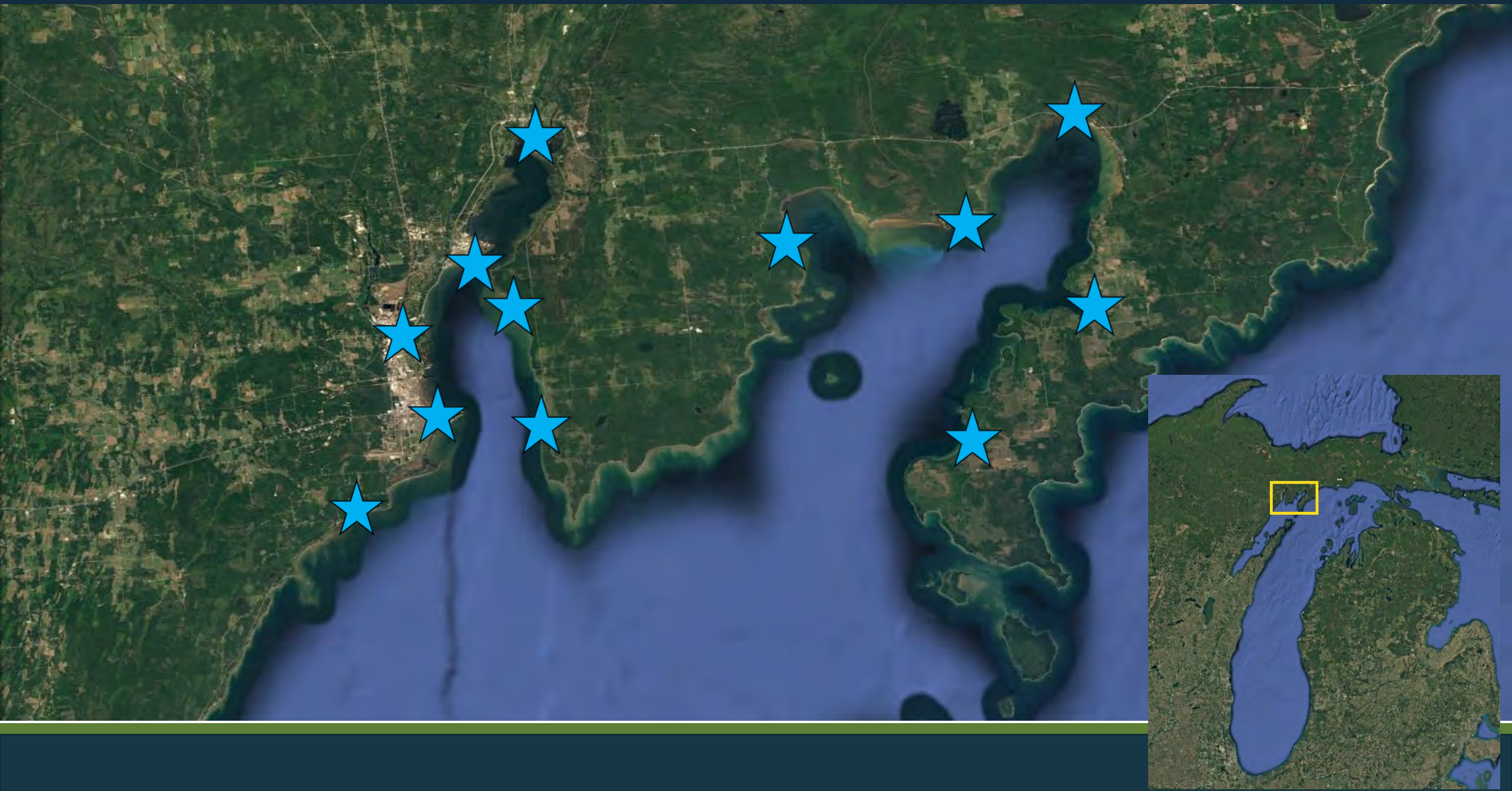

Questions?

Bays de Noc Fisheries

Darren Kramer-Unit Manager, Northern Lake Michigan Mgmt. Unit

Troy Zorn-Research Biologist, Marquette Fisheries Research Station

October 10, 2024



Bays de Noc-Habitat

Little Bay de Noc

- ~39,000 surface acres
- Six small-medium sized rivers
  - Gravelly-rocky substrate
- Shallow and Deep bathymetry
  - ≤10’ and 40’-100’ FOW

Big Bay de Noc

- ~93,000 surface acres
- Four small-medium sized rivers
  - Sandy substrate
- Shallow bathymetry
  - ½ of area ≤10’ FOW

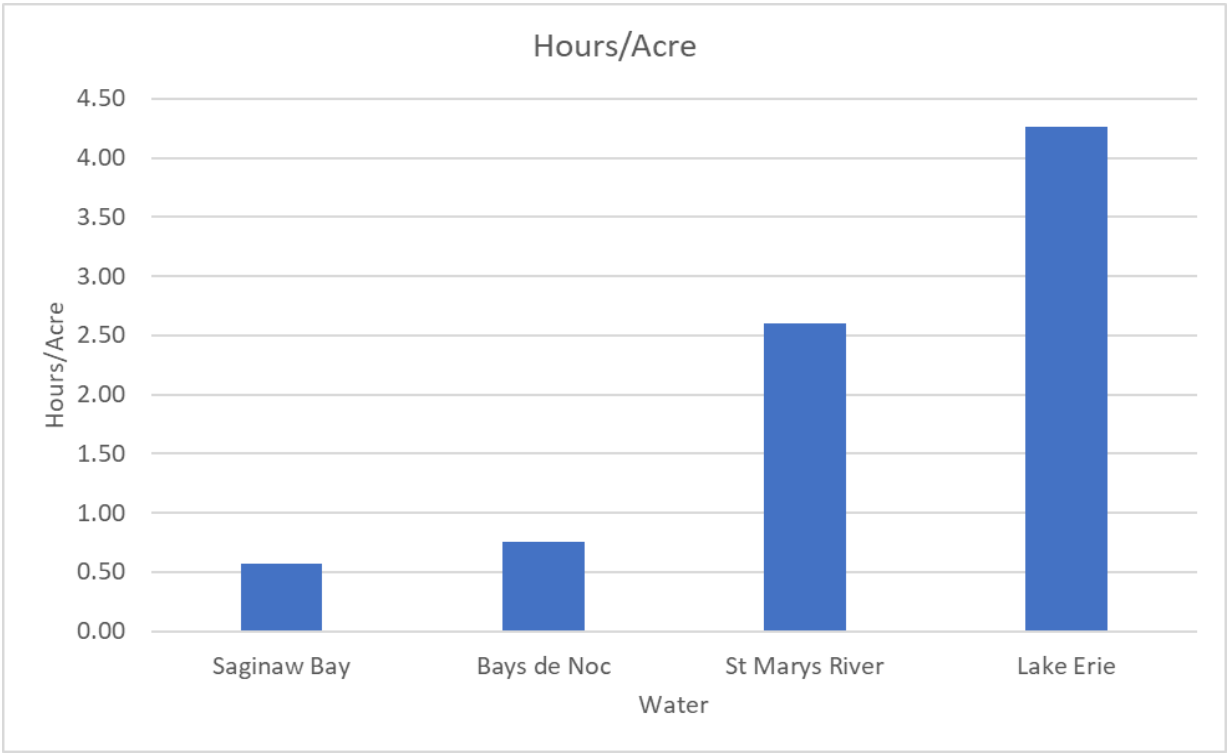
LBdN=higher fisheries diversity, abundance, angler effort vs BBdN

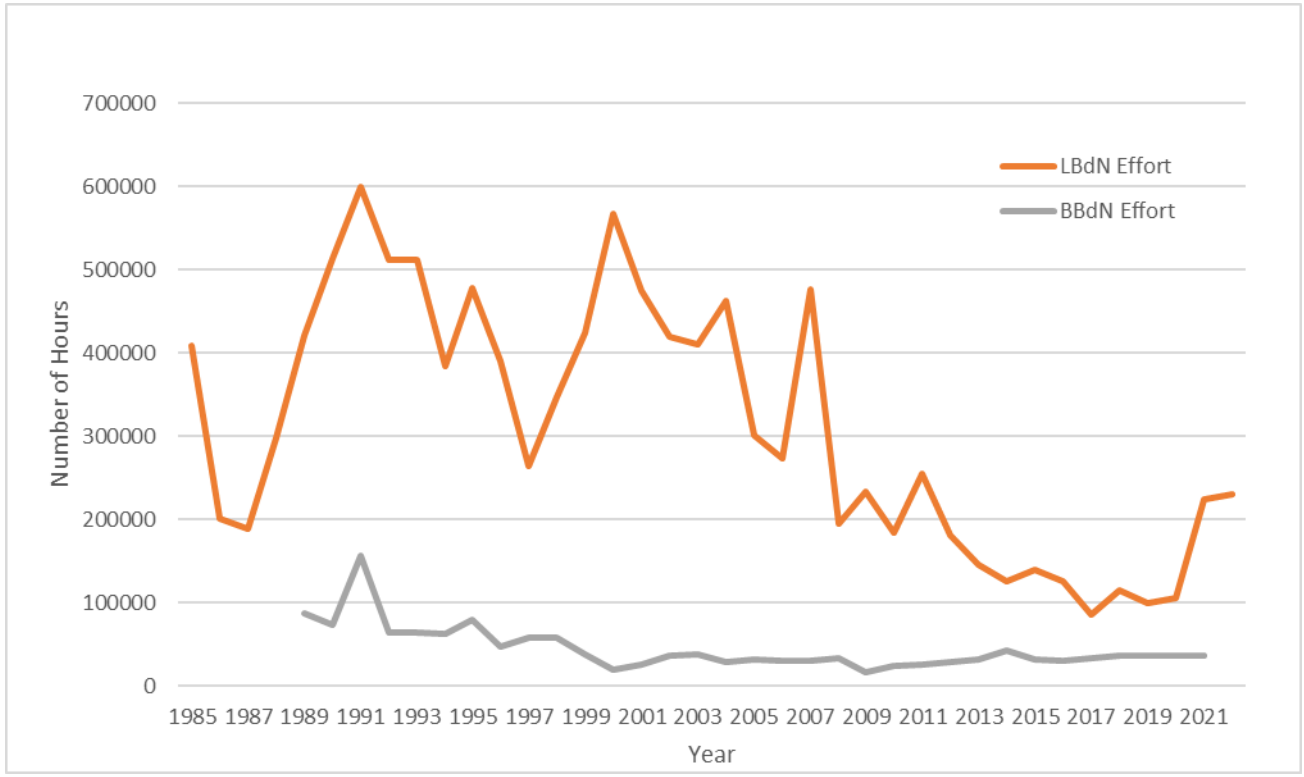
Bays de Noc-Fish Community

- Primarily cool-water community
- “Moderate” diversity with over 40+ species found in N. Green Bay area
- Additional local sport fisheries
  - Steelhead
  - Coho Salmon

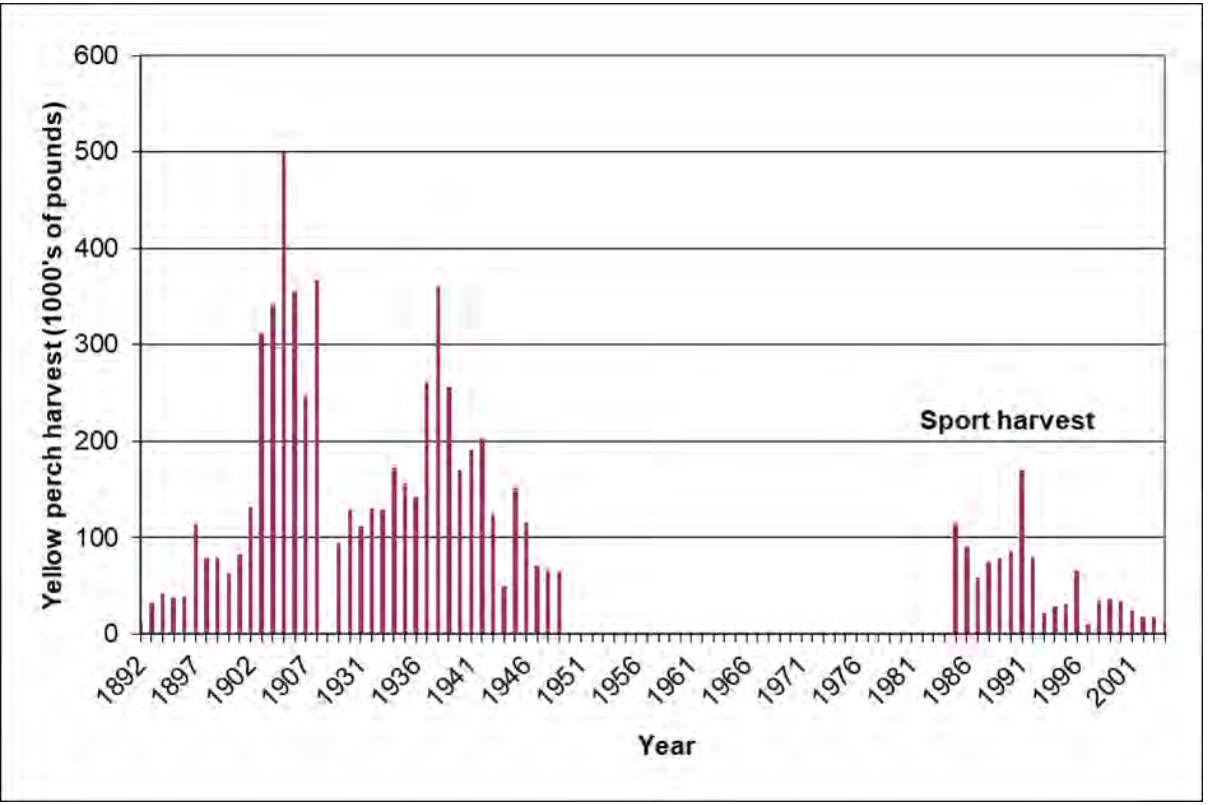
Bays de Noc-Sport Fishery

Bays de Noc-Angler Effort

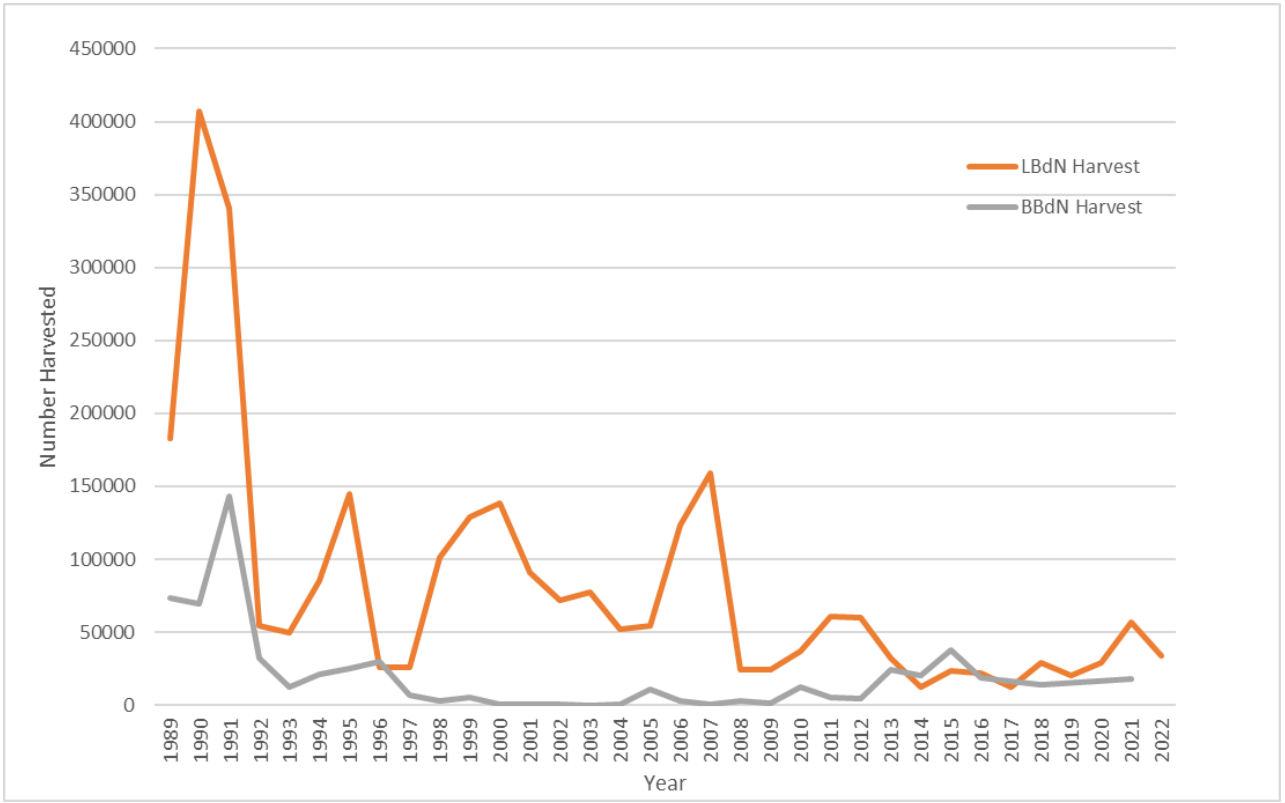




Bays de Noc-Yellow Perch Fishery

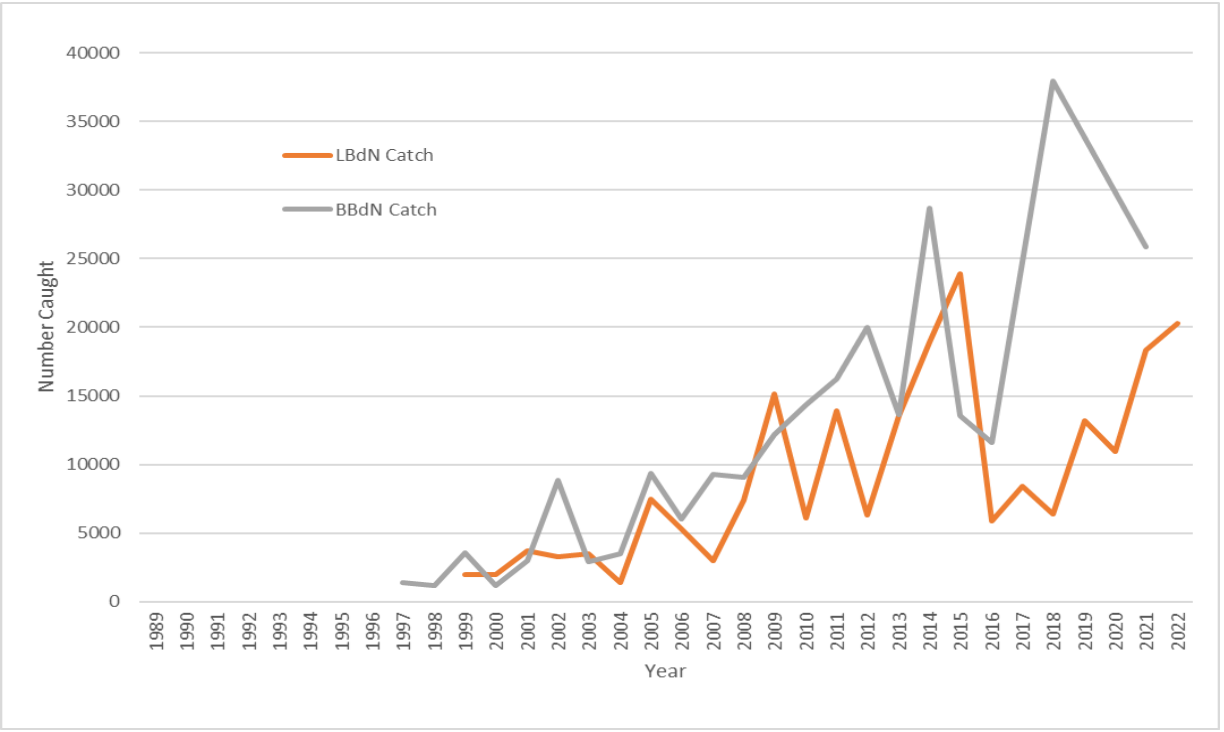


Harvest

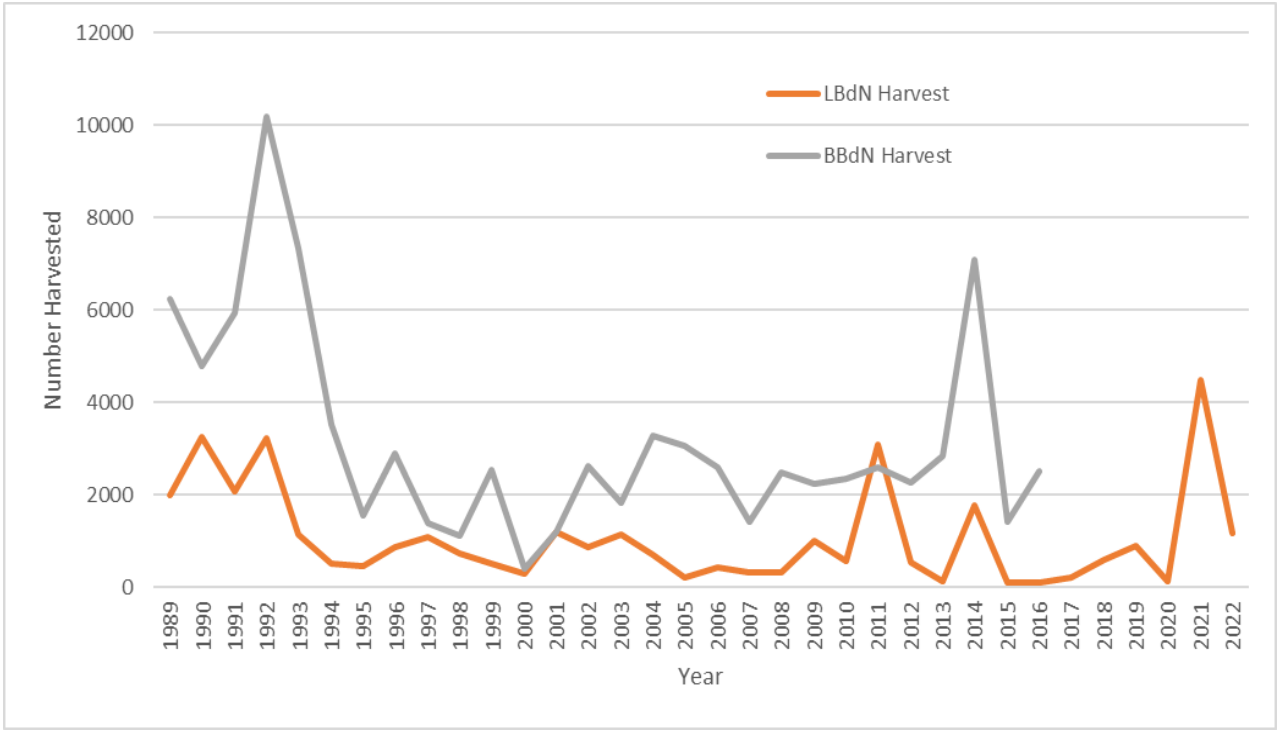


Bays de Noc-Smallmouth Bass Fishery-

Catch

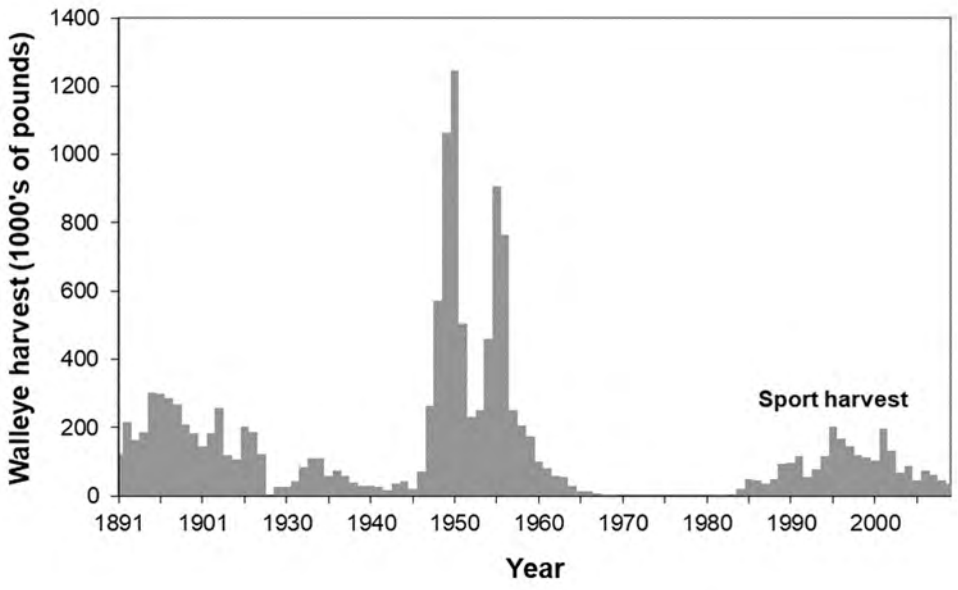


Harvest



Bays de Noc-Historic Walleye Fishery

- Late 1940s/early 1950s-large years classes from natural reproduction
- Spurred intense commercial and recreational fisheries
- Early 1960s-gradual population decline
    - overfishing, habitat loss, aquatic invasive species
- Commercial fishing closed-1969



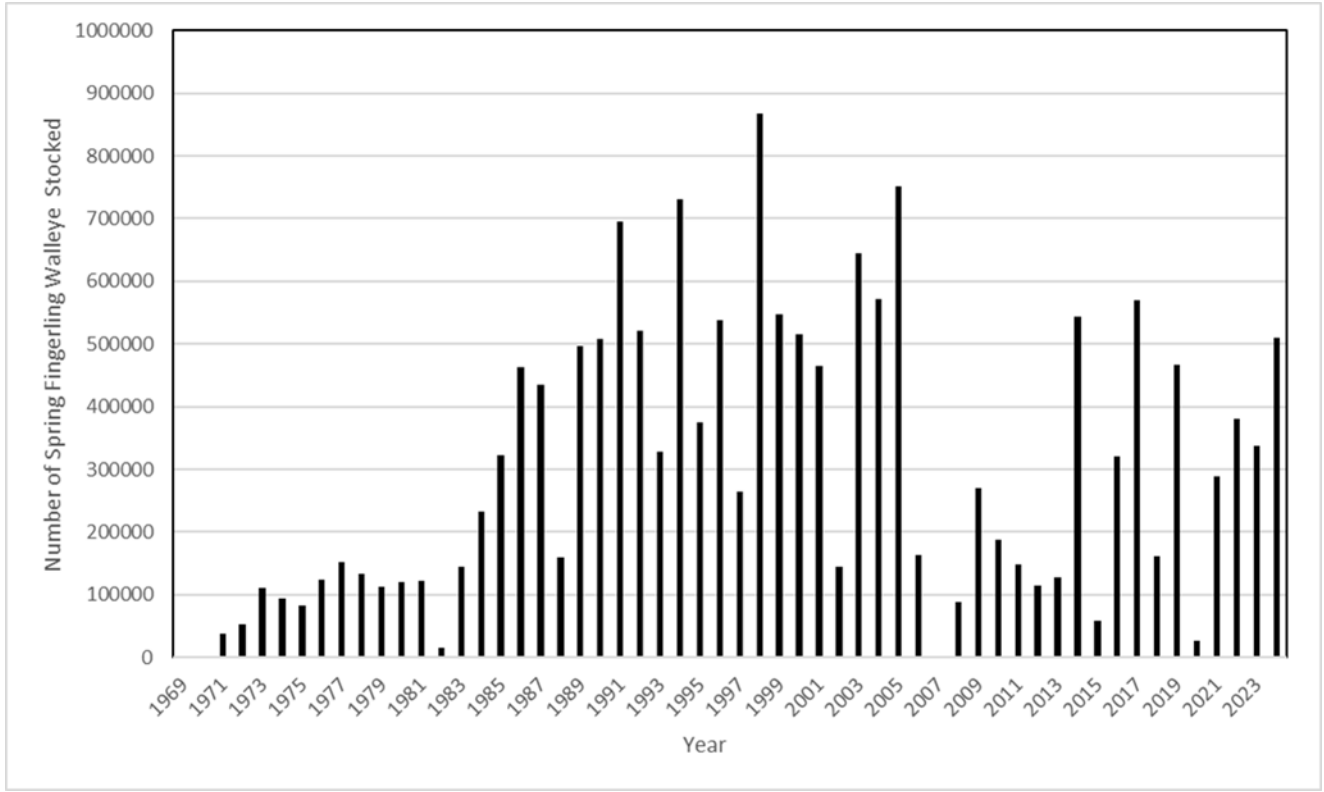
Gladstone's bay was hub of fishing activity in the 1950s

Bays de Noc-Walleye Stocking

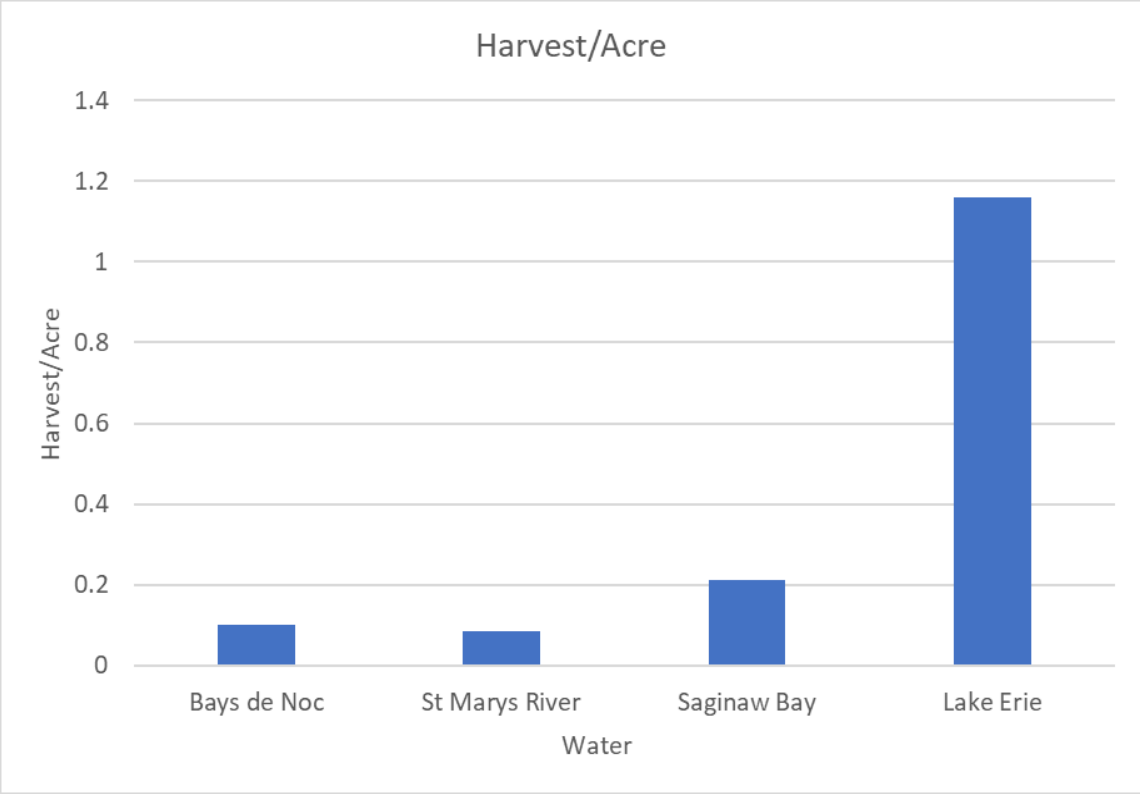
- Early 1970s-initiated stocking to rebuild population
- Perfected walleye rearing mid-1980s
- Late 1980s-natural reproduction documented

- LBdN=wild broodstock-U.P. stocking program

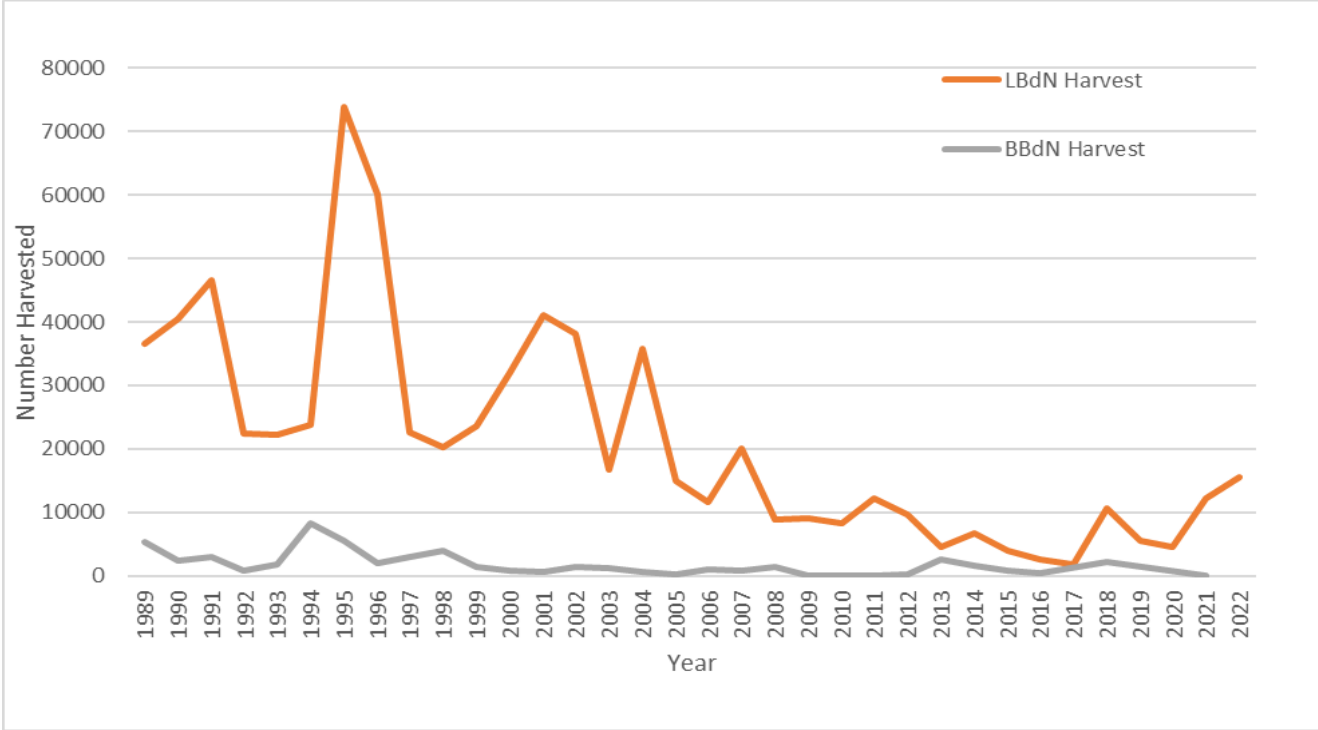
- Partnerships
  - Bays de Noc Great Lakes Sportfishermen
  - Wildlife Unlimited of Delta County
  - Sault Tribe of Chippewa Indians



Bays de Noc-Walleye Fishery



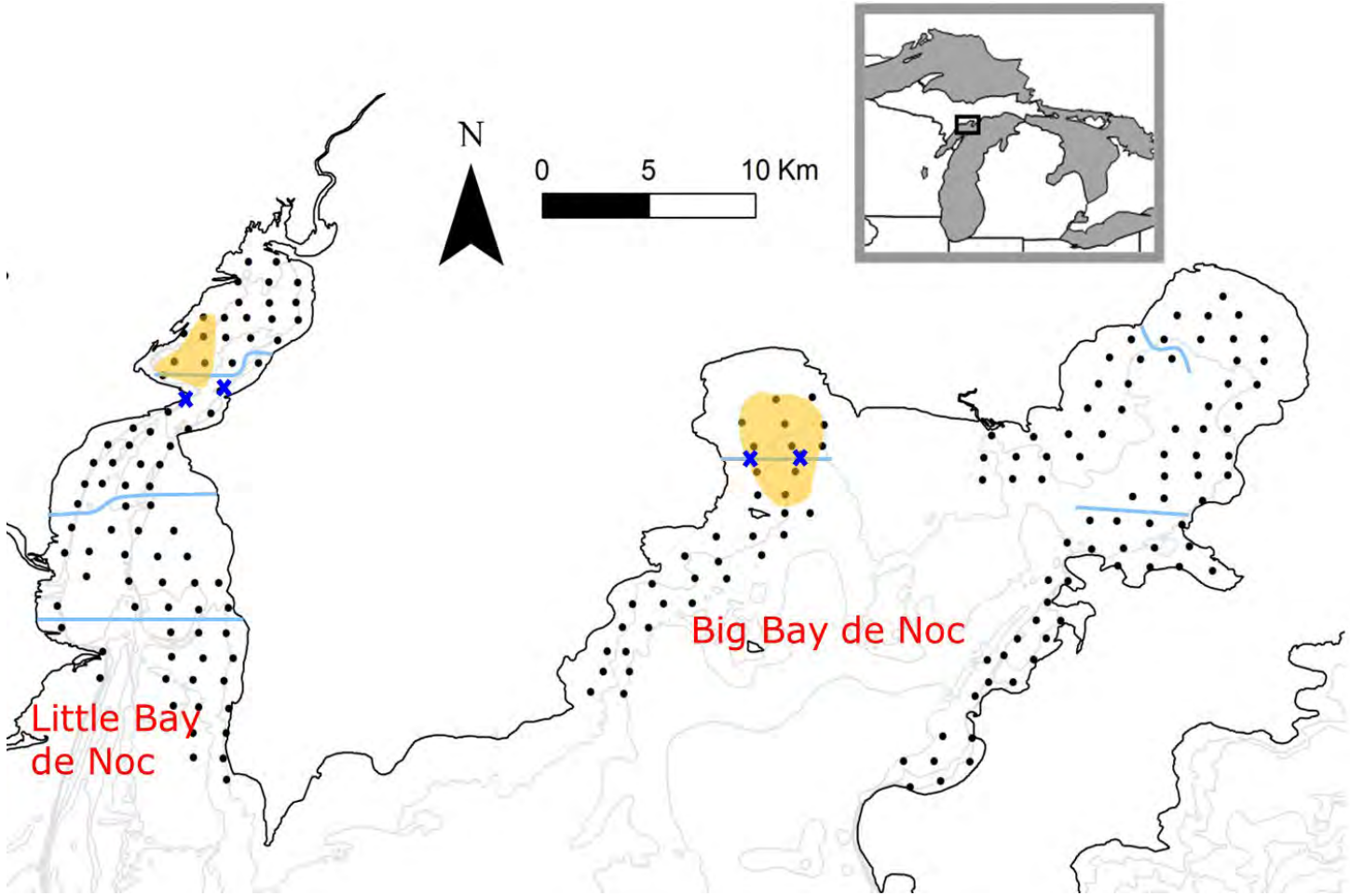
Annual Harvest



Bays de Noc fisheries assessments

Surveys:

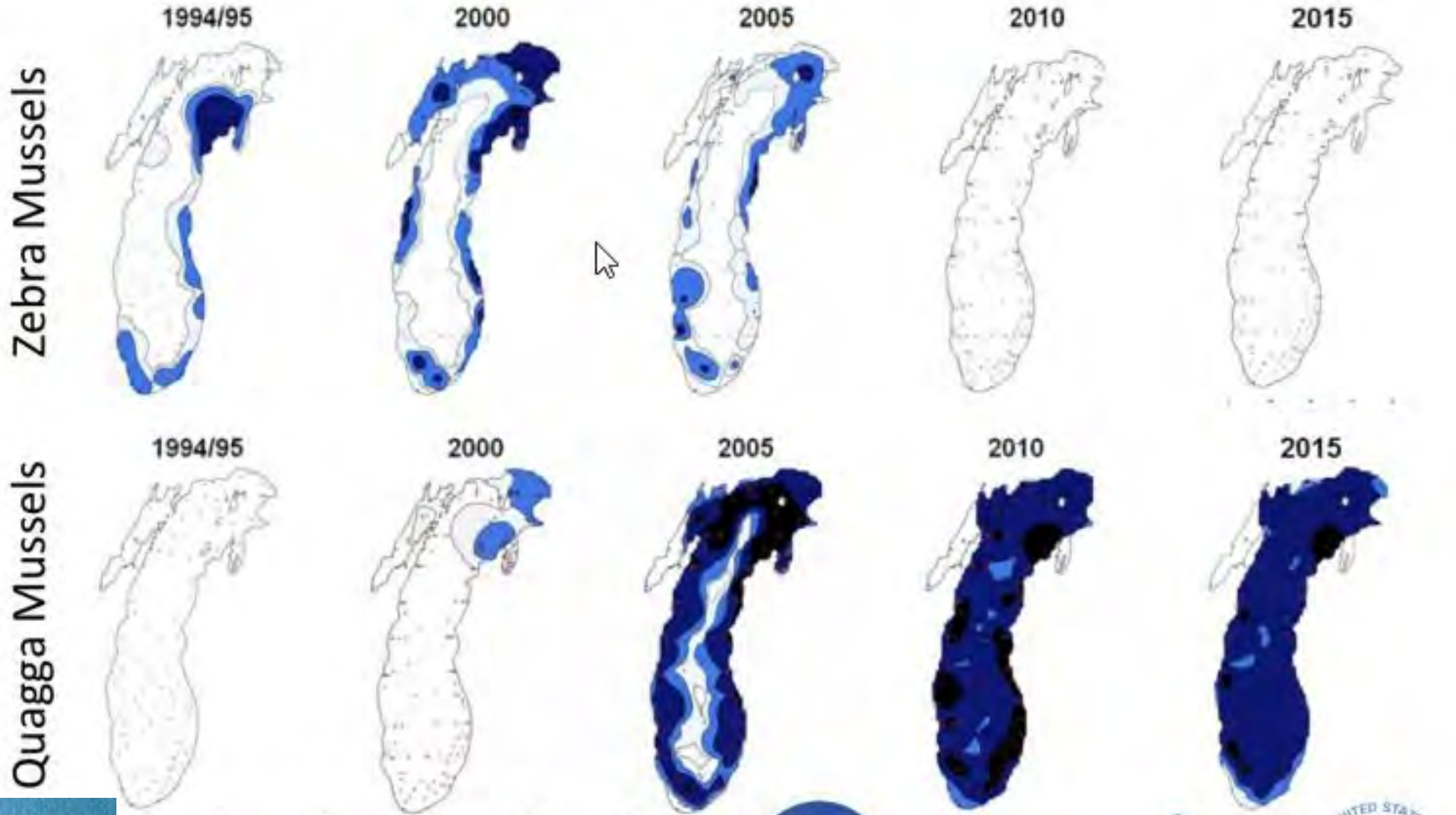
- 1989-2022: Aug-Sept gill net
- 1989-date: Aug-Sept trawl
- 2009-date: Sept, gill net
  - 24 sites per bay
- 1985-2019: On-site creel
  - LBDN- year-round
  - BBDN- Open water



- Small (20’) boat, big water
- Limited personnel (2 from MFRS)

Limited survey effort, big changes

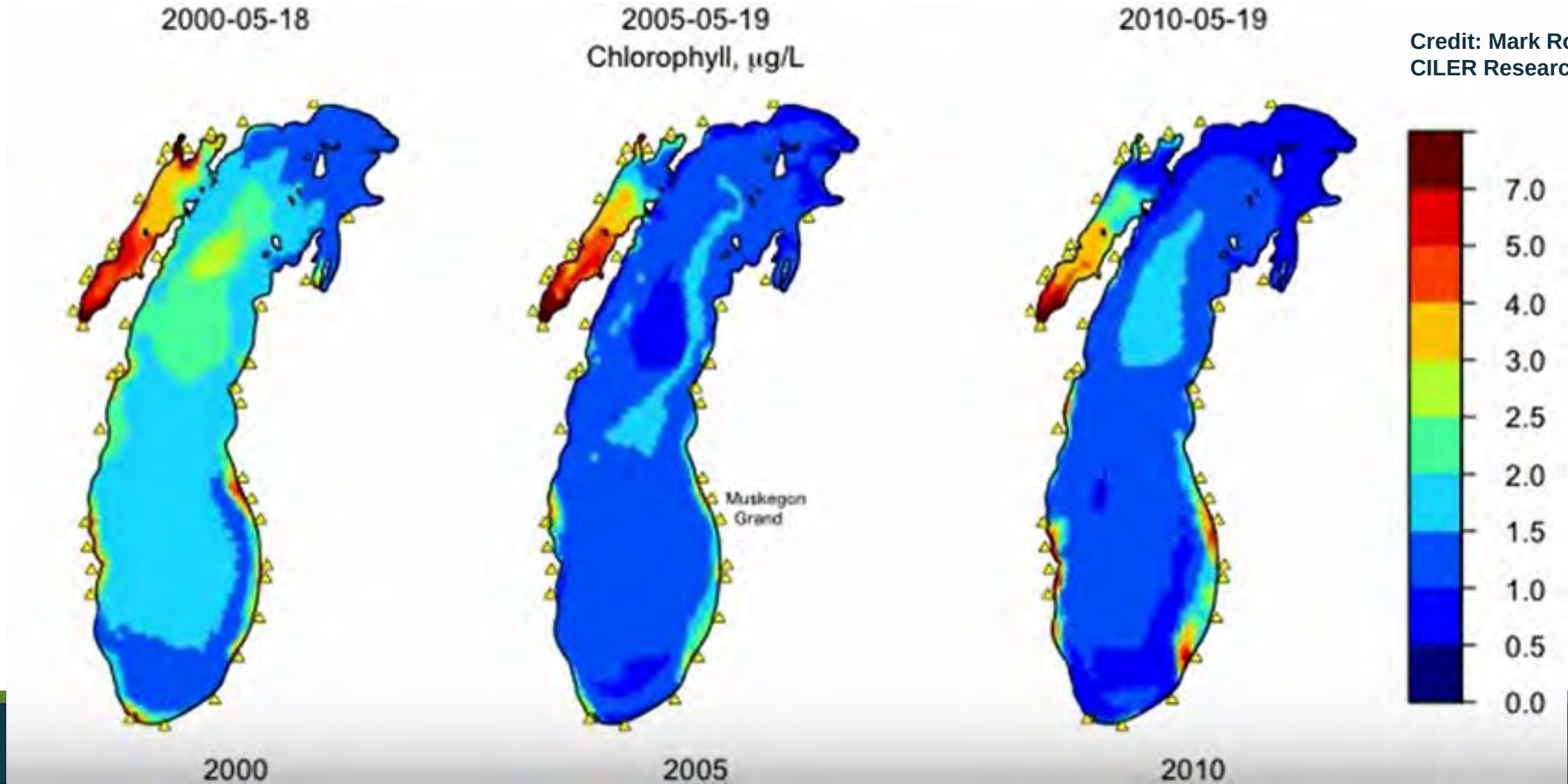
Invasive Mussels in Lake Michigan



Data not available for all locations each year.

Dreissenids alter productivity

Chlorophyll concentrations



Credit: Mark Rowe, U Mich, CILER Research Scientist

Reduced productivity, clearer water

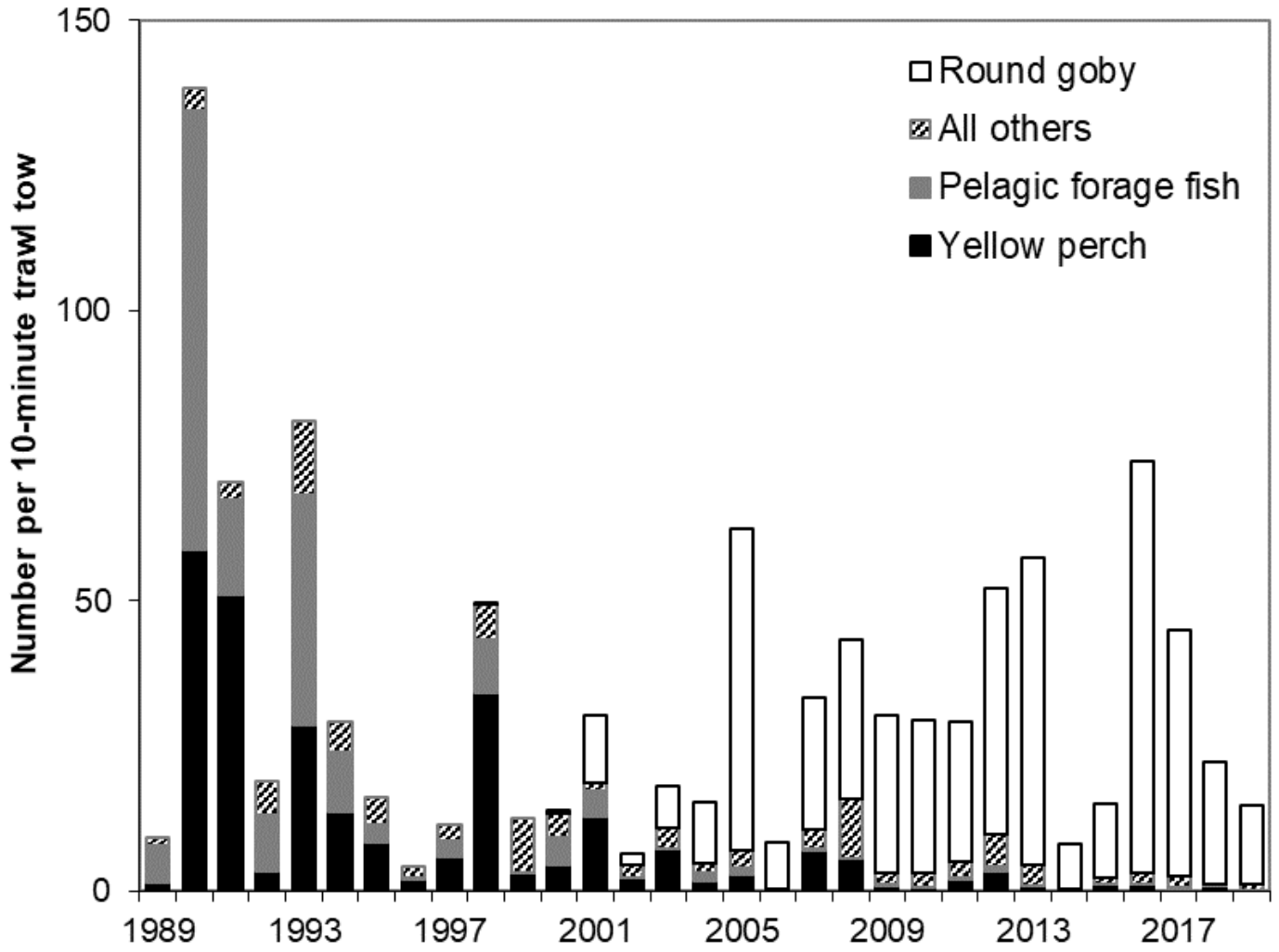
30% increase in clarity during 1989-2019

Secchi disk depth

Changes in LBDN

1989-2019 trawl survey:

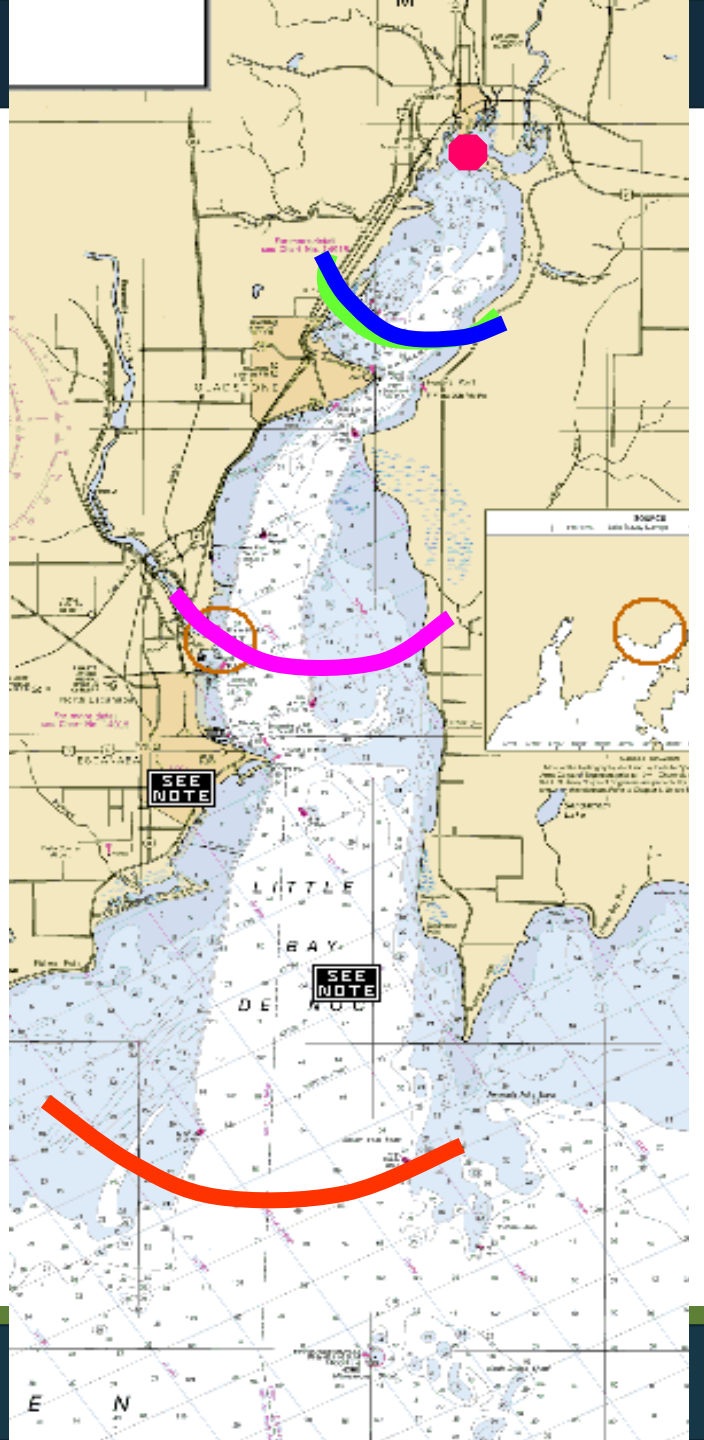
- Declines in yellow perch
- Declines in pelagic forage fish
  - Alewife, smelt, spottail shiner troutperch
- Round goby dominant since 2004



Walleye distribution changes

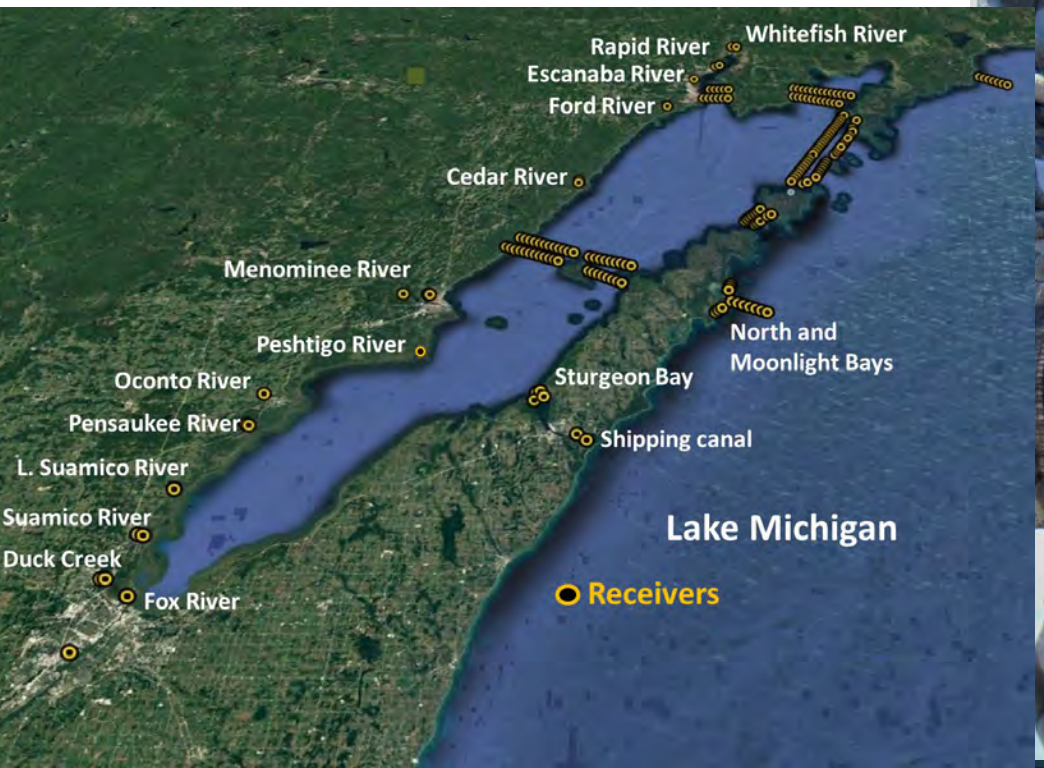
July-September recaptures of LBDN tagged walleyes

- 1988-93
- 1994-99
- 2000-05
- 2006-10

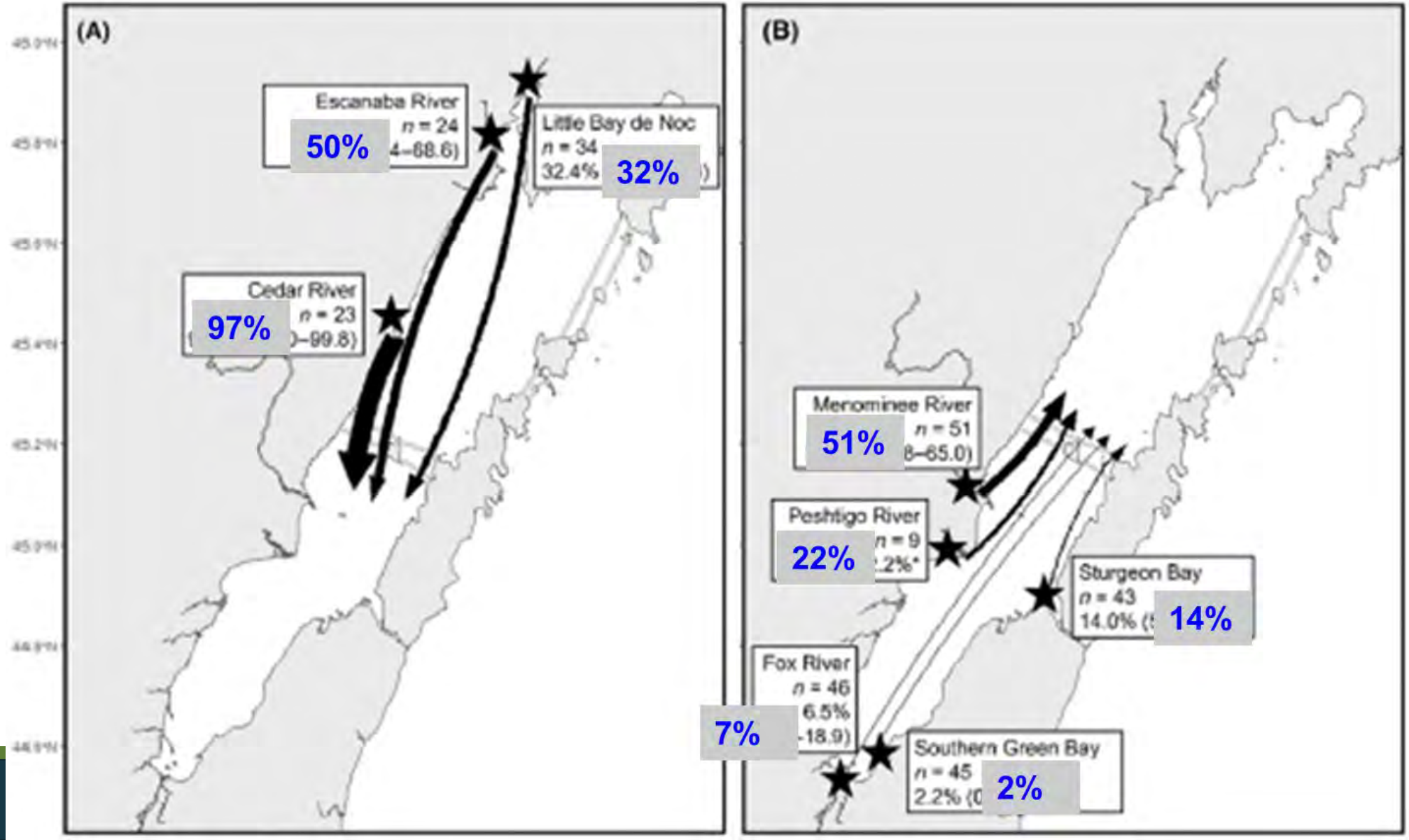


Acoustic telemetry of G B Walleye

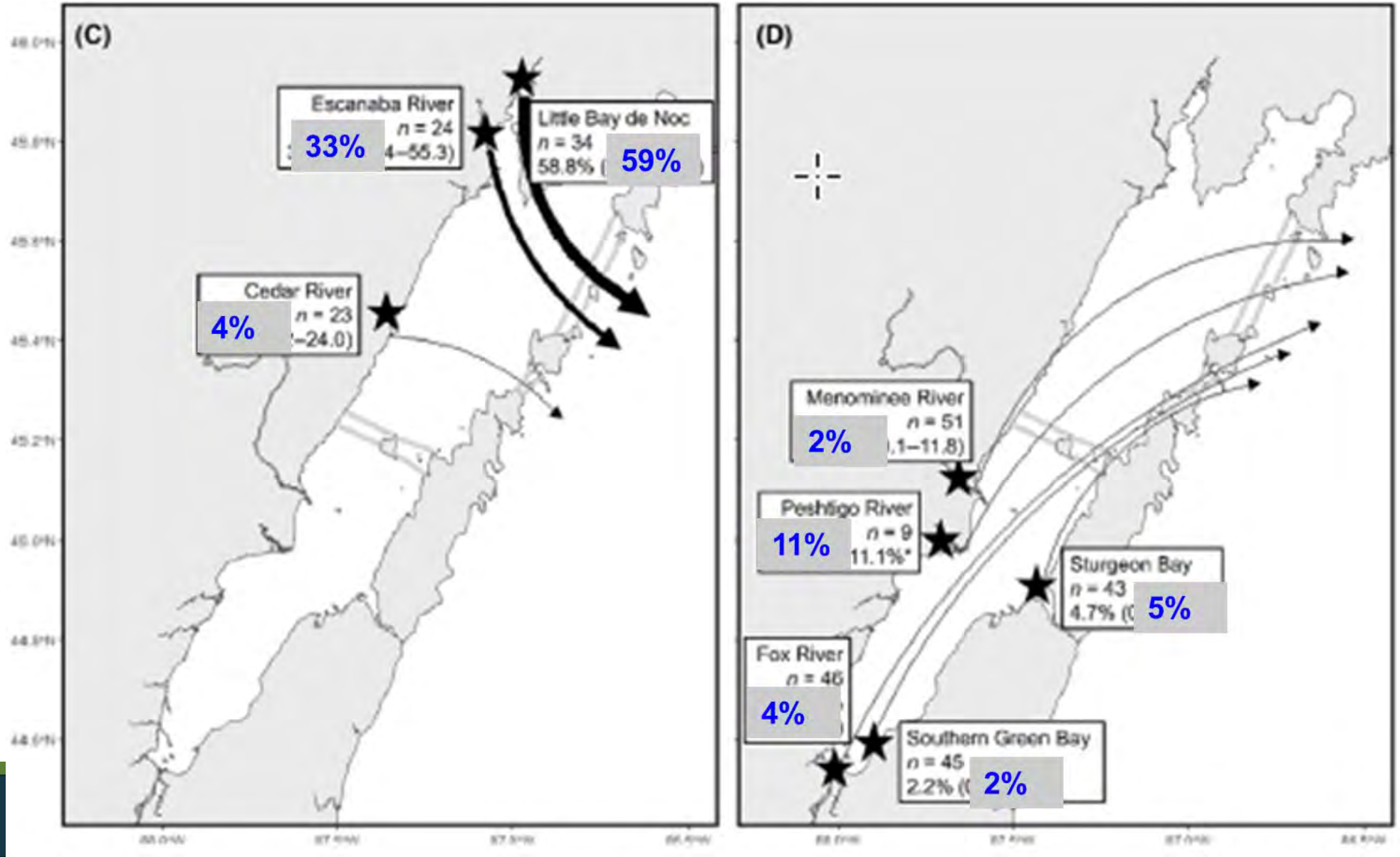
- 339 18+” walleyes tagged in 2017-2018
- 4 years of tracking



% moving to other half of Green Bay



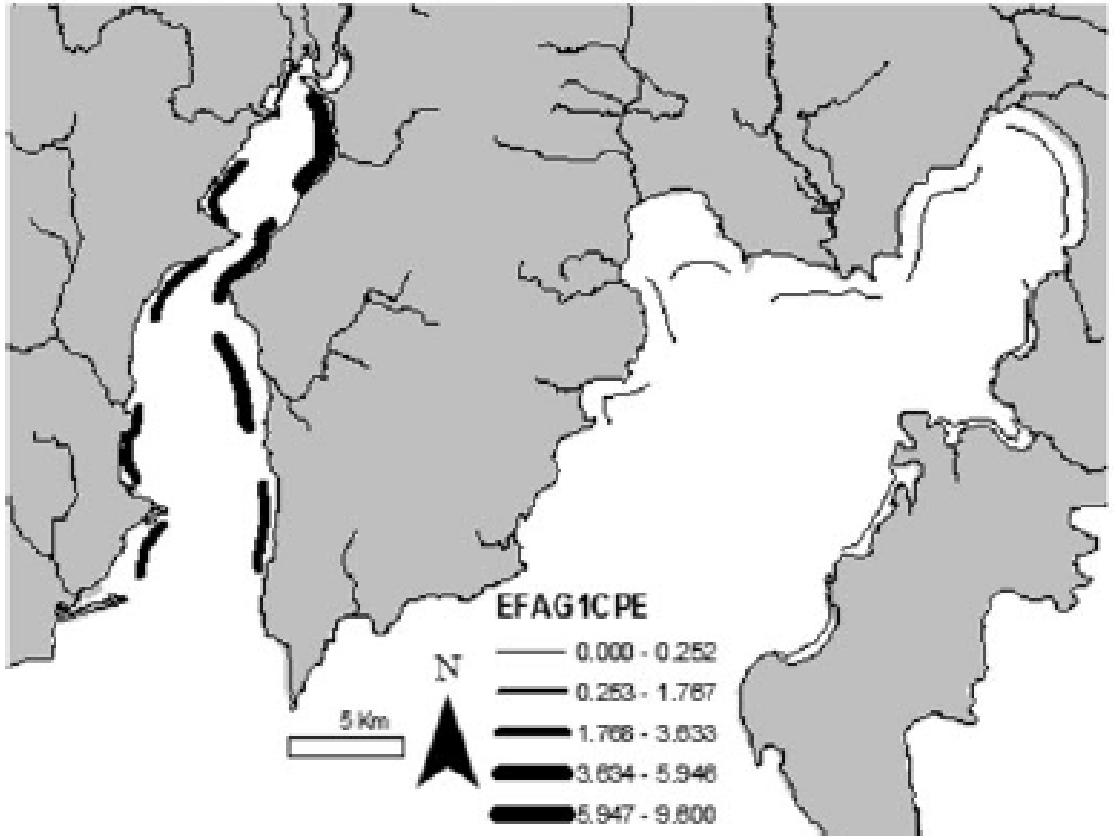
% moving into main basin of Lake Michigan



Assessing walleye stocking contribution

Oxytetracycline (OTC) marking study

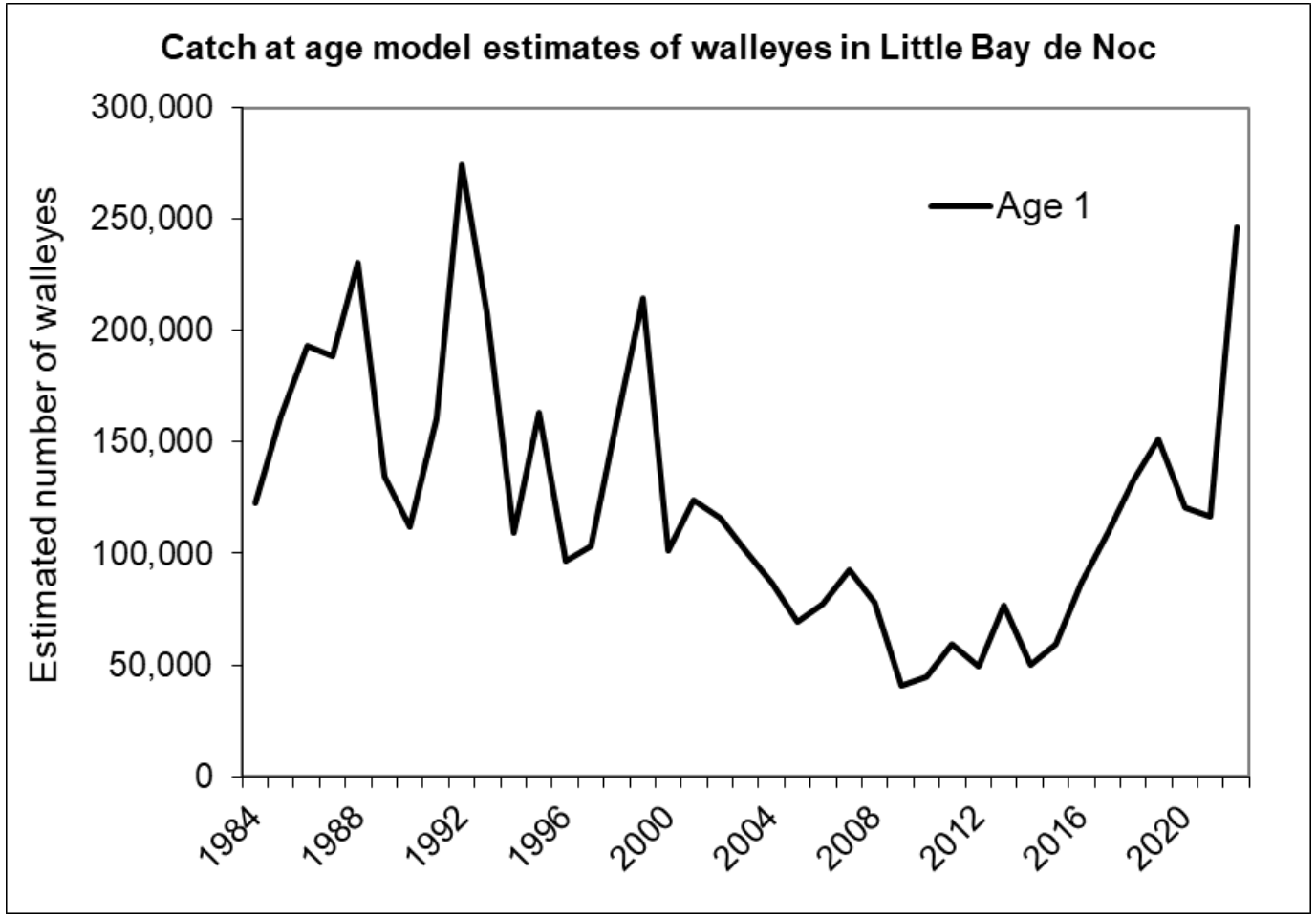
- 2004-9 year classes:
  - LBDN: 76% Natural reproduction
  - BBDN: 62% Natural reproduction
- BBDN: No evidence of stocked walleyes persisting or contributing to sport fishery
- LBDN: Persistence and potential contribution



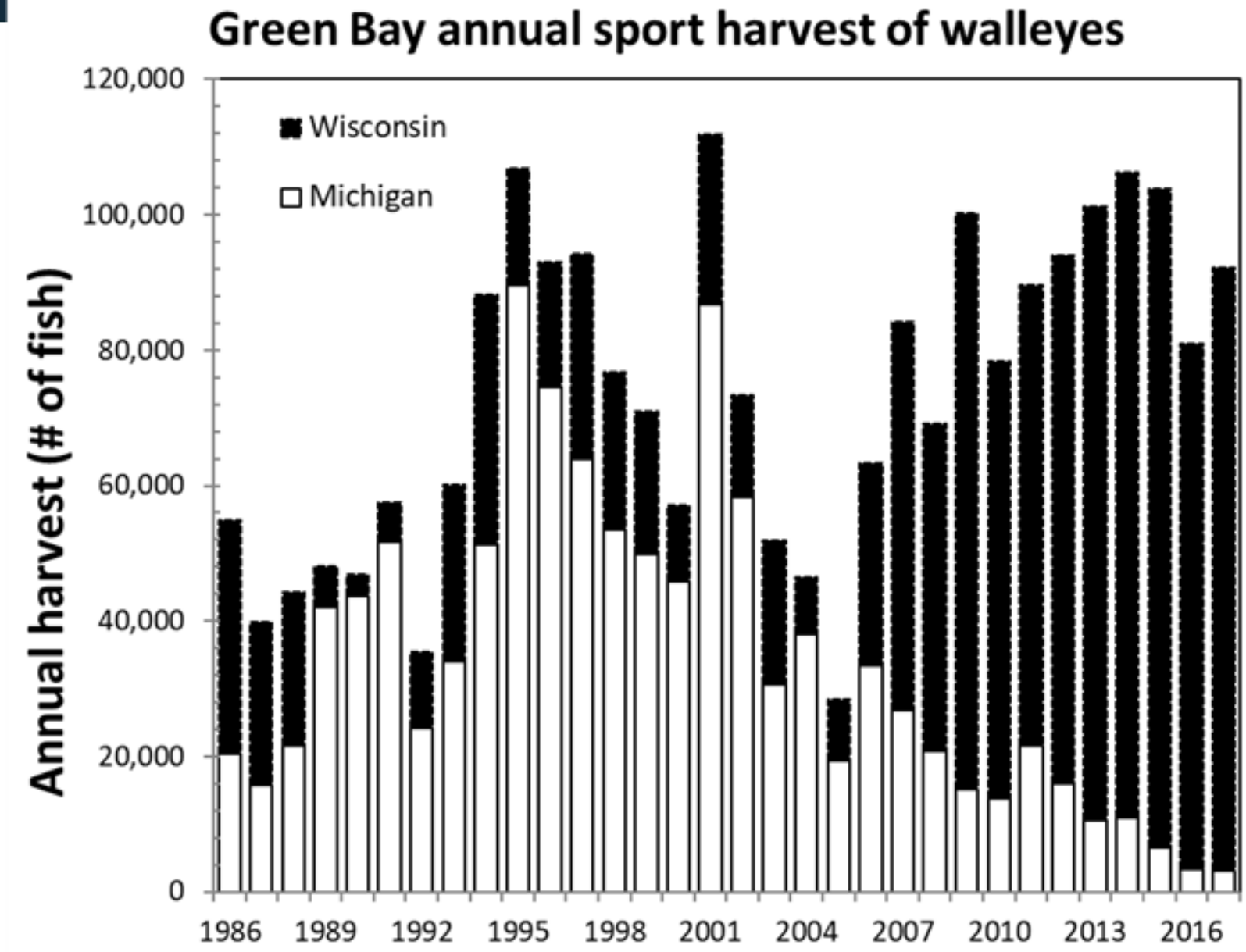
Above: Night electrofishing catch rate of age-1 walleyes

Walleye reproduction and spring zooplankton

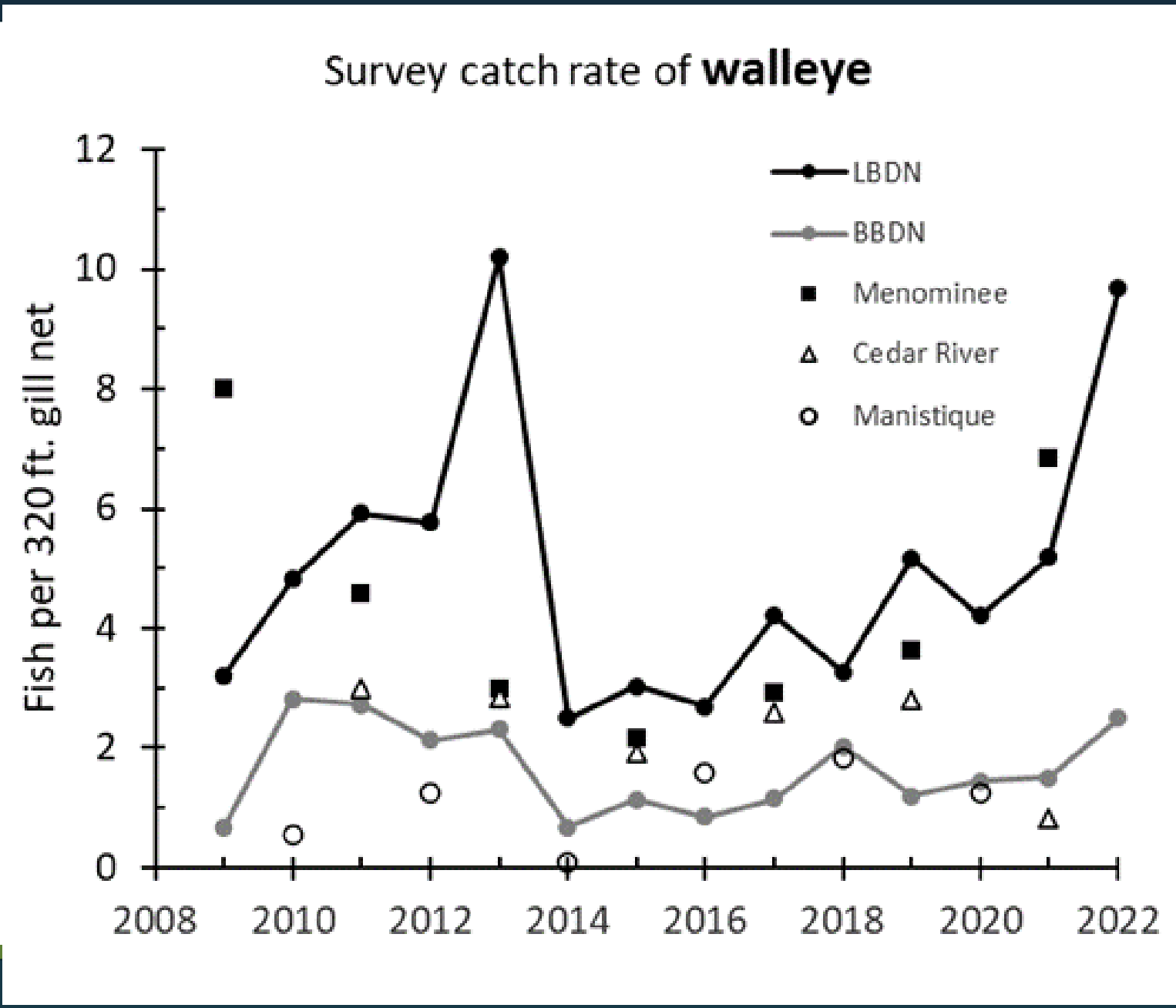
- Lack of strong year classes 2000-2015+ shown in age-1 abundance estimates
- Sampled zooplankton; spring 2014-2016
- Very limited zooplankton densities for walleye larvae



Walleye fishery has flipped

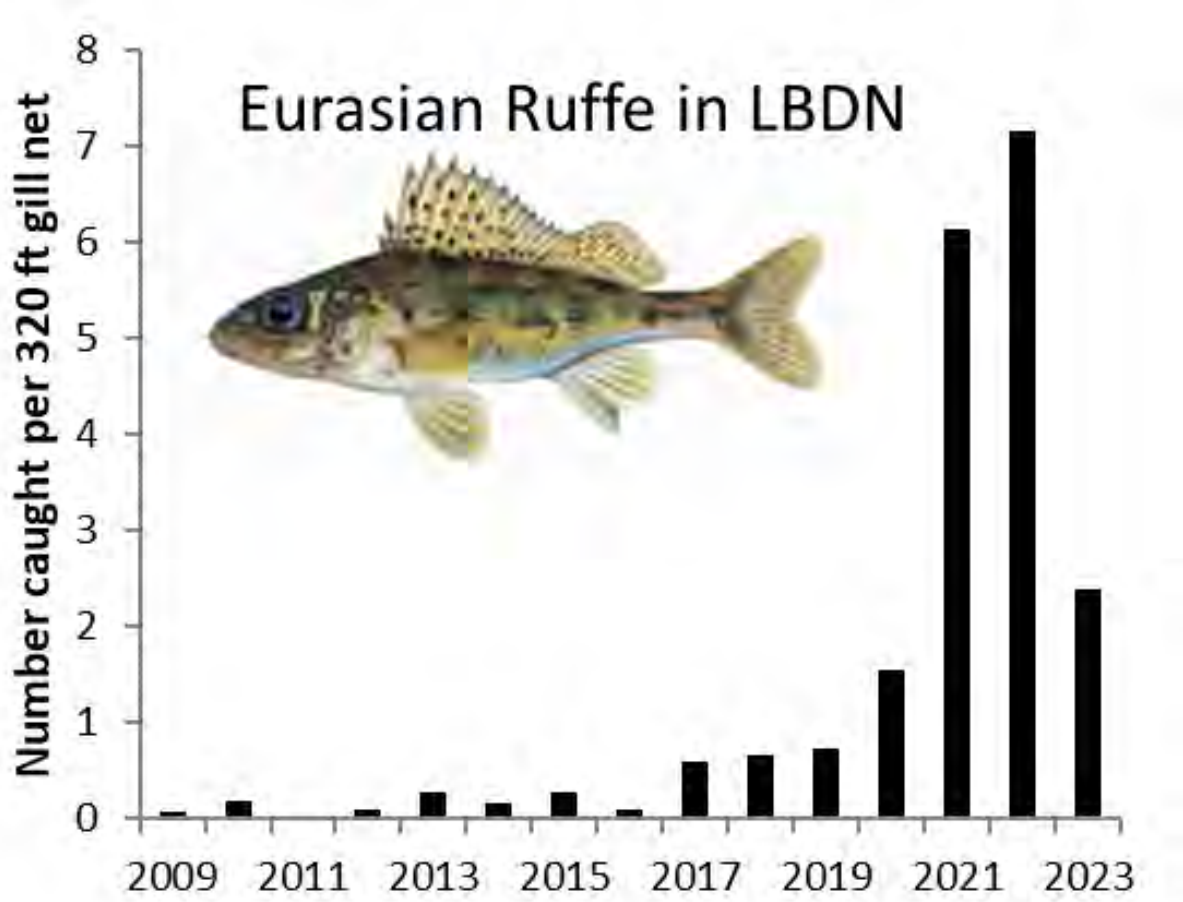


Recent walleye uptick?



Eurasian ruffe

- From northern Europe and Asia
- In LBDN since 2004.
- 3rd most common species in 2022 survey
- Fish > 9” caught in 2022 survey



Findings documented

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

RR2096 September 2011

Habitat and Fish Community Changes in the Michigan Waters of Green Bay 1989–2005

Troy G. Zorn
and
Philip J. Schneeberger

North American Journal of Fisheries Management

Special Section: Effects of Ecosystem Change on North American Percid Populations

Changes in Habitat Conditions, Fish Populations, and the Fishery in Northern Green Bay, Lake Michigan, 1989–2019

Troy G. Zorn ✉, Darren R. Kramer

North American Journal of Fisheries Management

Article | Open Access

Spawning Locations, Movements, and Potential for Stock Mixing of Walleye in Green Bay, Lake Michigan

Lisa K. Izzo ✉, Daniel Dembkowski, Todd Hayden, Tom Binder, Christopher Vandergoot, Steven Hogler, Michael Donofrio, Troy Zorn, Charles C. Krueger, Daniel Isermann

First published: 09 May 2023 | https://doi.org/10.1002/nafm.10883 | Citations: 1

North American Journal of Aquaculture

Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/unaj20

Contribution of Hatchery-Reared Walleyes to Populations in Northern Green Bay, Lake Michigan

Troy G. Zorn[a]

ELSEVIER

Journal of Great Lakes Research
Volume 46, Issue 5, October 2020, Pages 1491-1499

Crustacean zooplankton available for larval walleyes in a Lake Michigan embayment

Troy G. Zorn [a] ✉, Daniel B. Hayes [b] ✉, Darrin E. McCullough [b 1], Nicole M. Watson [b]

STATE OF MICHIGAN
DEPARTMENT OF NATURAL RESOURCES

FR33 September 2021

Assessment of Walleye Spawning Runs in Tributaries to the Upper Great Lakes and Factors Potentially Influencing the Magnitude of Spawning Runs

Troy G. Zorn

Bays de Noc-To Be Continued.....

- Annual Creel Surveys
- Annual Fall Fish Community Surveys (2009-.....)
- Walleye Stocking Efforts
  - Continue Cooperative Partnerships
- Walleye Telemetry Research (river-spawning)

Questions?

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Bats & White-Nose Syndrome Status in Michigan

John DePue, Bat/ HCP Specialist
NRC meeting October 10, 2024

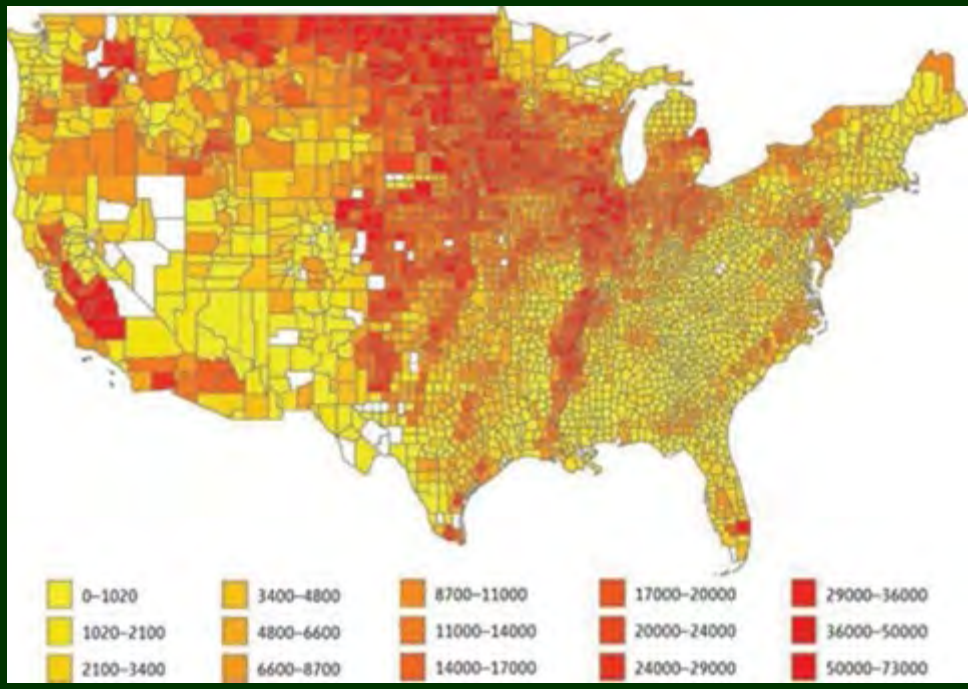
Bats of Michigan

- Nine species, all insectivores
  - Primary nocturnal insect predator
- Two federally endangered bat species:
  - Indiana Bat
  - Northern long-eared bat

  *tri-colored bats listing decision due this fall
- All have legal protection in MI
- Long lived, BBB 30+ years in wild

Why Should We Care About Bats?

- Economic Importance
  - Pest control benefits $3.7 – $53 billion / year nationally
  - **Michigan agriculture $528 million to $1.2 billion annually (2011)**
    - **~$74 per farmed acre**
  - Increase in insecticide use increased infant mortality, F.G. Eyal. Science 385, eadog0344 (2024).

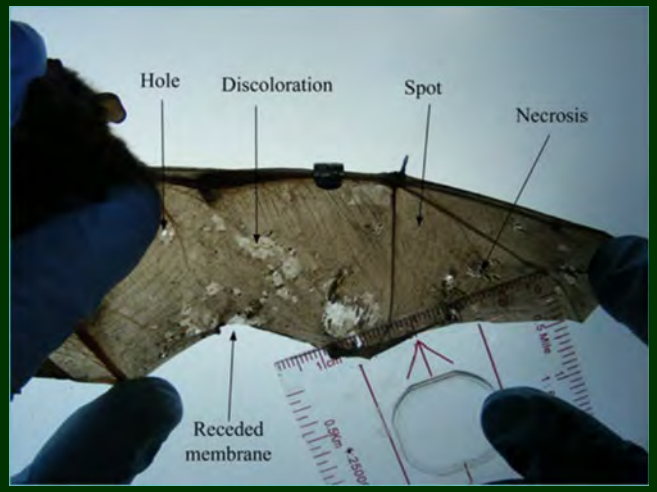


J G Boyles et al. Science 2011;332:41-42

Science
AAAS

What is WNS

- Disease caused by a fungus
- *Pseudogymnoascus destructans (Pd)*
- Causes energy depletion
- Impacts whole suite of cave bat species; little brown, northern long-eared, tri-colored, and big brown bats

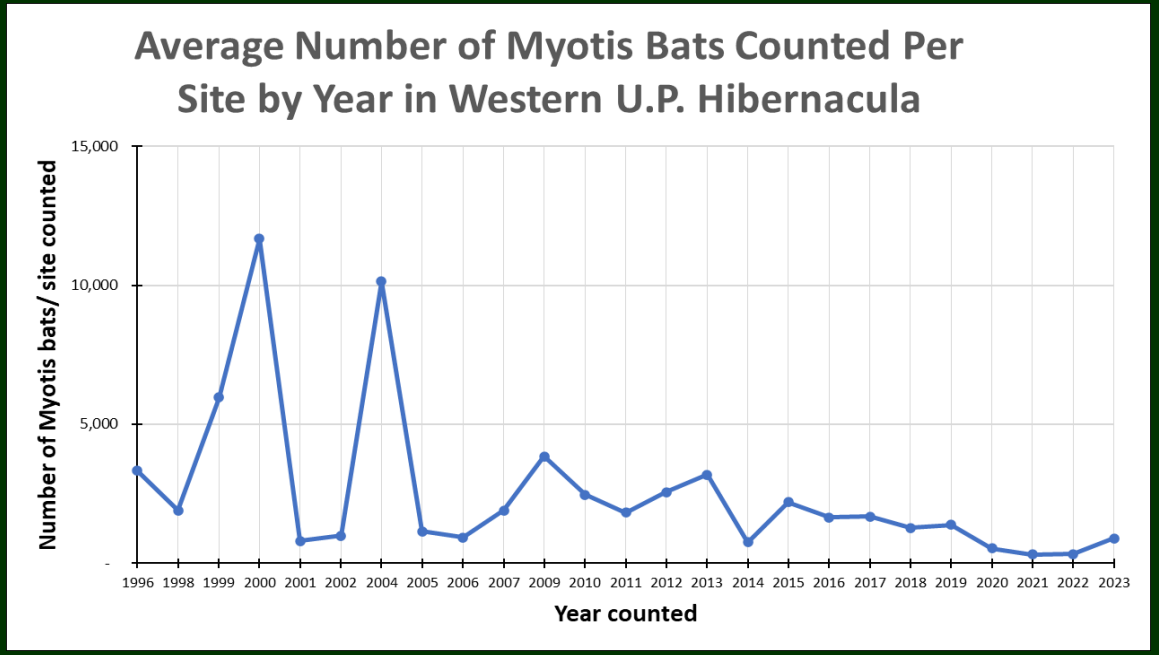


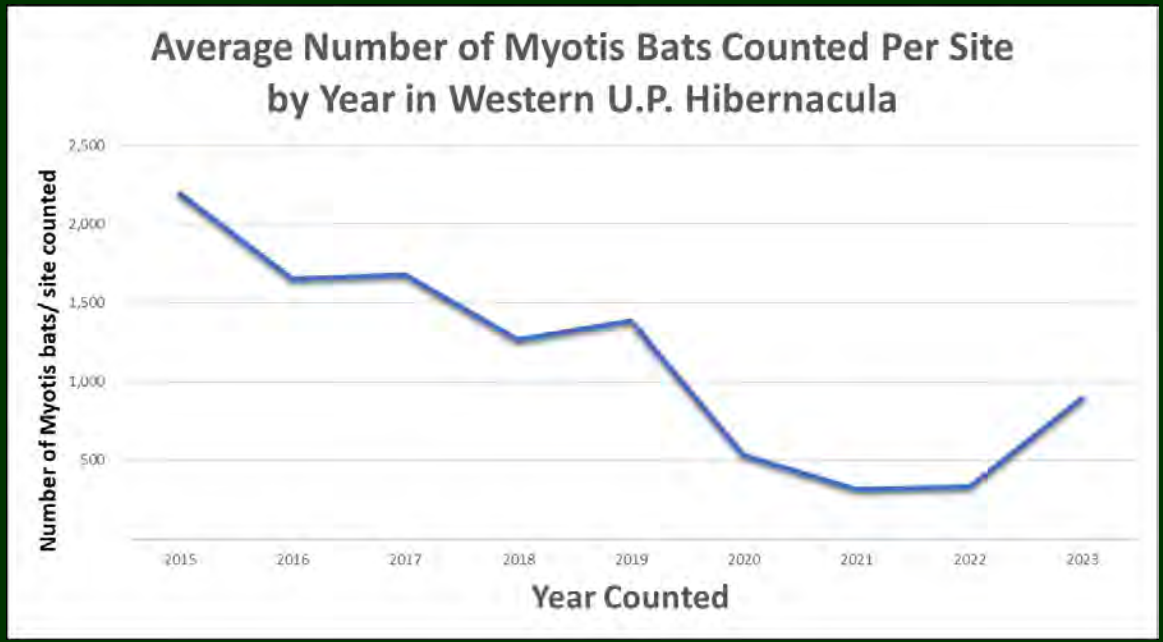
WNS in Michigan

- Michigan in 11th year of infection
- All hibernacula have presence of WNS

WNS Impacts in Michigan

- Survey data indicate 89% decline of the sites surveyed post-WNS infection
- Colder hibernacula continue to have higher survival





MI DNR Bat Conservation Actions

- Statewide bat monitoring
  - Disease
  - Population
- Protect critical hibernacula
- WNS treatment trials
- Outreach/ education
- Bat Habitat Conservation Plan (HCP)

Hibernaculum Climate Manipulation

- Reduce internal temperatures to 36-38 degrees F

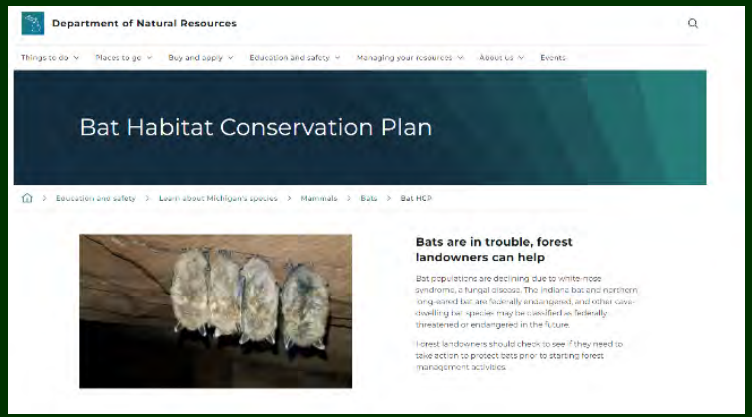
If We Warm It, Will They Come?

Lake States HCP

- Covers; Indiana, northern long-eared, tri-colored, little brown bats
- Necessary to obtain incidental take permit
- Allows for continued forestry management practices while providing habitat conservation for federally listed species

Lake States HCP Status

- HCP approved in March 2023
- Committed bat conservation measures
  - within-stand retention
  - Bat surveys and WNS mitigation
- Accepting applications from private landowners into the Landowner Enrollment Program



Thank You