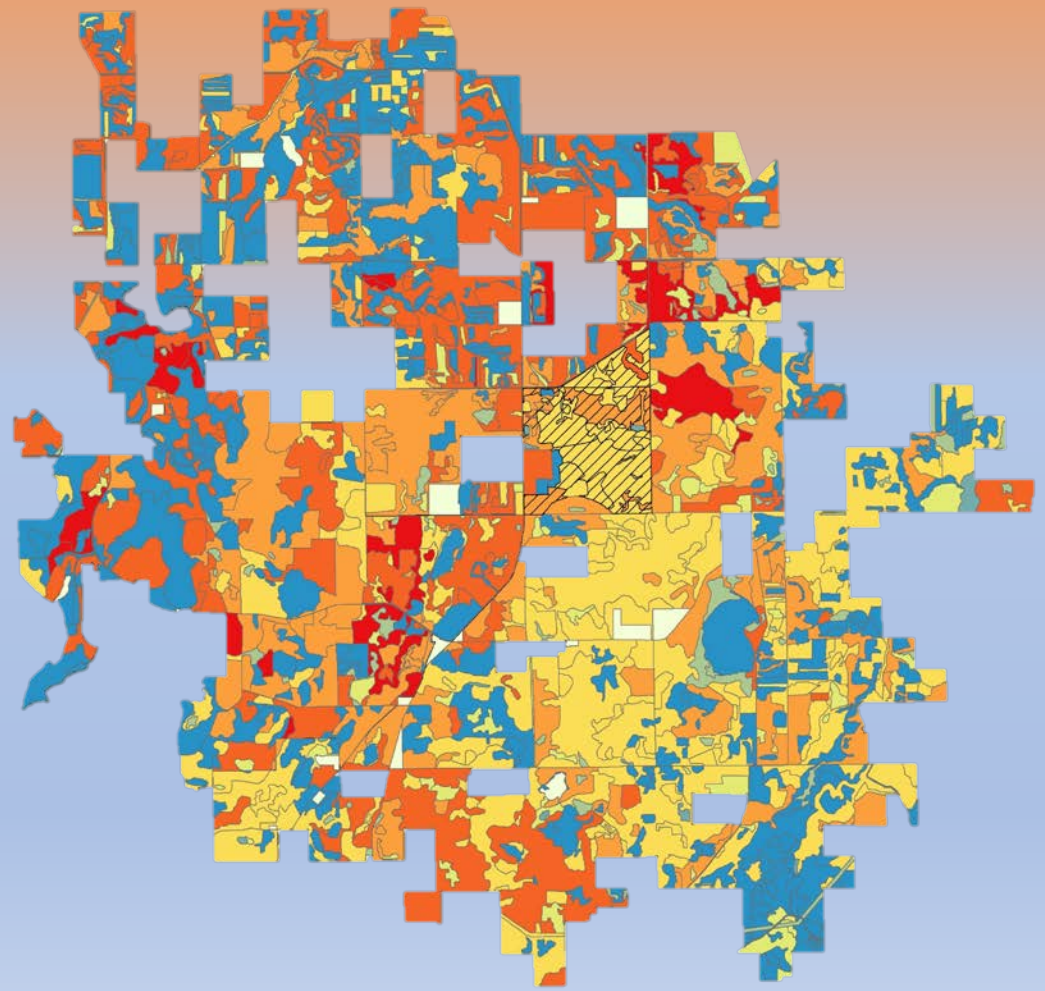
Prescribed Fire Needs Assessment for State Lands in Southern Michigan



Joshua Cohen, Clay Wilton, and Helen Enander
Michigan Natural Features Inventory
MSU Extension
DNR WLD Sponsors: Mark Sargent,
Chris Hoving, and Mark Monroe
Wildlife Division Management Team Meeting
February 20, 2019
Lansing, Michigan

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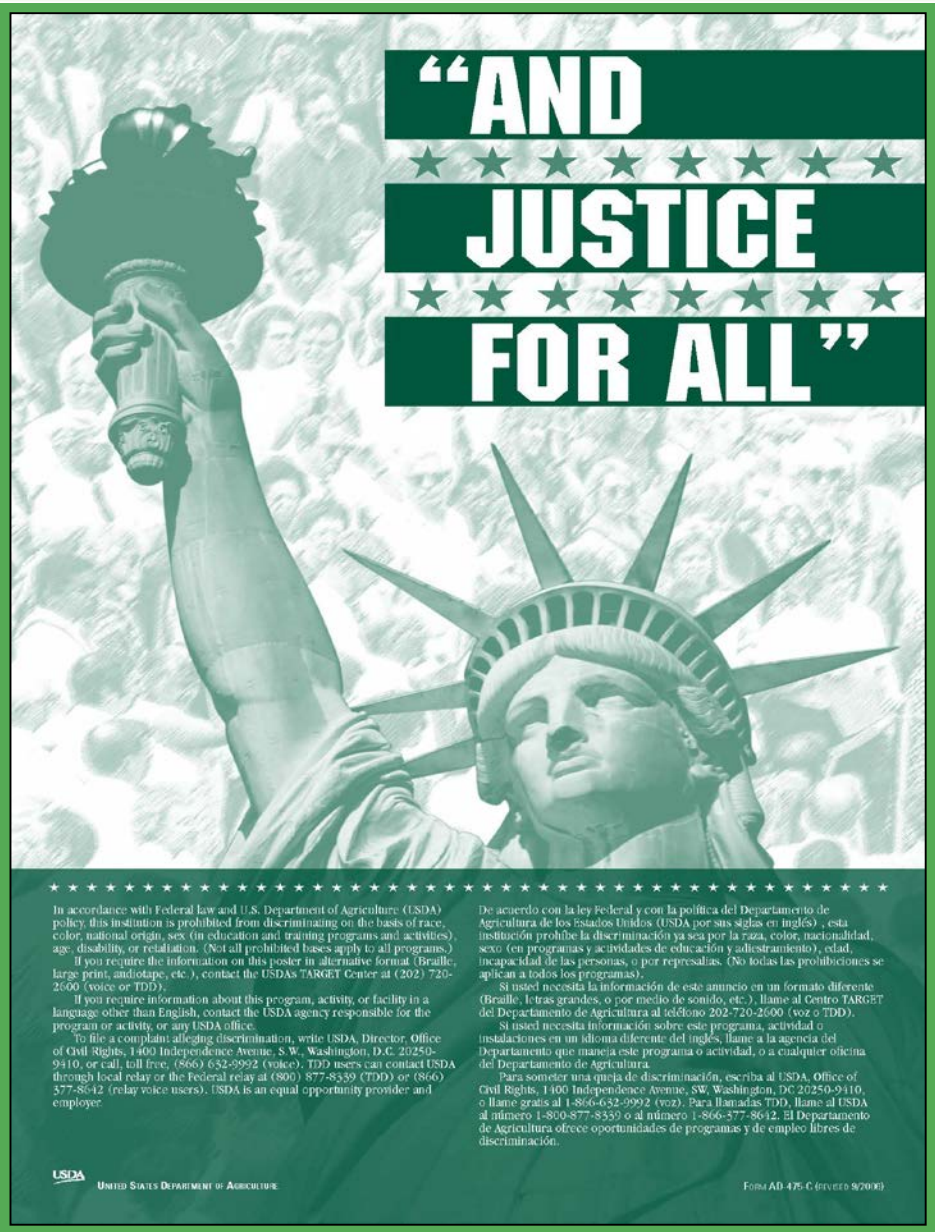
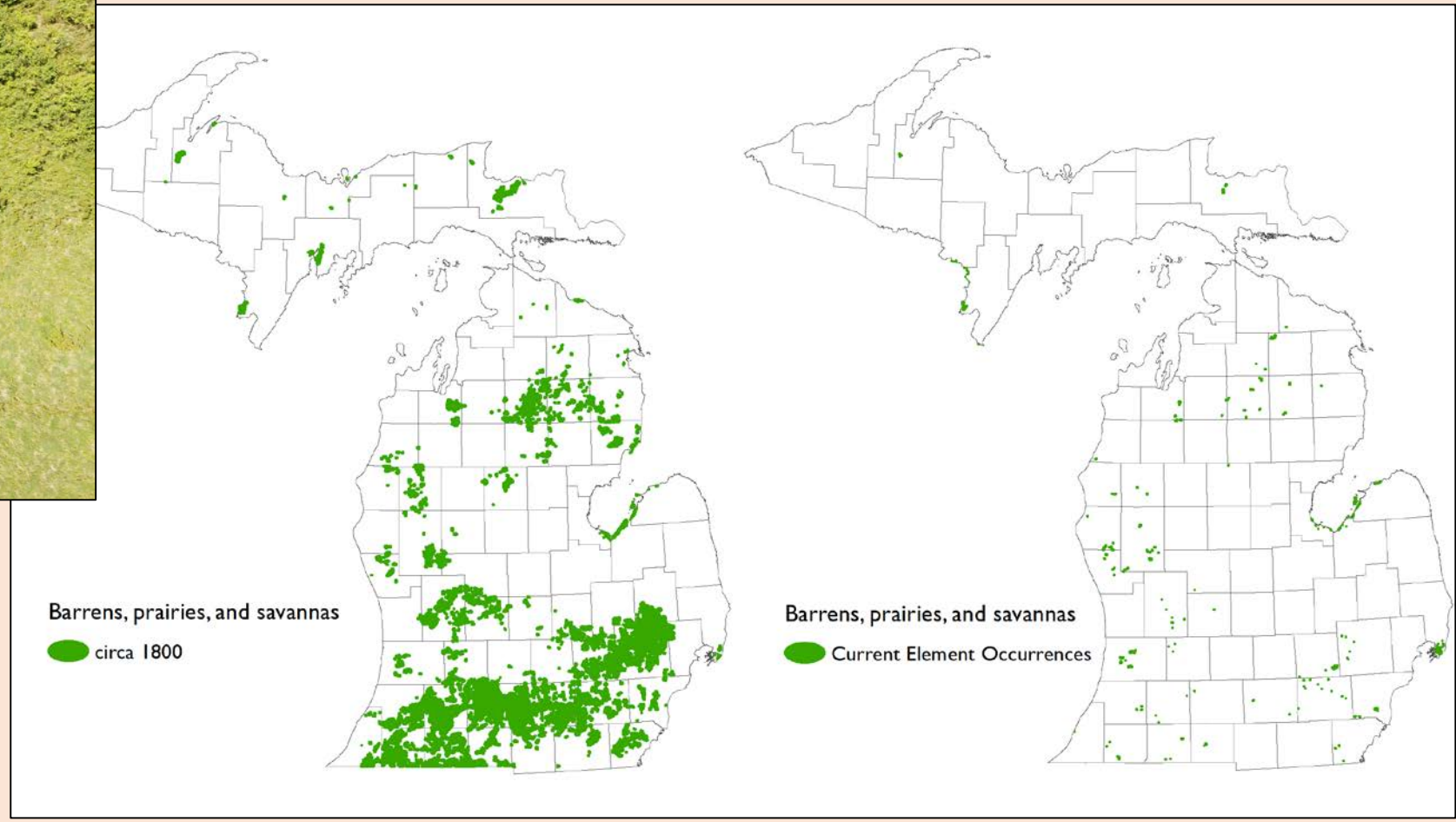


The Need for Rx Fire



The Need for Rx Fire

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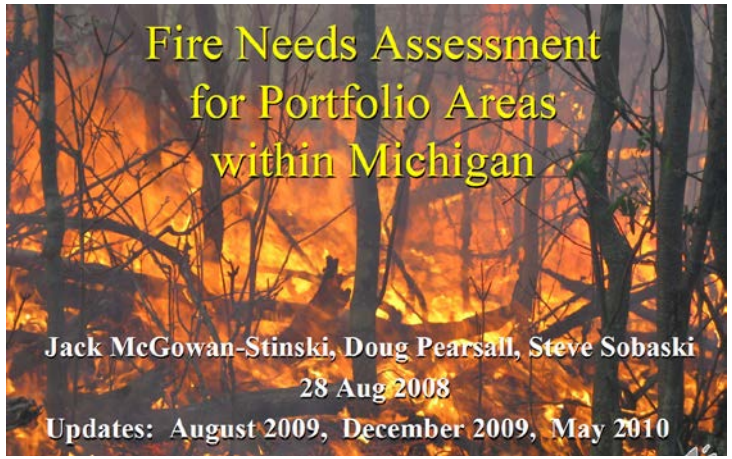
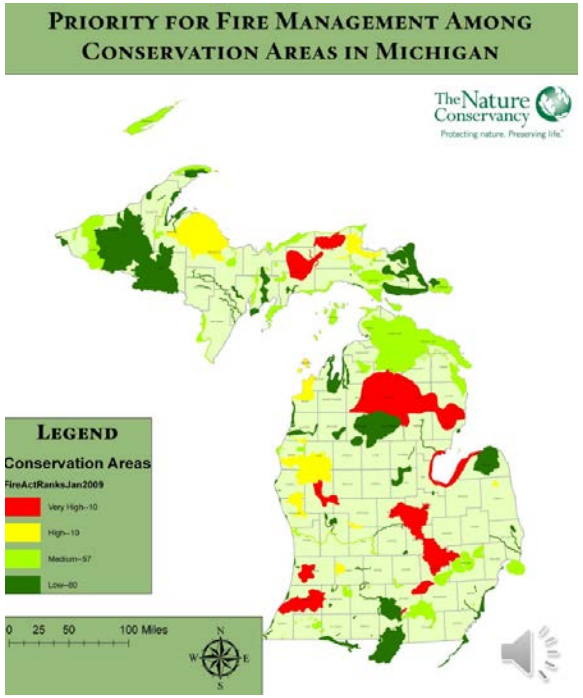




Prior Assessments: Where and How Much?

Introduction

- DNR WLD invests substantial resources into prescribed burn plans.
- No way to systematically evaluate ecological condition of all stands.
- Prescribed burns need to be informed by best available ecological information.
- Objective is to develop a tool to assess ecological need of prescribed fire for WLD managed lands in Southern Michigan at multiple scales.
- Facilitate implementation of prescribed fire in the ecologically most important areas.

The Approach

1. Review the literature on fire frequency and return intervals for southern Michigan's ecosystems and key species.

2. Classify stands by natural community type and scale of fire dependence.

3. Assign a fire frequency range to each stand (>18,650 stands).

4. Evaluate each stand's need for prescribed fire based on an array of spatial variables and the presence of fire-dependent and fire-sensitive species.

5. Develop data files and maps at the stand-level attributed with the above ecological information.

6. Calculate a "Fire Need Score" for each stand.

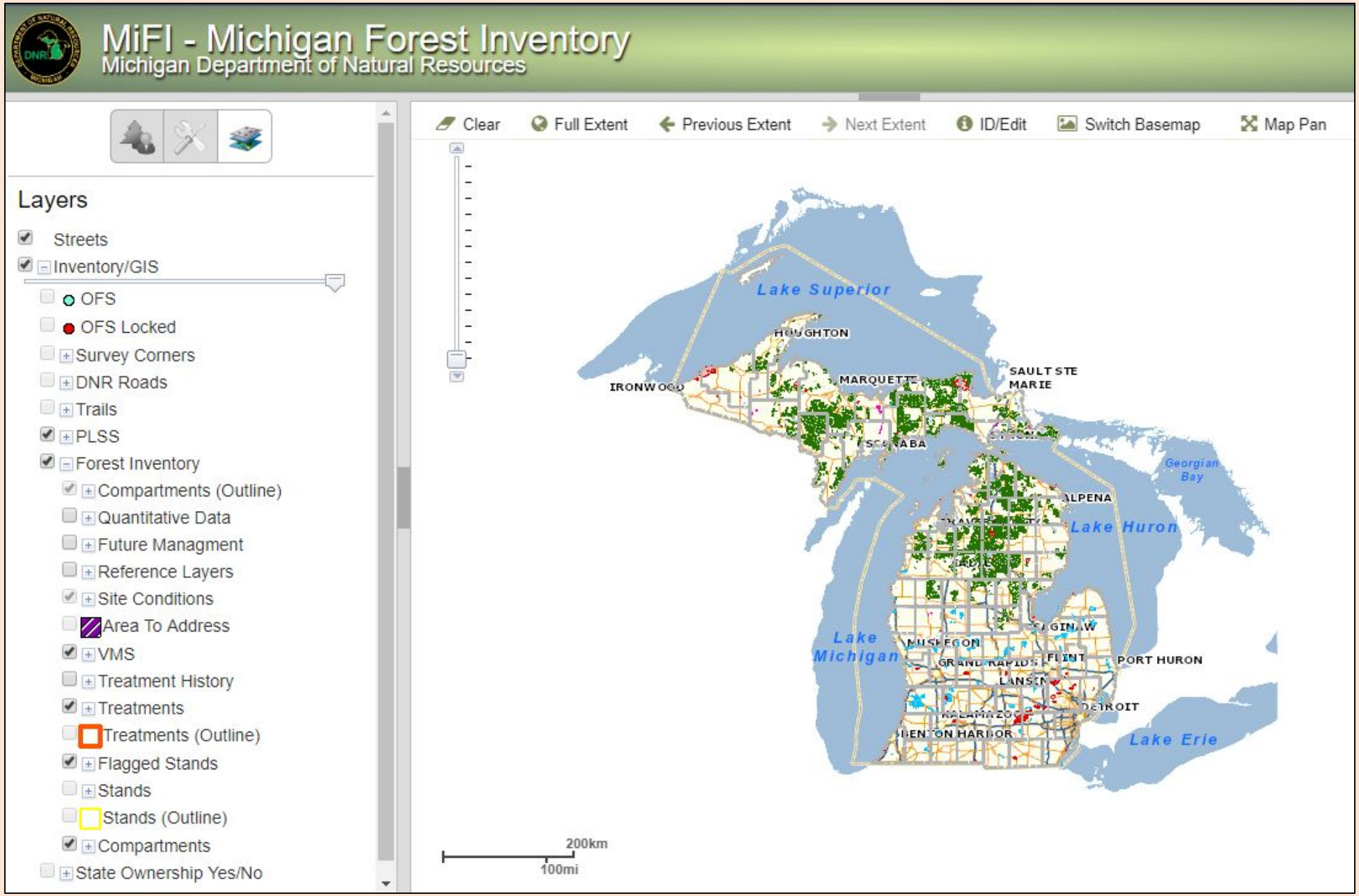
Keep in mind…

Evaluation of fire need is complicated.

Like all models, it's not perfect.

Still a work in progress.

The Data Source



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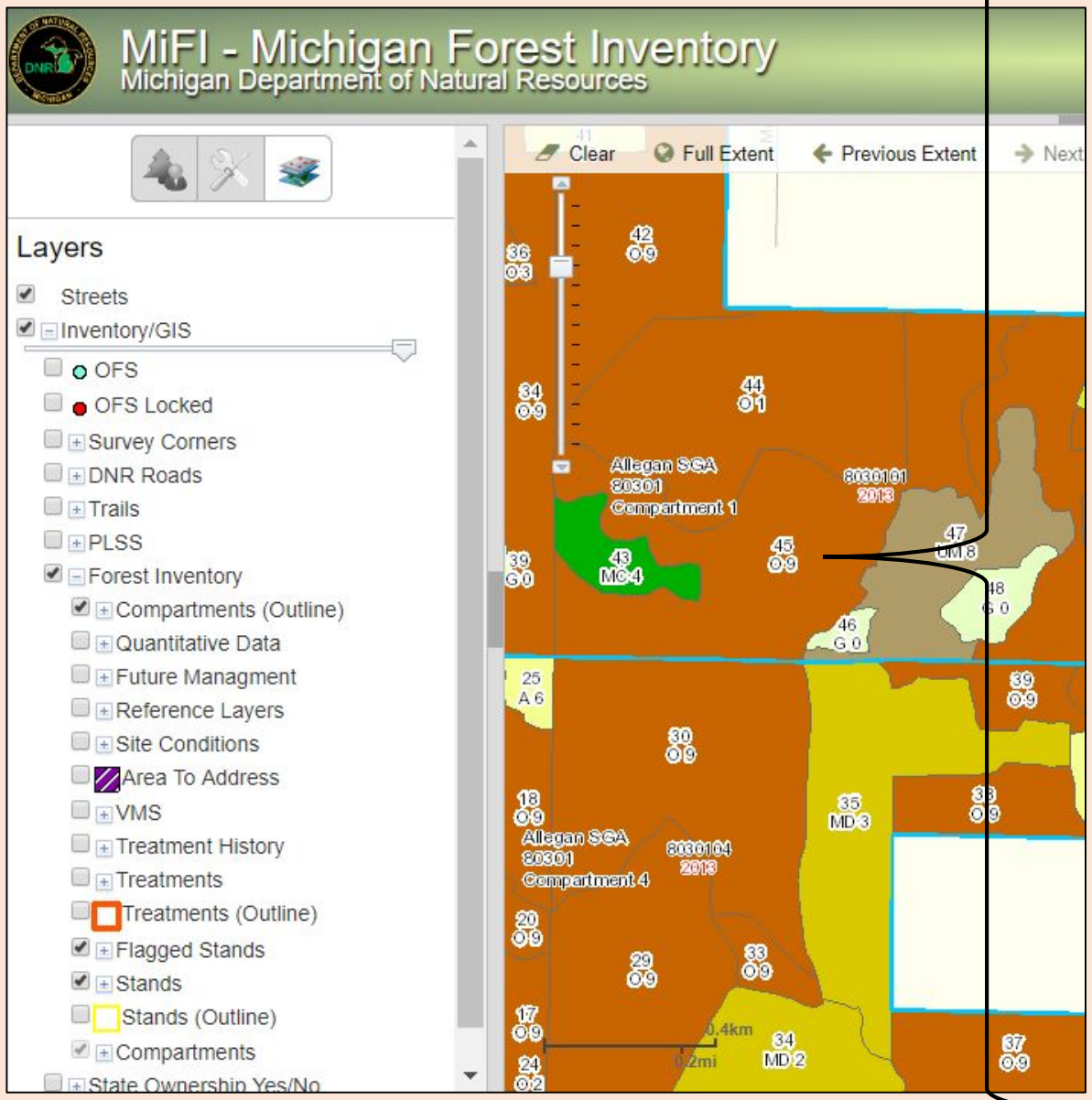


Cover Type	Survey Date	Examiner
O 9 4126 - White, Black, N. Pin Oak	03/24/2011	Unspecified

Overall Size	Planted/Natural	BA range	Structure
Log	Natural	81-110	Even-Aged

Dominant Age	Dominant Age Source
105	Current

UpLow	Silv Criteria Met	Flag
Upland	Yes	

Canopy

0 % Remaining ☑ Common ☐ Scientific

Code	Common Name	%	DBH	Size	Age
13	Black/Red (Hybrid) Oak	50	16	Log/Pole	105
9	White Oak	48	14	Log/Pole	
30	White Pine	2	12	Log/Pole	

Page 1 of 1 View 1 - 3 of 3

Sub-Canopy

☑ Common ☐ Scientific

Code	Common Name	Density	Size	Avg Height	Age
9	White Oak	Medium	Sapling	Variable	
13	Black/Red (Hybrid) Oak	Medium	Sapling	Variable	
30	White Pine	Medium	Sapling	Variable	
49	Black Cherry	Medium	Sapling	Variable	
490	Dogwood (spp.)	Low	Shrub	Variable	
931	Sassafras	Low	Sapling	Variable	

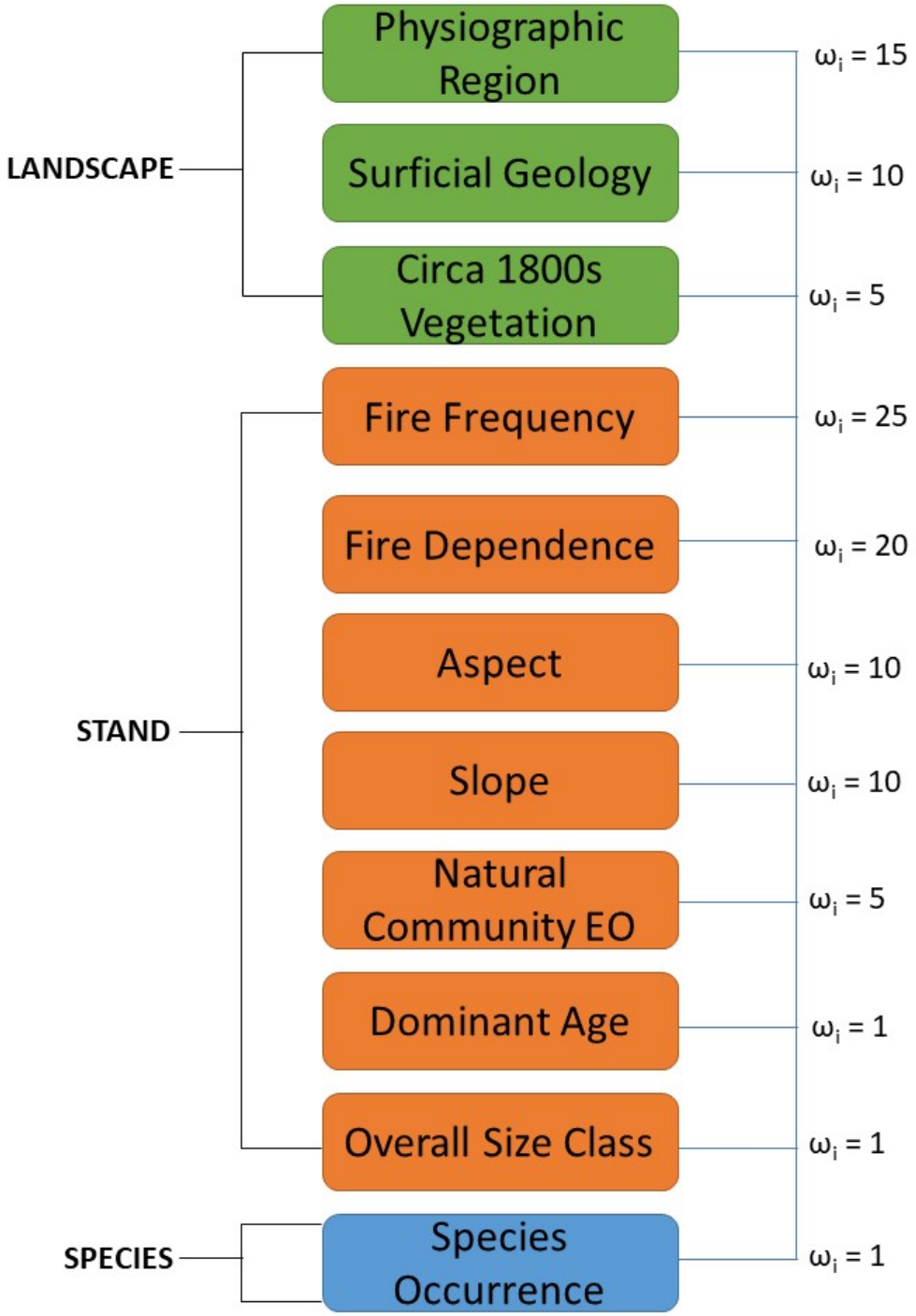
Page 1 of 1 View 1 - 6 of 6

Crosswalks & Assigning Fire Frequency Range

	A	B	C	D
1	**L4CoverType**	**NATURAL COMMUNITY TYPE**	**Scale of Fire Dependence**	**Fire Frequency Range**
2	110 - Low Intensity Urban	110 - Low Intensity Urban	Not Applicable	Not Applicable
3	122 - Road/Parking Lot	122 - Road/Parking Lot	Not Applicable	Not Applicable
4	31022 - Warm Season Grass	31022 - Warm Season Grass	Very Fire Dependent	Not Applicable?
5	31022 - Warm Season Grass	Dry Sand Prairie	Very Fire Dependent	1-10 Years
6	31022 - Warm Season Grass	Dry-Mesic Prairie	Extremely Fire Dependent	1-5 Years
7	3202 - Autumn Olive/Honeysuckle	3202 - Autumn Olive/Honeysuckle	Very Fire Sensitive	Not Applicable
8	3202 - Autumn Olive/Honeysuckle	Dry Sand Prairie	Very Fire Dependent	1-10 Years
9	330 - Low-Density Trees	Oak Barrens	Very Fire Dependent	5-20 Years
10	330 - Low-Density Trees	Oak-Pine Barrens	Very Fire Dependent	5-20 Years
11	4112 - Maple, Beech, Cherry Associa	Mesic Southern Forest	Extremely Fire Sensitive	>1000 Years
12	412 - Oak Types	Dry-Mesic Northern Forest	Fire Dependent	10-20 Years
13	412 - Oak Types	Dry-Mesic Southern Forest	Fire Dependent	10-20 Years
14	412 - Oak Types	Oak-Pine Barrens	Very Fire Dependent	5-20 Years
15	4120 - Oak, Hickory	Dry Southern Forest	Very Fire Dependent	10-20 Years
16	4120 - Oak, Hickory	Dry Southern Forest/Oak Barrens	Very Fire Dependent	10-20 Years
17	6113 - Lowland Maple	Floodplain Forest	Fire Neutral	500-1000 Years
18	6113 - Lowland Maple	Hardwood-Conifer Swamp	Fire Sensitive	100-200 Years
19	6221 - Fen	Northern Fen	Fire Neutral	200-500 Years
20	6221 - Fen	Poor Fen	Fire Dependent	100-200 Years
21	6221 - Fen	Prairie Fen	Very Fire Dependent	20-100 Years
22	623 - Emergent Wetland	Wet-Mesic Prairie	Very Fire Dependent	1-10 Years
23	6230 - Cattail	Bog	Fire Sensitive	200-500 Years
24	6230 - Cattail	Emergent Marsh	Fire Neutral	500-1000 Years
25	6230 - Cattail	Emergent Marsh (narrow-leaved cat-tail)	Fire Neutral	500-1000 Years
26				

The Model

$$\textbf{\textit{Fire Need}}_i = 15p_i + 10g_i + 5v_i + 25f_i + 20d_i + 10a_i + 10s_i + \ldots$$



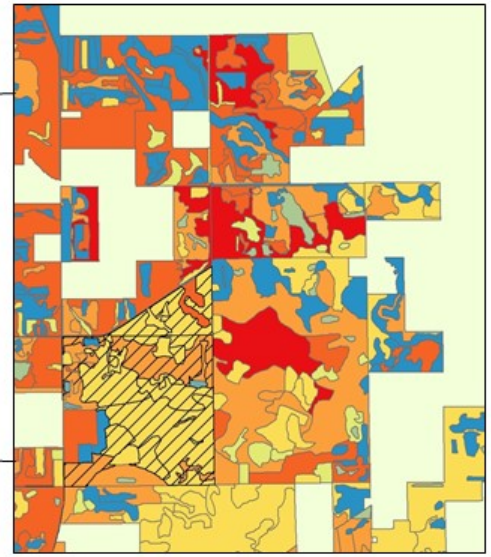
X

Fire Needs Score:
0 = None
1 = Low
2 = Moderate
3 = High
4 = Very High
5 = Highest

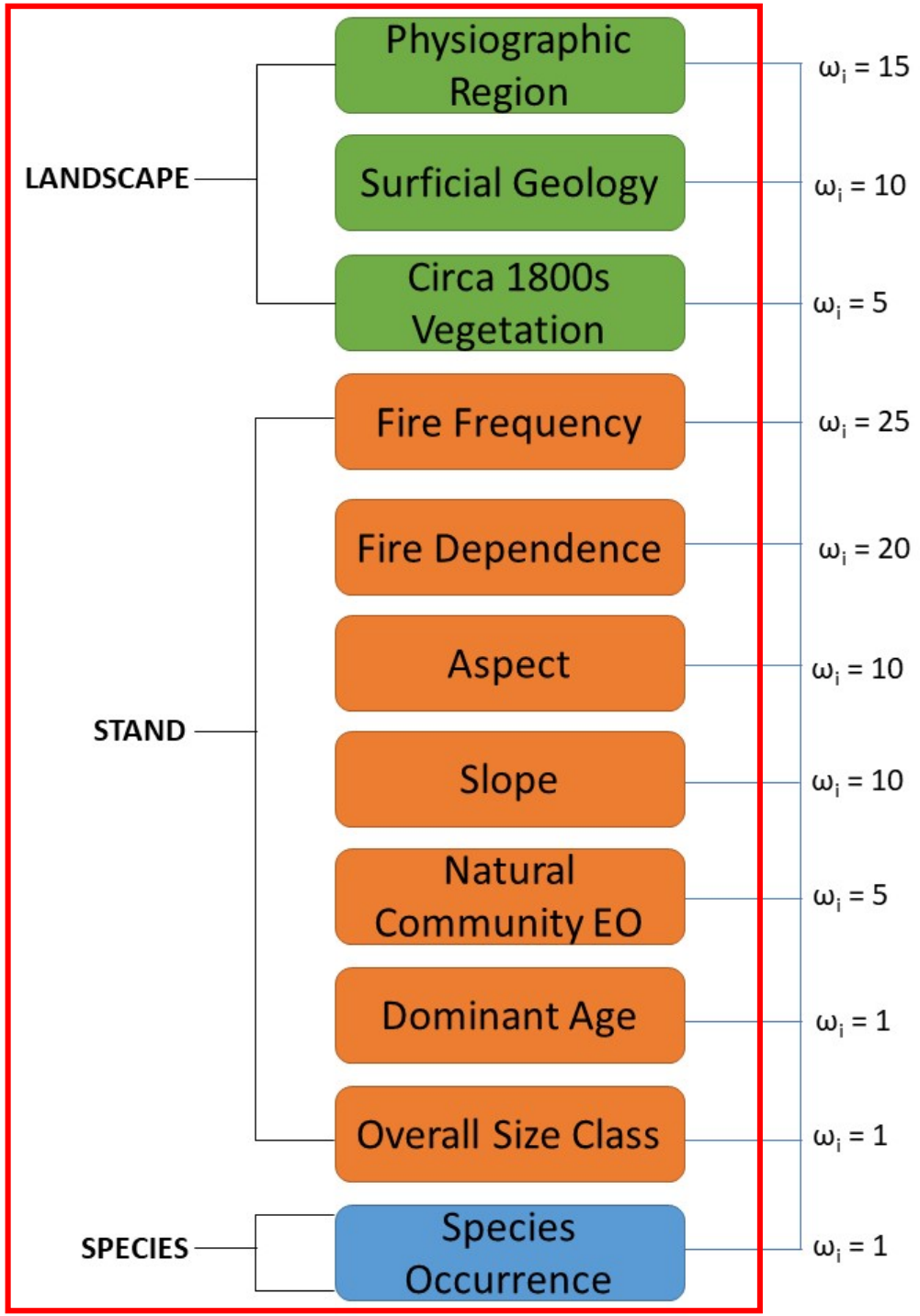
=

Stand-level Fire Needs Database

GIS Functionality



Creating the database



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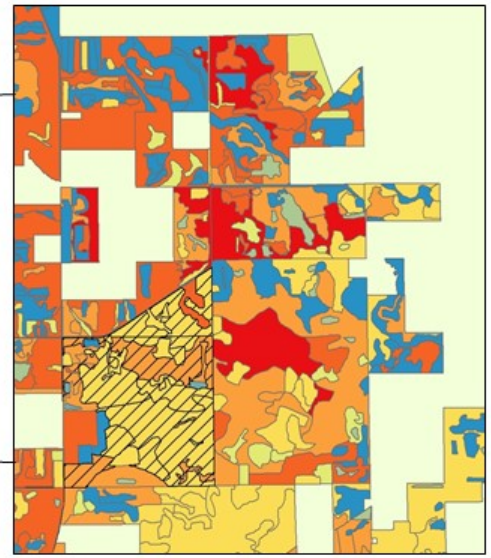


Assigning the Fire Needs Score

	Fire Frequency Range	Fire Needs Score	Rule
None	>1000 Years	0	IF Fire Frequency Range = >1000 Years, THEN +0
	100-200 Years	0	IF Fire Frequency Range = 100-200 Years, THEN +0
	200-500 Years	0	IF Fire Frequency Range = 200-500 Years, THEN +0
	500-1000 Years	0	IF Fire Frequency Range = 500-1000 Years, THEN +0
	Not Applicable	0	IF Fire Frequency Range = Not Applicable, THEN +0
	Not Applicable?	0	IF Fire Frequency Range = Not Applicable?, THEN +0
Low	70-300 Years	1	IF Fire Frequency Range = 70-300 Years, THEN +1
	80-300 Years	1	IF Fire Frequency Range = 80-300 Years, THEN +1
Moderate	50-100 Years	2	IF Fire Frequency Range = 50-100 Years, THEN +2
High	20-100 Years	3	IF Fire Frequency Range = 20-100 Years, THEN +3
Very High	10-80 Years	4	IF Fire Frequency Range = 10-80 Years, THEN +4
Highest	10-20 Years	5	IF Fire Frequency Range = 10-20 Years, THEN +5
	5-20 Years	5	IF Fire Frequency Range = 5-20 Years, THEN +5
	1-20 Years	5	IF Fire Frequency Range = 1-20 Years, THEN +5
	1-10 Years	5	IF Fire Frequency Range = 1-10 Years, THEN +5
	1-5 Years	5	IF Fire Frequency Range = 1-5 Years, THEN +5

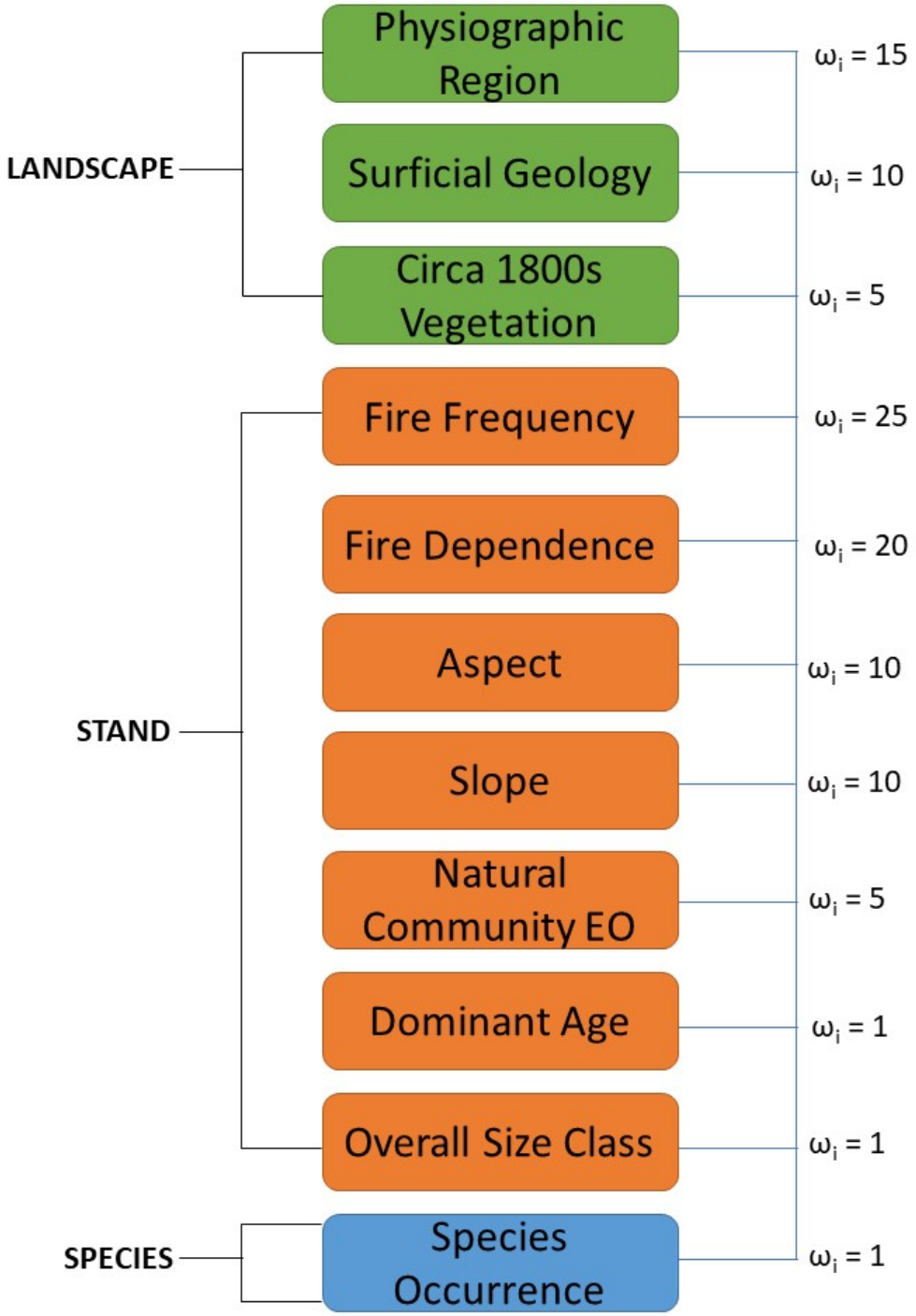
MiFI: Fire-adapted and fire-sensitive species

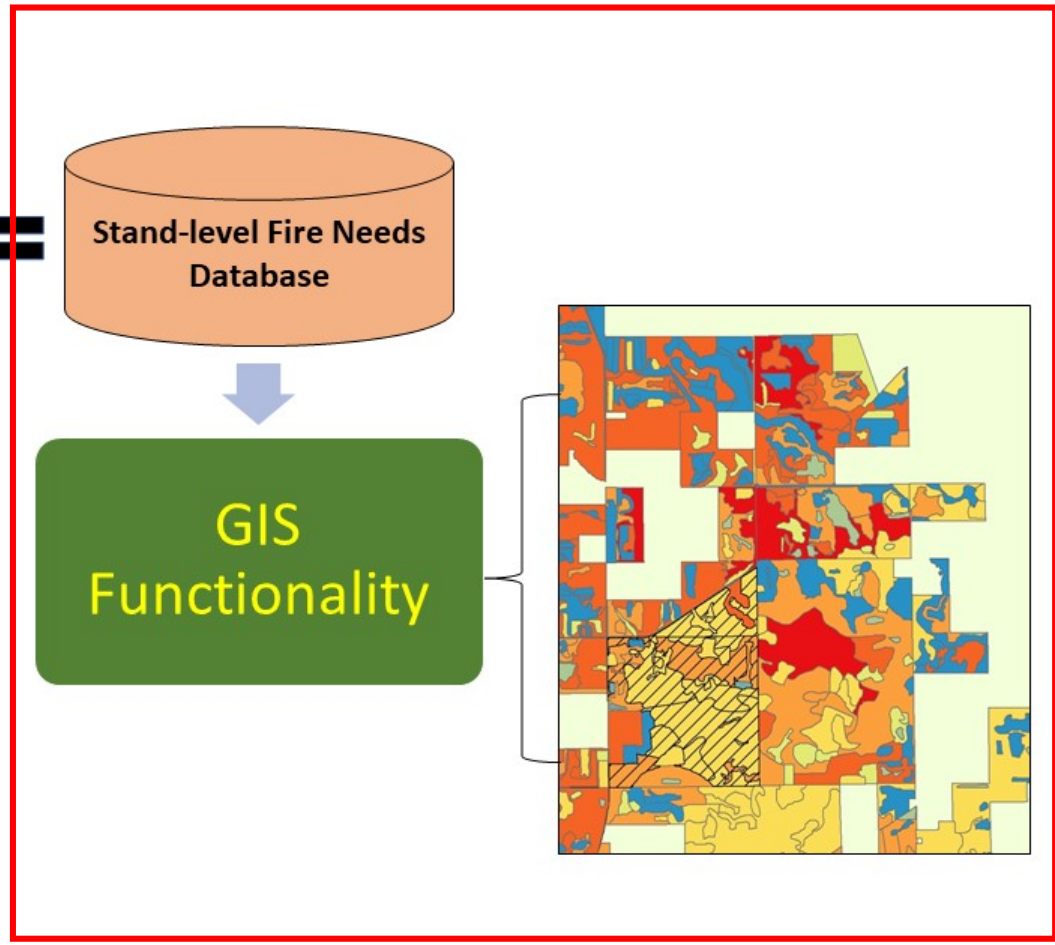
	A	D	E	F	L	M	N	O	P	Q	R
1	SC_common_name	SC_Genus_species	Propos	Comment	Range	Type	Physio	Coeff o	W	WET	Invasiv
2	Basswood	Tilia americana	-5		Nt	Tree	Nt Tree	5	3	FACU	Noninvasi
3	Black Ash	Fraxinus nigra	-5		Nt	Tree	Nt Tree	6	-3	FACW	Noninvasi
4	Hemlock	Tsuga canadensis	-5		Nt	Tree	Nt Tree	5	3	FACU	Noninvasi
5	Narrow-leaved Cattail	Typha angustifolia	Stipple	Negative score or	Ad	Non-woo	Ad P-Forb	*	-5	OBL	Invasive
6	Oriental Bittersweet	Celastrus orbiculata	Stipple	Negative score or	Ad	Vine	#N/A	#N/A	#N/A	#N/A	Invasive
7	Tree of Heaven	Ailanthus altissima	Stipple	Negative score or	Ad	Tree	Ad Tree	*	5	UPL	Invasive
8	Big Bluestem	Andropogon gerardii	5		Nt	Non-woo	Nt P-Gras	5	0	FAC	Noninvasi
9	Blue Lupine	Lupinis perennis	5		Nt	Non-woo	#N/A	#N/A	#N/A	#N/A	Noninvasi
10	Bur Oak	Quercus macrocarpa	5		Nt	Tree	Nt Tree	5	3	FACU	Noninvasi
11	Cordgrass spp.	Spartina spp.	5		Both	Non-woo	#N/A	#N/A	#N/A	#N/A	Possibly
12	Black Cherry	Prunus serotina	5		Nt	Tree	Nt Tree	2	3	FACU	Noninvasi
13	Border Privet	Ligustrum obtusifolium	5		Ad	Shrub	Ad Shrub	*	3	FACU	Invasive
14	Common Privet	Ligustrum vulgare	5		Ad	Shrub	Ad Shrub	*	3	FACU	Invasive
15	Autumn Olive	Elaeagnus umbellata	Crosshatc	Add column with	Ad	Shrub	Ad Shrub	*	3	FACU	Invasive
16	Common Buckthorn	Rhamnus cathartica	Crosshatc	Add column with	Ad	Shrub	Ad Tree	*	0	FAC	Invasive
17	Glossy Buckthorn	Rhamnus frangula	Crosshatc	Add column with	Ad	Shrub	#N/A	#N/A	#N/A	#N/A	Invasive
18	Honeysuckle (spp.)	Lonicera spp.	Crosshatc	Add column with	Both	Shrub	#N/A	#N/A	#N/A	#N/A	Possibly

EO's: Rare plants & animals

	A	B	C	F	G	H	I	
1	SNAME	SCOMMON	ELCAT	Fire Tolera	Fire Depende	Fire Dependent Habitat	Potential Score	Comment
7	Agalinis gattingeri	Gattinger's gerardia	Plant	1	1	0	3	
8	Agalinis skinneriana	Skinner's gerardia	Plant	1	1	0	5	
12	Ambystoma opacum	Marbled salamander	Animal	1	1	1	-5	
14	Ammodramus henslowii	Henslow's sparrow	Animal	0	1	0	3	
15	Ammodramus savannarum	Grasshopper sparrow	Animal	0	1	0	3	
16	Amorpha canescens	Leadplant	Plant	1	1	0	5	
17	Angelica venenosa	Hairy angelica	Plant	1	1	0	3	
19	Aristida dichotoma	Three-awned grass	Plant	1	1	0	3	
20	Aristida longespica	Three-awned grass	Plant	1	1	0	3	
22	Asclepias hirtella	Tall green milkweed	Plant	1	1	0	3	
23	Asclepias purpurascens	Purple milkweed	Plant	1	1	0	3	
24	Asclepias sullivantii	Sullivant's milkweed	Plant	1	1	0	3	
28	Atrytonopsis hianna	Dusted skipper	Animal	1	1	0	5	Need refugia
29	Baptisia lactea	White or prairie false indigo	Plant	1	1	0	3	
30	Bartonia paniculata	Panicled screwstem	Plant	1	1	0	1	
33	Boechera dentata	Rock cress	Plant	1	1	1	-3	

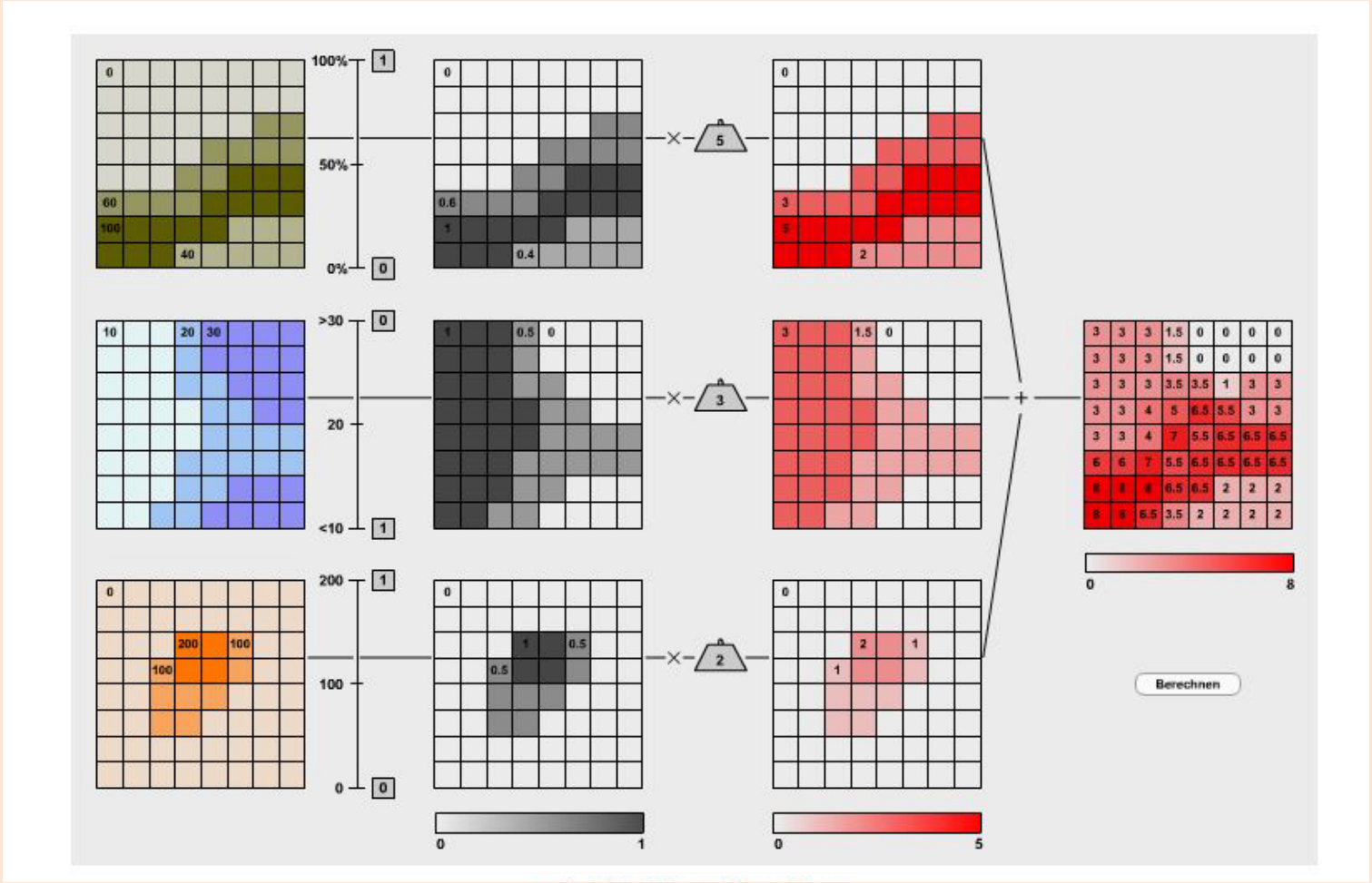
Creating the maps



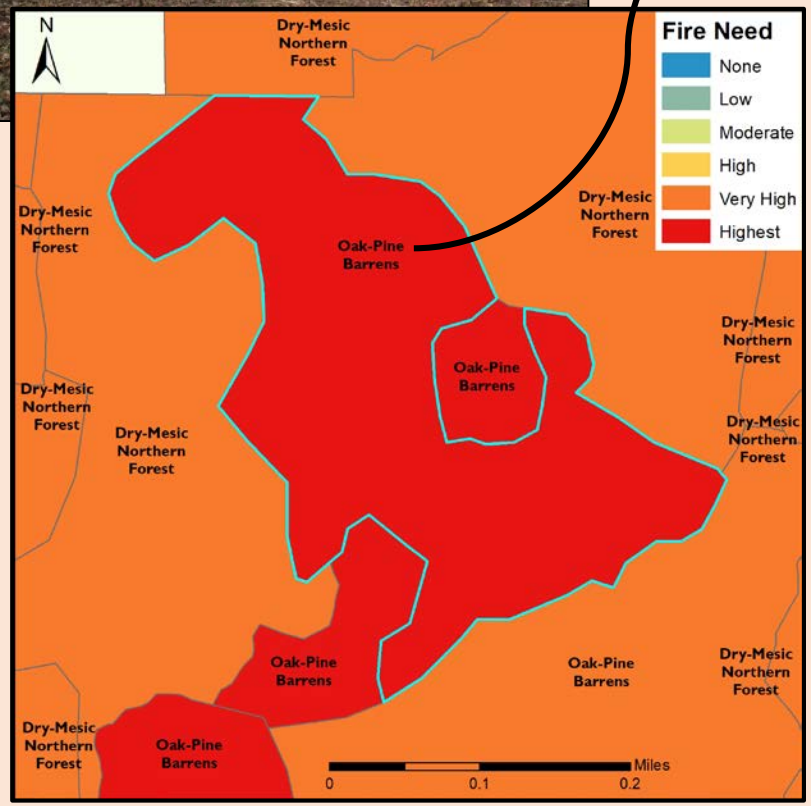


Geographic Overlay

- Identified multiple input variable with different units of measure
- Reclassified to common value scale
- Applied weights
- Summed scores
- Generated weighted geographic overlay



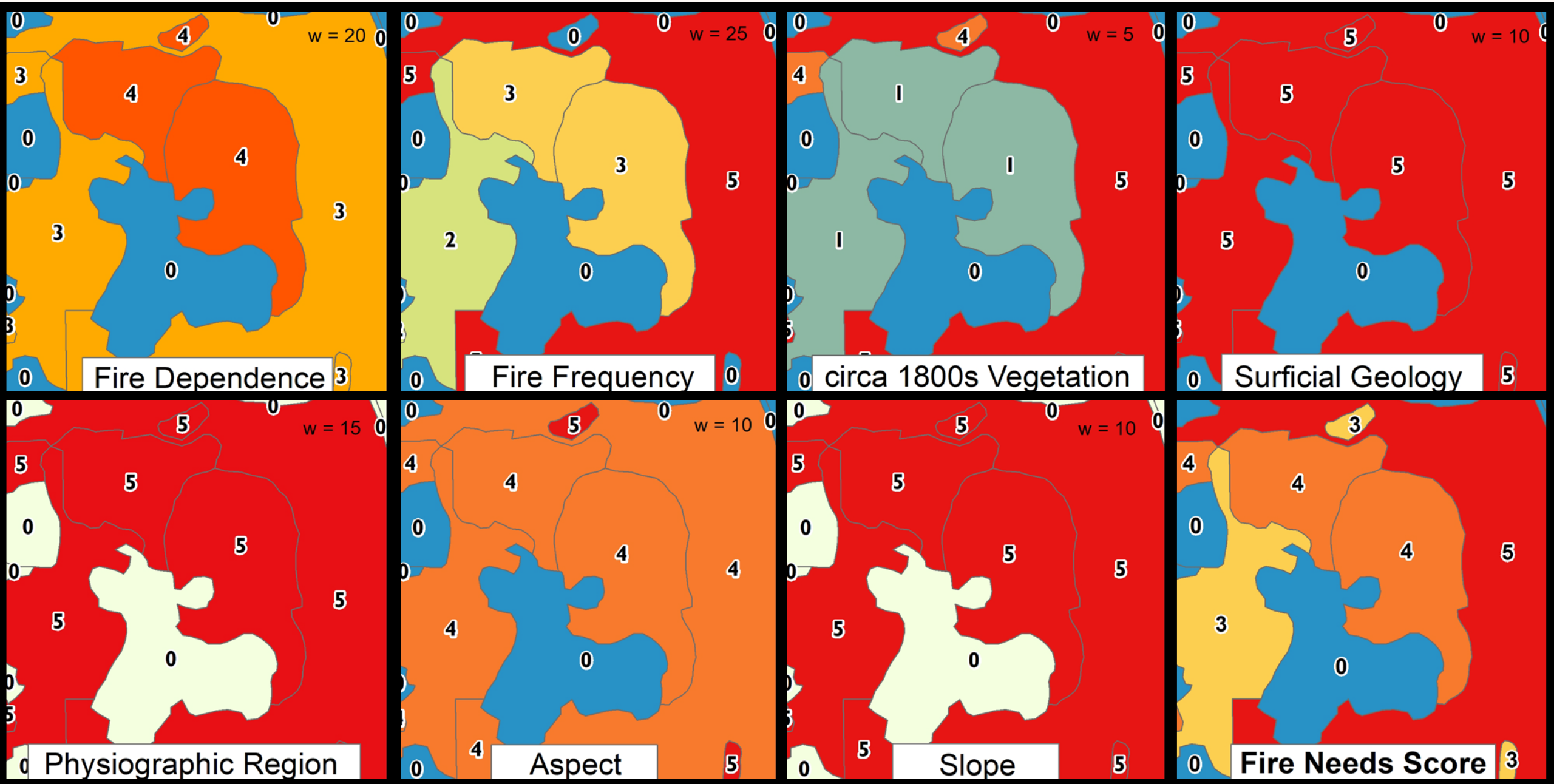
Breaking down a Fire Needs Score



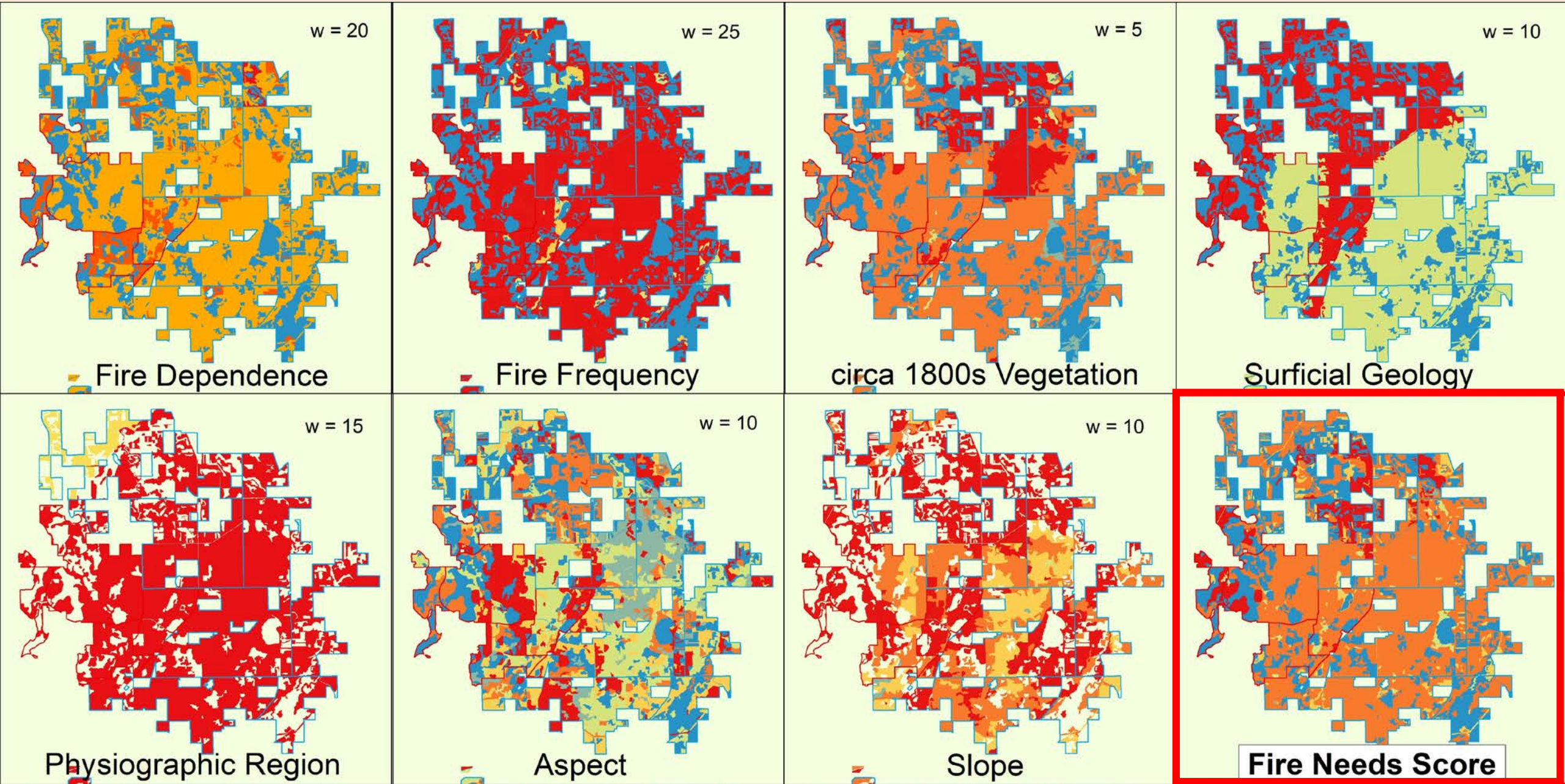
Submodel	Field	Value	Score	Weight	Weighted Score
Landscape	Physiographic Region	Chicago Lake Plain - South	3	15	45
Landscape	Surficial Geology	Lacustrine sand and gravel	4	10	40
Landscape	c1800	OAK/PINE BARRENS	5	5	25
Stand	Fire Frequency	5-20 years	5	25	125
Stand	Fire Dependence	Very Fire Dependent	4	20	80
Stand	VCC (LANDFIRE)	2.9	3	20	58
Stand	Aspect	Flat	4	10	40
Stand	Slope	0.7	5	10	50
Stand	Community (EO)	Oak-Pine Barrens	5	5	25
Stand	Dominant_Age	<null>	0	0	0
Stand	FF Certainty	High	3	0	3
Stand	Overall_Size	Unspecified	0	0	0
Species	Desirable Sensitive Spp.	No	0	0	0
Species	Desirable Tolerant Spp.	Yes	5	0	5
Species	Undersirable Sensitive	Yes	5	0	5
Species	Undesirable Red Maple	No	0	0	0
		Total	**51**	**120**	**501**

5 = Highest Fire Need

Building the Geographic Overlay



Barry SGA and Yankee Springs SRA



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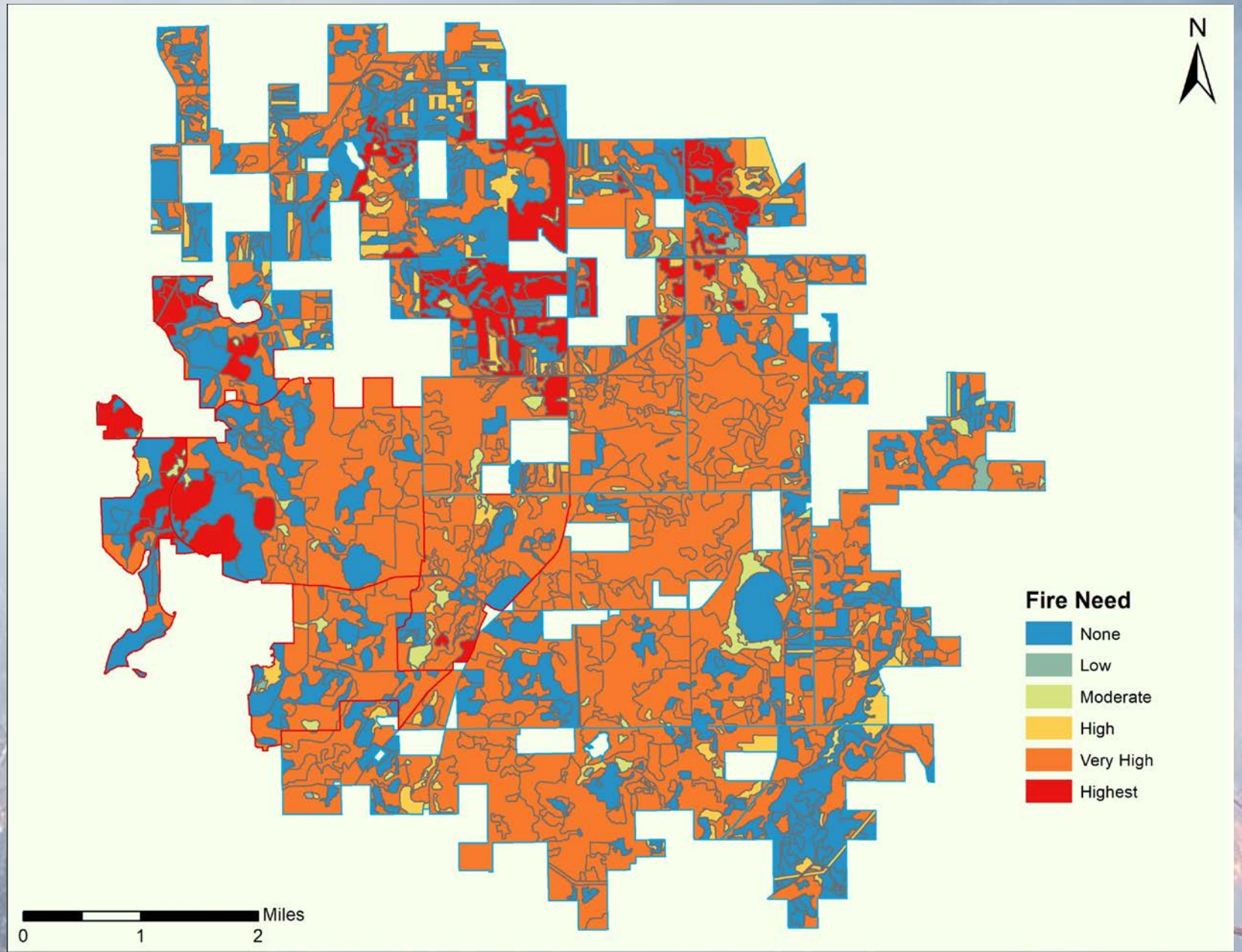
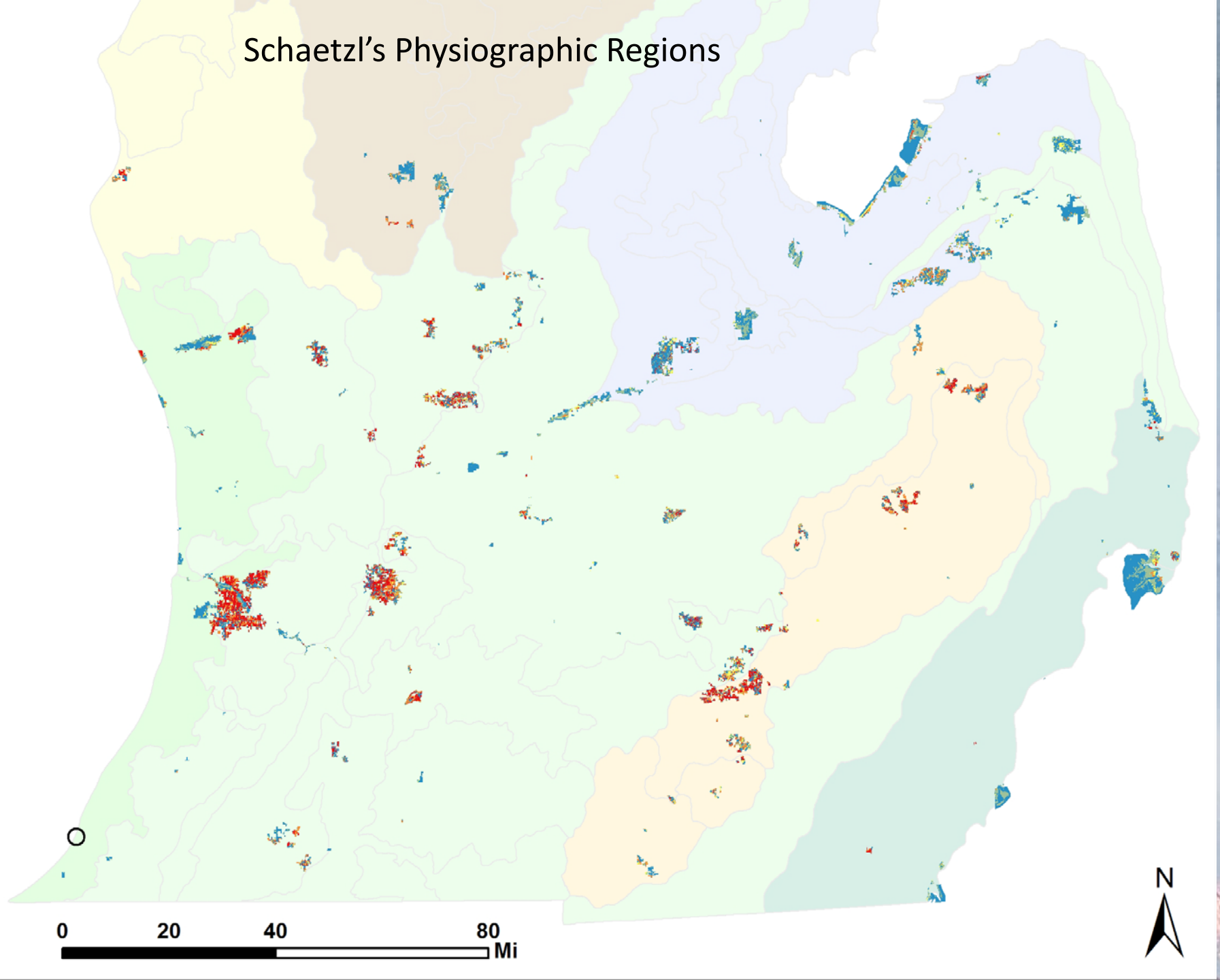
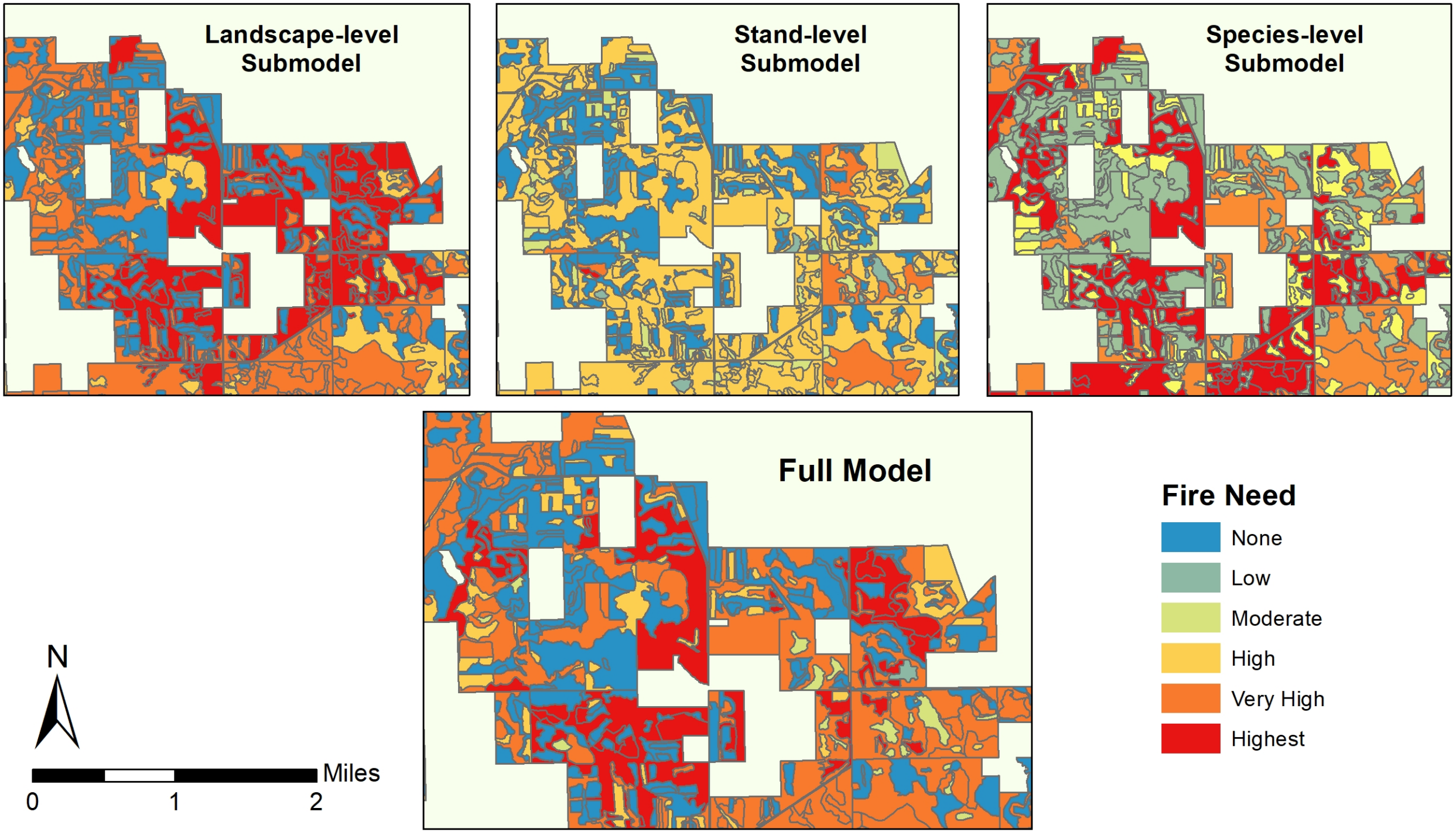
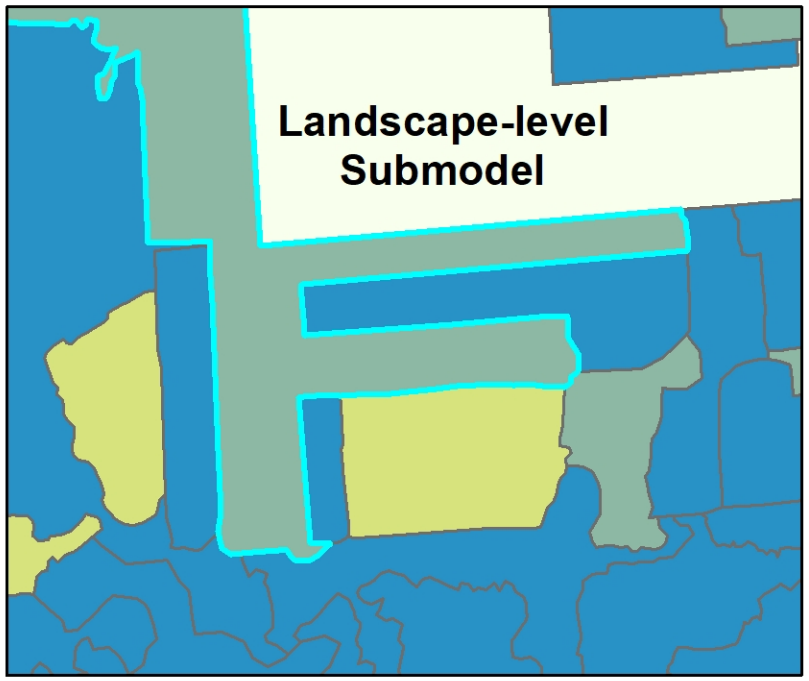
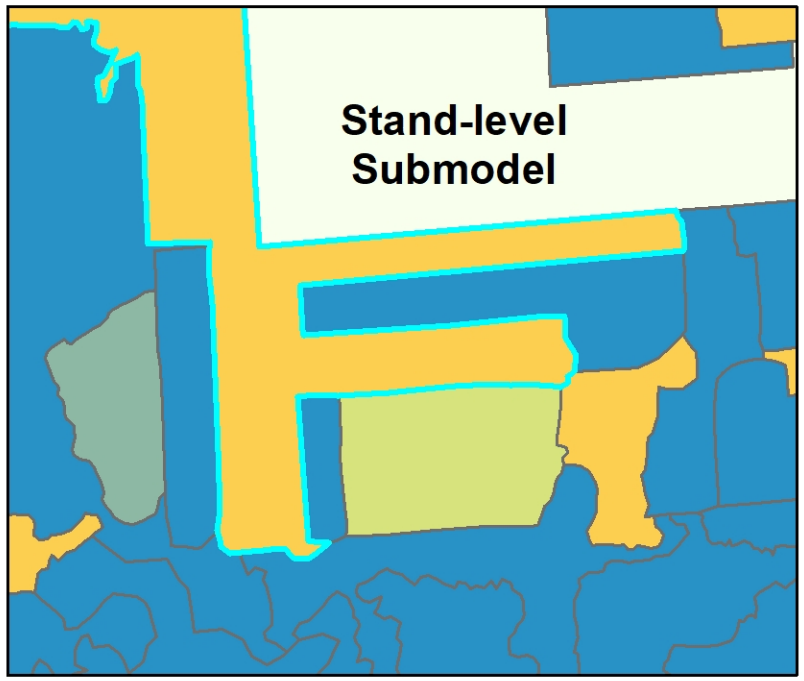


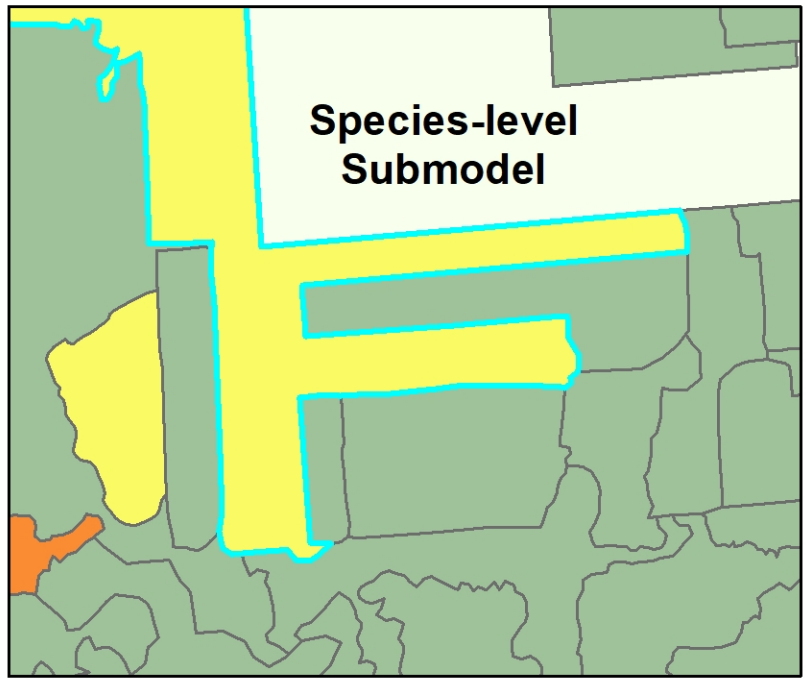
Schaetzl's Physiographic Regions

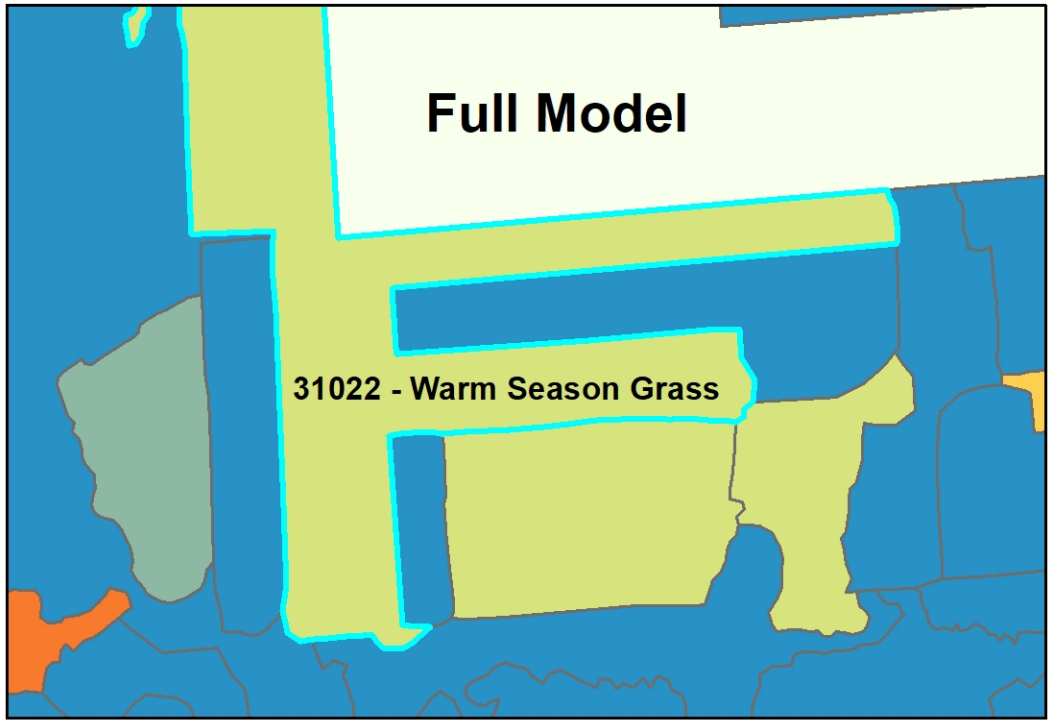



Landscape-level Submodel
Stand-level Submodel
Species-level Submodel
Full Model
Fire Need
None
Low
Moderate
High
Very High
Highest
N
Miles
0
1
2









N

Miles

0 0.15 0.3

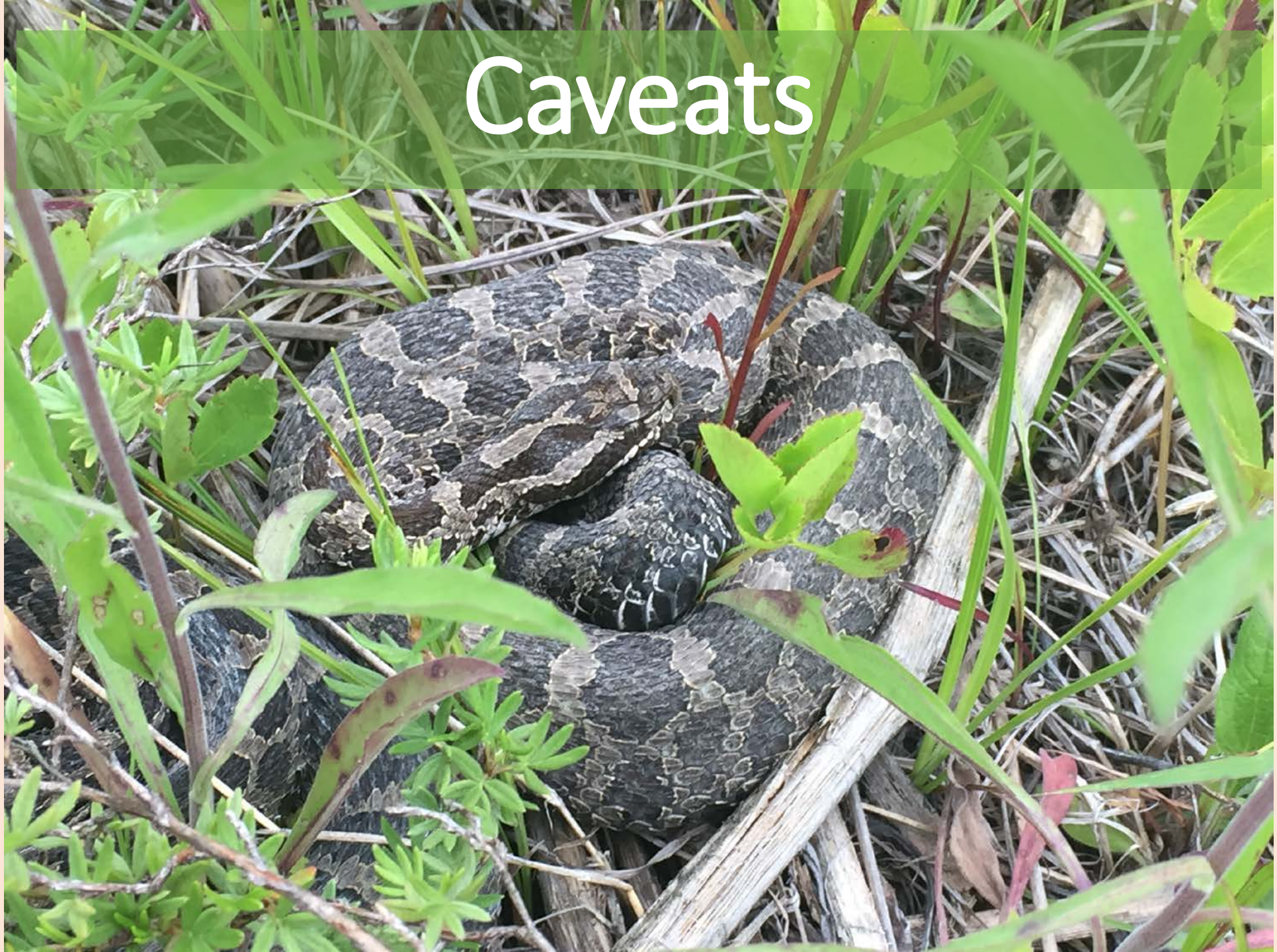
Fire Need

- None
- Low
- Moderate
- High
- Very High
- Highest

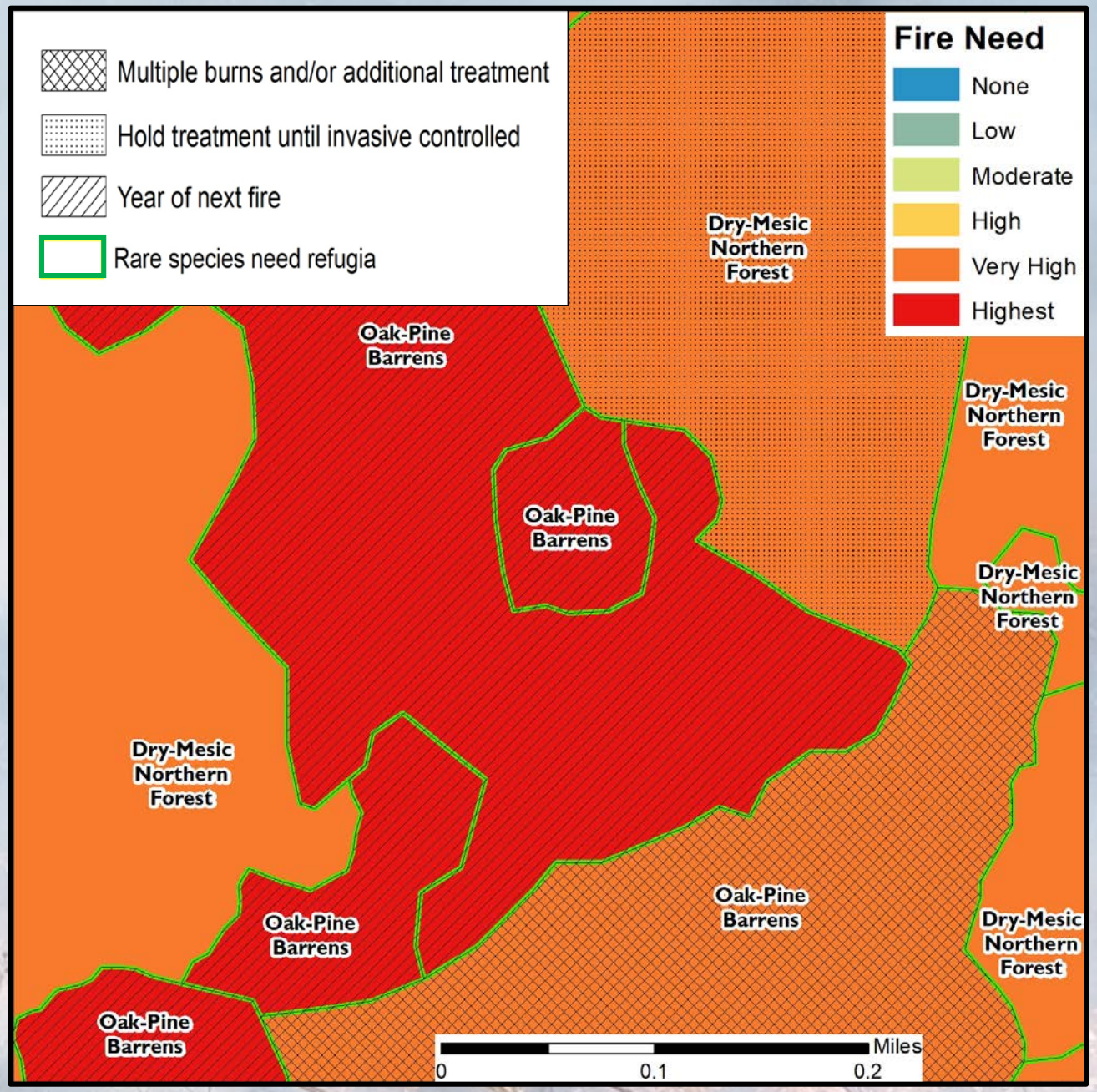
Caveats

Caveats

Caveats

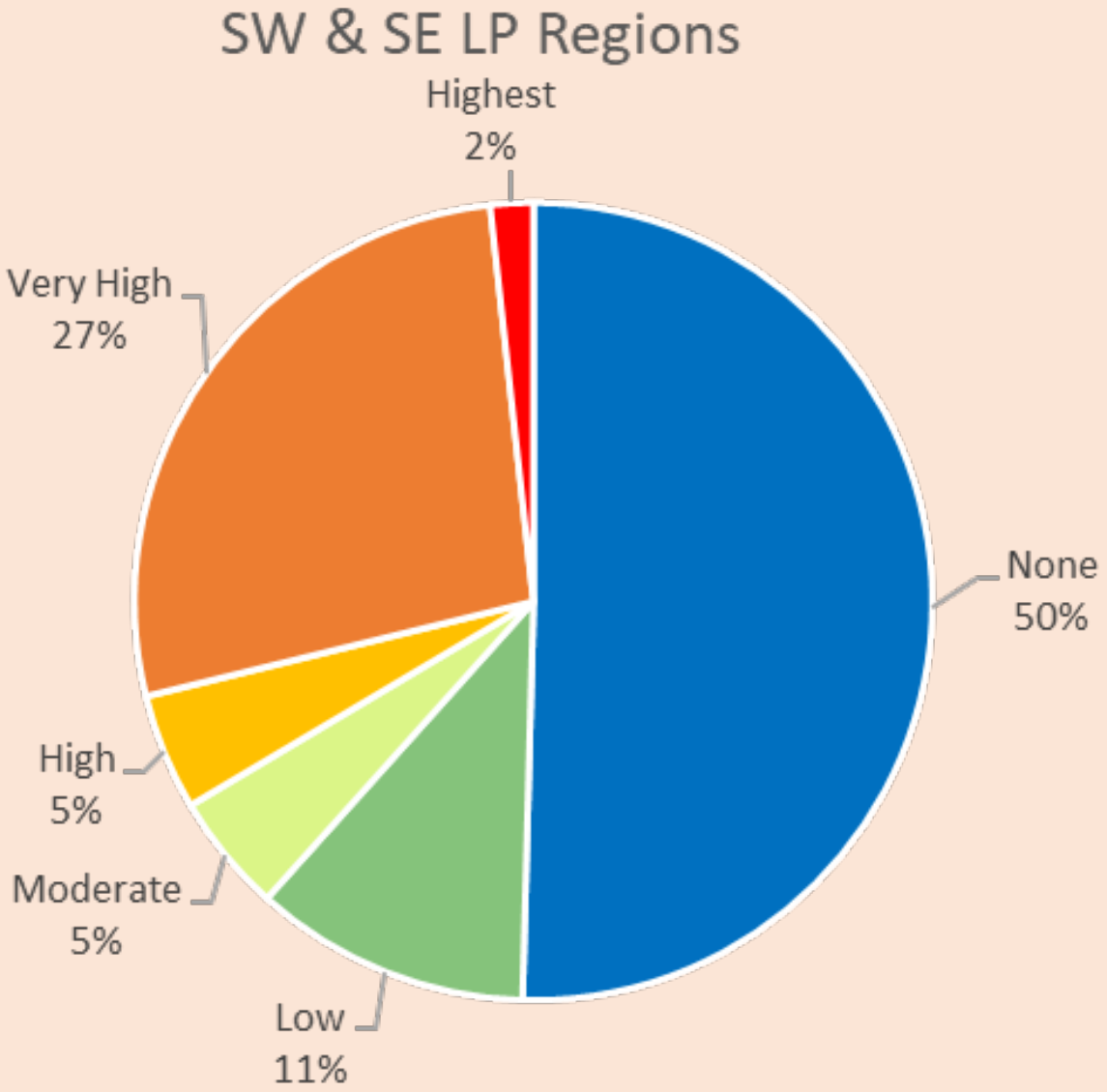


Caveats for rare species, invasive species, and frequency of fire

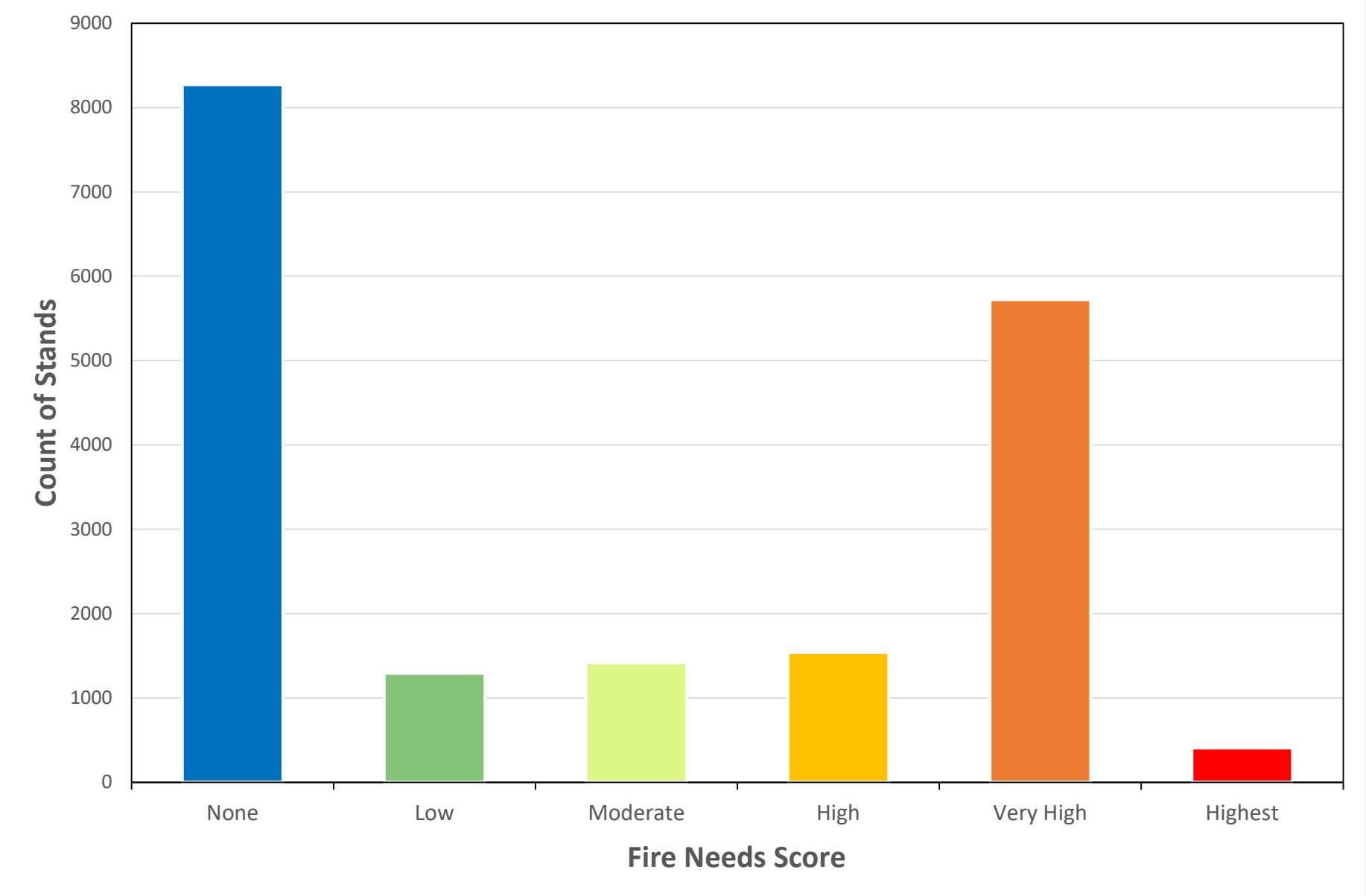


Proportion of Total Acreage by Fire Needs Score

Fire Need	Acres
None	185,045
Low	41,105
Moderate	17,678
High	17,315
Very High	99,348
Highest	6,382
Total	**366,873**



Distribution of Stands by Fire Needs Score



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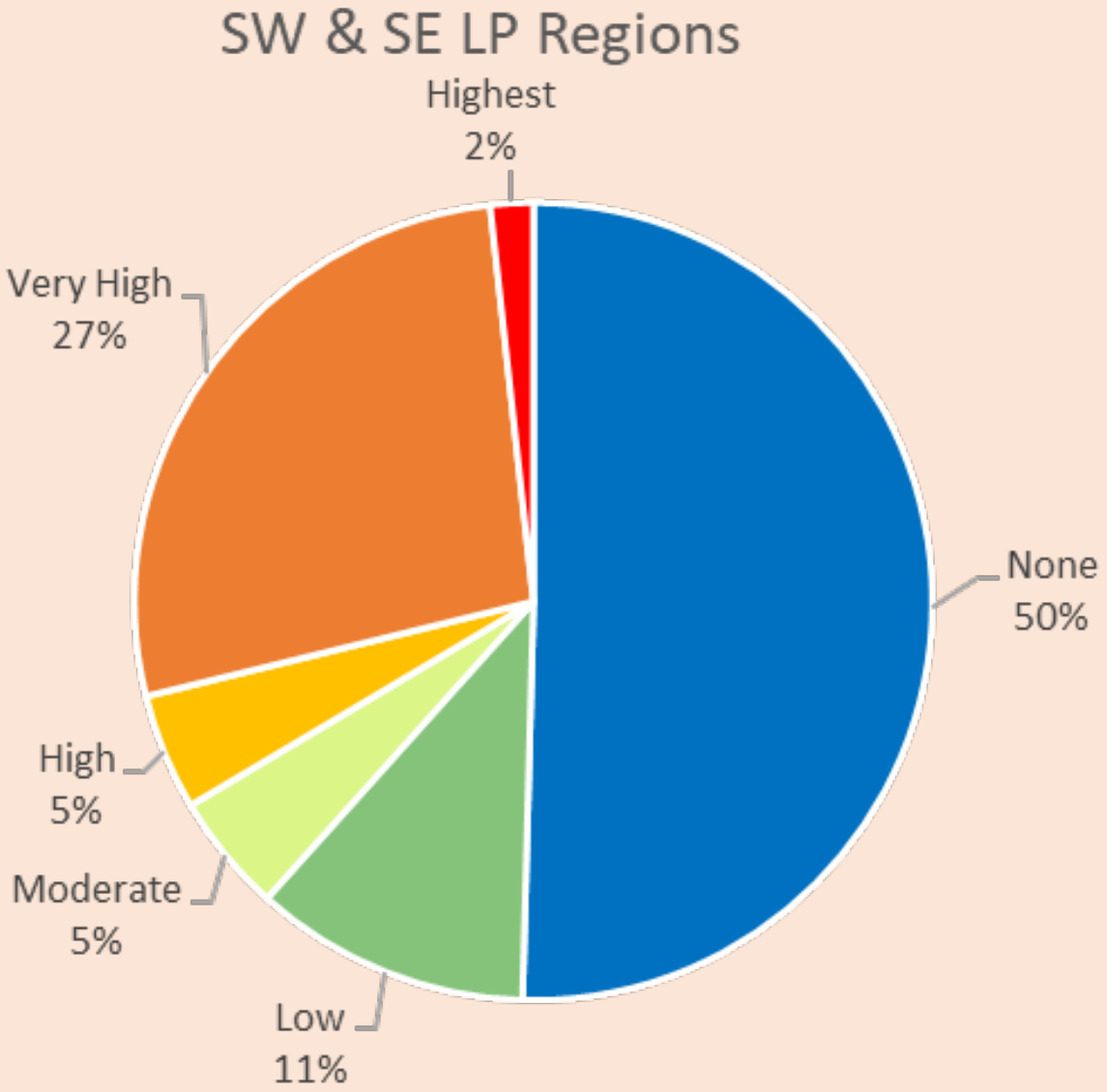
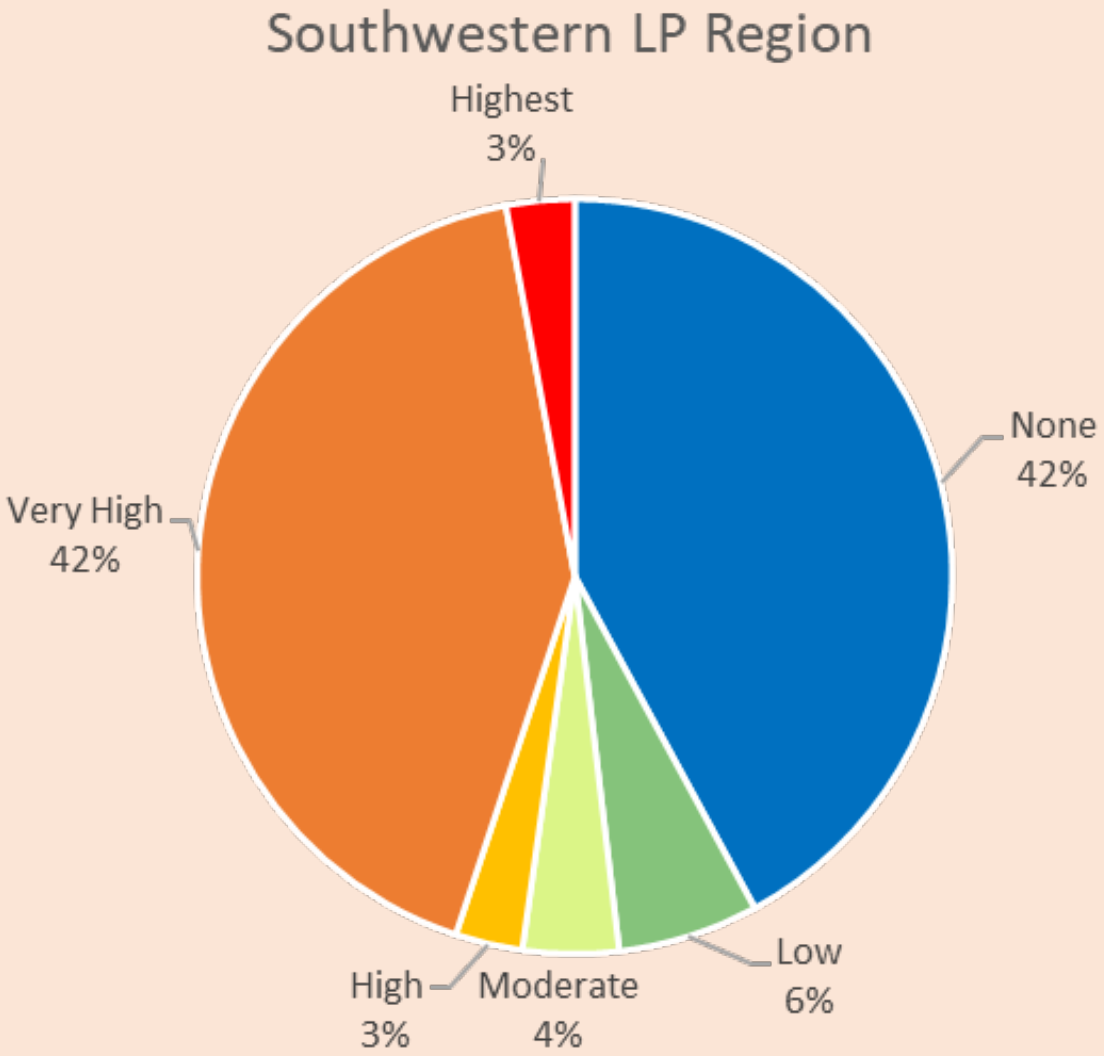
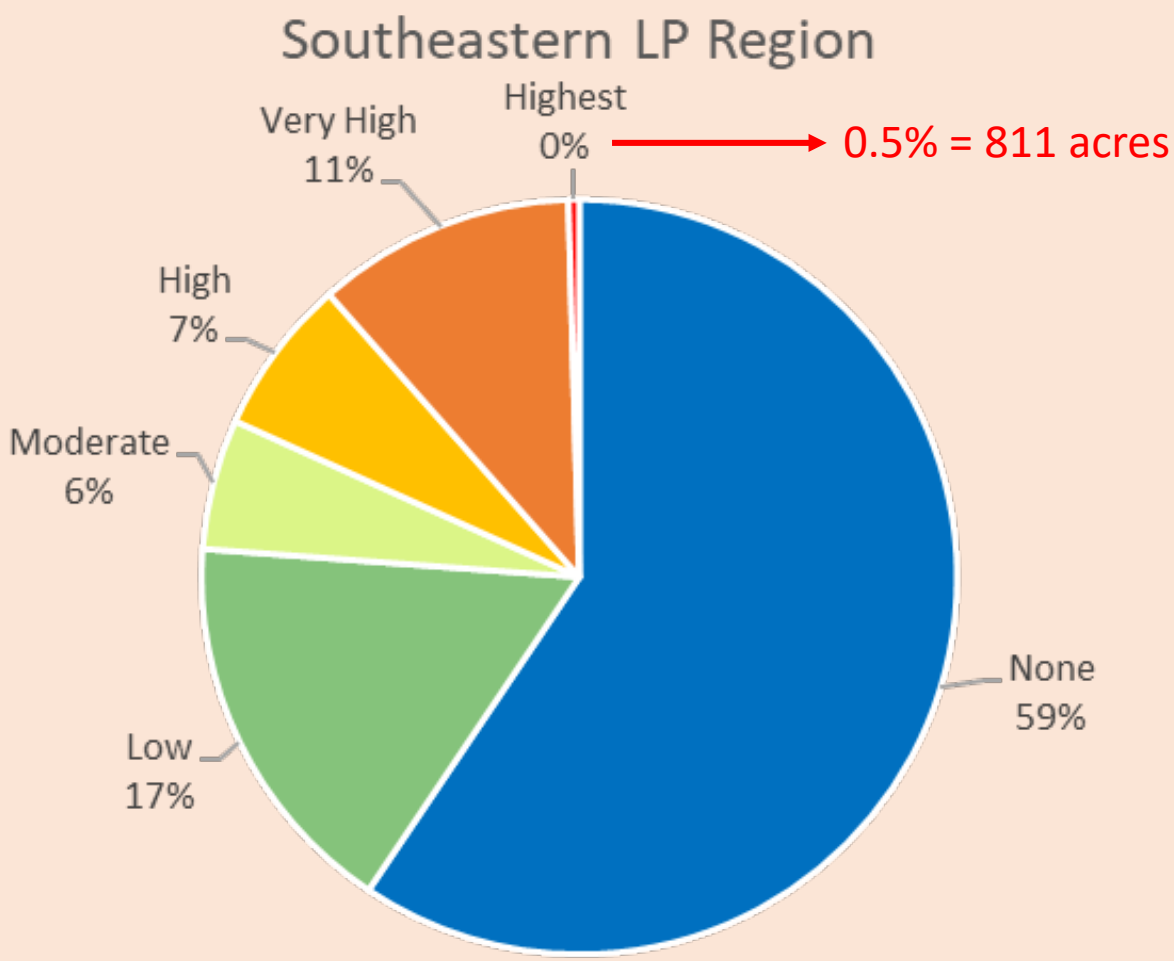


WLD Lands

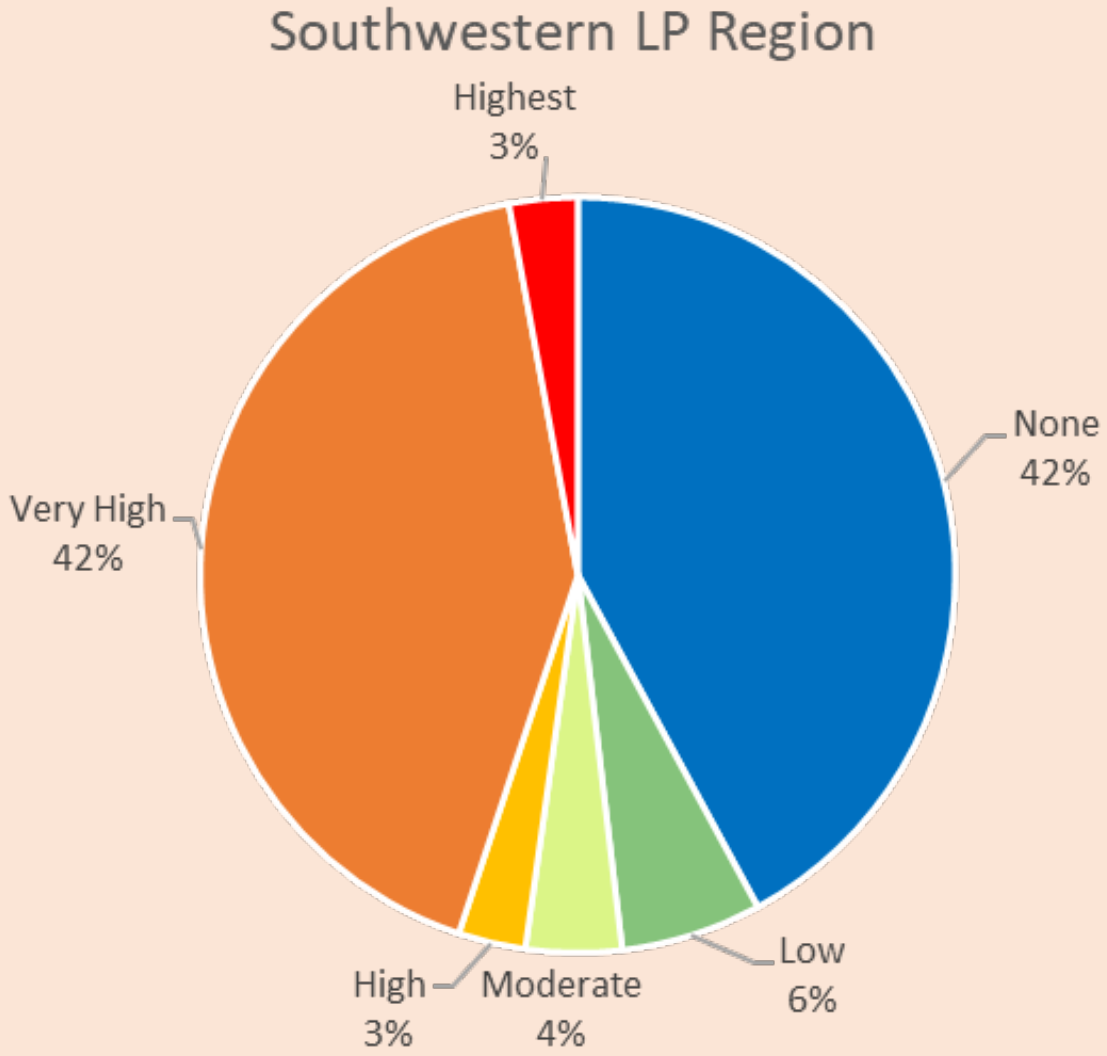
Proportion of Total Acreage by Fire Needs Score



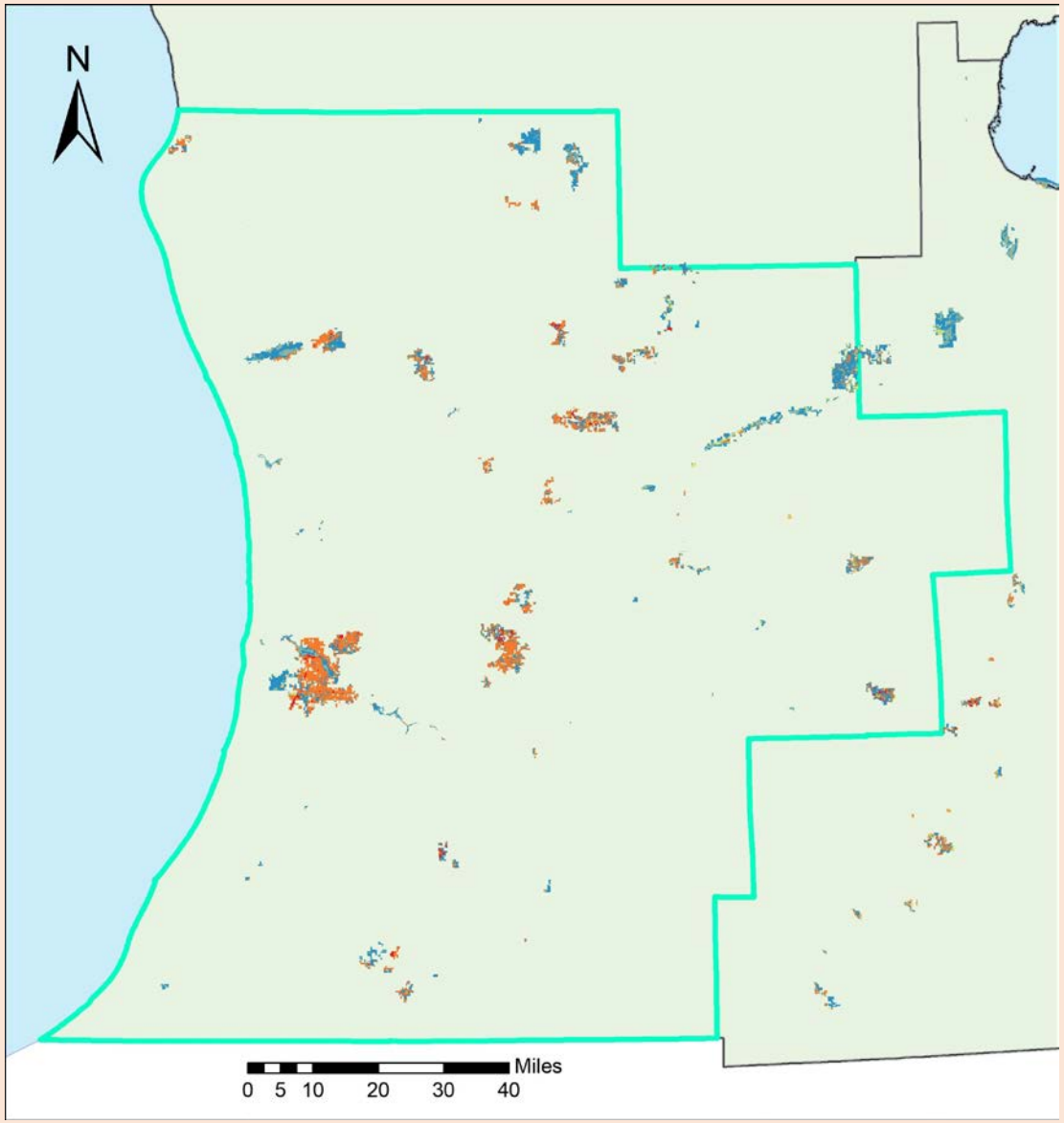


WLD Lands

Proportion of Total Acreage by Fire Needs Score



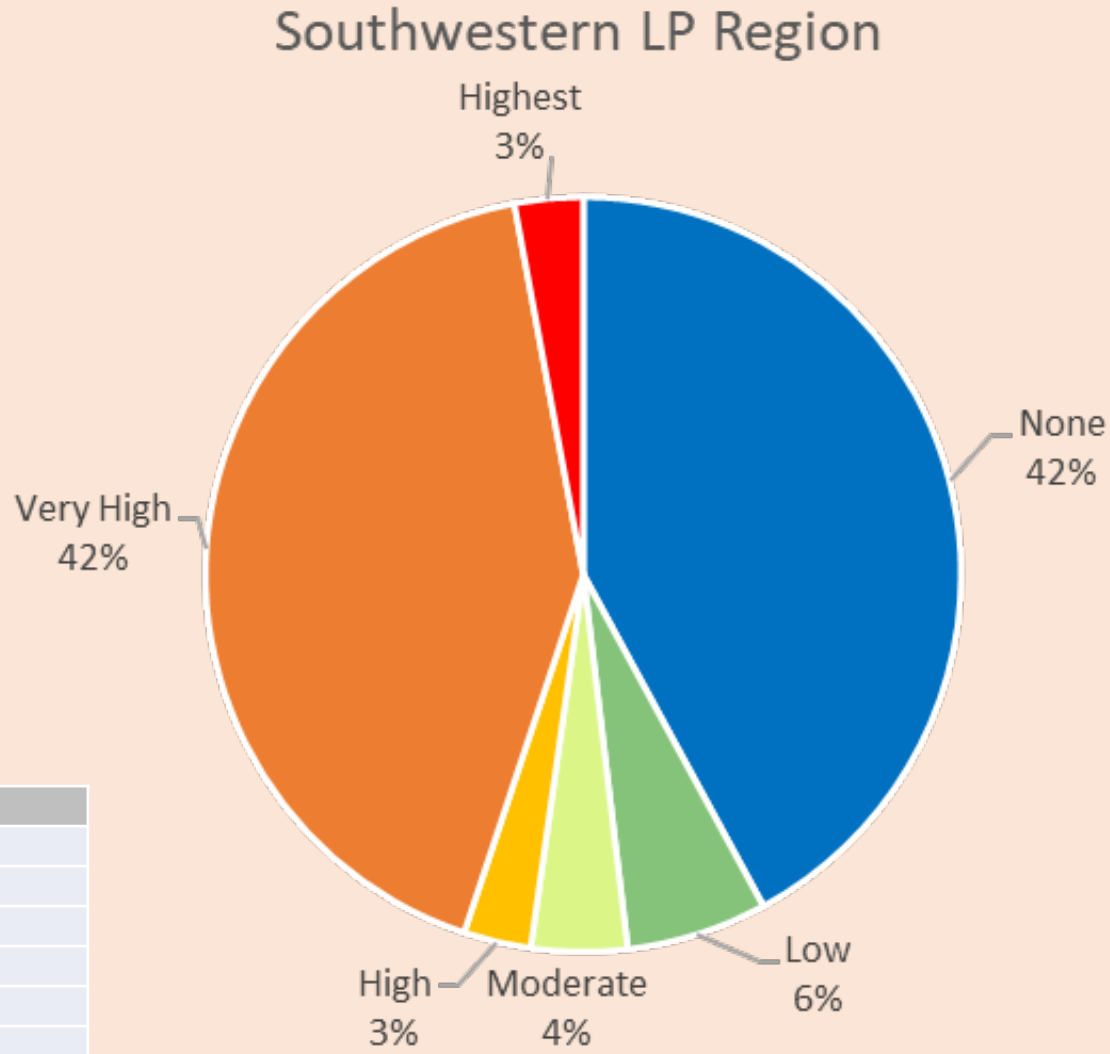
Southwestern LP Region Total = **190,159 acres**



WLD Lands

Proportion of Total Acreage by Fire Needs Score

Fire Need	Fire Frequency	Acres
Very High	1-5 years	190
	1-10 years	199
	1-20 years	78
	5-20 years	4,010
	10-20 years	74,496
	10-80 years	254
	20-100 years	339
	50-100 years	180
	Not Applicable?	46
Very High Total		**79,792**

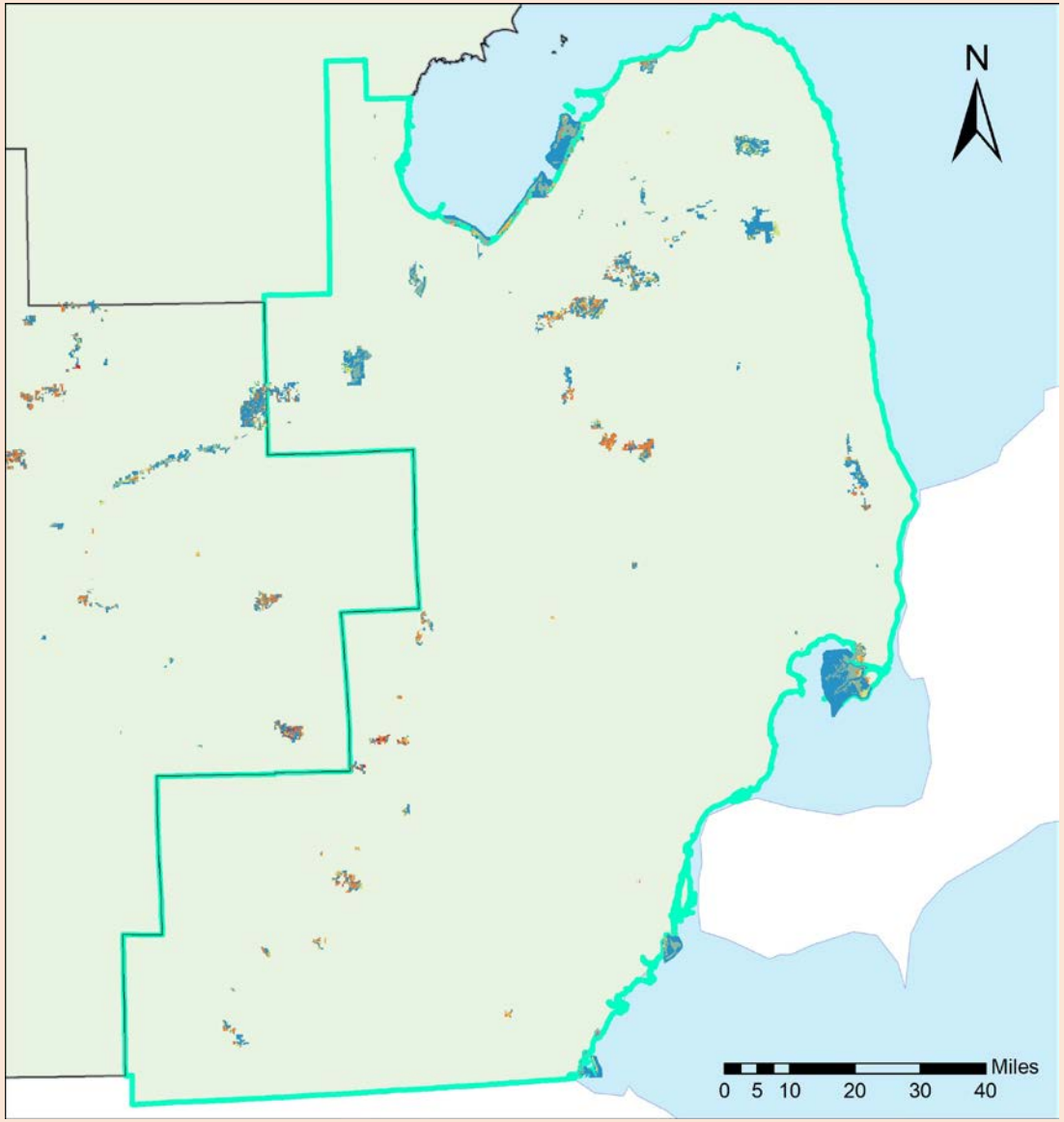


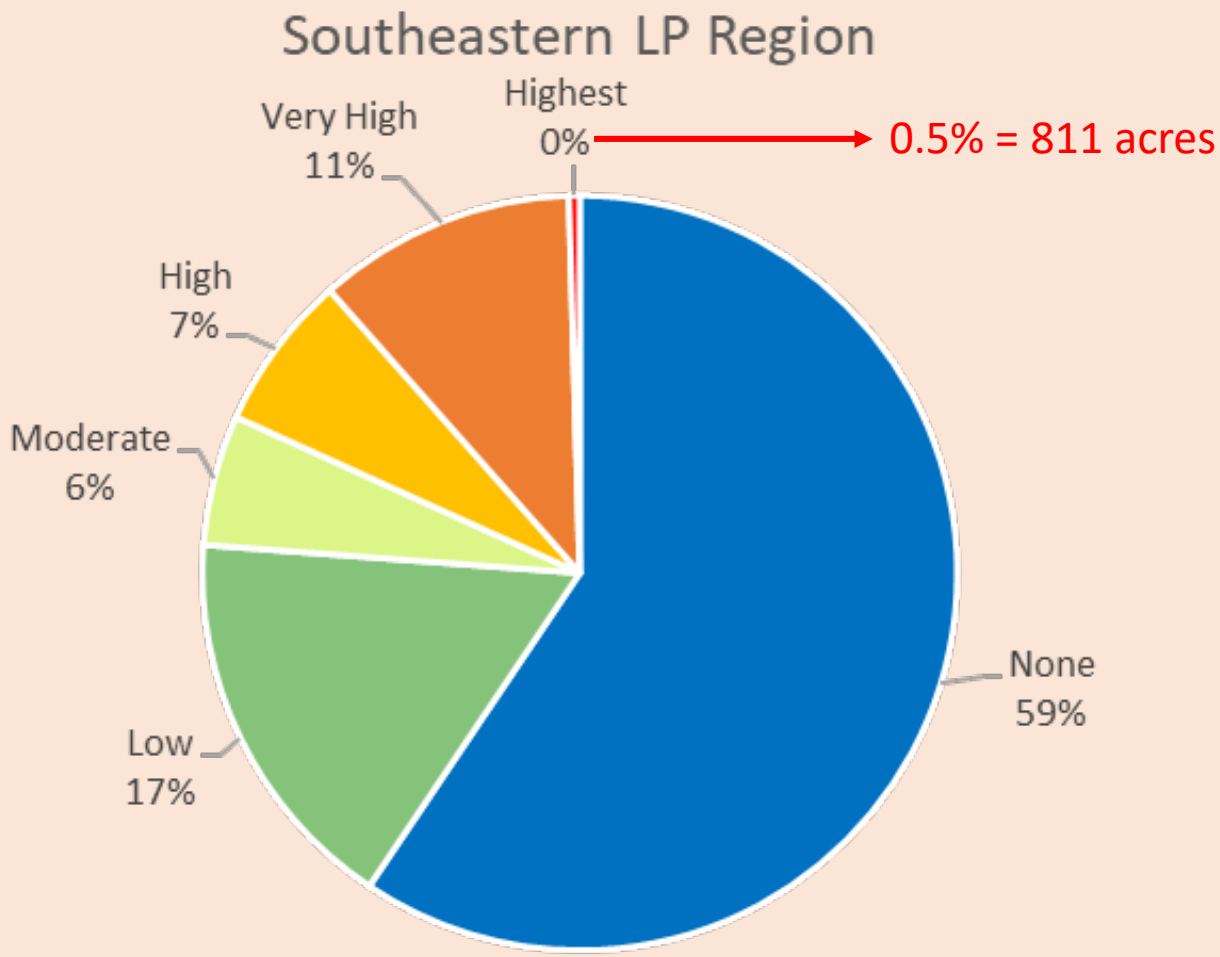
Fire Frequency	Natural Community
1-5 years	Dry-Mesic Prairie, Mesic Sand Prairie, Warm Season Grass
1-10 years	Dry Sand Prairie, Wet-mesic [sand] Prairie
1-20 years	Oak Openings
5-20 years	Lakeplain Oak Opening, Oak Barrens, Oak-Pine Barrens, Wet Prairie
10-20 years	Dry forests, Dry-mesic forests, Oak barrens, WDS Complex
10-80 years	Dry Northern Forest
20-100 years	Prairie Fen
50-100 years	Southern Wet Meadow

Southwestern LP Region Total = **190,159 acres**

WLD Lands

Proportion of Total Acreage by Fire Needs Score



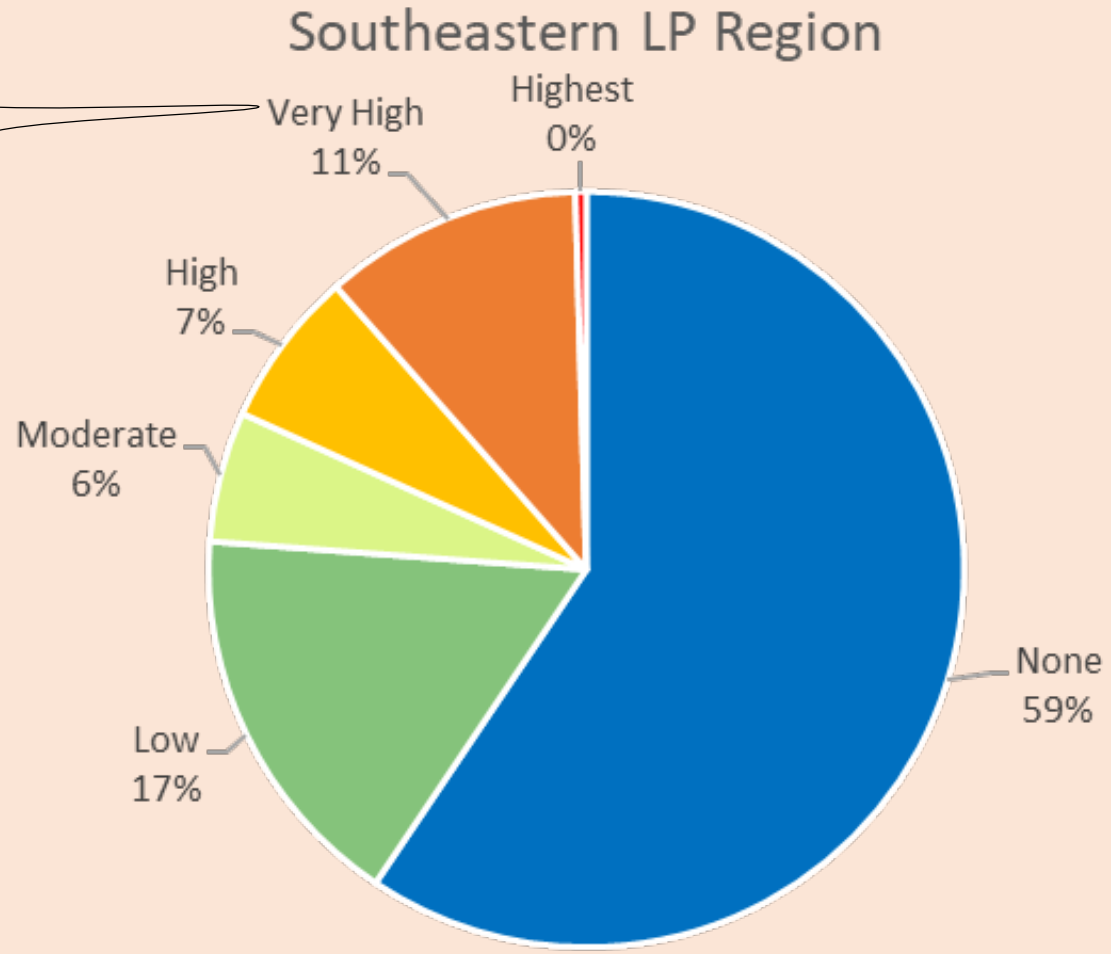


Southeastern LP Region Total = **176,714 acres**

WLD Lands

Proportion of Total Acreage by Fire Needs Score

Fire Need	Fire Frequency	Acres
Very High	1-5 years	147
	1-10 years	650
	1-20 years	58
	5-20 years	1,277
	10-20 years	17,105
	10-80 years	25
	20-100 years	274
	50-100 years	19
	Not Applicable?	1
Very High Total		**19,556**



Fire Frequency	Natural Community
1-5 years	Dry-Mesic Prairie, Mesic Sand Prairie, Warm Season Grass
1-10 years	Lakeplain Wet-mesic Prairie, Wet-mesic Prairie, Wet-mesic Sand Prairie
1-20 years	Oak Openings
5-20 years	Lakeplain Oak Openings, Lakeplain Wet Prairie, Oak Barrens, Oak-Pine Barrens, Wet Prairie
10-20 years	Dry forests, Dry-mesic forests, Oak barrens, WDS Complex
10-80 years	Dry Northern Forest
20-100 years	Prairie Fen
50-100 years	Southern Wet Meadow

Southeastern LP Region Total = **176,714 acres**

Limitations

Limitations

- Tool to provide resource managers with information about the **ecological** need of stands for prescribed fire on state lands across southern Michigan.
- Does not provide information about seasonality and severity of prescribed fire within those stands.
- Does not provide site-specific detail about the required frequency of prescribed fire in fire-suppressed stands in fire-suppressed landscapes.

2019 Objectives

- Incorporate input from reviewers, partners, and experts (DNR biologists, TNC, Lake States Fire Science Consortium, USFS, Prescribed Fire Council).
- Development of this tool across southern Michigan (beyond state lands).
- Development of this tool in northern Michigan.
- Modify the scoring using spatial information at larger scales (contagion modelling).
- Burn priority component looking at rarity and integrity at multiple scales.
- Burn feasibility component.
- Develop a manger's handbook.
- Develop a user-friendly GIS-interface.

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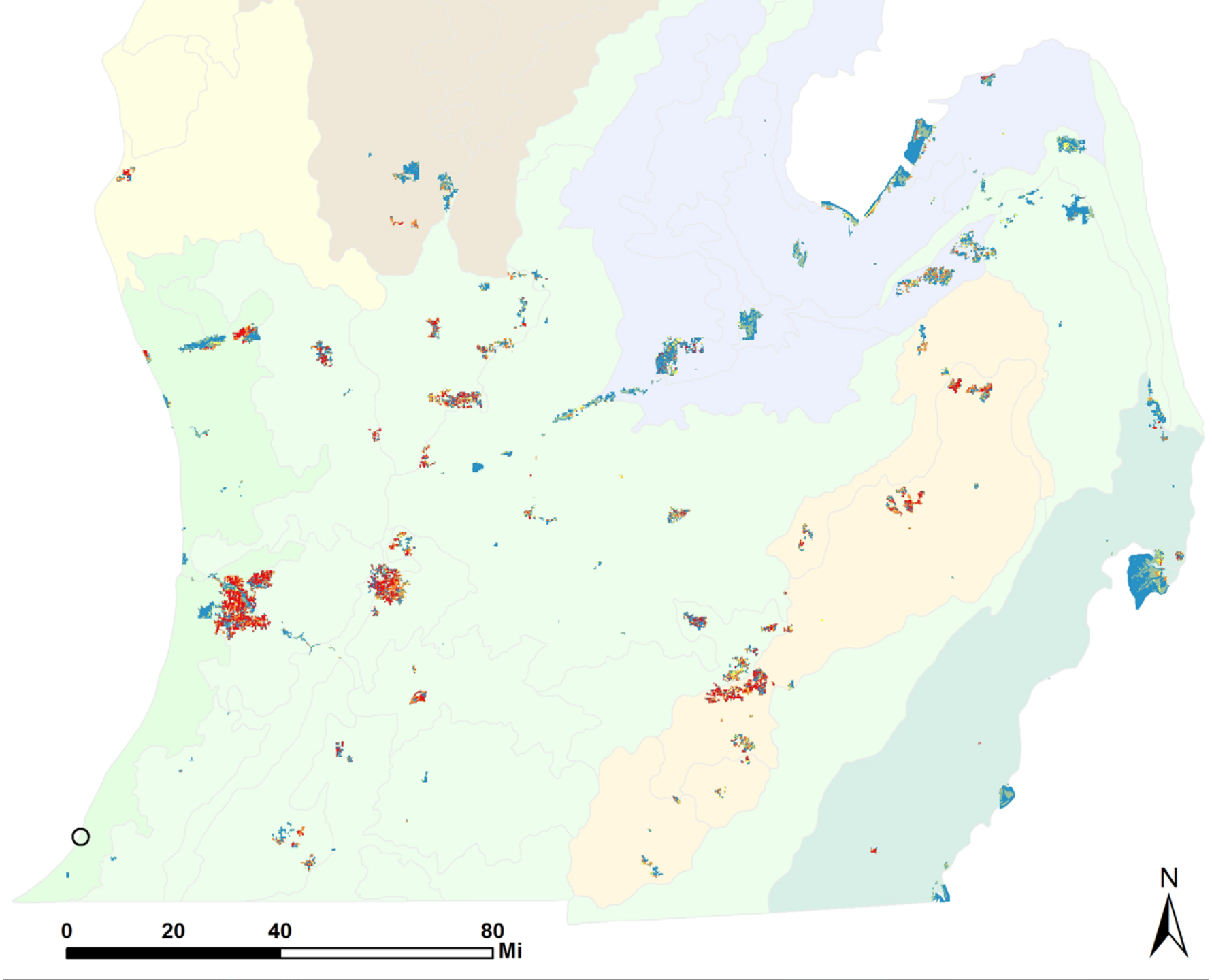
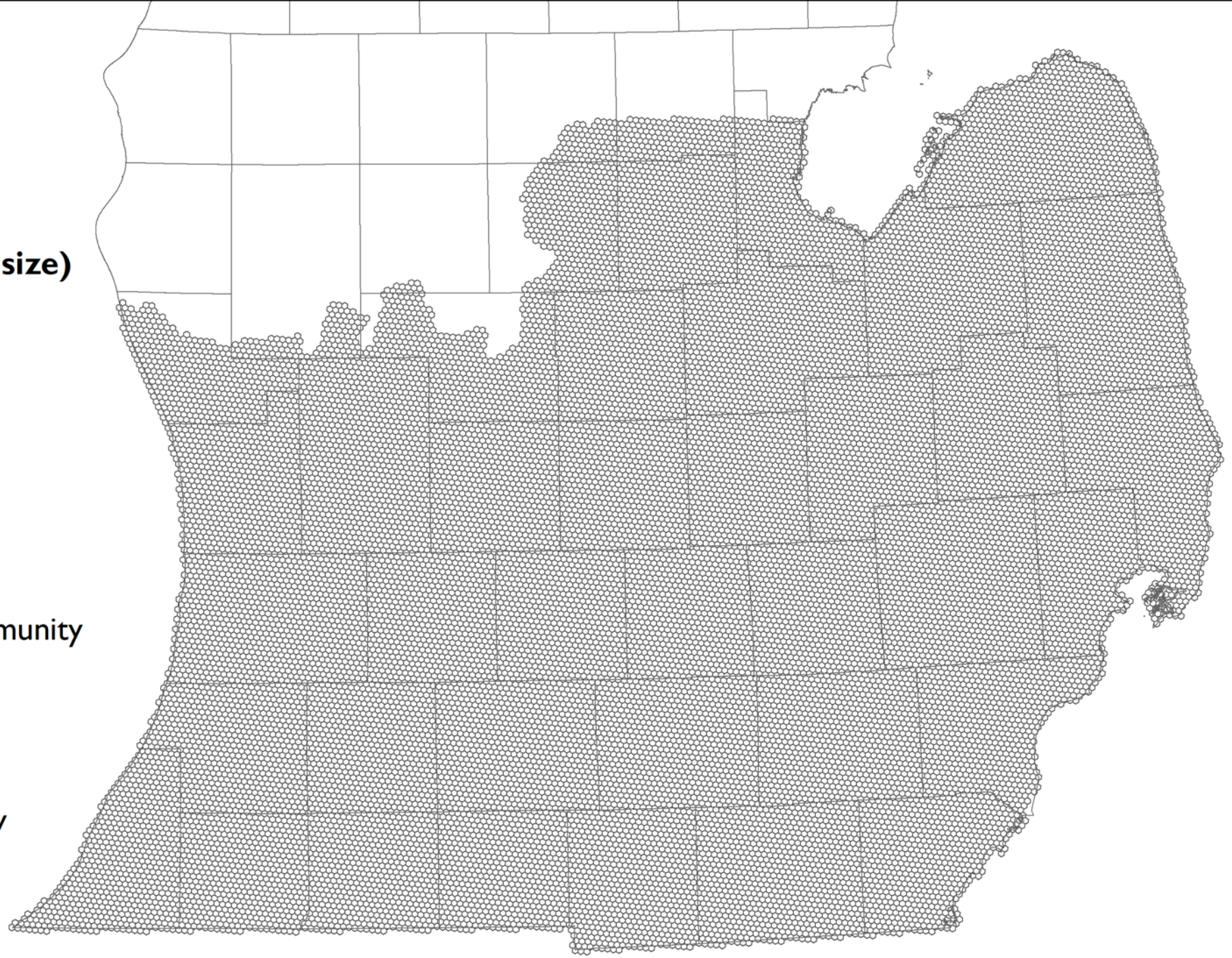
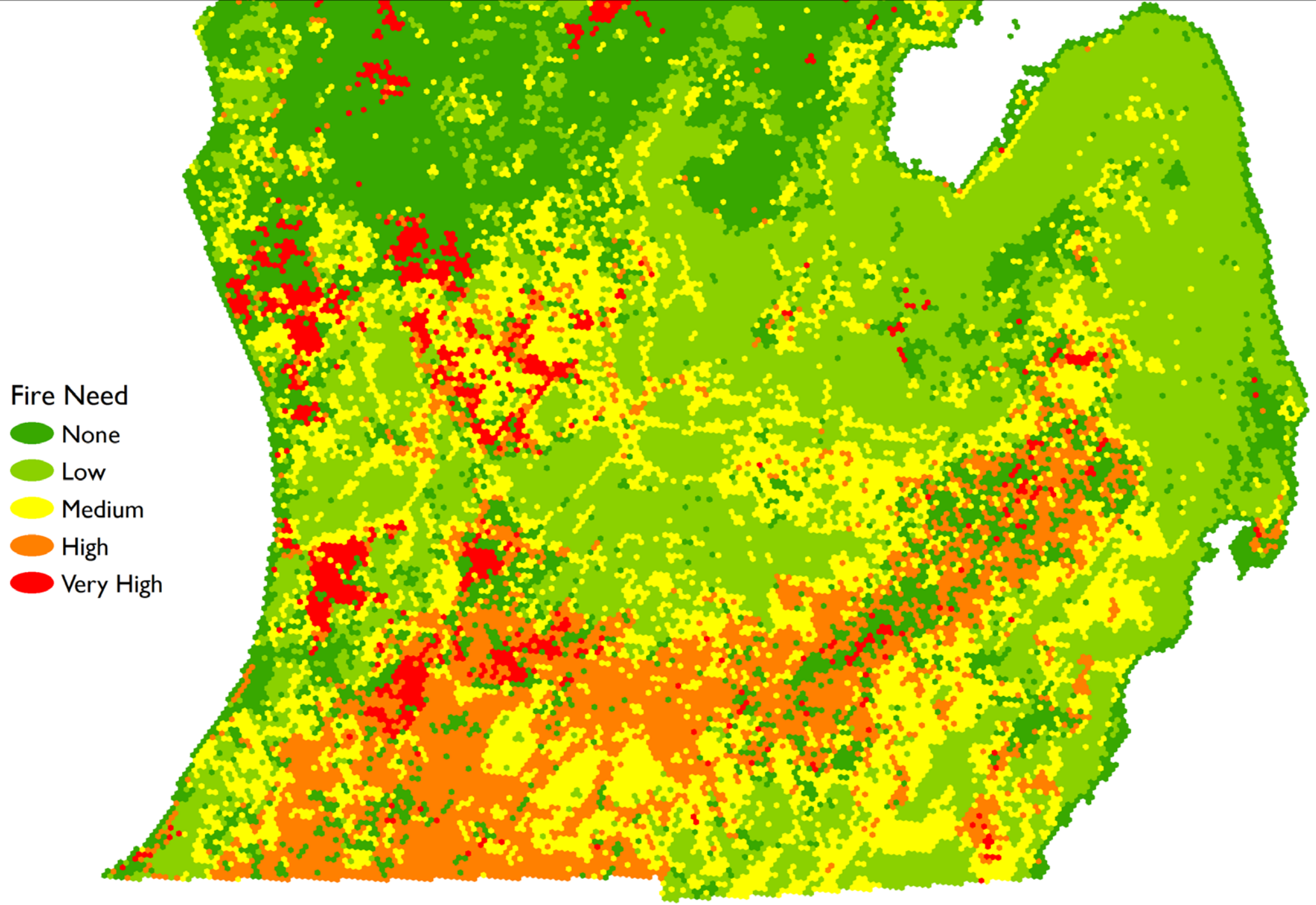

0
20
40
80
Mi
N

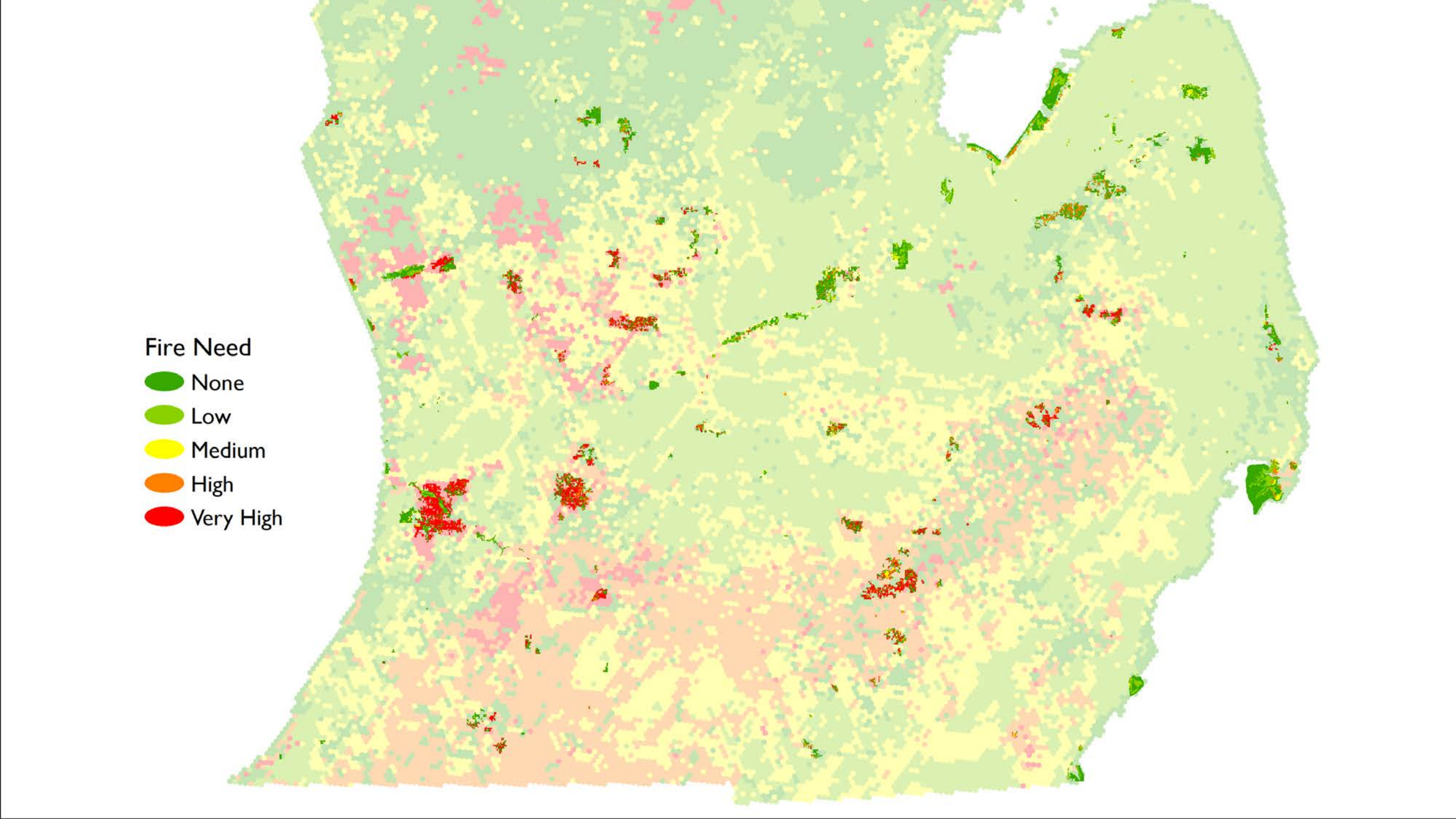
Hexagons (640 acres in size)

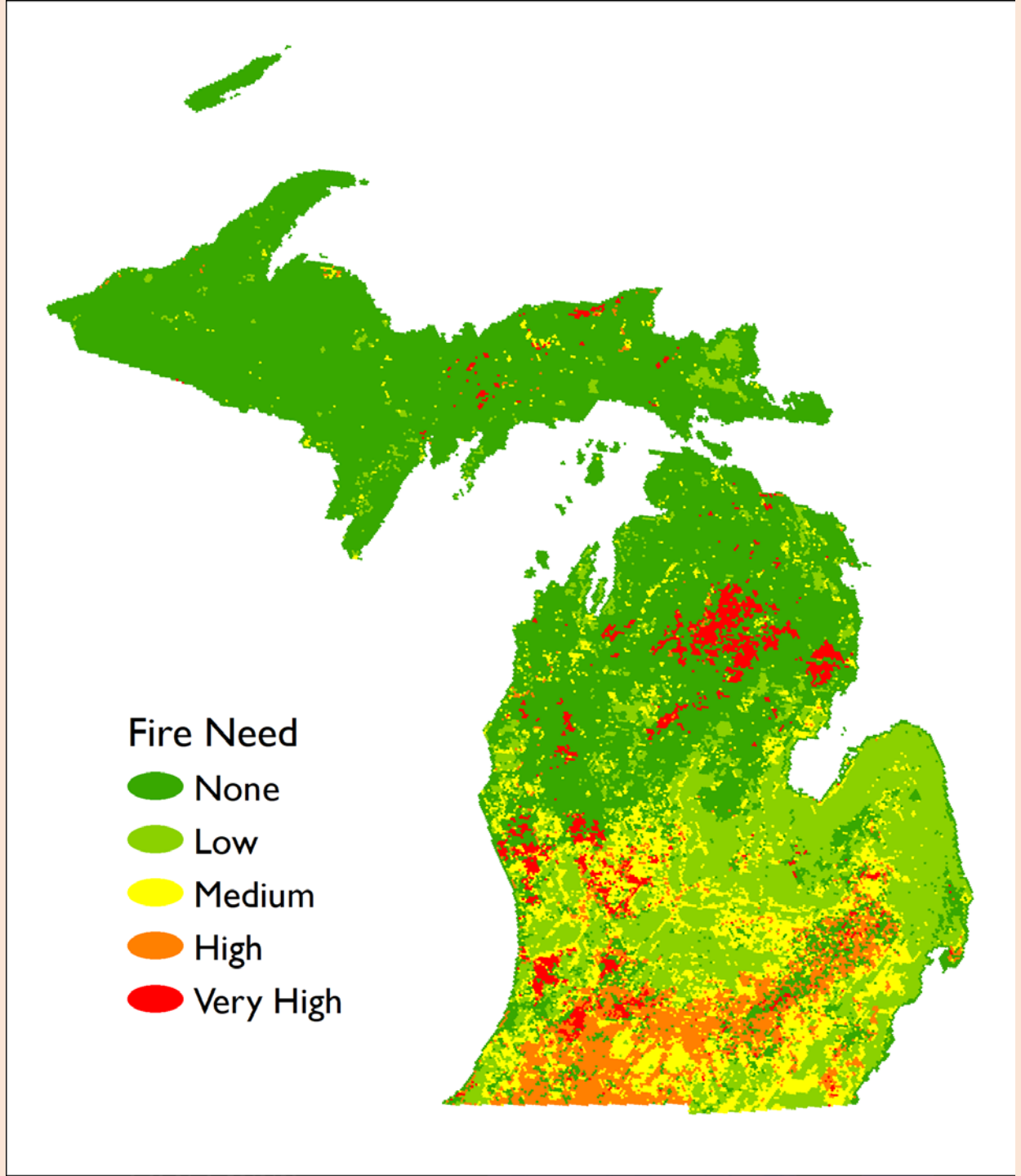
Attributed with:

- Slope
- Aspect
- Surficial geology
- Physiographic region
- Ecoregion subsection
- Vegetation condition class
- c1800 covertype
- Element occurrence community
- Existing vegetation type
- Fire dependence
- Fire frequency
- Fire frequency range
- Fire frequency uncertainty

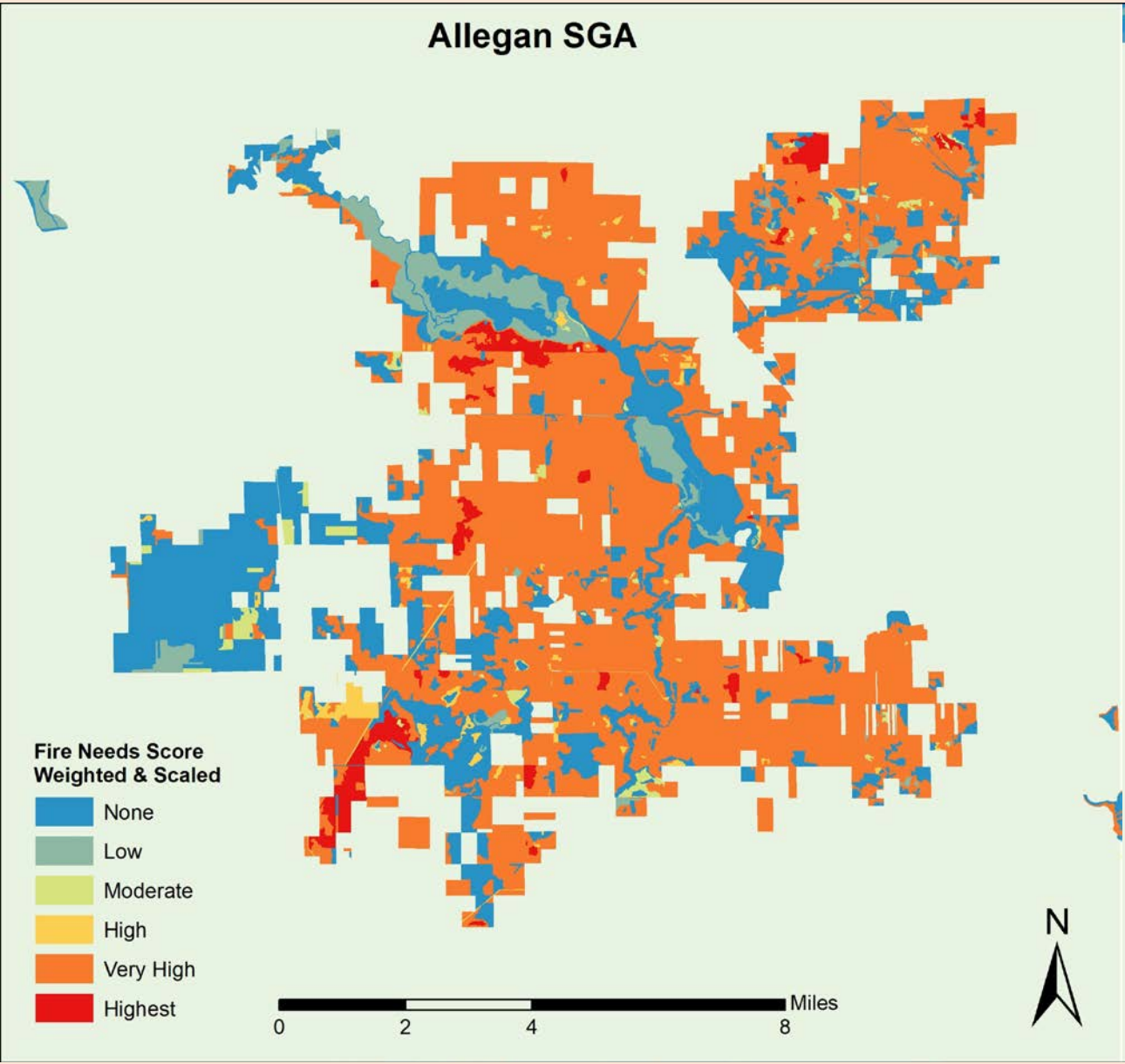


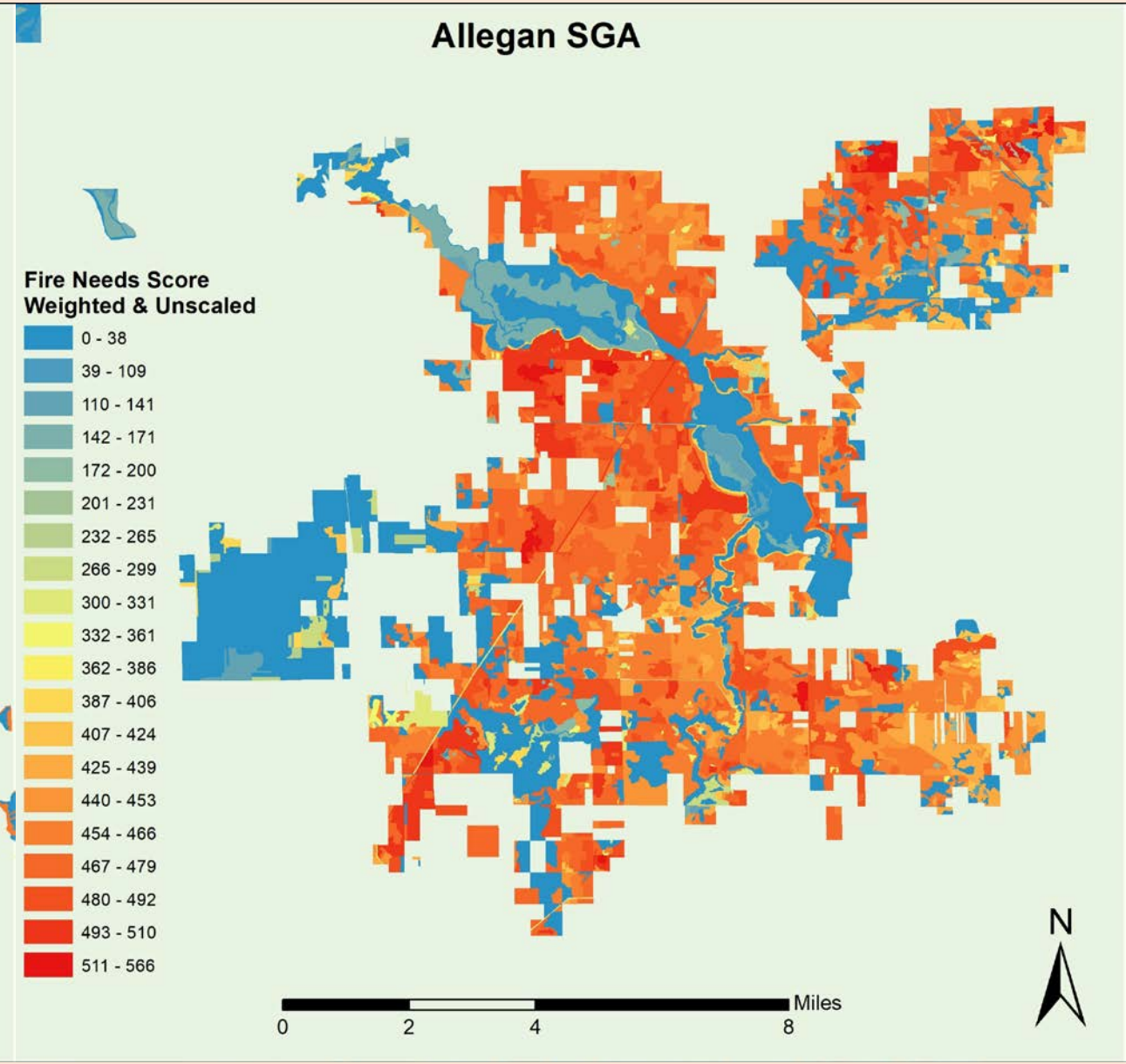

Fire Need
None
Low
Medium
High
Very High


Fire Need
None
Low
Medium
High
Very High


Fire Need
None
Low
Medium
High
Very High

The effect of scaling Fire Needs Score

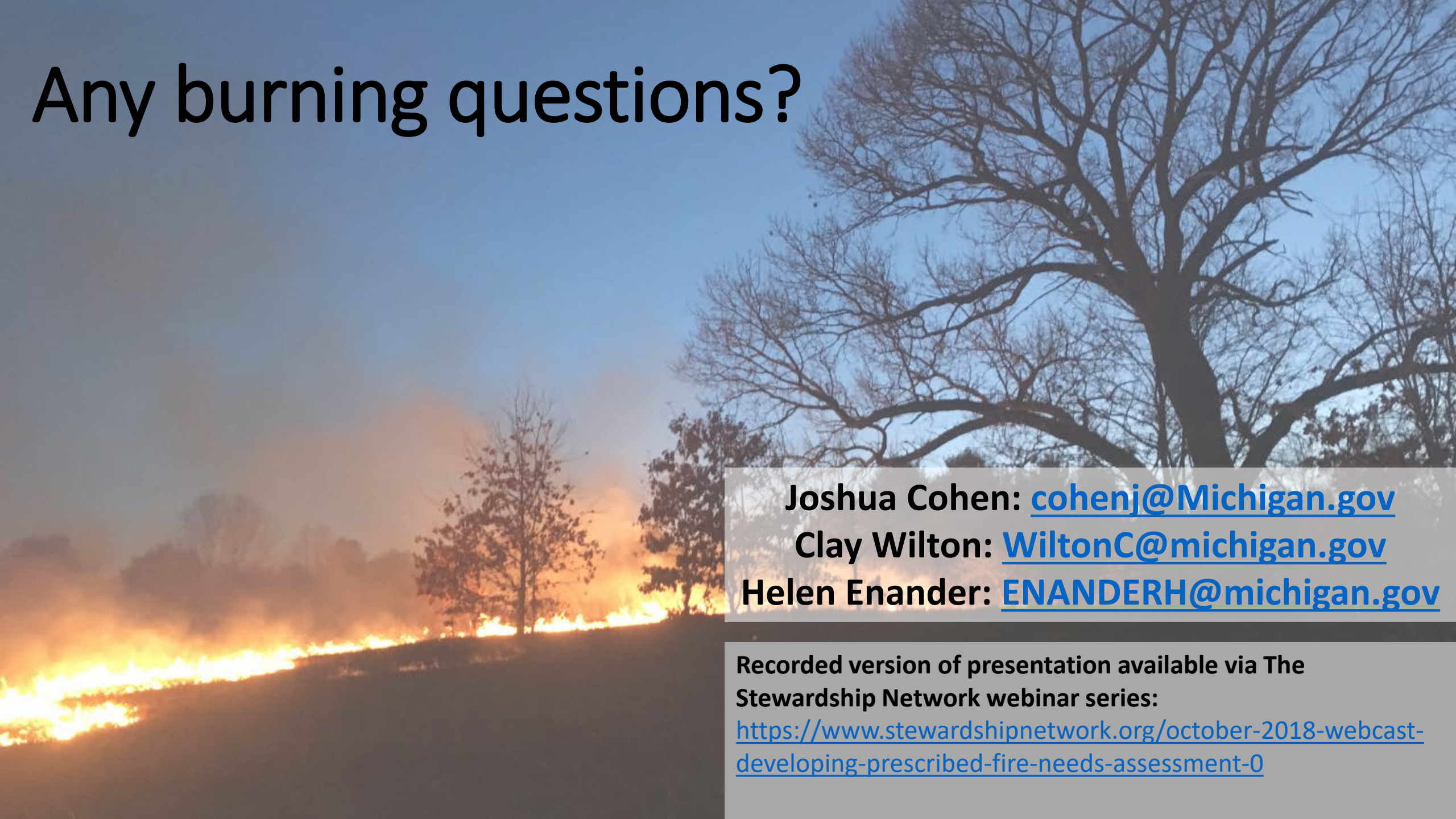




Acknowledgments

- Mark Sargent (DNR WLD)
- Christopher Hoving (DNR WLD)
- Michael Donovan (DNR WLD)
- Mark Monroe (DNR WLD)
- Jesse Lincoln (MNFI)
- Aaron Kortenhoven (MNFI)
- Randy Swaty (TNC Landfire)
- Jack McGowan-Stinski (Lake States Fire Consortium)
- Photo Credits
  - Michigan Prescribed Fire Council (Michele Richards, DMVA)
  - Southwest Michigan Land Conservancy (Nate Fuller)
  - Glenn Palmgren (DNR FRD)
  - Maria Albright (DNR WLD)
  - Jesse Lincoln (MNFI)
  - Matt Lewis (Michigan Aerospace Corporation)

Any burning questions?



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Recorded version of presentation available via The Stewardship Network webinar series:
https://www.stewardshipnetwork.org/october-2018-webcast-developing-prescribed-fire-needs-assessment-0