Monitoring Restoration & Management Progress

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Lake States Fire Science Consortium

WHAT IS COARSE-LEVEL MONITORING / METRICS?

- focuses on key ecological attributes, or metrics, that are biologically important for plant and animal species and that can be influenced by management
- relatively quick and inexpensive means to track the progress of restoration &/or maintenance (in prairie fens, oak & pine barrens/ savanna/ woodland/ forest, & adapted for other natural communities)
- requires basic understanding of systems, but not extensive botanical expertise
- designed so land managers evaluate success & determine next restoration/management step(s) needed
- Tested assumption that coarse-level progress reflects fine-scale conditions

MONITORING (& RESEARCH)…NATIVE SPECIES

- floristic quality assessment/ vegetation transects/ nectar sources
- oak seedling germination
- native prairie plant seeding versus plant plugs
- lupine enclosure and deer exclosure
- Karner blue butterfly (KBB) meander surveys & Occupied v. unoccupied KBB habitat
- Great plains spittlebug surveys

- Eastern Box turtle genetics study (one M.S. project)
- Eastern Massasauga habitat requirements, prey selection, & live fire (three M.S. projects)
- Mitchell's satyr habitat requirements (one PhD project)
- breeding bird nesting behavior/ shrub use (one M.S. project)

MONITORING – NON-NATIVE AND COMPETITIVE SPECIES

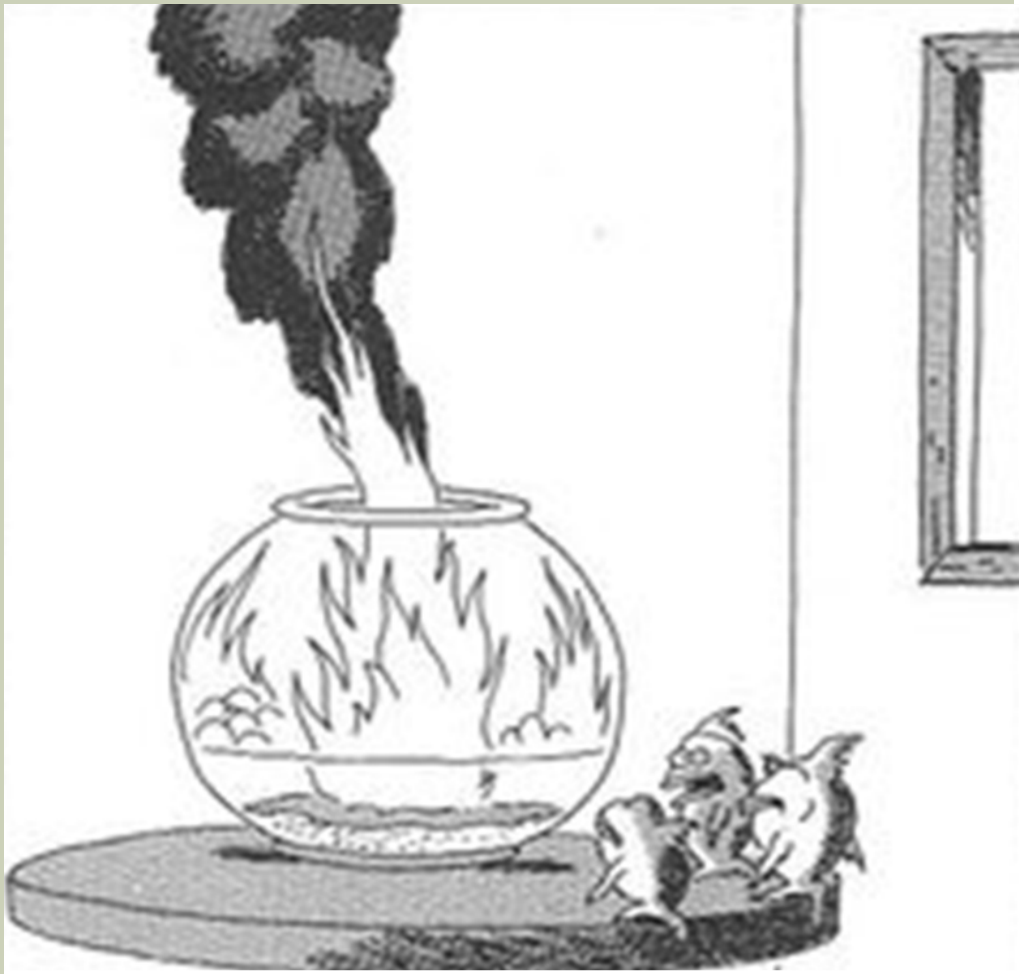
- comparison herbaceous herbicide treatments
- drill & fill for woody species
- knapweed density on fuel loading/ fire behavior; and change in soil chemistry (research)
- mechanical removal of invasive's (hand/ chainsaw/ large equipment)
- Pennsylvania sedge burn – herbicide plots
- "spot-burning and swath burning" with propane torches – season, heat/area/time

FIRE

- Photomonitoring, and developing photoload guide(s)
- Brown's, mortality, severity…
- Fire behavior

Impediments or Opportunities…*"Why are We Burning????"*

- fire effects on rare species (T&E, SC), invasive species, vegetative diversity?
- fire frequency, intensity & severity?
- ecological resilience – restoration-phase to maintenance-phase?
- other treatments (mechanical/herbicide)?
- **What are the burn window(s) – seasonality?**



"Well, thank God we all made it out in time….
'Course, now we're equally screwed."

Impediments or Opportunities…*"Why are We Burning????"*

- fire effects on rare species (T&E, SC), invasive species, vegetative diversity?
- fire frequency, intensity & severity?
- ecological resilience – restoration-phase to maintenance-phase?
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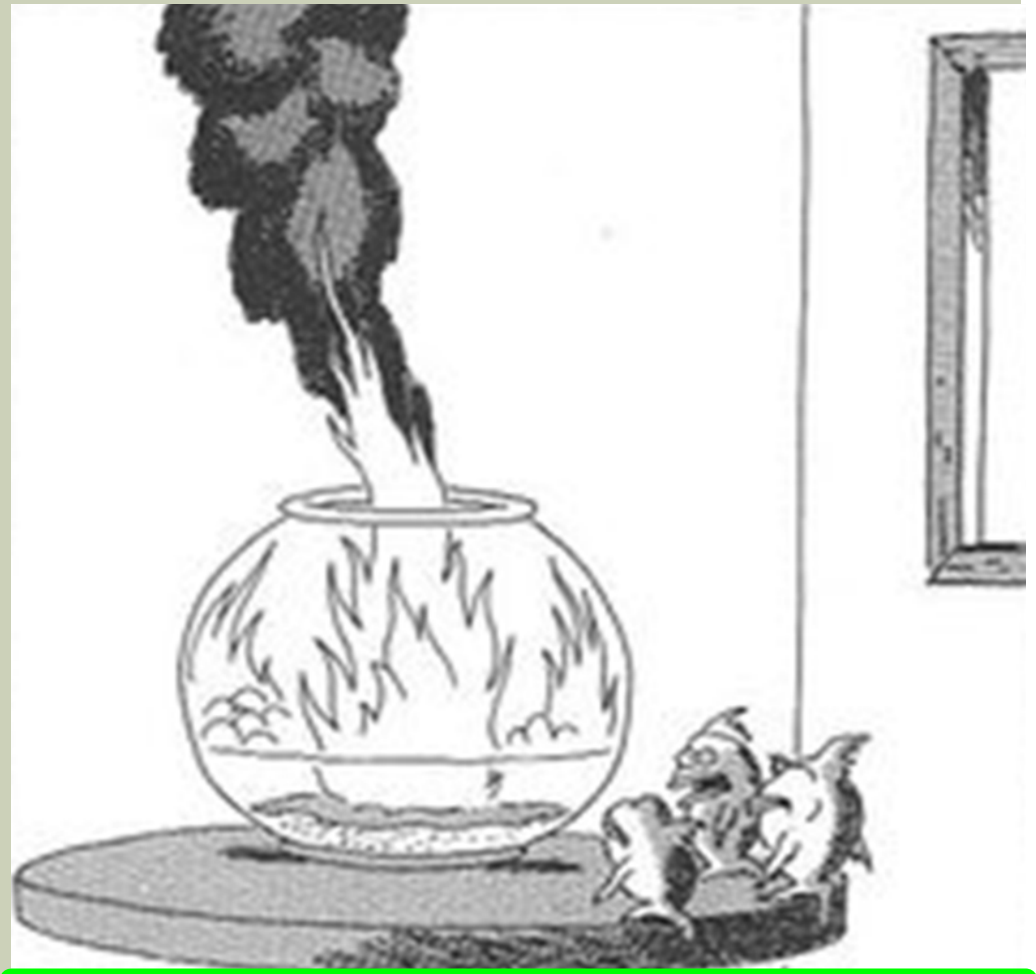


development
of
coarse-level metrics


“Goal is not the flames, but what the flames do...
... achieving desired fire effects”

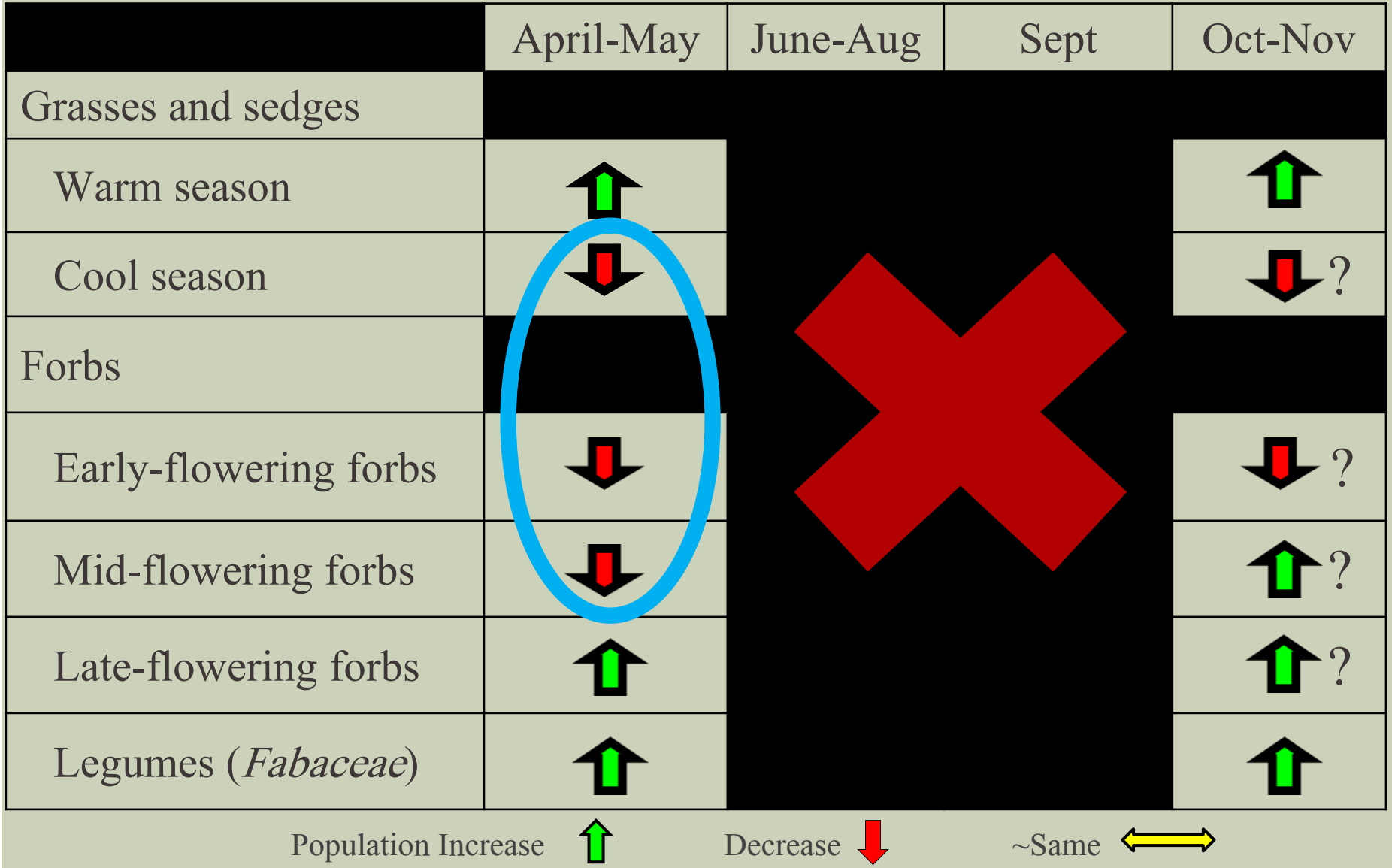

July
Aug
Sep
June
May
Oct
Apr
Nov
Mar
Dec
Feb
Jan
NO Burn
OK to Burn


Jul
Aug
Oct
Nov
Dec
Jan
Feb
Mar
Apr
OK to Burn


Jul
Aug
Apr
Dec
Jan
Feb
Mar
Son of
a ….

"Spring" & "Fall Burn Windows" = ~ 60 total days
minus (burn ban/wildfire risk days plus rain days) =
~ 30 operational days

Dormant Season Fire Effects – Native Plants



Note: it is better to use yearly Phenology, but illustrated above in general terms with calendar dates in N. Midwest

Dormant Season Fire Effects - non-native or competitive

	March-April	May	June-Aug	Sept	Oct-Nov
knapweed	↑				↑
sweet clovers	↑				↑
garlic mustard	↔				↑
St. Johnswort	↑				↑
bouncing bet	↑				↑
buckthorn	↑				↑
autumn olive	↔				↔
honeysuckles	↑				↑
Pennsylvania sedge	↑				↑

Population Increase ↑ Decrease ↓ ~Same ↔

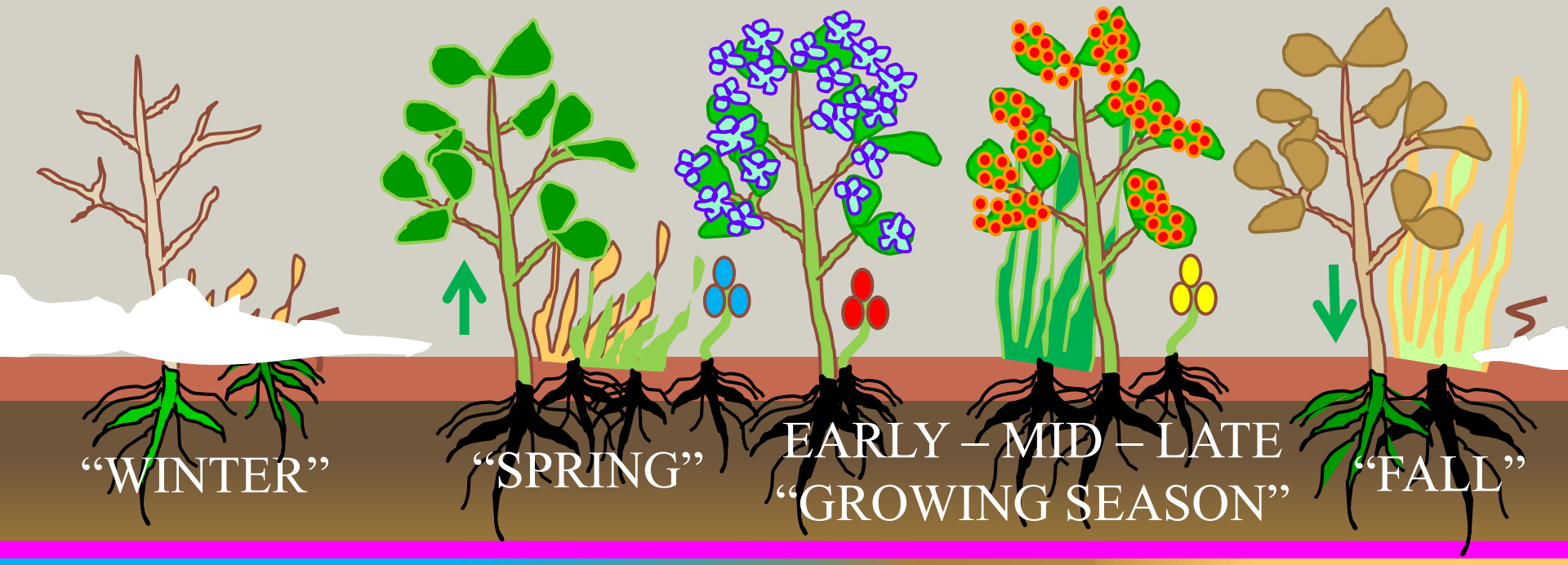
Note: it is better to use [illegible]early Phenology, but illustrated above in general terms with calendar dates in N. Midwest


Jan
Feb
Mar
Apr
Dec
Nov

PHENOLOGY & PHYSIOLOGY

Woody – Coniferous & Deciduous

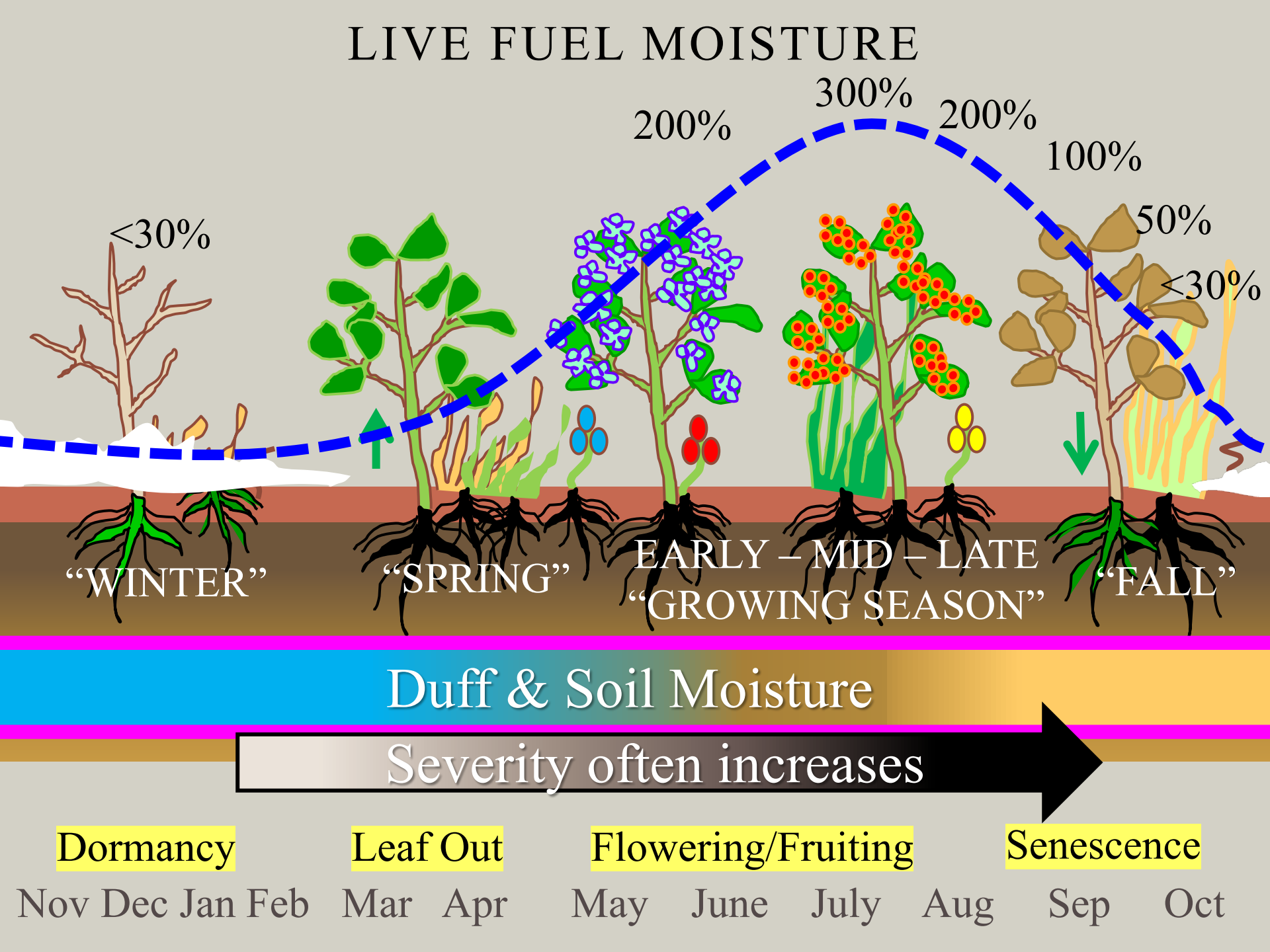
Herbaceous – Annuals & Perennials



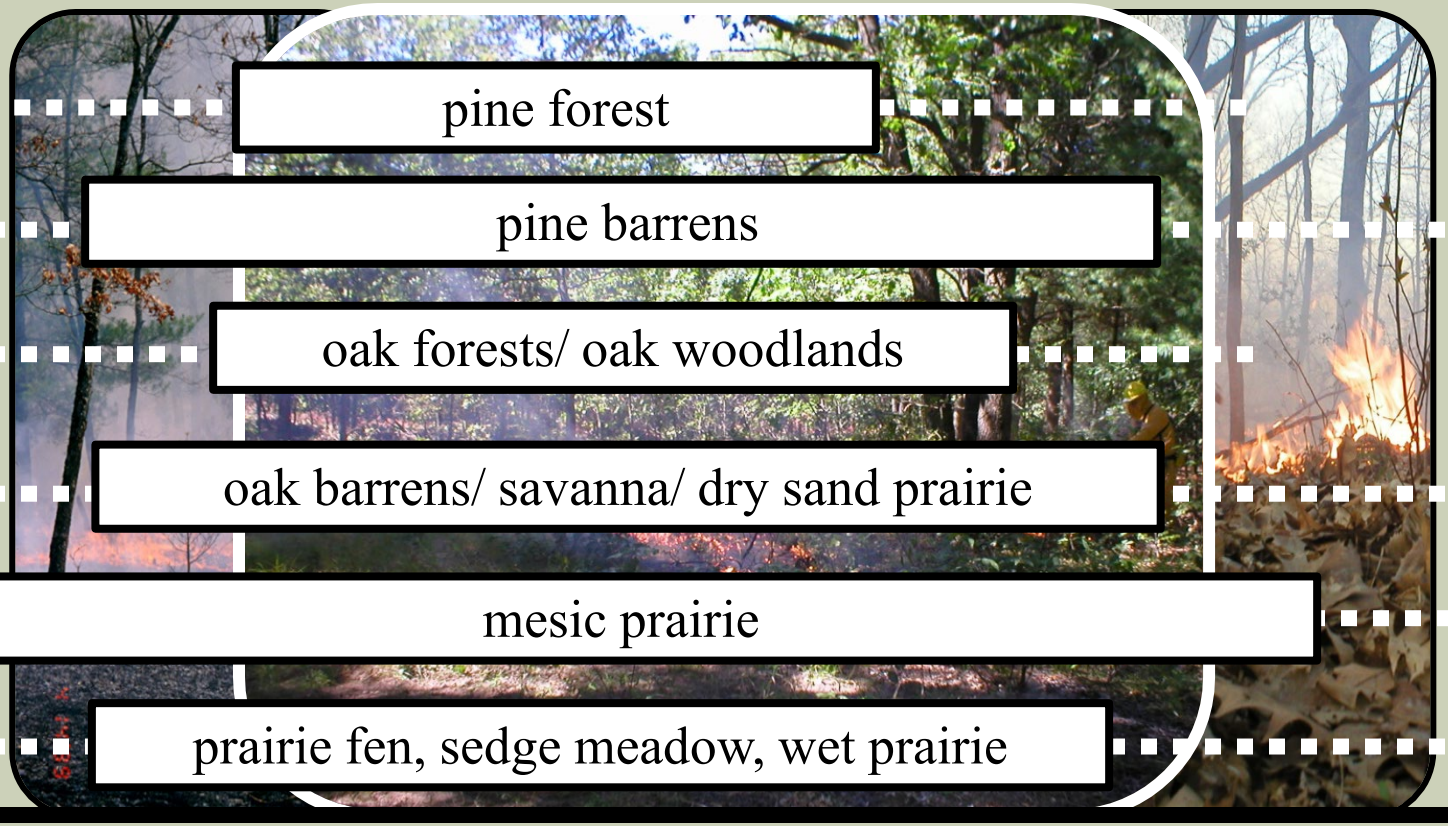
higher Duff & Soil Moisture *lower*

Severity often increases

Dormancy	Leaf Out	Flowering/Fruiting	Senescence
Nov Dec Jan Feb	Mar Apr	May June July Aug	Sep Oct


LIVE FUEL MOISTURE
<30%
200%
300%
200%
100%
50%
<30%
"WINTER"
"SPRING"
EARLY – MID – LATE
"GROWING SEASON"
"FALL"
Duff & Soil Moisture
Severity often increases
Dormancy
Leaf Out
Flowering/Fruiting
Senescence
Nov Dec Jan Feb Mar Apr May June July Aug Sep Oct

SEASONALITY:
BURN WINDOWS BY NATURAL COMMUNITY*



Jan Feb Mar Apr May June July Aug Sep Oct Nov Dec

*in the N. Midwest

GROWING SEASON: EARLY-MID-LATE

Apr

May

June

July

Aug

Sep

Seasonal Fire Effects – native plants

	April-May	June-Aug	Sept	Oct-Nov
Grasses and sedges				
Warm season	↑	↓	↔	↑
Cool season	↓	↑	↑	↓?
Forbs				
Early-flowering forbs	↓	↑	↑	↓?
Mid-flowering forbs	↓	↑	↑	↑?
Late-flowering forbs	↑	↓	↑	↑?
Legumes (*Fabaceae*)	↑	↑	↑	↑

Population Increase ↑ Decrease ↓ ~Same ↔

Note: it is better to use yearly Phenology, but illustrated above in general terms with calendar dates for N. Midwest

Seasonal Fire Effects – non-native plants

	March-April	May	June-Aug	Sept	Oct-Nov
knapweed	↑	↔	↓	↓	↑
sweet clovers	↑	↑	↔	↔	↑
garlic mustard	↔	↓	↓	↑	↑
St. Johnswort	↑	↔	↓	↔	↑
bouncing bet	↑	↑	↔	↔	↑
buckthorn	↑	↔	↓	↓	↑
autumn olive	↔	↓	↓	↓	↔
honeysuckles	↑	↓	↓	↔	↑

Population Increase ↑ Decrease ↓ ~Same ↔

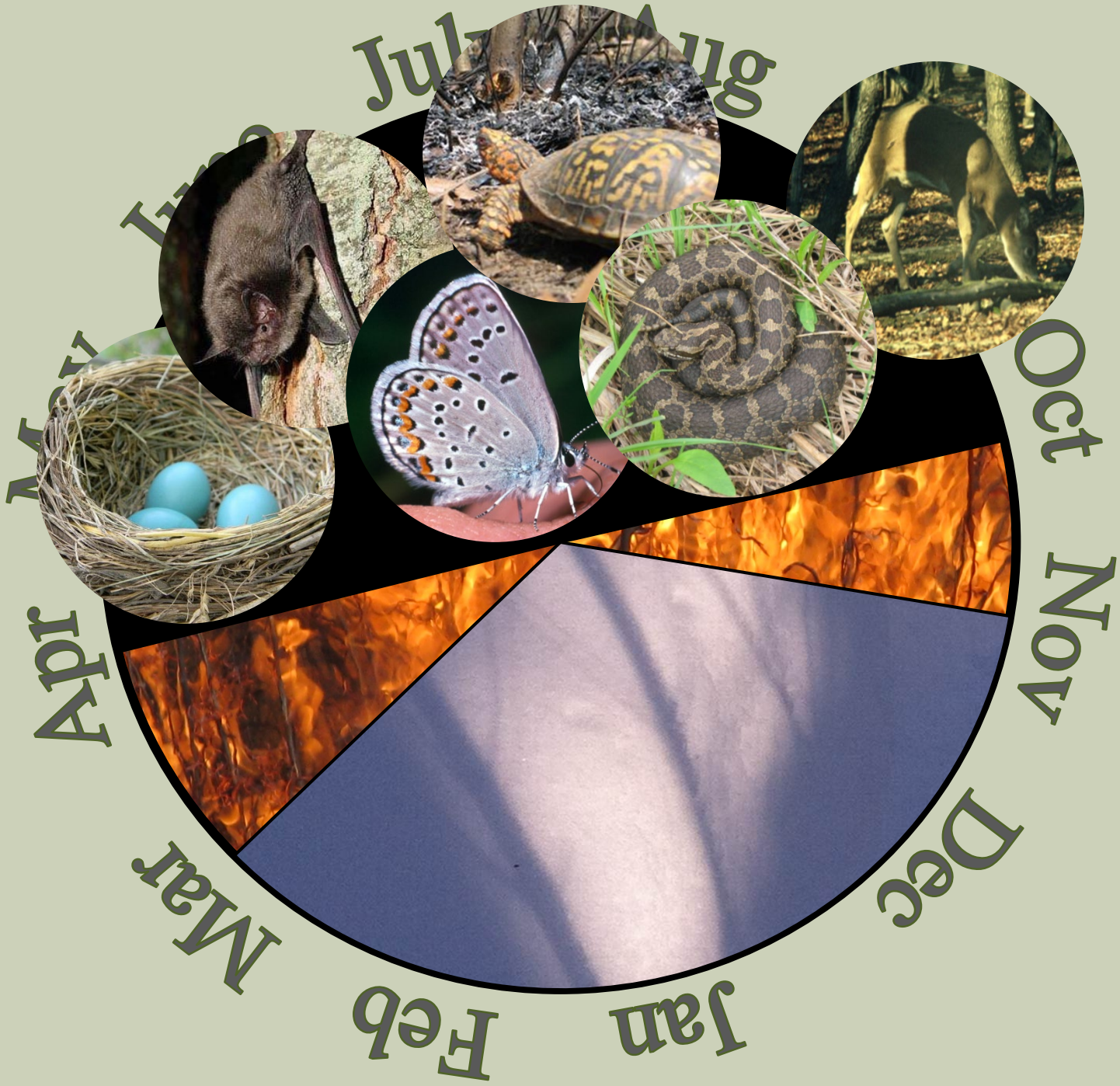
Note: it is better to use yearly Phenology, but illustrated above in general terms with calendar dates for N. Midwest

Seasonal Fire Effects – competitive plants

	March-April	May	June-Aug	Sept	Oct-Nov
bracken fern	↑	↔	↓	↔	↑
red maple	↑	↓	↓	↑	↑
Pennsylvania sedge	↑	↔	↓	↔	↑

Population Increase ↑ Decrease ↓ ~Same ↔

Note: it is better to use yearly Phenology, but illustrated above in general terms with calendar dates for N. Midwest


Jul
Aug
Oct
Nov
Dec
Jan
Feb
Mar
Apr

overcoming wildlife-fire impediments?

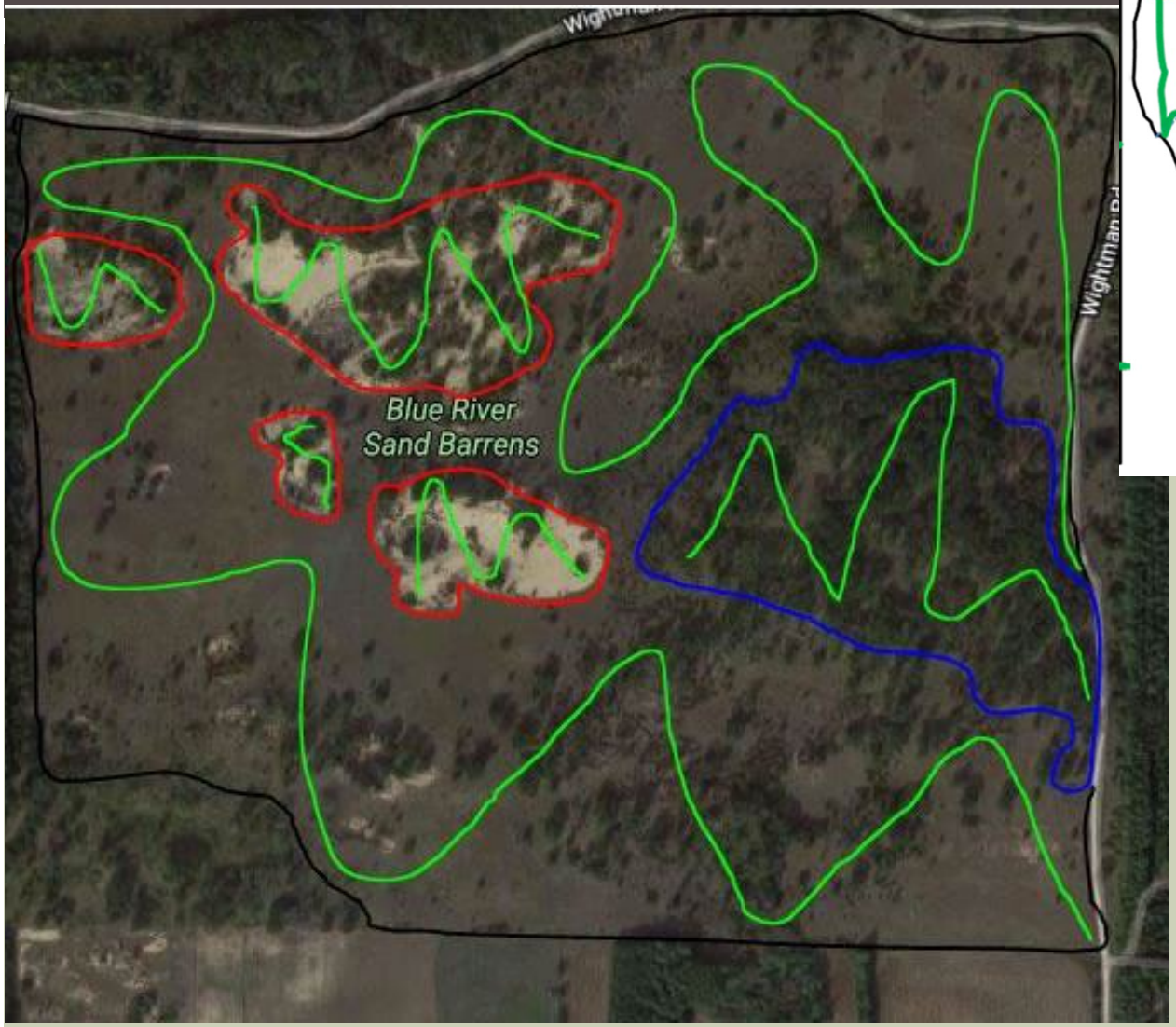
"Now! *That* should clear up a few things around here!"

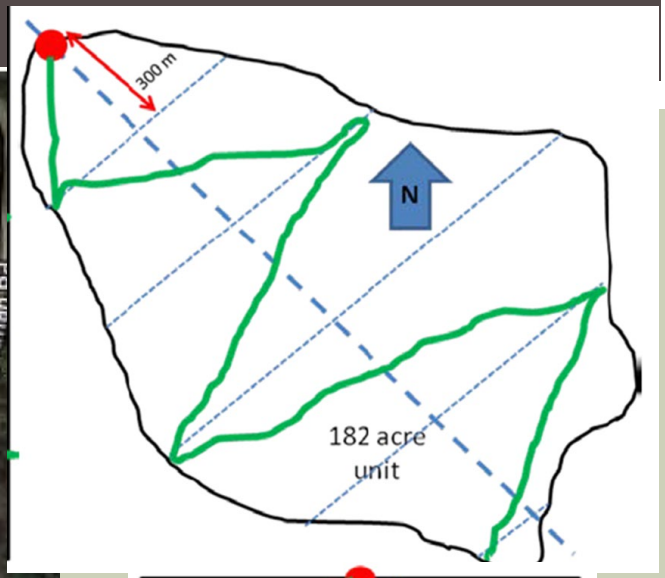

Fire Effects

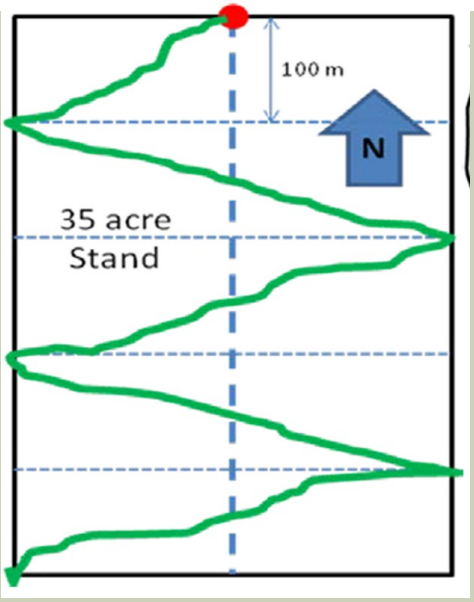
GUIDELINES FOR FIELD ESTIMATES

1. Conduct evaluations during full leaf out conditions for canopy species
2. Ensure visual access to areas that are representative of all portions of the unit – and average – composite score
3. Conduct evaluation when high priority native, or invasive species, are most visible
4. Evaluate each metric independently, i.e., percent cover of herbaceous species should include plants that occur underneath shrubs - Total percent cover of the herbaceous and shrub metrics can/ and will exceed 100%
5. Weighted value used for each metric for the proportional area of each management unit/burn unit stand/area
6. Gestalt: overall rating for entire area

MEANDER ROUTES EXAMPLES IN ASSESSMENT AREAS







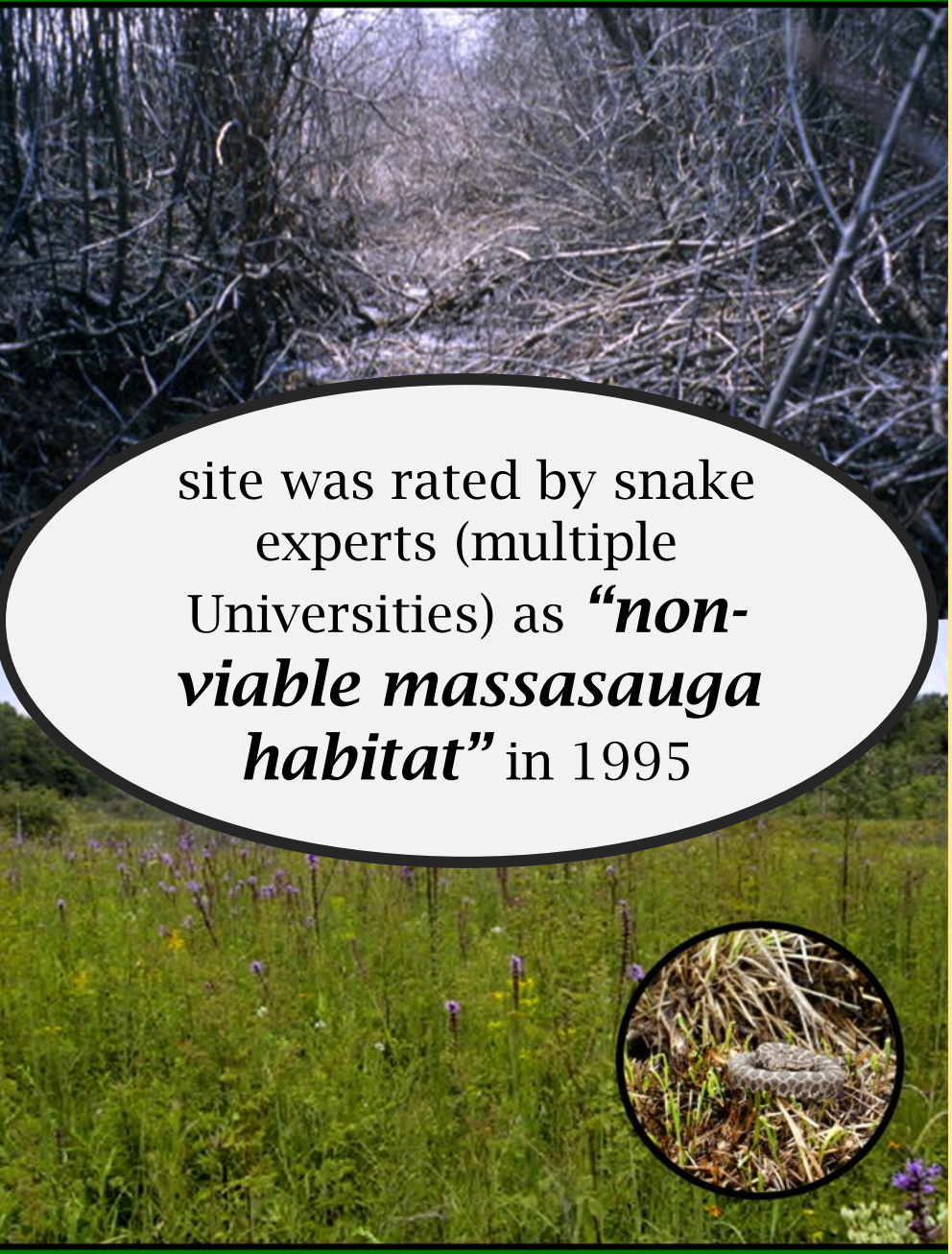
COARSE-LEVEL METRICS FOR PRAIRIE FENS

Meander survey/ walk through each unit & **visual assessment** of percent cover of:

- herbaceous species - native versus non-native / invasive
- shrubs
- flammability (% unit with fuel that can be broadcast burned)

Key Attribute	Indicator	**Bold = Current** Indicator Ratings			*Italics = Desired*
		Poor	Fair	Good	Very Good
Community architecture	% of managed fen soils supporting low, herbaceous communities	<10%	10% - <60%	**60% - <80%**	*80% - 100%*
Community architecture	percent cover of native species in the managed fen	<25%	**25% - <60%**	60% - 90%	*>90% - 100%*
Fire regime	percent of managed fen that will carry a prescribed fire	<10%	**10% - <60%**	60% - <80%	*80% - 100%*

1995 pre-restoration

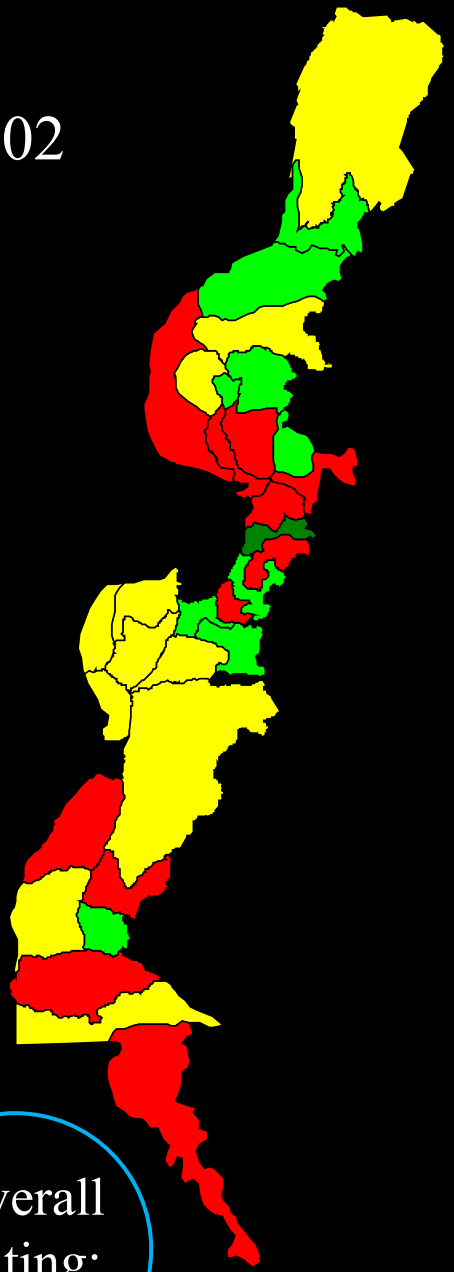


site was rated by snake experts (multiple Universities) as ***"non-viable massasauga habitat"*** in 1995

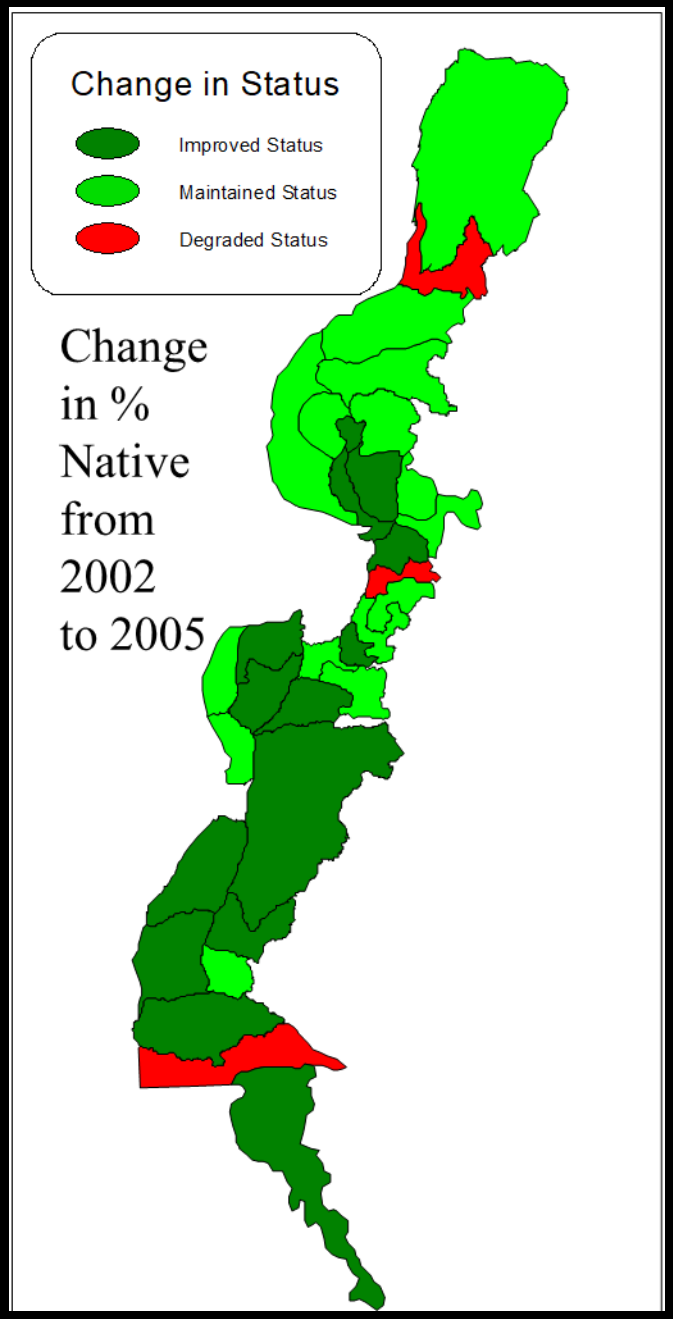
2010 post-restoration

Eradication of buckthorn, other shrubs, loosestrife, reed canary grass, phragmites, swallowwort, thistles

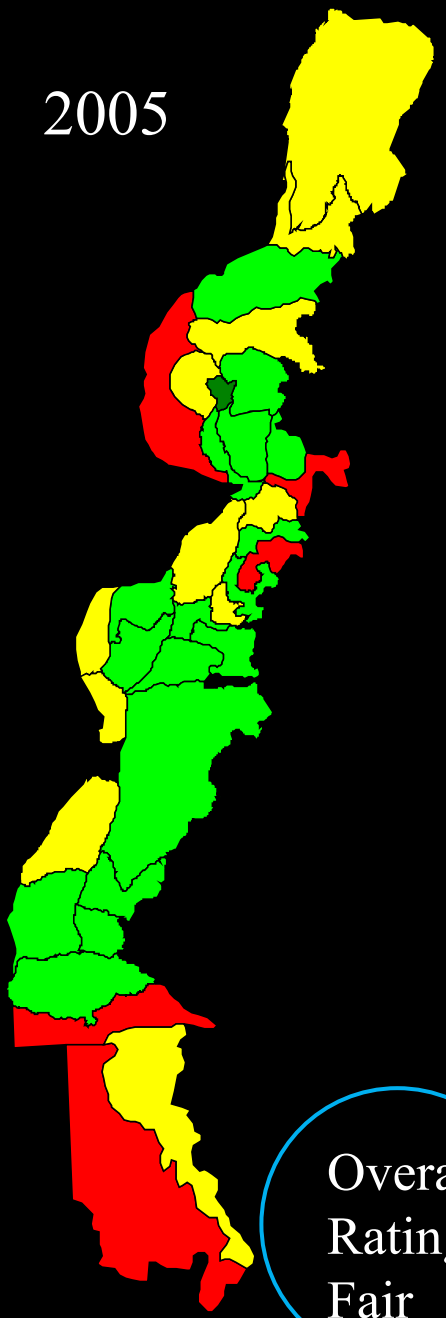
2002



Overall Rating: Fair



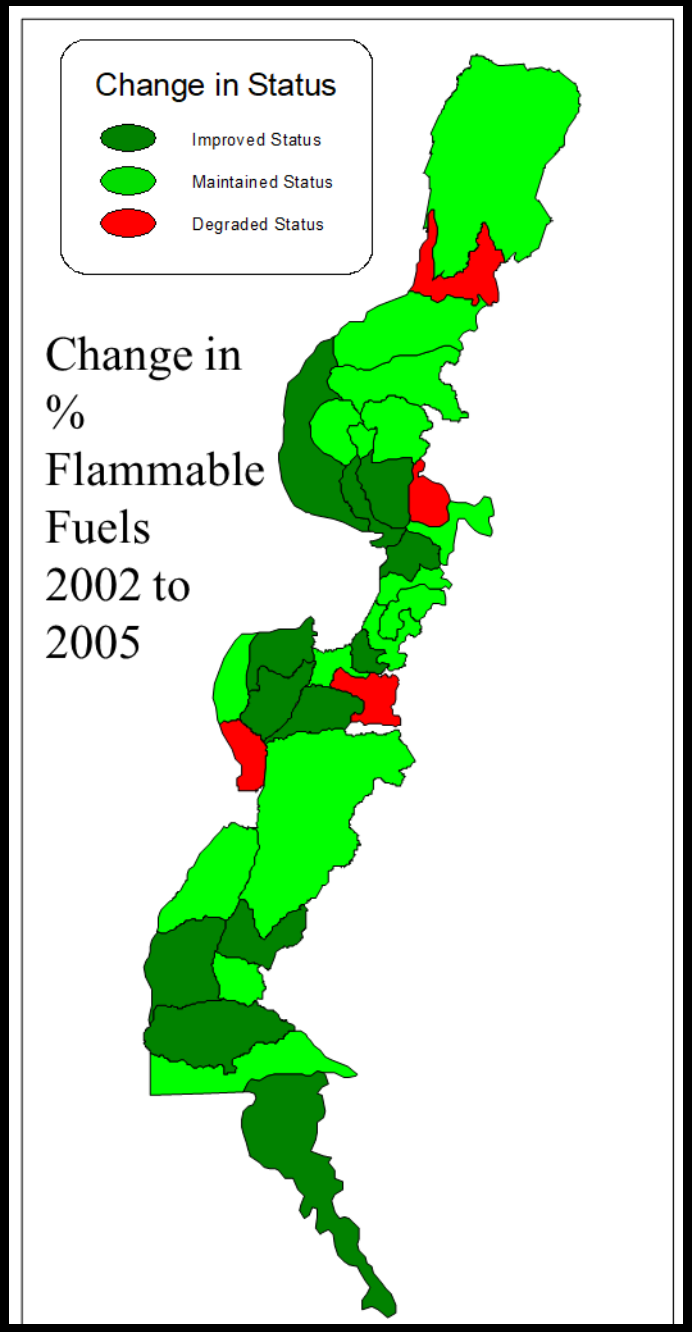
2005



Overall Rating: Fair

Percentage Native Vegetation

2002



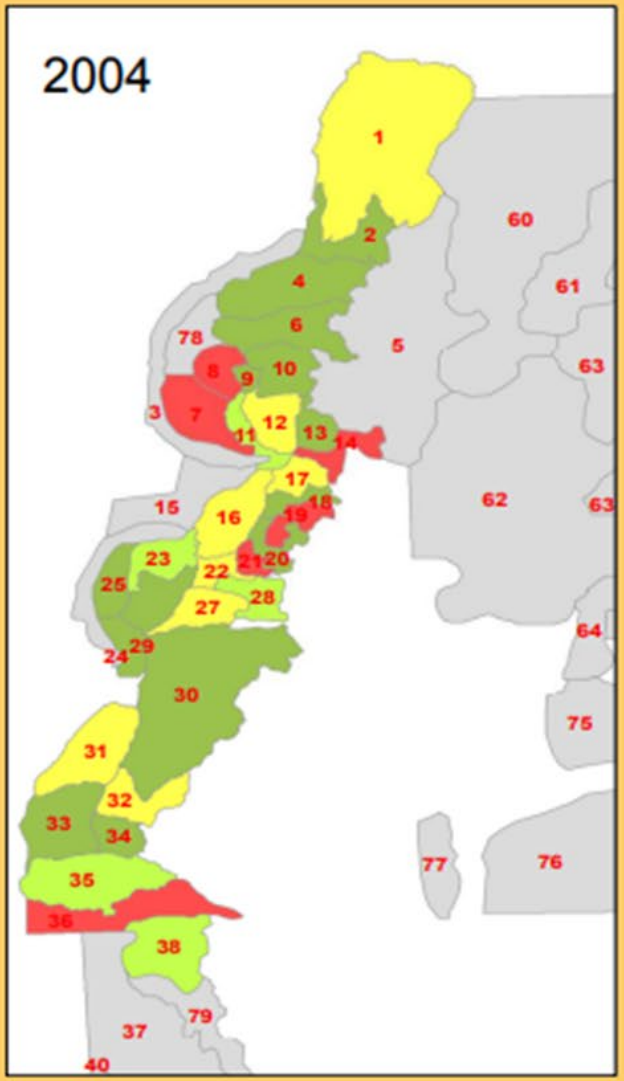
2005

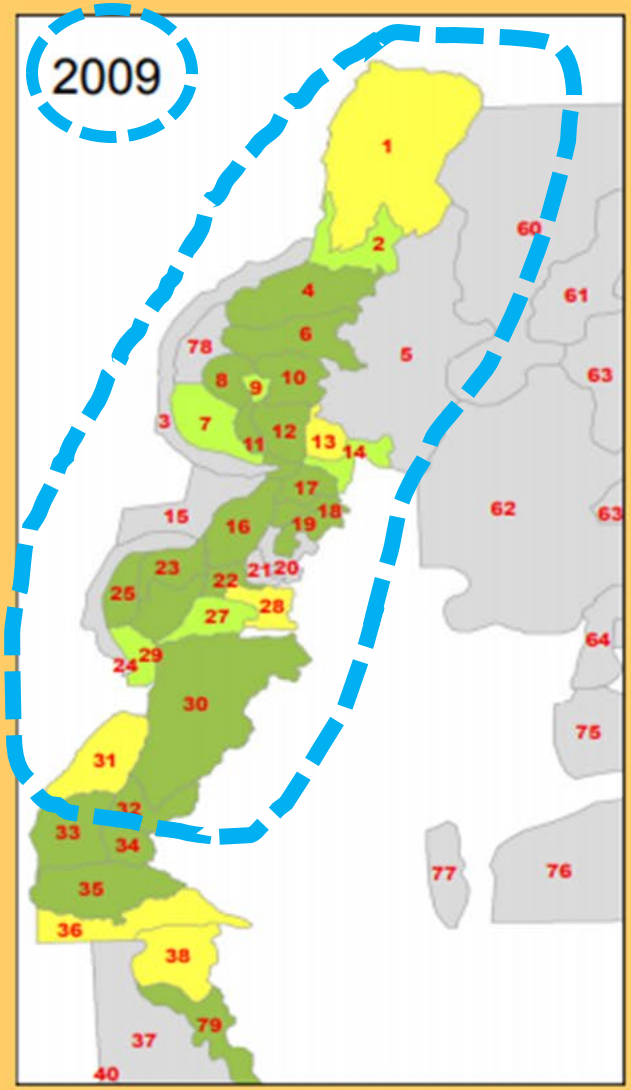
Overall Rating: Fair

Overall Rating: Fair

Percentage Flammable Fuels

Coarse Metrics – Restoration Effectiveness

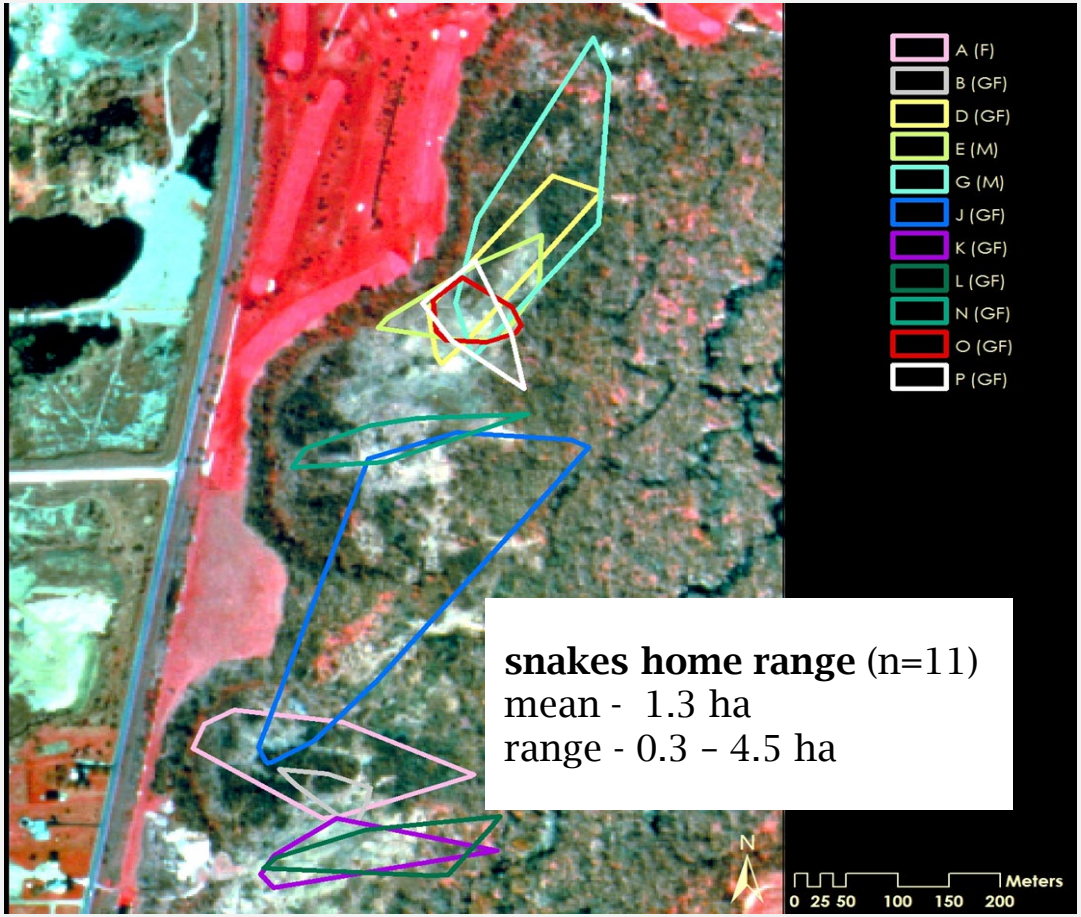




Flammable Cover Ratings

- implementing fire with a rare snake -

this is not a “BURN-NO BURN” restoration option, so what questions need to be asked to minimize individual loss?

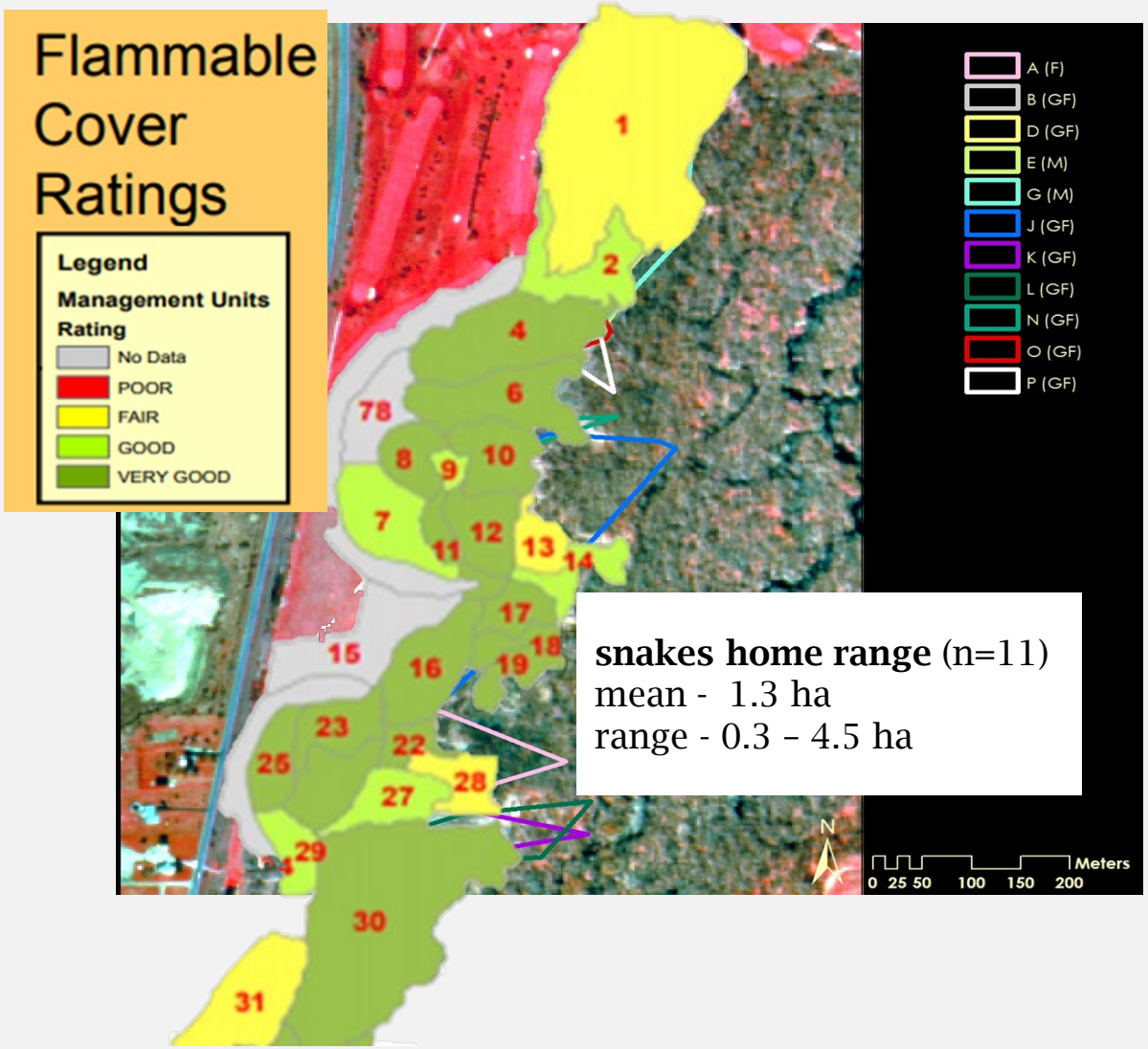


snakes home range (n=11)
mean - 1.3 ha
range - 0.3 – 4.5 ha

- direct versus indirect fire injury/mortality?
- what are all the other mortality factors?
- how fast and how far can a massasauga move to get to refugia?
- what are the cues to escape – visual, audio, smoke, thermal?
- effects on prey species?

- implementing fire with a rare snake -

this is not a “BURN-NO BURN” restoration option, so what questions need to be asked to minimize individual loss?



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results

- average massasauga escape speed: 0.234 m/s (46 ft/min)
- future fire implementation – keep maximum rate of spread no faster than 16 ch/hr (17.6 ft/min) with a targeted rate of 10 ch/hr or less (11 ft/min)
- all prey species increased shortly after each burn and any season of burn
  - prey base consists of mammals (largest amount of adult snake diet) and herps (neonates/young snake diet)
- two massasauga's (2 males) direct mortality during early growing season burn, internal strip-firing for smoke management (WUI) – almost shutdown us down by USFWS-State permits for Rx with EMR
  - 23 snakes (13 unmarked/unknown) were found in same burn area two weeks post-burn
  - 69 snakes marked in first year of study 2005 (site was rated non-viable habitat in 1995!) – **the monitoring and research saved fire program!**
- raptors main predators of adult massasauga

COARSE-LEVEL METRICS - OAK AND/OR PINE SAVANNA/BARRENS

Metrics are evaluated independently, there are multiple structural layers, and total cover of any two metrics can exceed 100 %

- **canopy closure and complexity of canopy structure** and **percent of canopy** composed of oak or pine species
- **sub-canopy** oak/pine and oak/pine recruitment
- **shrub** cover
- ground cover of **native herbaceous plant species** (grass, sedge, forbs) compared to **non-native invasive and competitive plant species**

2019 UPGRADES

Coarse-level monitoring protocol for assessing baseline condition and restoration progress in oak and pine barrens - version 2.2. PUB NH 746 2019. Wisconsin DNR. Madison, WI

Ryan O'Connor[1], Amy Staffen[1], and Jack McGowan-Stinski[2]

[1] Bureau of Natural Heritage Conservation, Wisconsin Department of Natural Resources

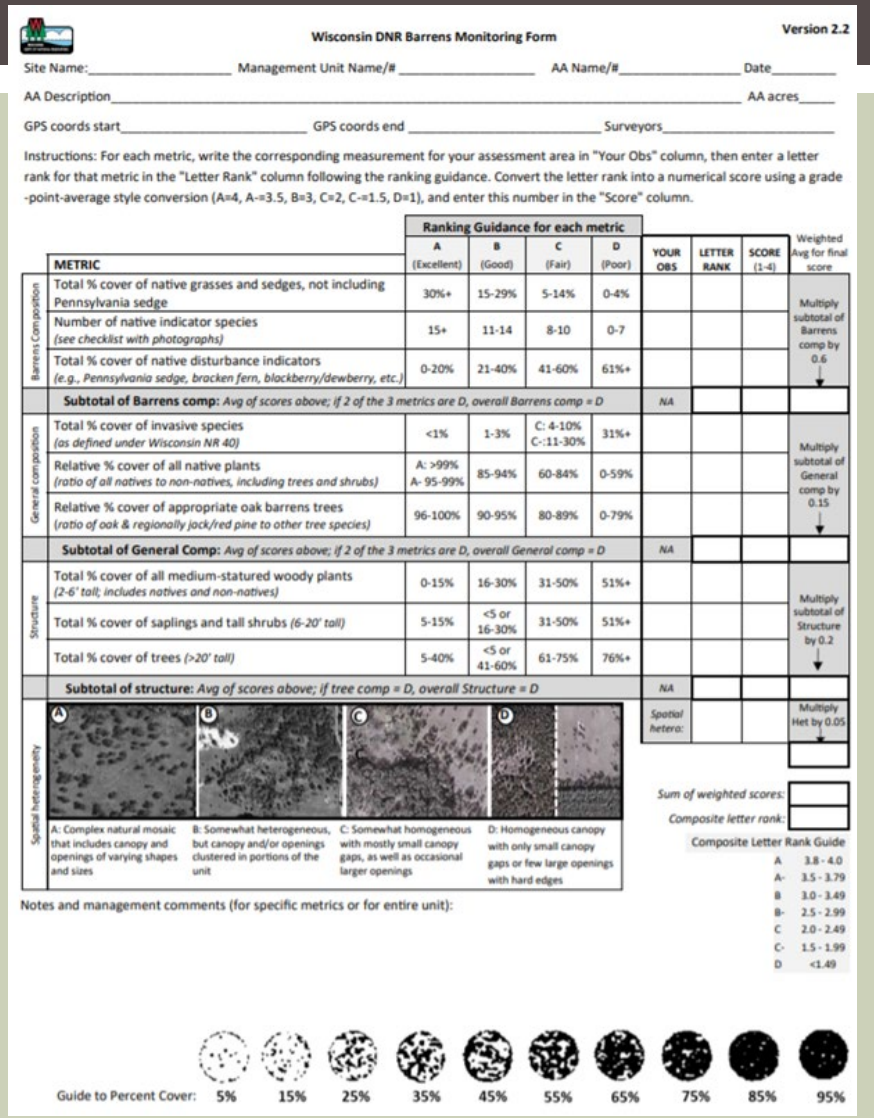
[2] Lakes States Fire Science Consortium

http://lakestatesfiresci.net/Fire&FuelsMonitoringWorkshop2021/WDNR%20Barrens%20coarse-level%20monitoring%20SOP%20v2.2.pdf

2019 UPGRADES

Wisconsin DNR Barrens Monitoring Form

http://lakestatesfiresci.net/Fire&FuelsMonitoringWorkshop2021/WDNR%20Barrens%20CLM_Monitoring%20Form_v2.2.pdf



Wisconsin DNR Barrens Monitoring Form Version 2.2

Site Name:_____ Management Unit Name/# _____ AA Name/#_____ Date_____

AA Description_____ AA acres_____

GPS coords start_____ GPS coords end _____ Surveyors_____

Instructions: For each metric, write the corresponding measurement for your assessment area in "Your Obs" column, then enter a letter rank for that metric in the "Letter Rank" column following the ranking guidance. Convert the letter rank into a numerical score using a grade-point-average style conversion (A=4, A-=3.5, B=3, C=2, C-=1.5, D=1), and enter this number in the "Score" column.

	METRIC	Ranking Guidance for each metric: A (Excellent)	B (Good)	C (Fair)	D (Poor)	YOUR OBS	LETTER RANK	SCORE (1-4)	Weighted Avg for final score
Barrens Composition	Total % cover of native grasses and sedges, not including Pennsylvania sedge	30%+	15-29%	5-14%	0-4%				Multiply subtotal of Barrens comp by 0.6
	Number of native indicator species *(see checklist with photographs)*	15+	11-14	8-10	0-7				
	Total % cover of native disturbance indicators *(e.g., Pennsylvania sedge, bracken fern, blackberry/dewberry, etc.)*	0-20%	21-40%	41-60%	61%+				
	Subtotal of Barrens comp: *Avg of scores above; if 2 of the 3 metrics are D, overall Barrens comp = D*					NA			
General composition	Total % cover of invasive species *(as defined under Wisconsin NR 40)*	<1%	1-3%	C: 4-10% C-:11-30%	31%+				Multiply subtotal of General comp by 0.15
	Relative % cover of all native plants *(ratio of all natives to non-natives, including trees and shrubs)*	A: >99% A- 95-99%	85-94%	60-84%	0-59%				
	Relative % cover of appropriate oak barrens trees *(ratio of oak & regionally jack/red pine to other tree species)*	96-100%	90-95%	80-89%	0-79%				
	Subtotal of General Comp: *Avg of scores above; if 2 of the 3 metrics are D, overall General comp = D*					NA			
Structure	Total % cover of all medium-statured woody plants *(2-6' tall; includes natives and non-natives)*	0-15%	16-30%	31-50%	51%+				Multiply subtotal of Structure by 0.2
	Total % cover of saplings and tall shrubs *(6-20' tall)*	5-15%	<5 or 16-30%	31-50%	51%+				
	Total % cover of trees *(>20' tall)*	5-40%	<5 or 41-60%	61-75%	76%+				
	Subtotal of structure: *Avg of scores above; if tree comp = D, overall Structure = D*					NA			
Spatial heterogeneity	A: Complex natural mosaic that includes canopy and openings of varying shapes and sizes B: Somewhat heterogeneous, but canopy and/or openings clustered in portions of the unit C: Somewhat homogeneous with mostly small canopy gaps, as well as occasional larger openings D: Homogeneous canopy with only small canopy gaps or few large openings with hard edges					*Spatial hetero:*			Multiply Het by 0.05

Sum of weighted scores:

Composite letter rank:

Composite Letter Rank Guide

A	3.8 - 4.0
A-	3.5 - 3.79
B	3.0 - 3.49
B-	2.5 - 2.99
C	2.0 - 2.49
C-	1.5 - 1.99
D	<1.49

Notes and management comments (for specific metrics or for entire unit):

Guide to Percent Cover: 5% 15% 25% 35% 45% 55% 65% 75% 85% 95%

Field tests of Coarse-level metrics for oak barrens, jack pine barrens, dry sand prairie

site	County	Metrics used	unit acres	person hours	*cost/hr salary	acres per hour	cost per acre	summary
Manni's tract**	Newaygo	dry sand prairie	30	9	206.73	3.33	6.89	range in acres = 10 to 310
Durkee Hunt Club - East Moffett Dam Unit	Montmorency	jack pine	182	12	275.64	15.17	1.51	range in acres/hour = 1.67 to 15.17
Black River Ranch - Stewart Creek Unit and Fairchild South Unit	Montmorency	jack pine	310	21	482.37	14.76	1.56	range in cost/acre = $1.51 to $13.78
Deur's tract	Newaygo	oak barrens	30	9	206.73	3.33	6.89	average acres/hour = 9.52
Coolbough - 58th St. Unit** and Hazelwood Unit	Newaygo	oak barrens	10	6	137.82	1.67	13.78	average cost/acre = $2.41
Hayes Road KBB**	Newaygo	dry sand prairie	17	3	68.91	5.67	4.05	
Big Prairie Cemetery	Newaygo	dry sand prairie	35	4.5	103.37	7.78	2.95	
7 sites, 9 units			**614**	**64.5**	**1481.57**	**9.52**	**2.41**	

*$22.97/hr average cost from 6 different individuals (two FTE's, four - 6 month "seasonals" [3 of the 4 seasonals get full benefits, and not all paid same/hour salary])
**occupied KBB sites

note: some permanent photopoints established/re-located during the time estimates, times not excluded from coarse-level metric tests


WAP WAP WAP
CALVIN! WHAT ARE YOU DOING TO THE COFFEE TABLE?!?
IS THIS SOME SORT OF TRICK QUESTION, OR WHAT?

Questions?


Lake States
Fire Science Consortium
A JFSP KNOWLEDGE EXCHANGE CONSORTIUM
JOINT FIRE SCIENCE PROGRAM