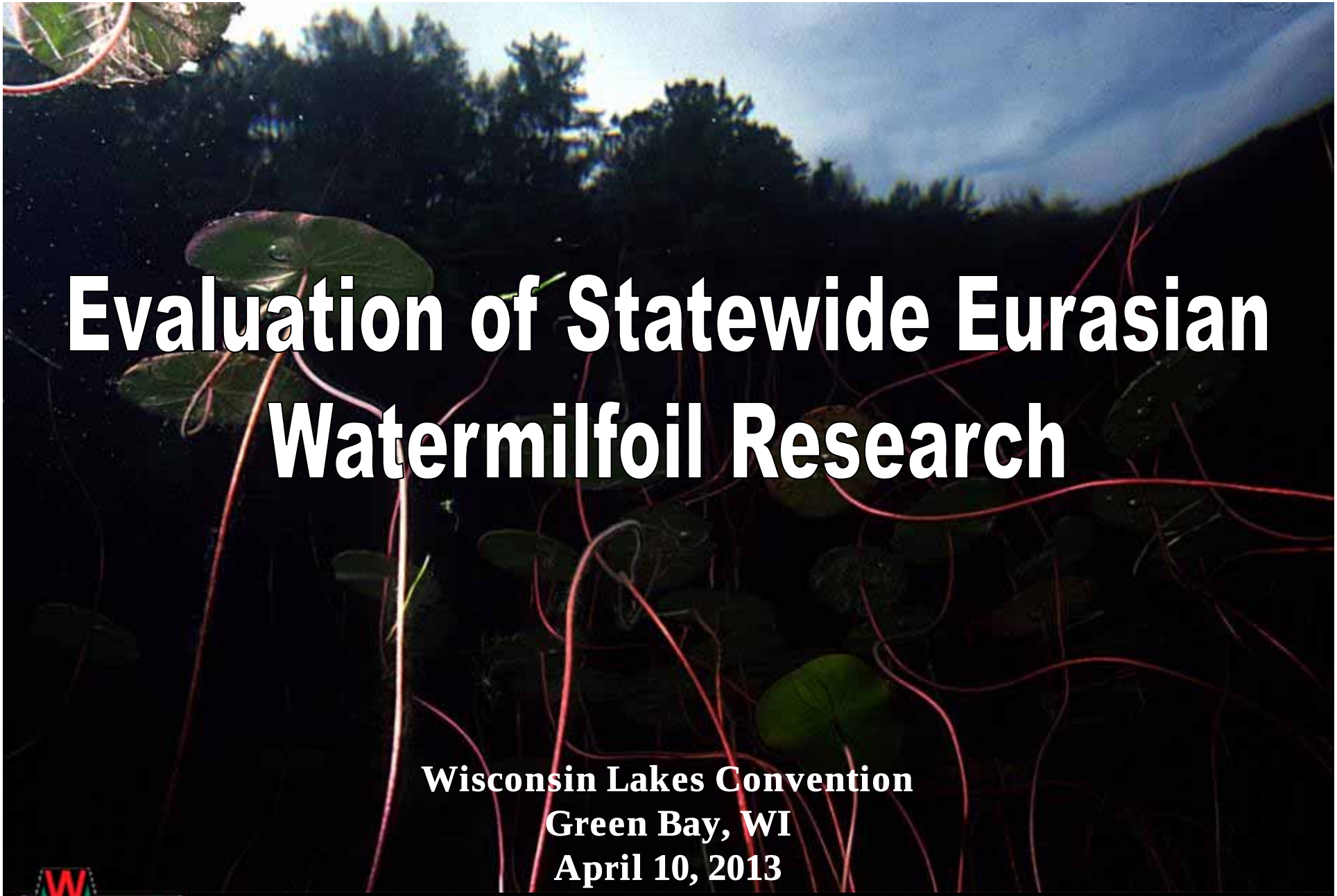
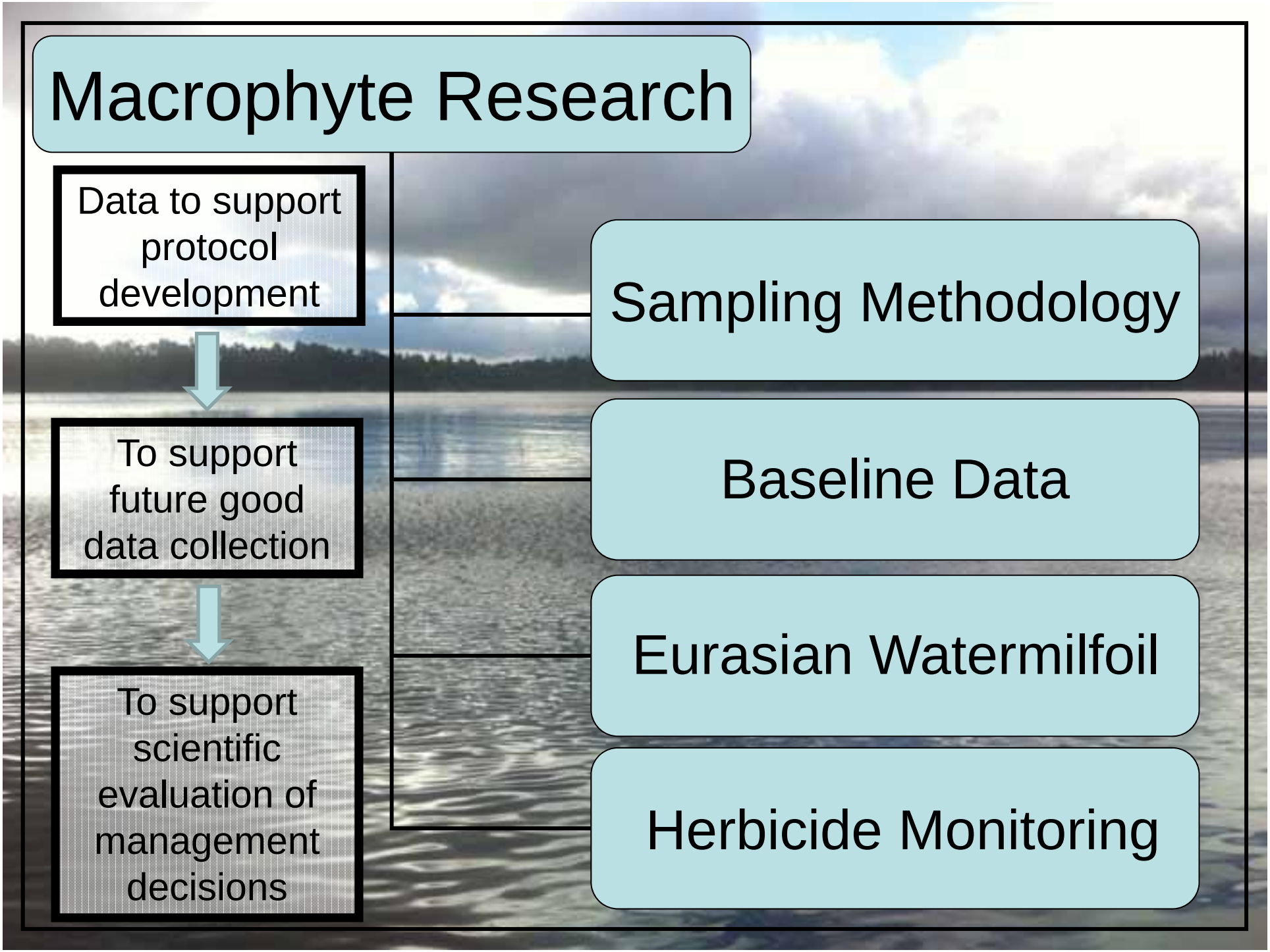


Evaluation of Statewide Eurasian Watermilfoil Research

Wisconsin Lakes Convention
Green Bay, WI
April 10, 2013

Michelle Nault, Wisconsin Department of Natural Resources, Science Services
John Skogerboe, US Army Corps of Engineers, ERDC


Macrophyte Research
Data to support protocol development
To support future good data collection
To support scientific evaluation of management decisions
Sampling Methodology
Baseline Data
Eurasian Watermilfoil
Herbicide Monitoring

Eurasian Watermilfoil

What:

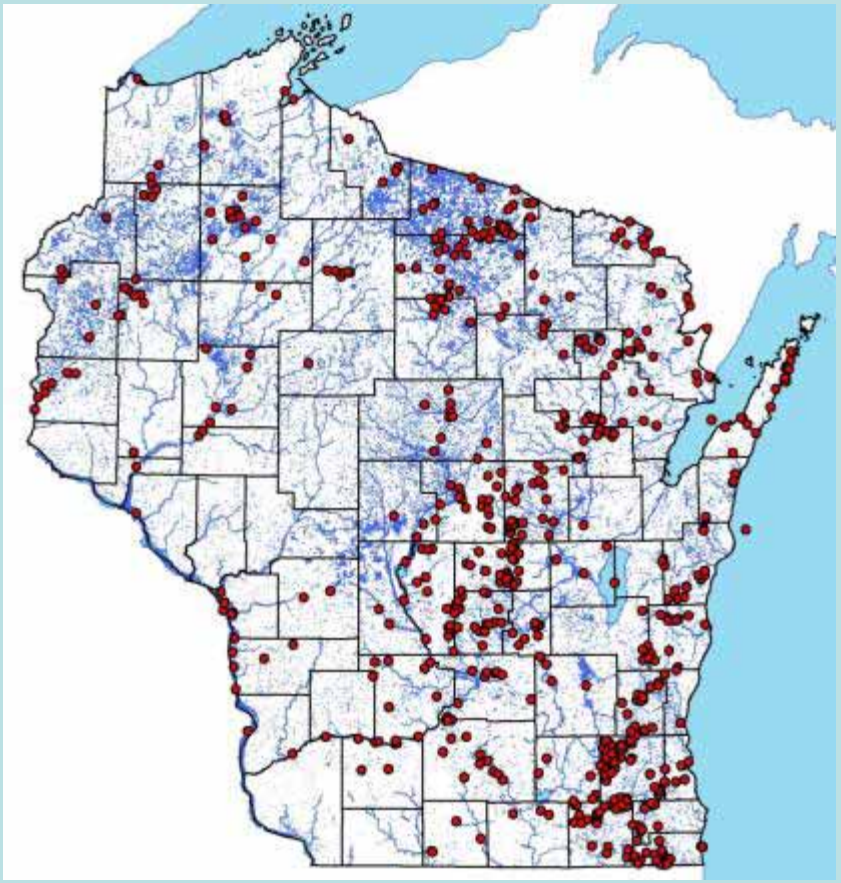
Collect data on the distribution, ecology, and management of EWM

Purpose:

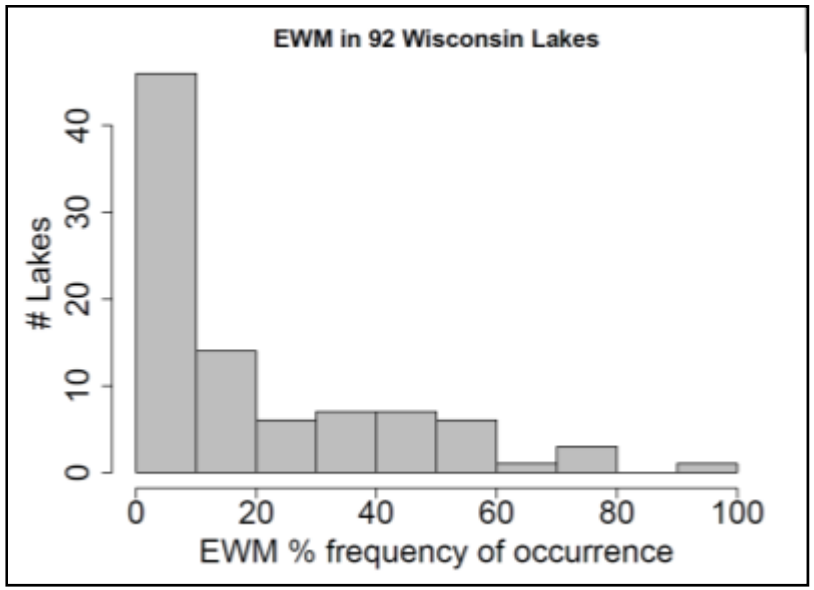
Create a baseline statewide dataset on EWM populations

Output:

EWM Factsheet (PUB-SS-1074 2011)

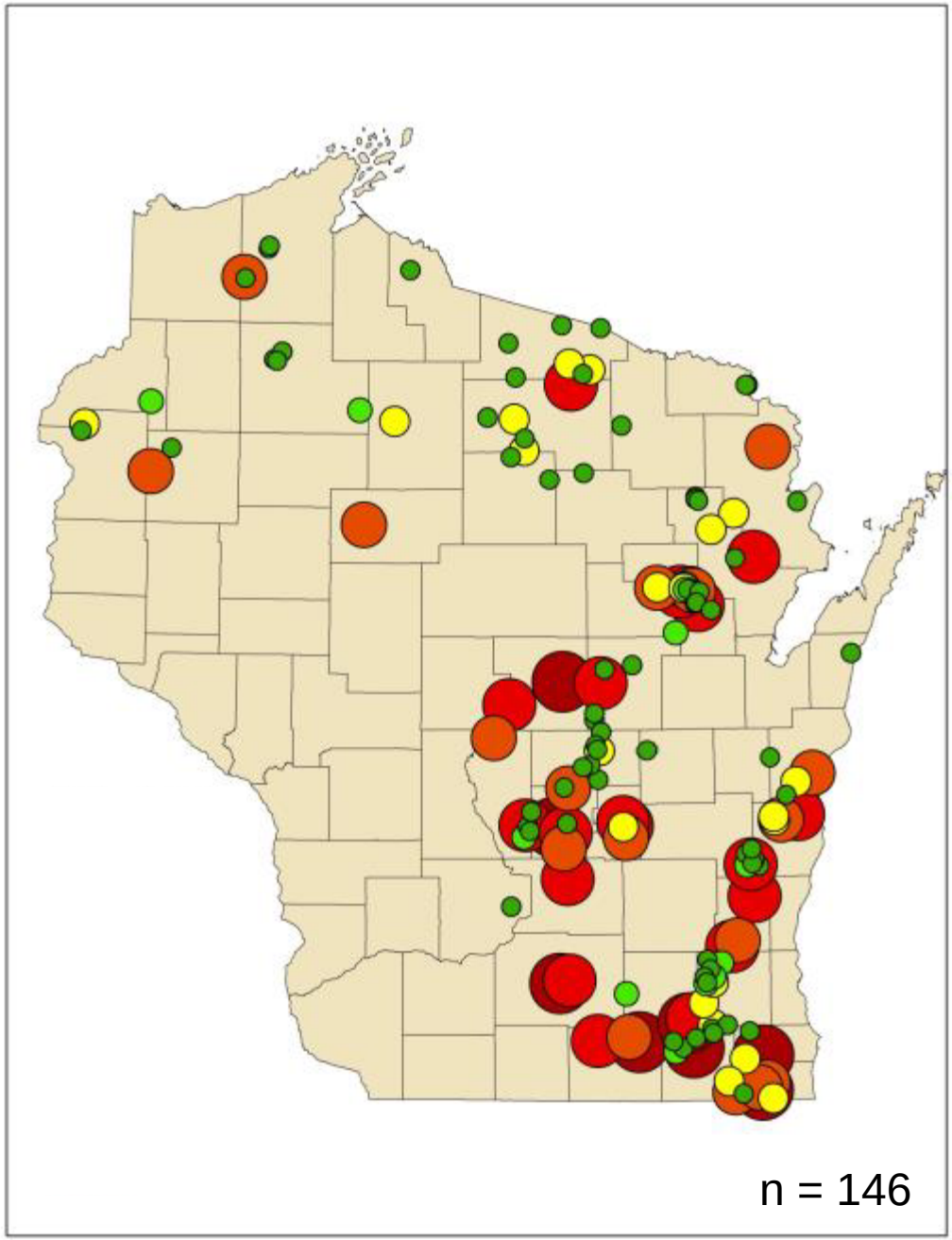


Littoral Frequency of Occurrence of EWM



EWM or Hybrid Littoral Frequency of Occurrence

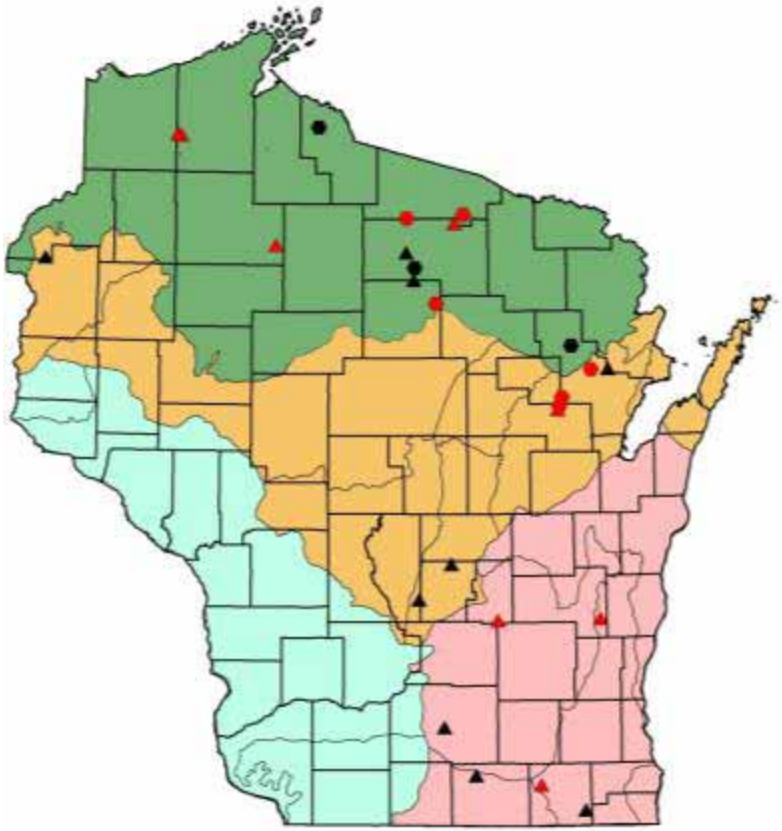
- 5% and under
- above 5%
- above 10%
- above 20%
- above 35%
- above 60%

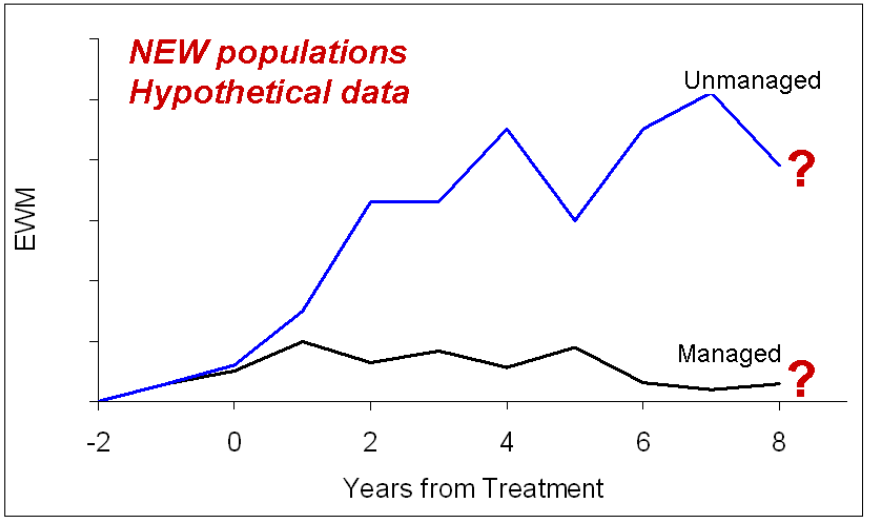


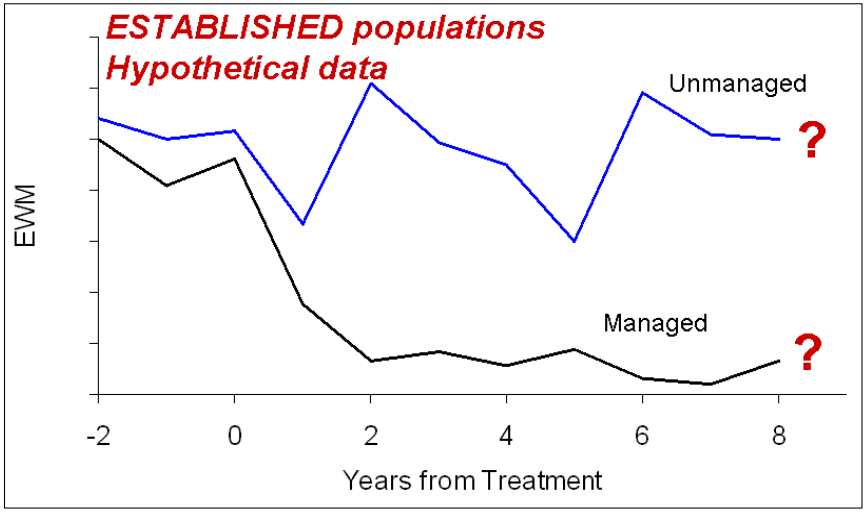
Long-Term EWM Management Study

-How does *strategic* management affect long-term EWM population levels?

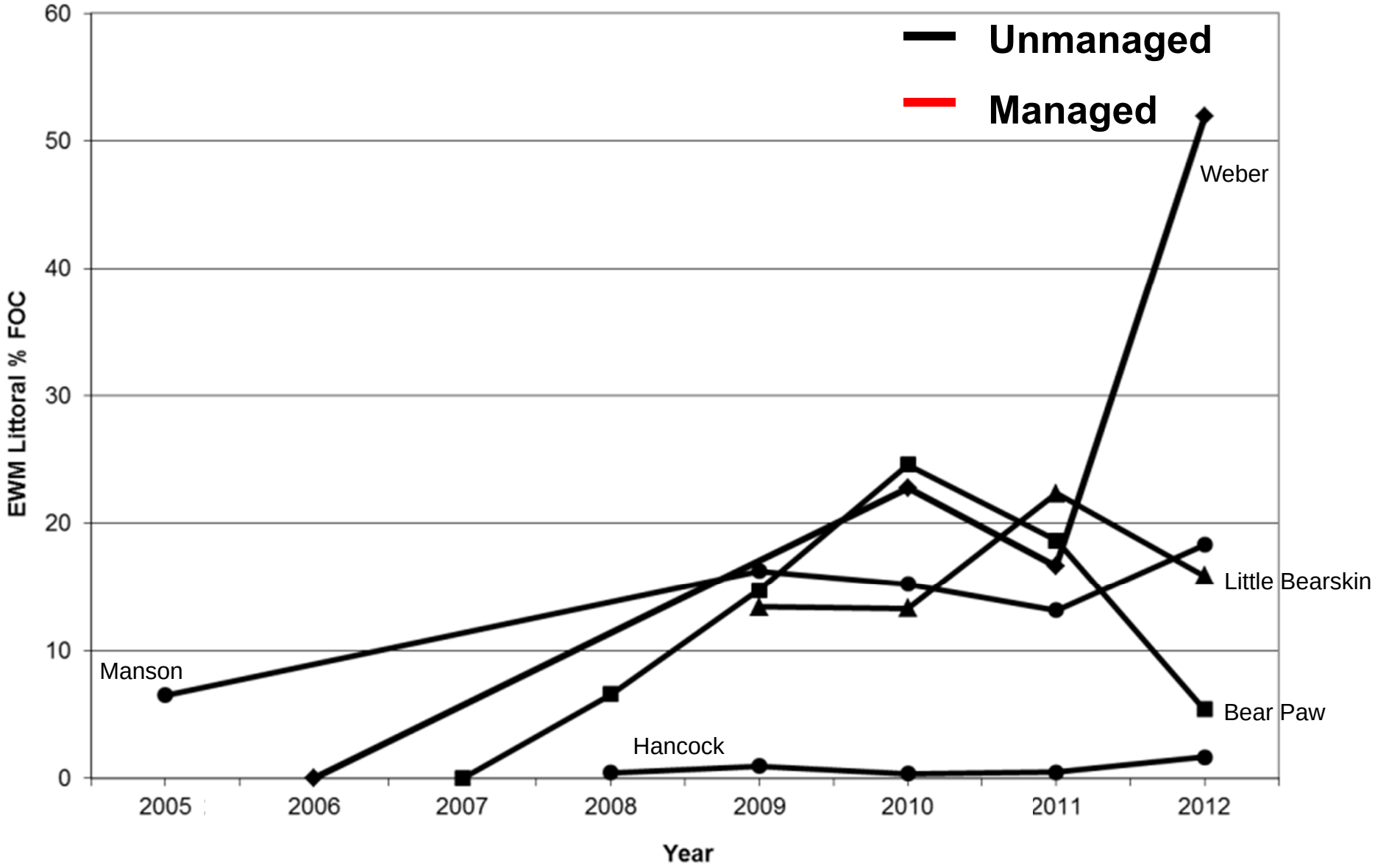
- Annual aquatic plant surveys & biomass collection on 24 lakes over time
- 3 ecoregions, established and new populations, managed and unmanaged



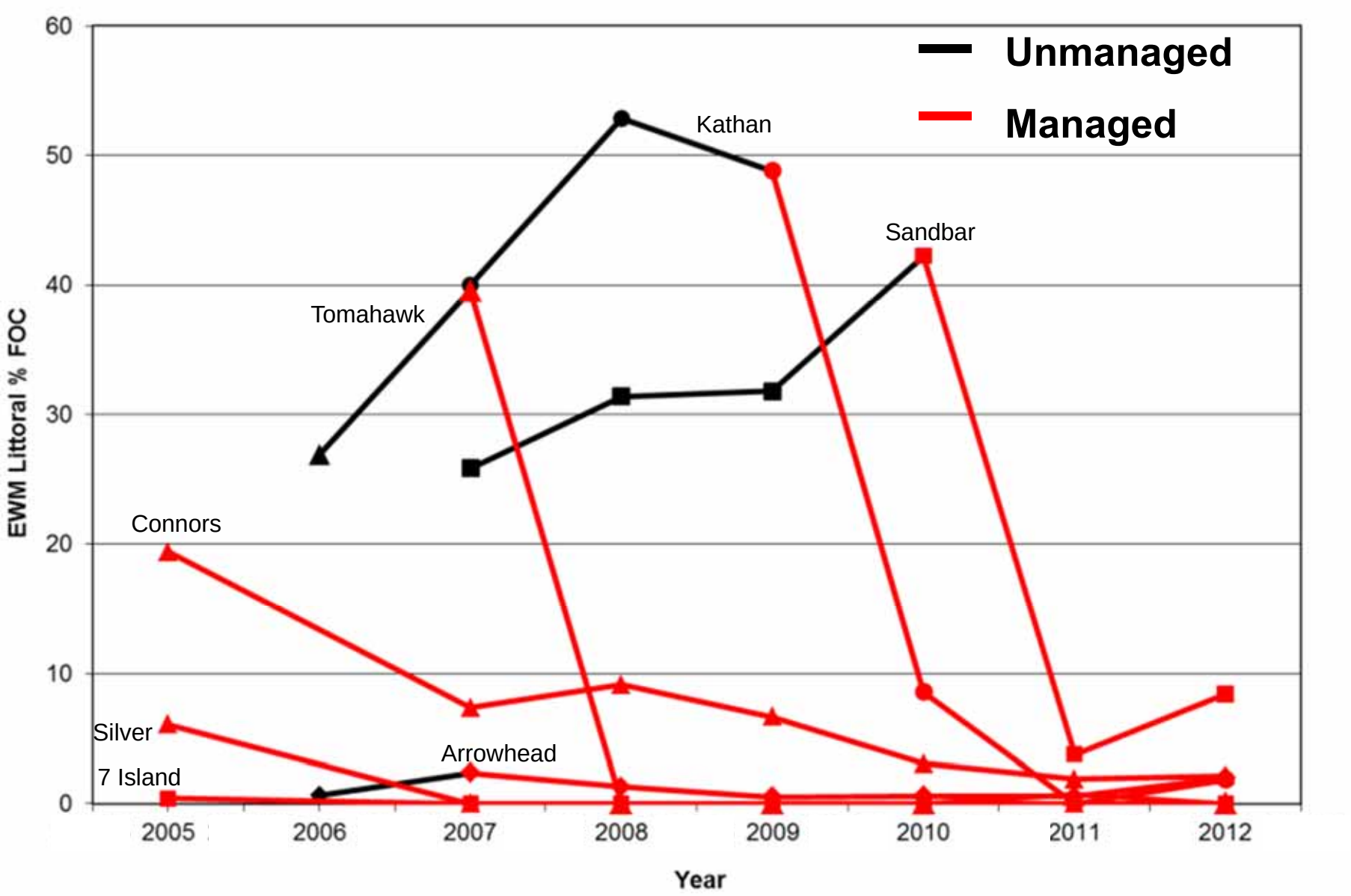




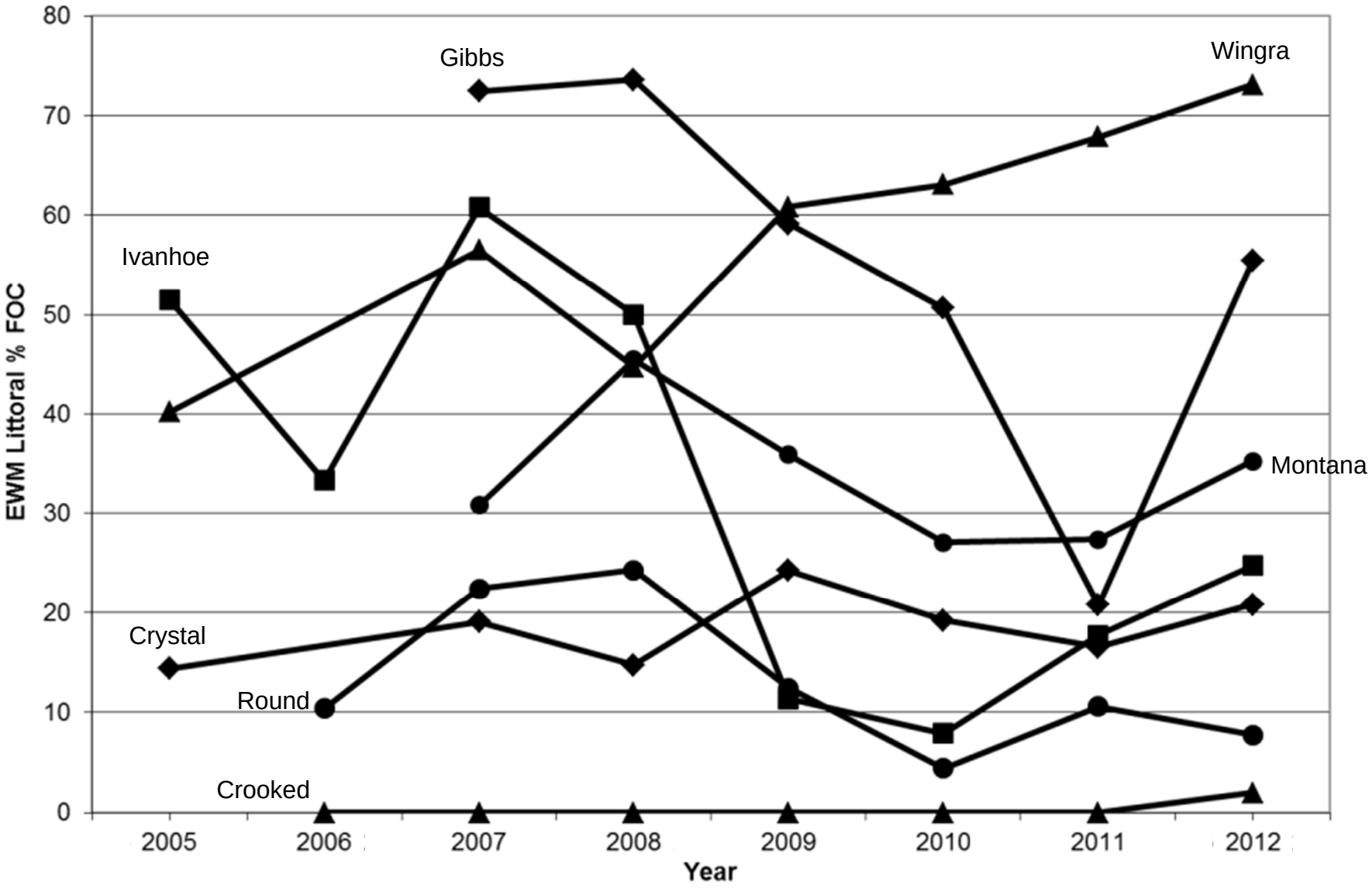
Northern Lakes & Forests



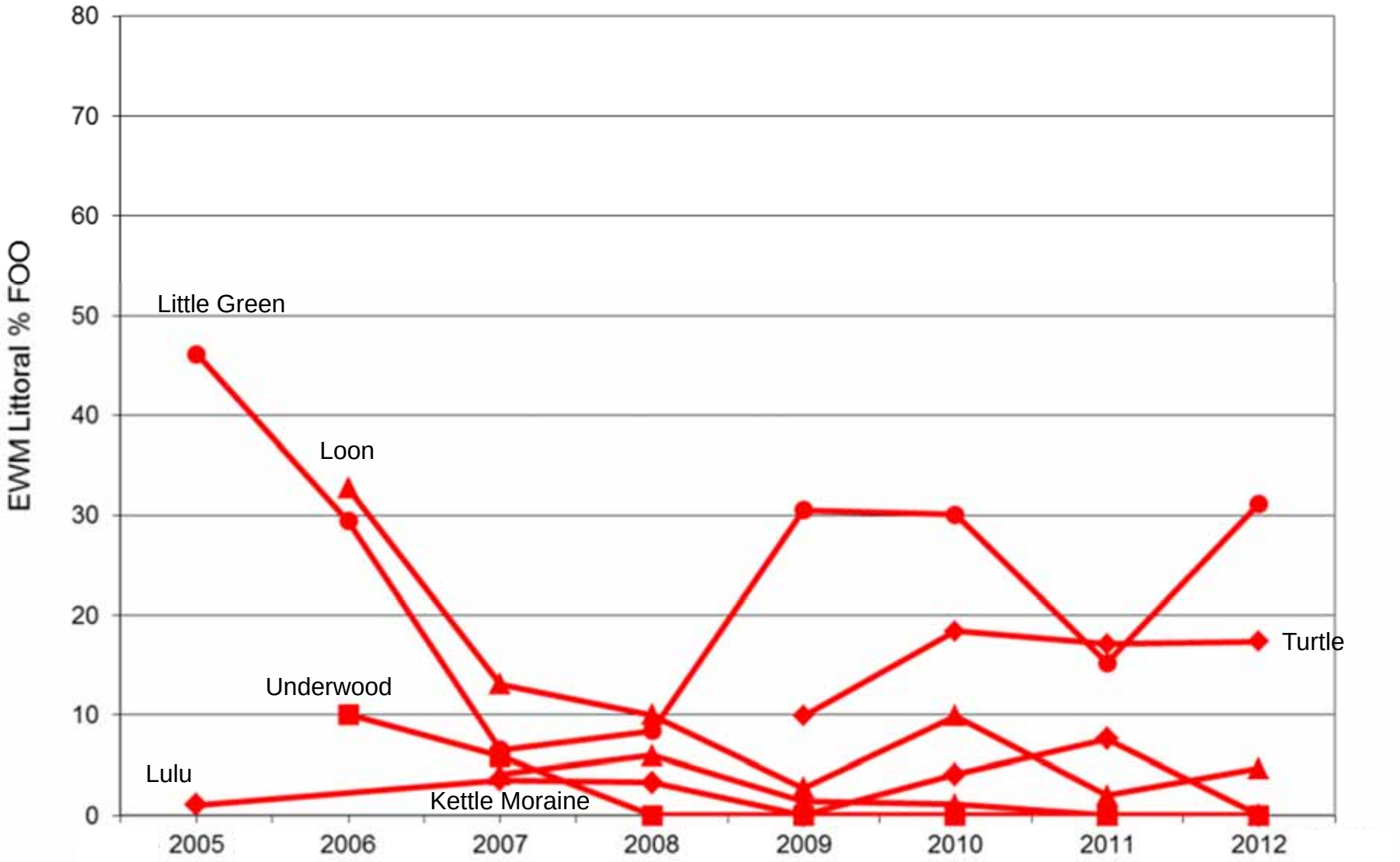
Northern Lakes & Forests



North Central Hardwood Forest Southeastern Till Plains



North Central Hardwood Forest Southeastern Till Plains



Herbicide Concentration

What:

Collect data on herbicide concentration and exposure times under varying operational conditions

Purpose:

To provide recommendations for improving control of invasive aquatic plants and reducing damage to native plants

Output:

Scientific evaluation of herbicide treatments

Nault et al., 2012. NALMS LakeLine 32(1):19-24

Nault et al., 2013. Tomahawk/Sandbar. Lake & Res. Submitted 2013.

Barton et al., 2013. Turville Bay Report. In Progress.

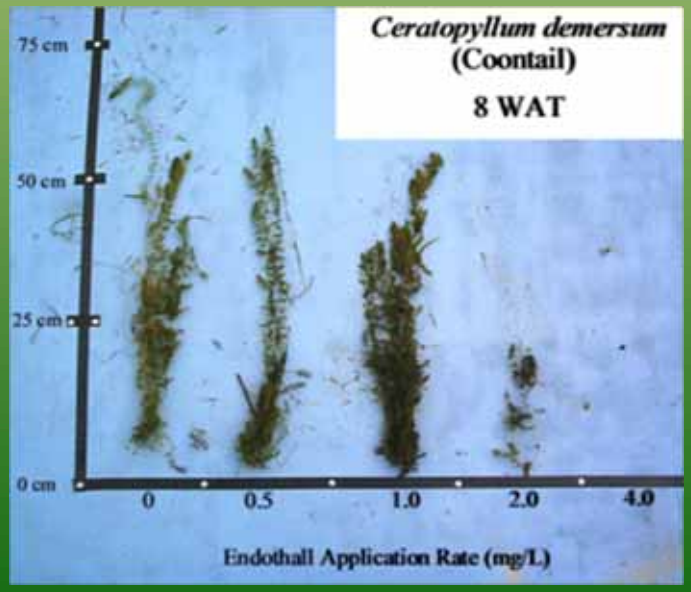
Large Scale Treatment Factsheet (PUB-SS-1077 2011)

Growth Chambers and Mesocosms

Indoor Growth Chambers

Outdoor Mesocosm Tanks

- Wide range of herbicide conc. and exposure times
- Replicated studies
- Species sensitivity

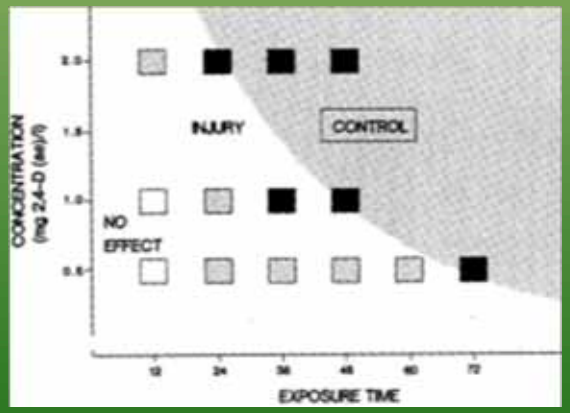


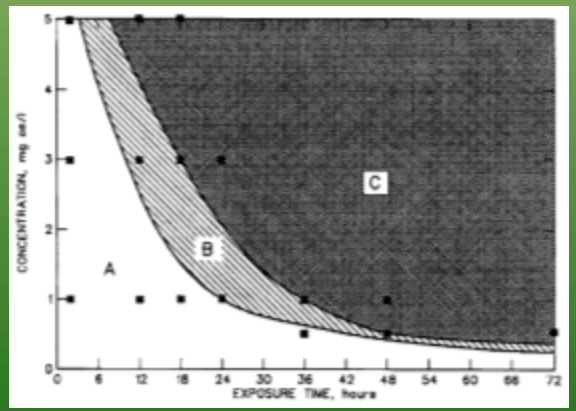
Aquatic Herbicides and Required Exposure Time for Control

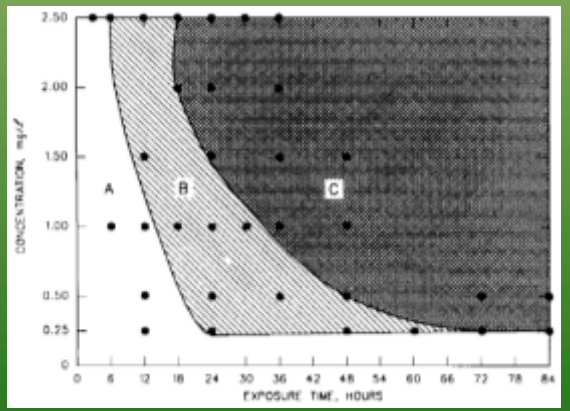
EWM

- **2,4-D: > 18 hours**
- **Triclopyr: > 18 hours**
- **Endothall: > 18 hours**
- **Diquat: > 1 hour**
- **Fluridone: > 60 days**

CLP







NR 107 Aquatic Plant Management – Chemical Use.

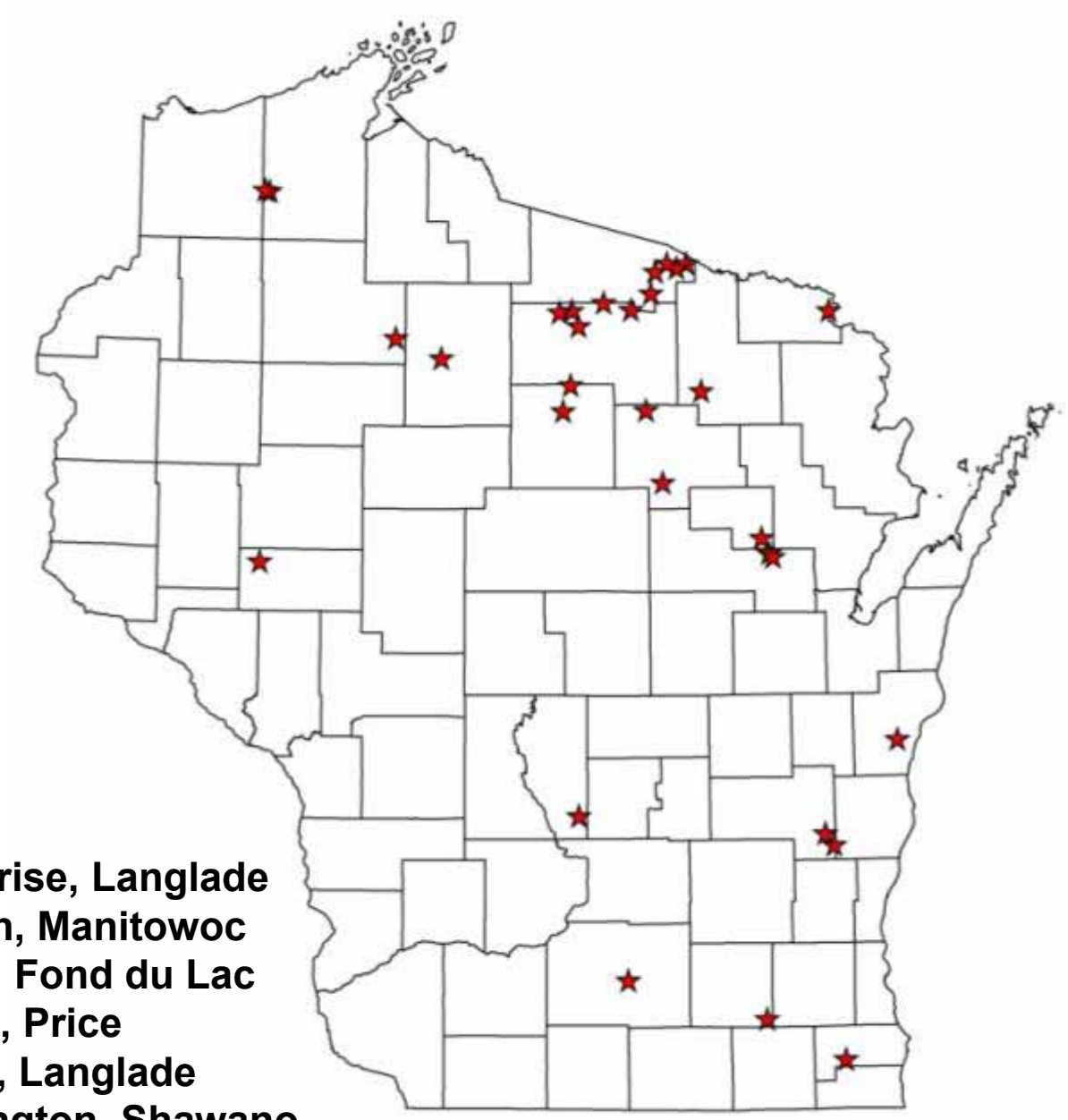
"NR 107.01. Purpose. The purpose of this chapter is to establish procedures for the management of aquatic plants and control of other aquatic organisms pursuant to s. 227.11 (2) (a), Stats., and interpreting s. 281.17 (2), Stats. A balanced aquatic plant community is recognized to be a vital and necessary component of a healthy aquatic ecosystem. The department may allow the management of nuisance-causing aquatic plants with chemicals registered and labeled by the U.S. environmental protection agency and labeled and registered by firms licensed as pesticide manufacturers and labelers with the Wisconsin department of agriculture, trade, and consumer protection. ***Chemical management shall be allowed in a manner consistent with sound ecosystem management and shall minimize the loss of ecological values in the water body****."*

Implementation Considerations

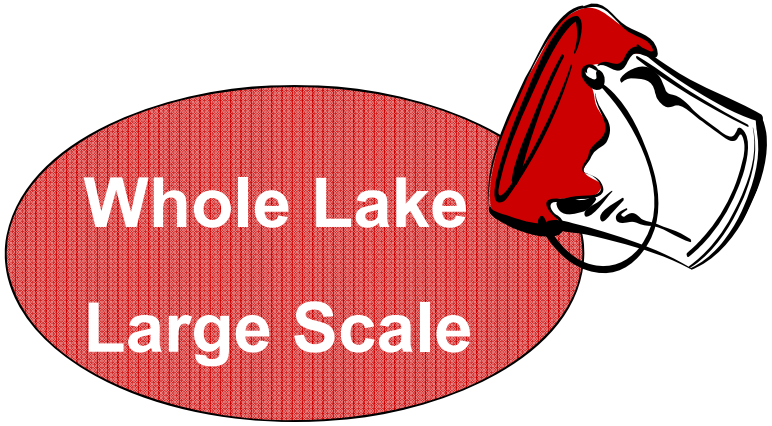
- Management tool(s)
- Management goal(s)
- Timing (seasonality, weather, water temps)
- Herbicide products and formulations
- Application rates
- Flowing water, water level management
- Lake type, size, bathymetry, water chemistry
- Target and non-target plant species

Herbicide Monitoring Project Lakes

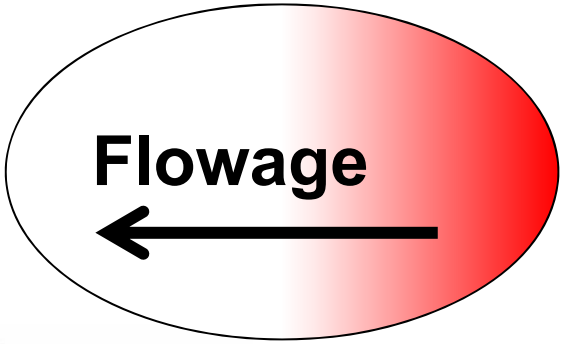
- Monona (Turville), Dane
- Tomahawk/Sandbar, Bayfield
- Kettle Moraine, Fond du Lac
- Eagle, Racine
- Half Moon, Eau Claire
- Lower Spring, Jefferson
- Loon, Shawano
- Bridge, Oneida/Lincoln
- Big Sand, Vilas
- Long, Vilas
- South Twin, Vilas
- North Twin, Vilas
- Little St. Germain, Vilas
- Eagle River Chain, Vilas
- Minocqua, Oneida
- Kawaquesaga, Oneida
- Tomahawk, Oneida
- Mohawksin, Lincoln
- Legend, Menominee
- Frog, Florence
- Jordan, Adams
- Metonga, Forest
- Connors, Sawyer
- Kathan, Oneida
- Enterprise, Langlade
- English, Manitowoc
- Forest, Fond du Lac
- Wilson, Price
- Antigo, Langlade
- Washington, Shawano



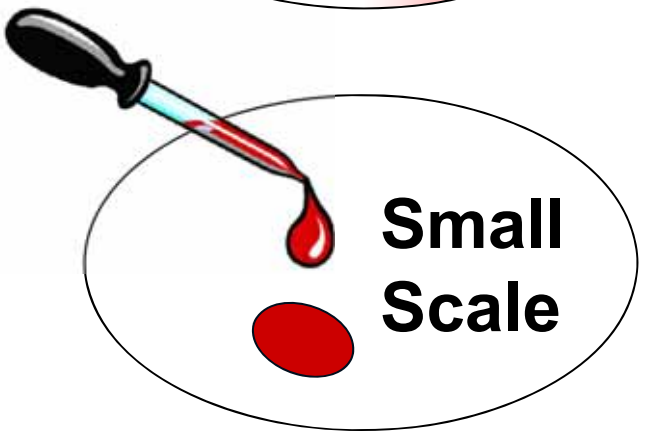
Case Study Scenarios



DEF: Amount of herbicide applied will have lakewide effects on plants (>0.1 ppm lakewide)

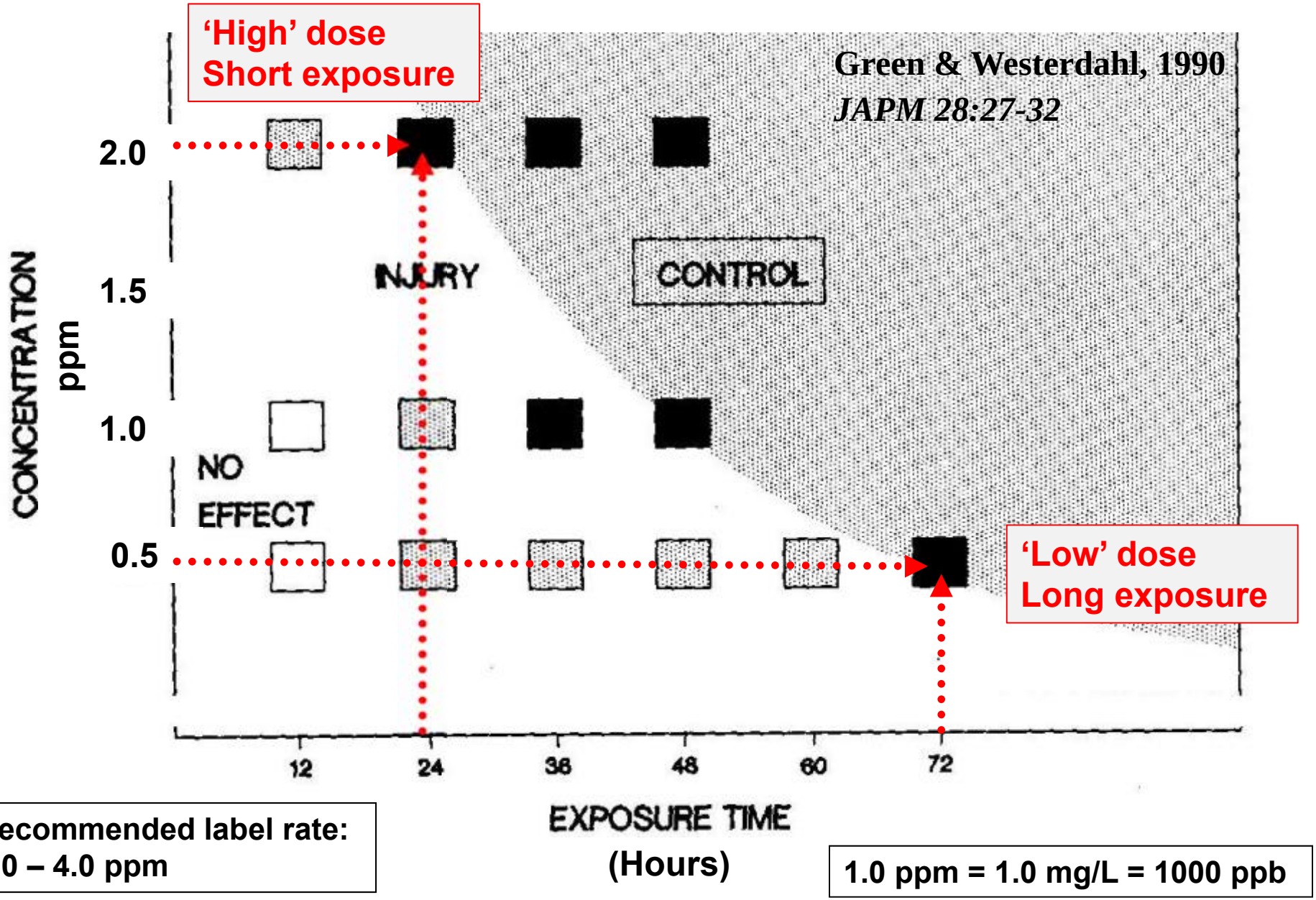


DEF: Dissipation off of treatment sites will be effected by water flow



DEF: Herbicide will be applied on a small scale where dissipation will not result in significant lakewide concentrations

2,4-D Concentration/Exposure Time



Recommended label rate:
2.0 – 4.0 ppm

1.0 ppm = 1.0 mg/L = 1000 ppb

Herbicide Exposure Time

- **Dissipation:** horizontal and vertical movement of herbicide within the water column
  - Water flow
  - Wind
  - Treatment area relative to lake
  - Water depth and temperature
- **Degradation:** physical breakdown of herbicide into inert components
  - Microbial
  - Photolytic

Application Timing/Phenology

Early Spring Herbicide Applications

- **Exotic species are small and most vulnerable**
- **Many native species are dormant**
- **Cool water temperatures result in slower microbial degradation**
- **Minimize biomass decomposition**

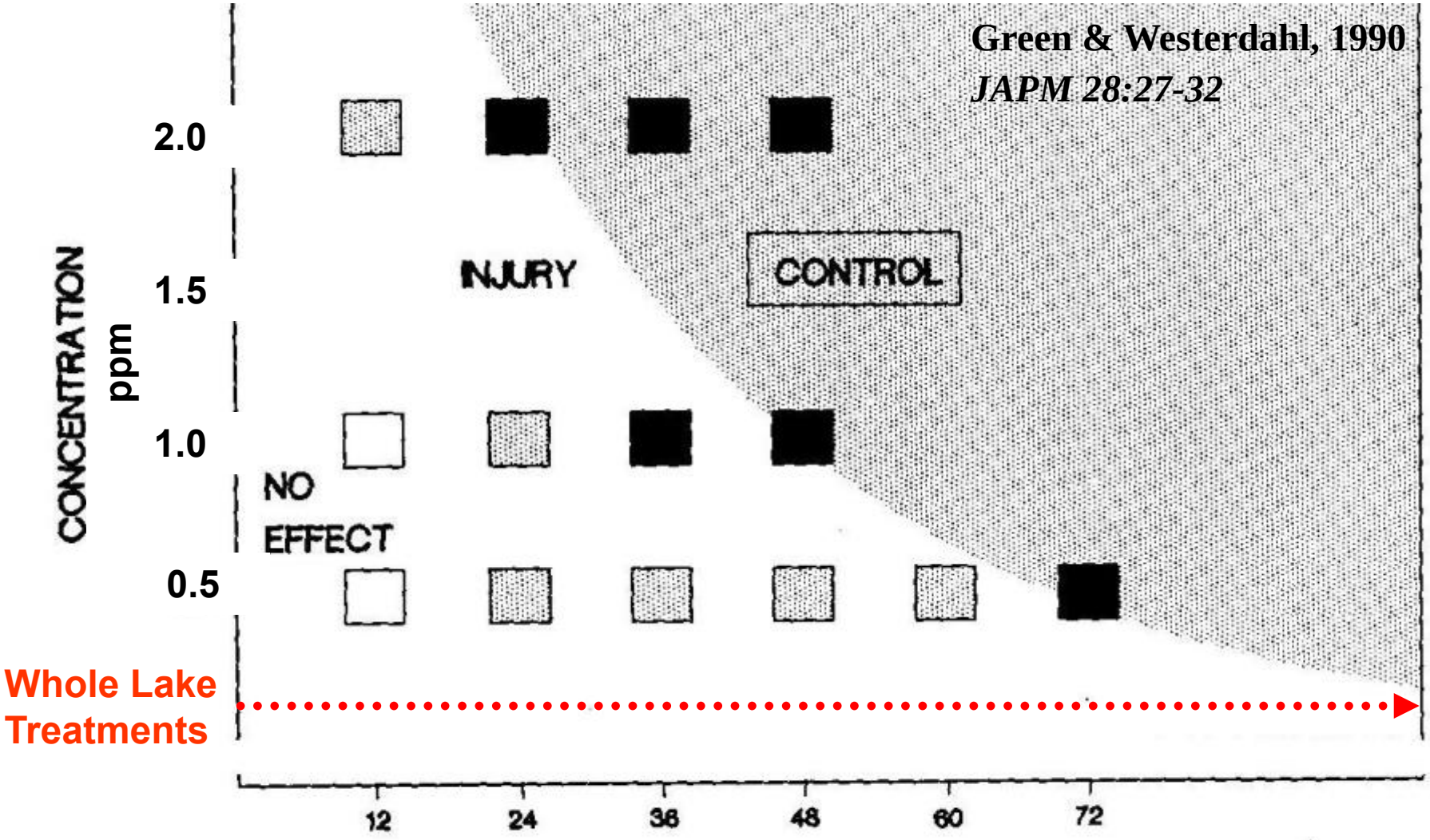
Standard Survey Methods

Herbicide Water Sample Collection

Immunoassay Test (ELISA)

Pre/Post Aquatic Plant Surveys – Hauxwell et. al 2010

2,4-D Concentration/Exposure Time



Recommended label rate:
2.0 – 4.0 ppm

1.0 ppm = 1.0 mg/L = 1000 ppb

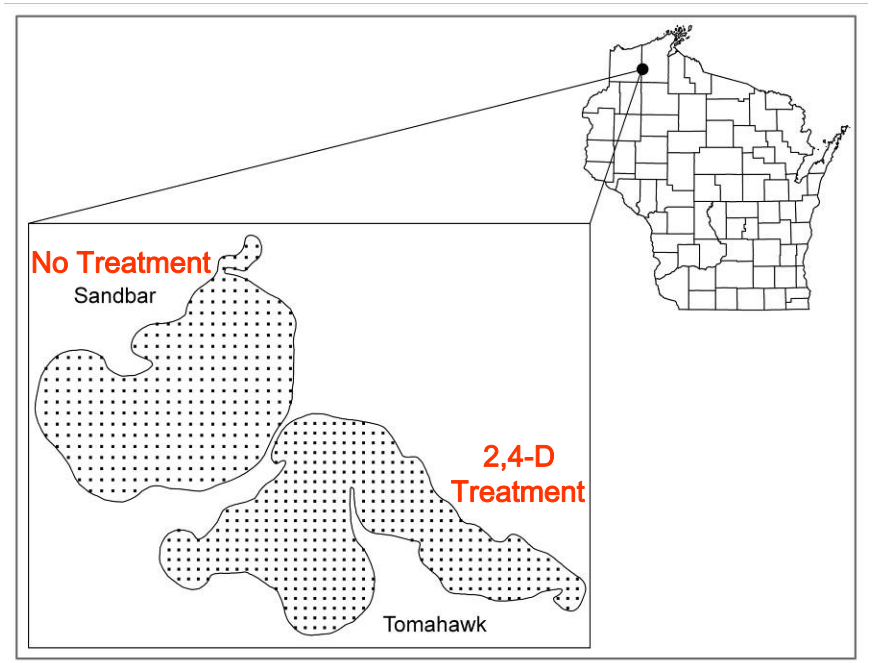
Sandbar/Tomahawk

WDNR, Army Corps of Engineers, Town of Barnes, Bayfield County

1) What are the effects of early season 2,4-D on Eurasian watermilfoil?

2) What about native plants?

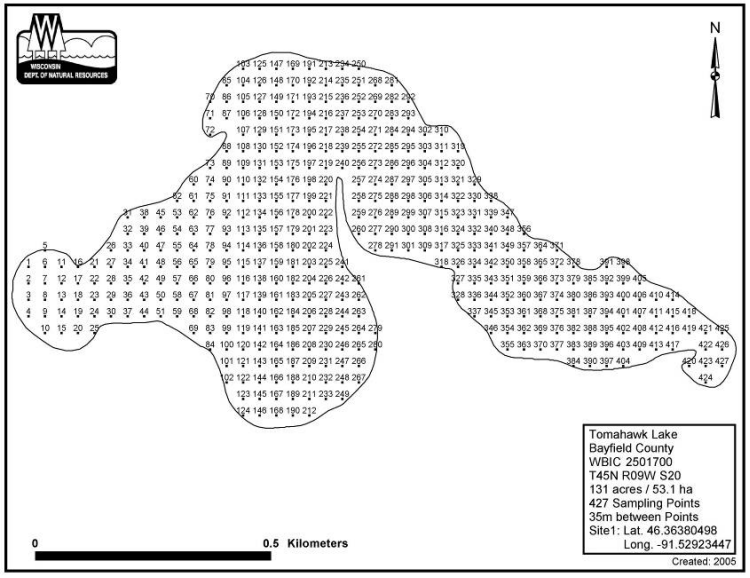
Approach: Monitor annual changes in plant communities in experimental lakes (herbicide or reference)



Study design

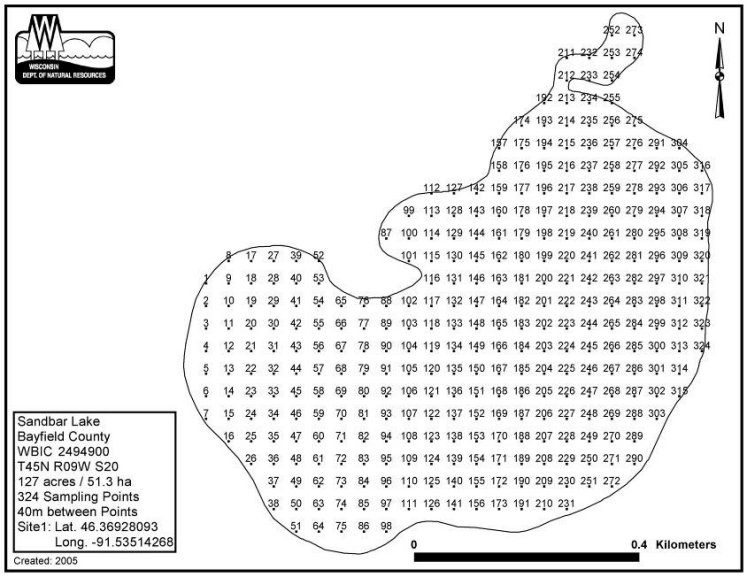
Tomahawk

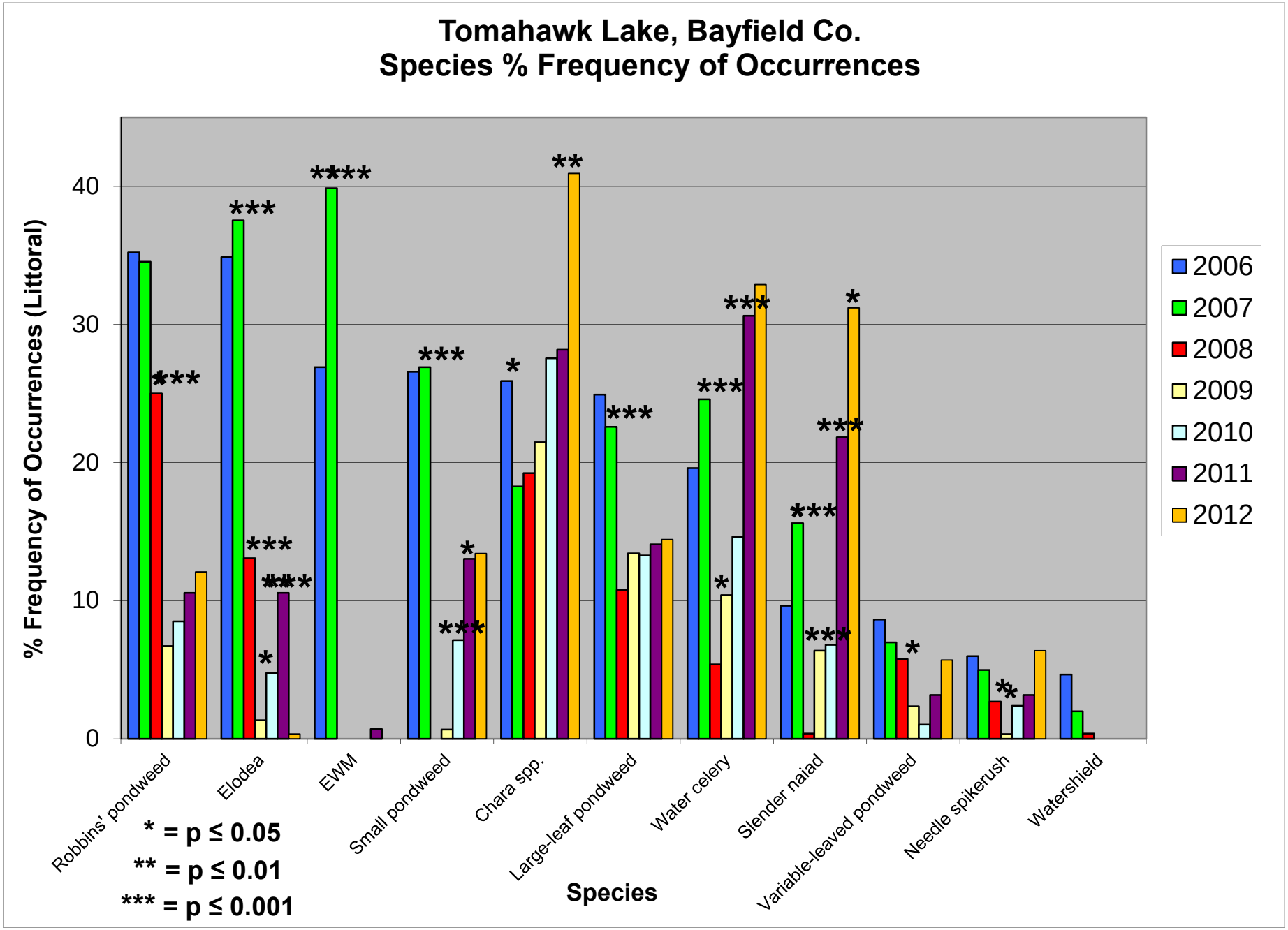
- Low dose liquid 2,4-D (0.5 ppm) treatment to whole lake (May 20, 2008)
- Aquatic plant surveys conducted 2006-2012
- Biomass collected during 2007-2012 surveys

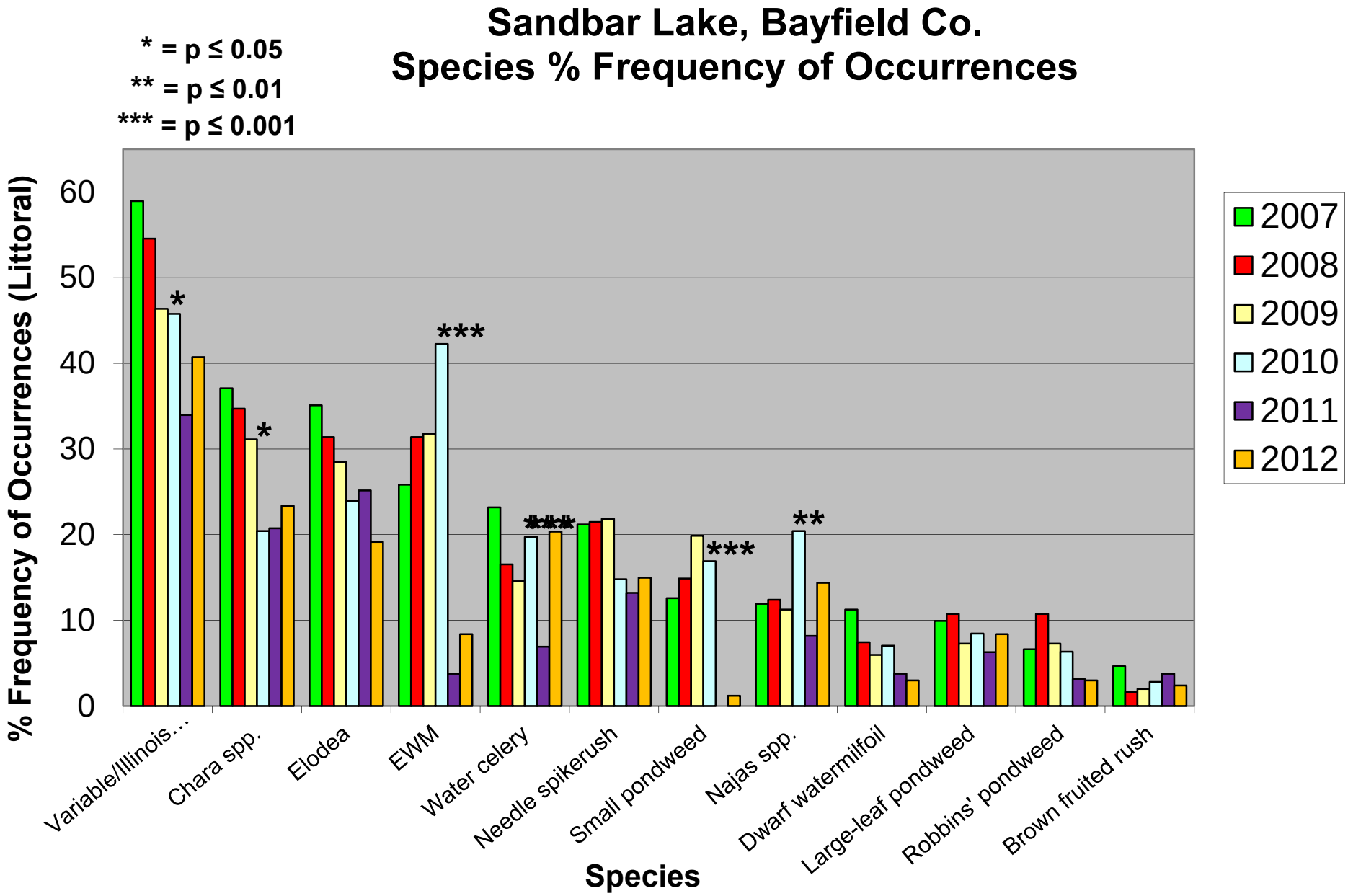


Sandbar

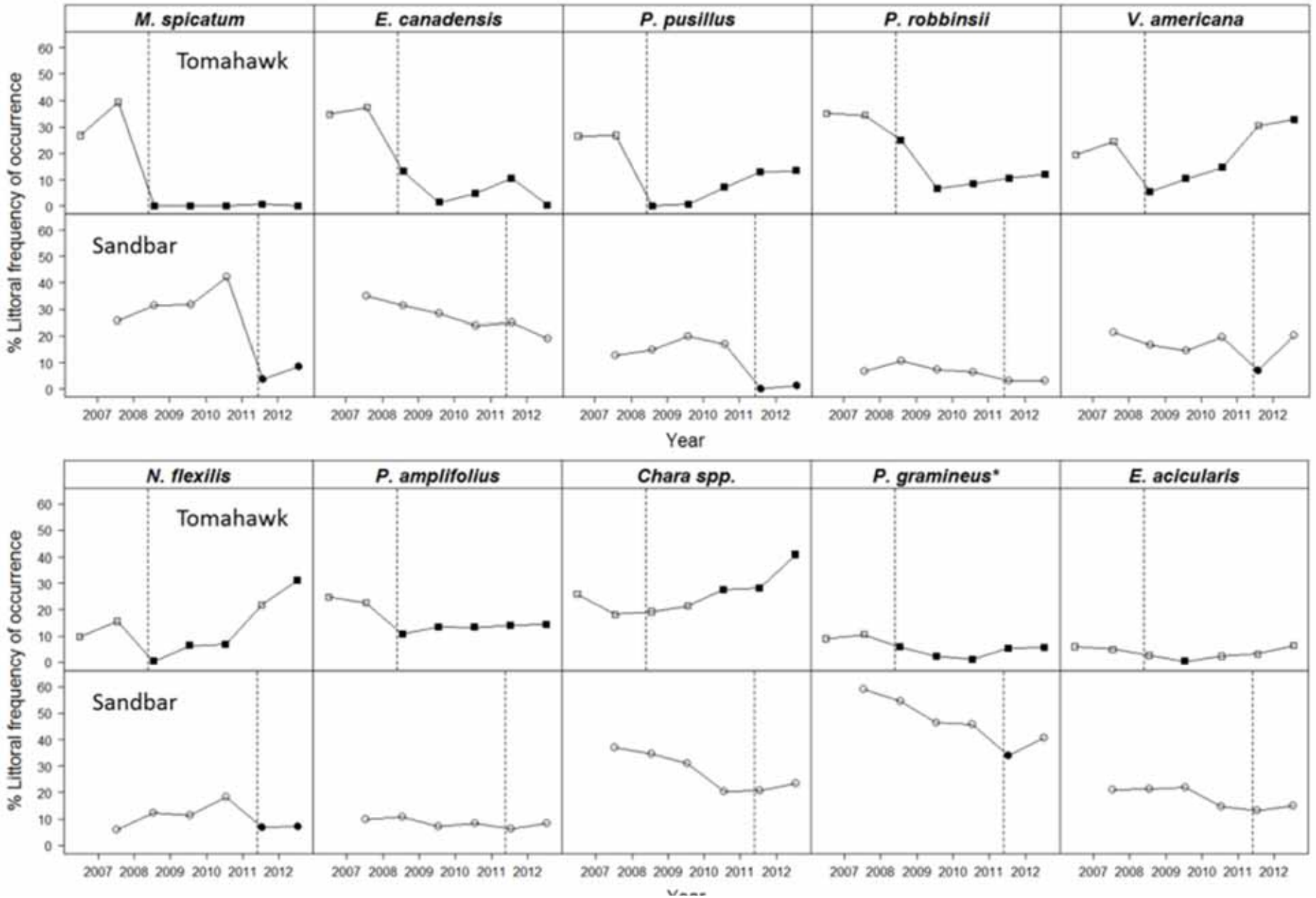
- Reference lake – no treatment (2007 - 2010)
- Low dose liquid 2,4-D (0.275 ppm) treatment to whole lake epilimnion (spring 2011)
- Aquatic plant surveys and biomass collected during 2007-2012



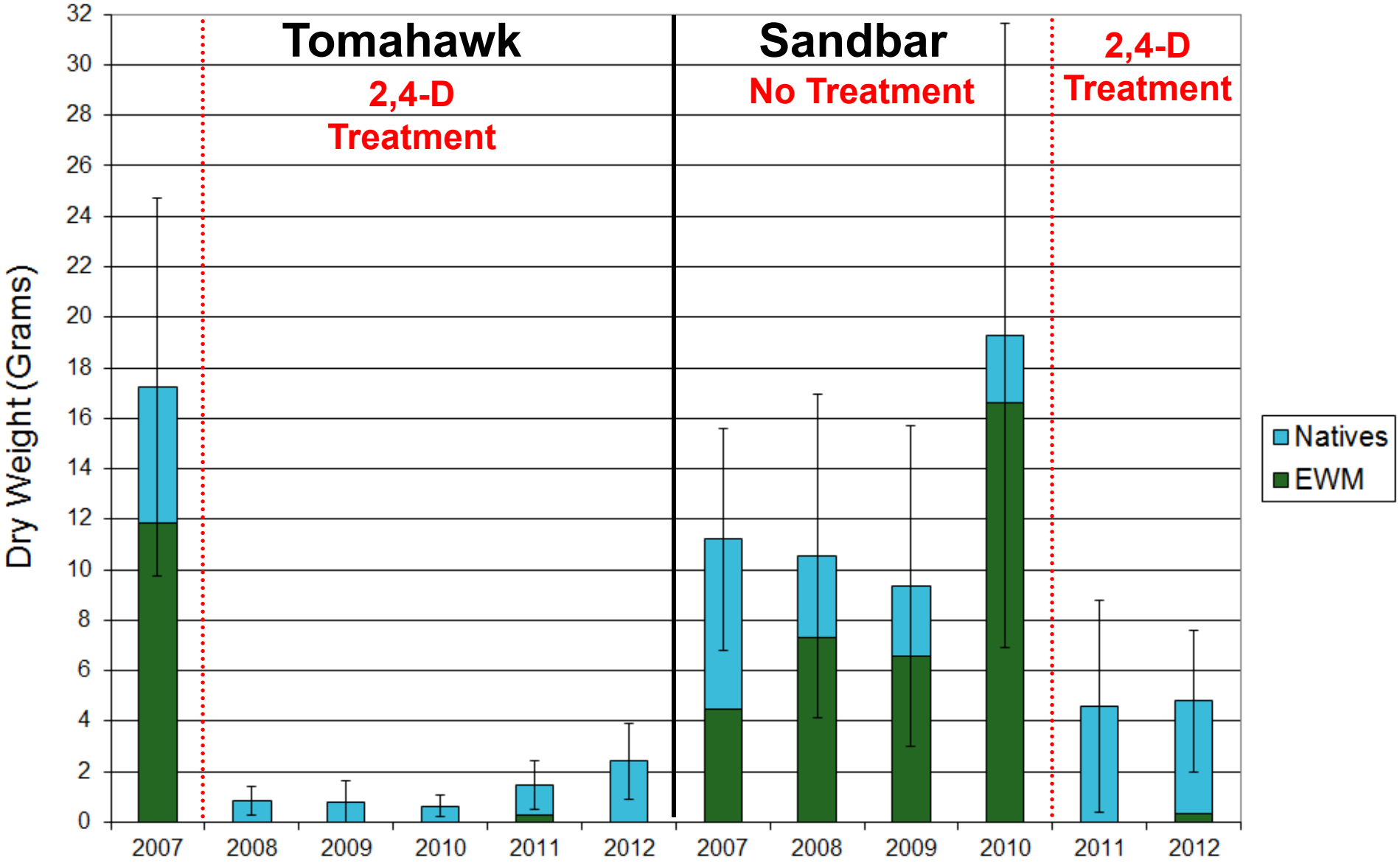

Tomahawk Lake, Bayfield Co.
Species % Frequency of Occurrences
% Frequency of Occurrences (Littoral)
0
10
20
30
40
2006
2007
2008
2009
2010
2011
2012
Robbins' pondweed
Elodea
EWM
Small pondweed
Chara spp.
Large-leaf pondweed
Water celery
Slender naiad
Variable-leaved pondweed
Needle spikerush
Watershield
Species
* = p ≤ 0.05
** = p ≤ 0.01
*** = p ≤ 0.001


Sandbar Lake, Bayfield Co.
Species % Frequency of Occurrences
* = p ≤ 0.05
** = p ≤ 0.01
*** = p ≤ 0.001
% Frequency of Occurrences (Littoral)
0
10
20
30
40
50
60
2007
2008
2009
2010
2011
2012
Variable/Illinois…
Chara spp.
Elodea
EWM
Water celery
Needle spikerush
Small pondweed
Najas spp.
Dwarf watermilfoil
Large-leaf pondweed
Robbins' pondweed
Brown fruited rush
Species

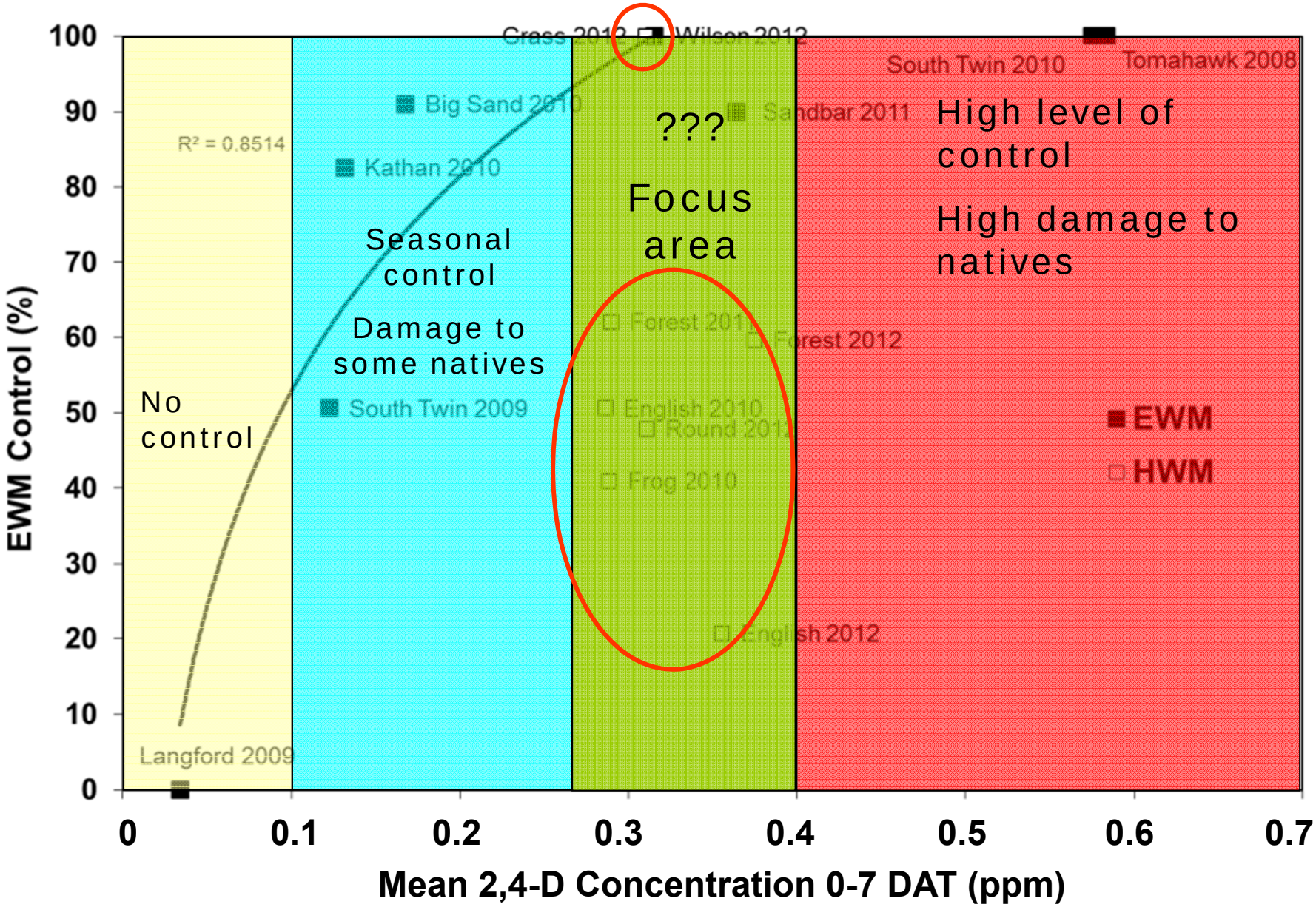
Tomahawk/Sandbar



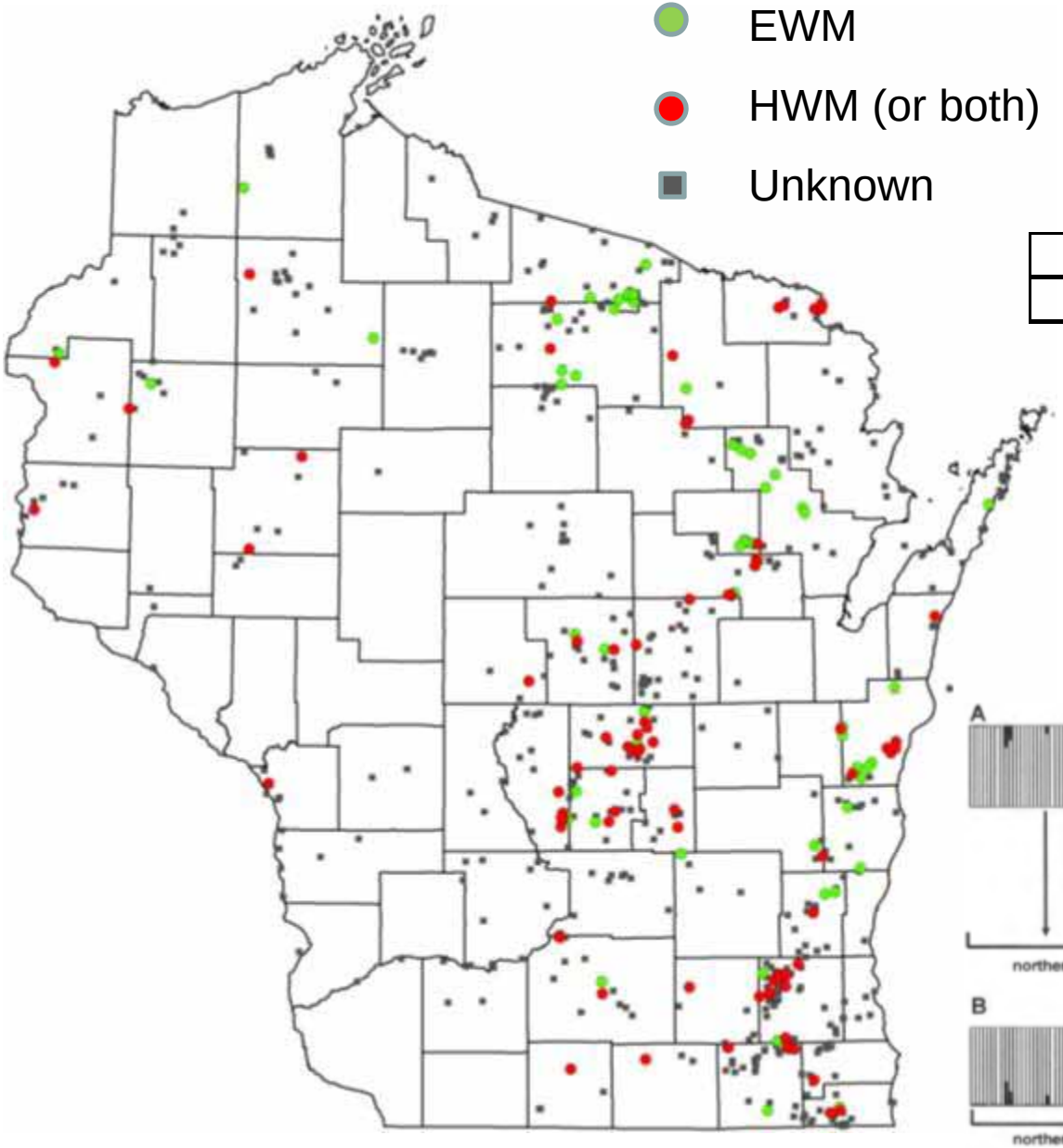
Average Biomass Per Site



EWM Control

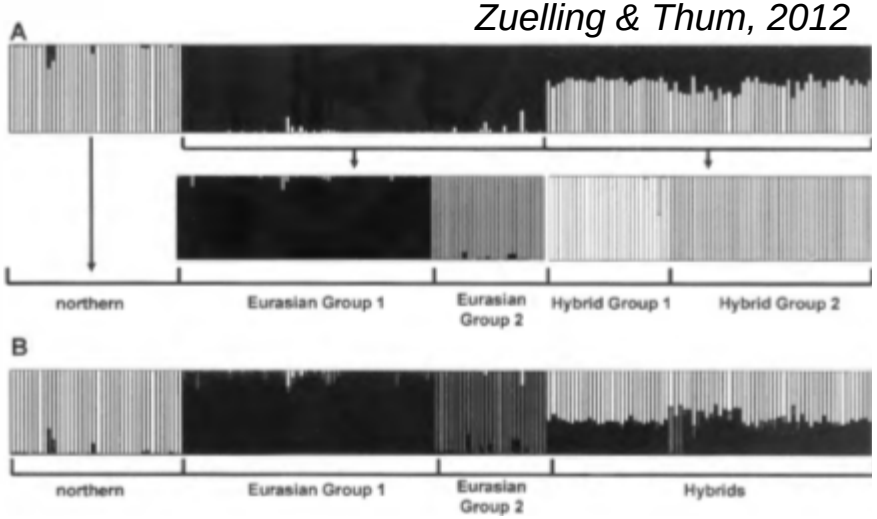

EWM Control (%)
100
90
80
70
60
50
40
30
20
10
0
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Mean 2,4-D Concentration 0-7 DAT (ppm)
R² = 0.8514
No control
Seasonal control
Damage to some natives
???
Focus area
High level of control
High damage to natives
Big Sand 2010
Kathan 2010
South Twin 2009
Langford 2009
Sandbar 2011
South Twin 2010
Tomahawk 2008
Forest 2012
English 2010
Frog 2010
EWM
HWM

Watermilfoil DNA Analysis



EWM	HWM	NWM	MyrVert	MyrHet
77	81	41	7	2

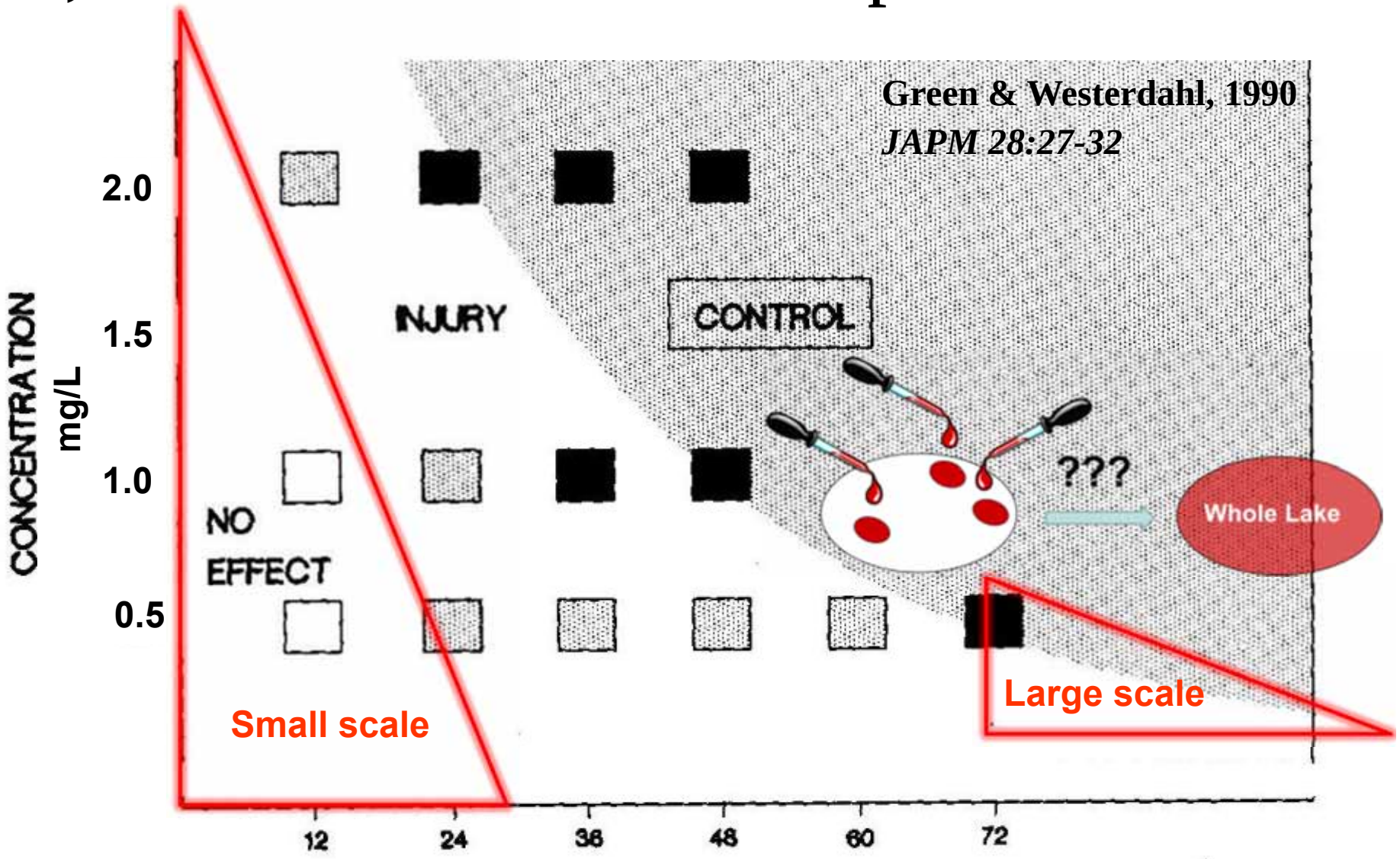
Zuelling & Thum, 2012



Native Species

Scientific Name, Common Name	Group	Sandbar	Tomahawk	Frog	Kathan	S. Twin '09	S. Twin '10	Berry	Wilson
Myriophyllum spicatum , Eurasian water milfoil	Dicot	***	***	n.s.	***	***	***	***	***
Bidens beckii , Water marigold	Dicot	-	<5%	-	-	***	***	-	-
Brasenia scherberi , Watershield	Dicot	-	<5%	-	n.s.	-	-	n.s.	<5%
Ceratophyllum demersum , Coontail	Dicot	<5%	<5%	-	n.s.	n.s.	n.s.	<5%	***
Chara spp., Muskgrasses	Macroalgae	n.s.	n.s.	n.s.	n.s.	***	n.s.	n.s.	*
Eleocharis acicularis , Needle spikerush	Monocot	n.s.	<5%	-	<5%	n.s.	n.s.	<5%	<5%
Elodea canadensis , Common waterweed	Monocot	n.s.	***	-	n.s.	n.s.	***	<5%	n.s.
Heteranthera dubia , Water star grass	Monocot	-	<5%	-	-	***	*	-	-
Myriophyllum tenellum , Dwarf watermilfoil	Dicot	n.s.	<5%	-	-	<5%	-	<5%	-
Myriophyllum sibiricum, Northern watermilfoil	Dicot	-	<5%	-	<5%	***	***	**	<5%
Najas flexilis , Bushy pondweed	Monocot	**	***	***	***	n.s.	***	*	*
Nitella spp., Stoneworts	Macroalgae	n.s.	***	-	***	<5%	<5%	<5%	n.s.
Nymphaea odorata , White water lily	Dicot	-	<5%	<5%	n.s.	-	-	<5%	n.s.
Potamogeton amplifolius , Large-leaf pondweed	Monocot	n.s.	***	n.s.	n.s.	<5%	<5%	n.s.	n.s.
Potamogeton epihydrus , Ribbon-leaf pondweed	Monocot	-	-	-	***	-	-	-	<5%
Potamogeton foliosus , Leafy pondweed	Monocot	-	-	*	-	-	-	-	-
Potamogeton friesii, Fries' pondweed	Monocot	-	-	-	-	**	<5%	-	-
Potamogeton gramineus , Variable leaf pondweed	Monocot	*	n.s.	<5%	<5%	n.s.	*	n.s.	-
Potamogeton pusillus , Small pondweed	Monocot	***	***	n.s.	***	*	***	<5%	**
Potamogeton richardsonii, Clasping-leaf pondweed	Monocot	<5%	-	-	<5%	+	n.s.	-	-
Potamogeton robbinsii , Robbins pondweed	Monocot	n.s.	*	-	-	n.s.	n.s.	n.s.	***
Potamogeton strictifolius , Stiff pondweed	Monocot	-	-	***	***	<5%	<5%	<5%	-
Potamogeton zosteriformis , Flat-stem pondweed	Monocot	-	-	n.s.	+	n.s.	***	<5%	***
Stuckenia pectinata , Sago pondweed	Monocot	-	-	n.s.	-	-	-	<5%	-
Utricularia minor , Small bladderwort	Dicot	-	-	-	*	-	-	-	-
Vallisneria americana , Wild celery	Monocot	***	***	<5%	+	***	+	+	*
Native spp. Significant Decrease (FOO > 5%)		4	7	3	6	7	8	2	7
Native spp. Significant Increase (FOO > 5%)		0	0	0	2	1	1	1	0
Net Native spp. Loss/Gain		-4	-7	-3	-4	-6	-7	-1	-7

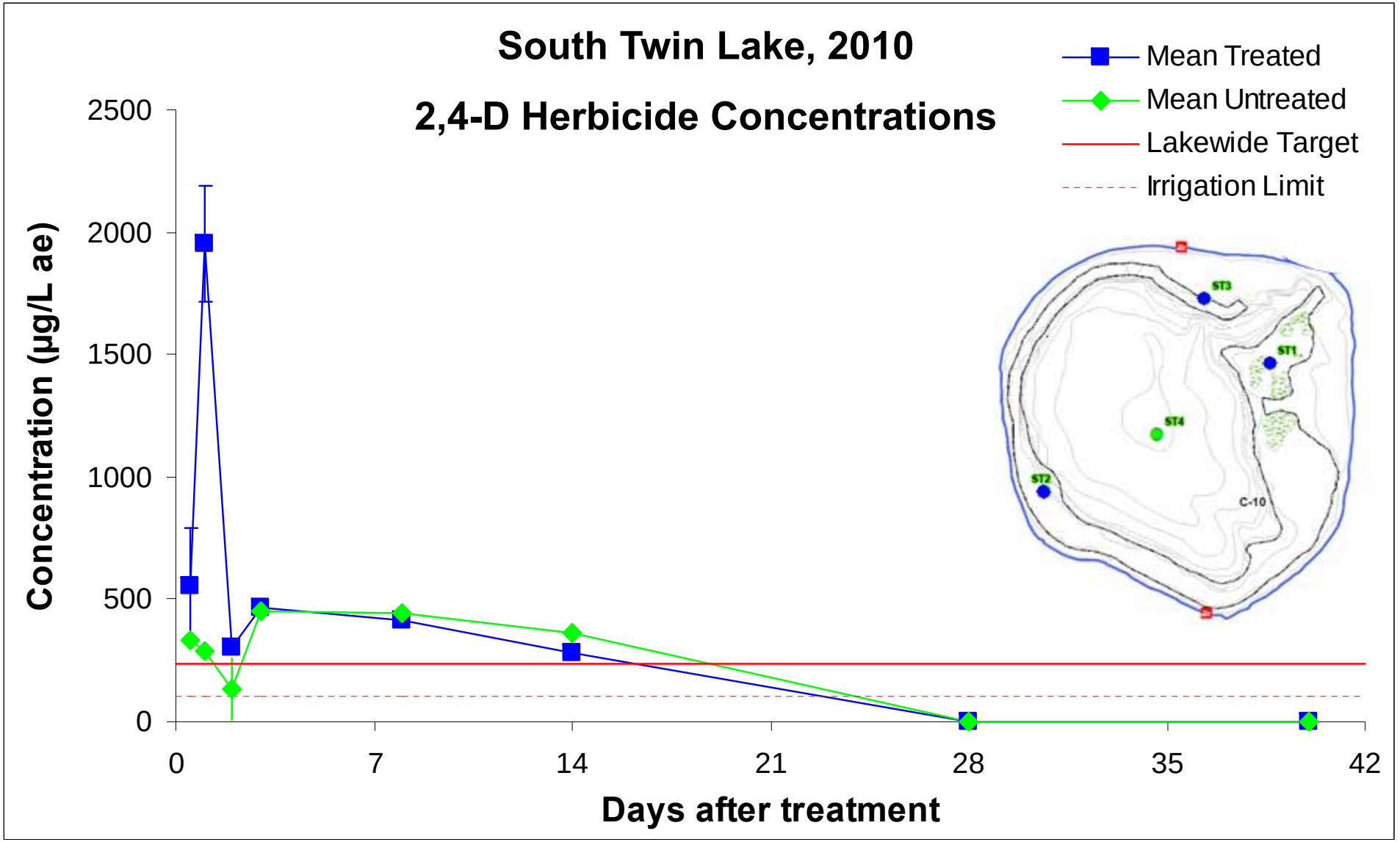
2,4-D Concentration/Exposure Time



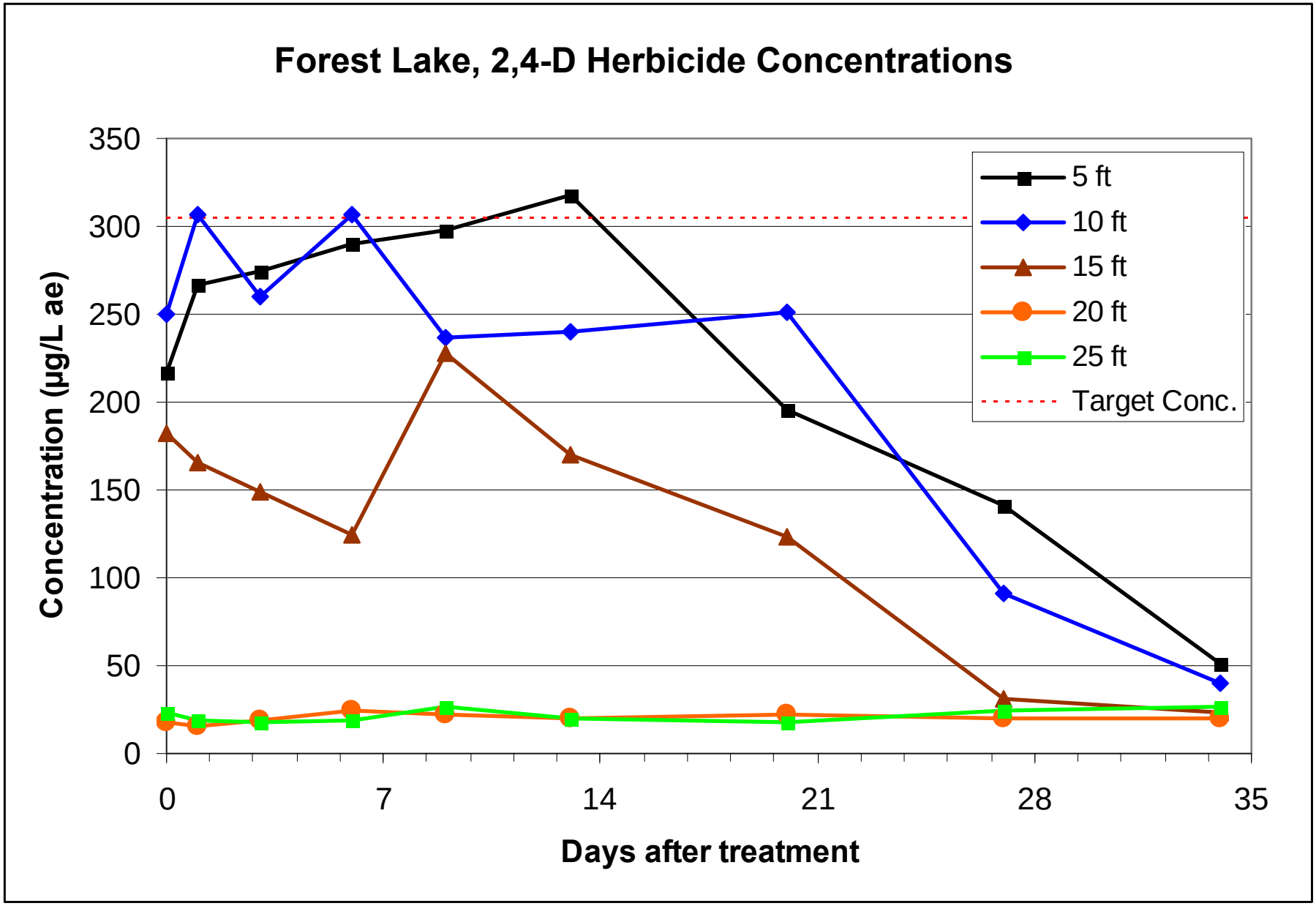
Recommended label rate: 2.0 – 4.0 ppm

1.0 mg/L = 1.0ppm = 1000 ppb

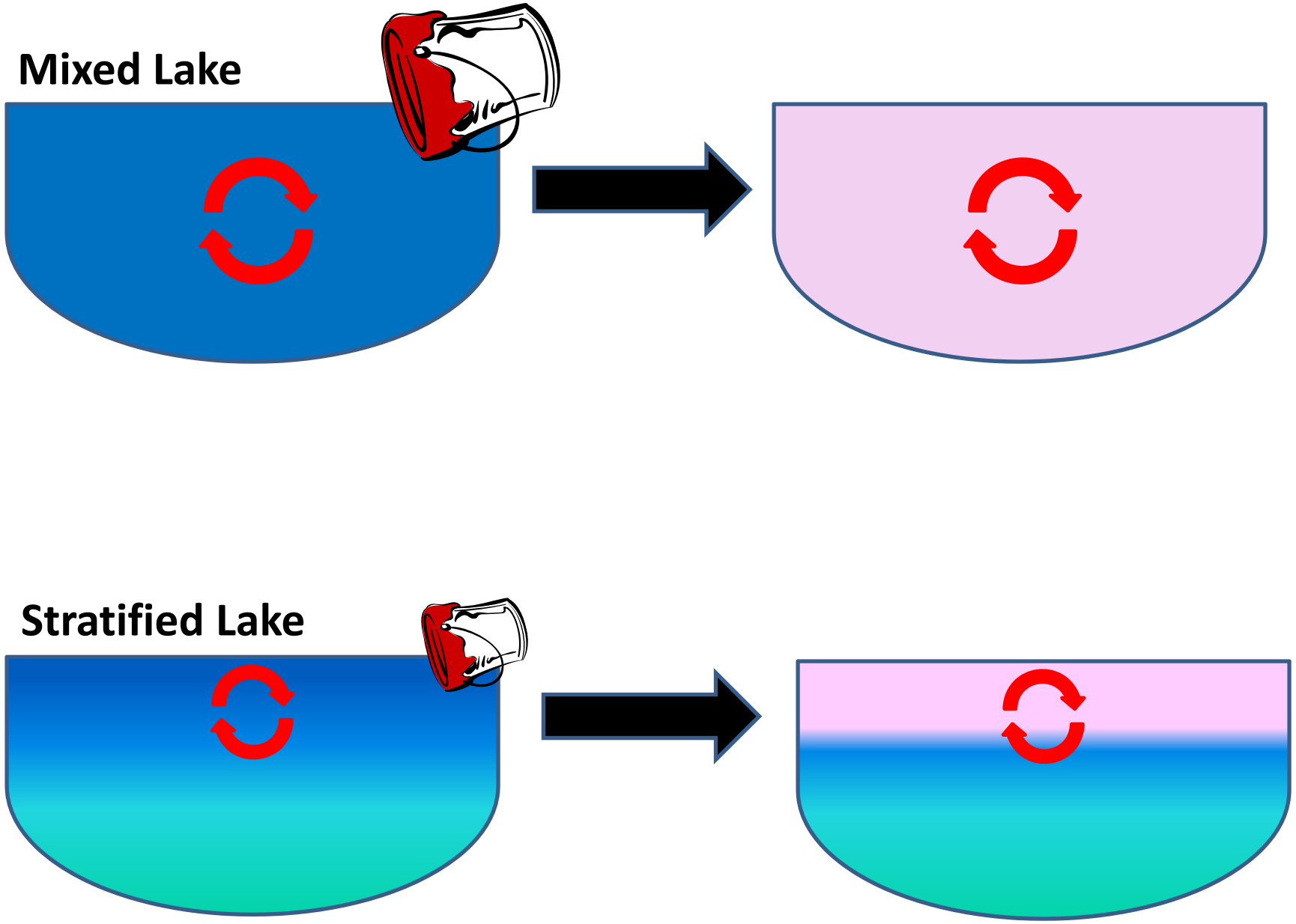
Lakewide Dissipation



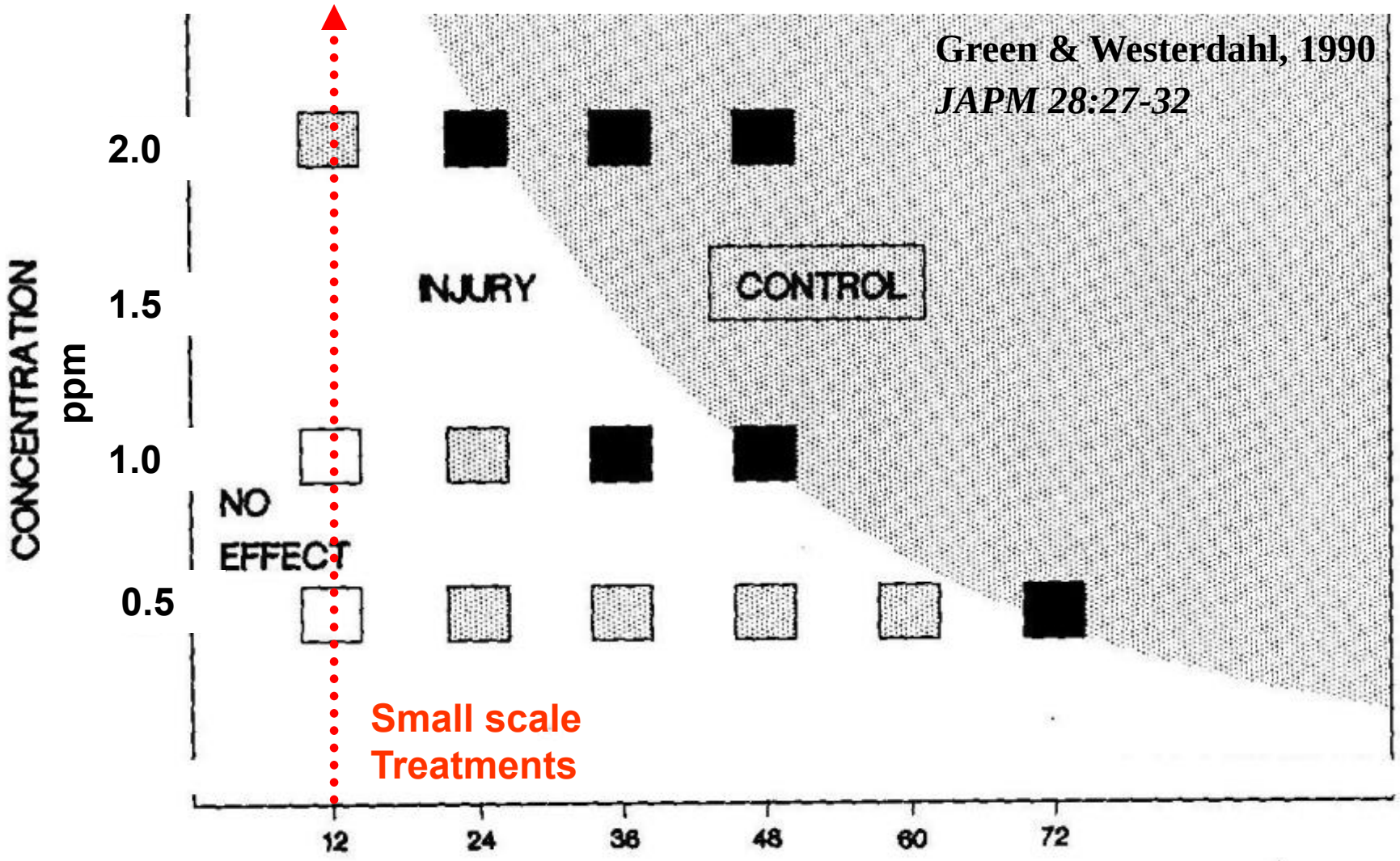
Lakewide Stratification



Herbicide Use Patterns



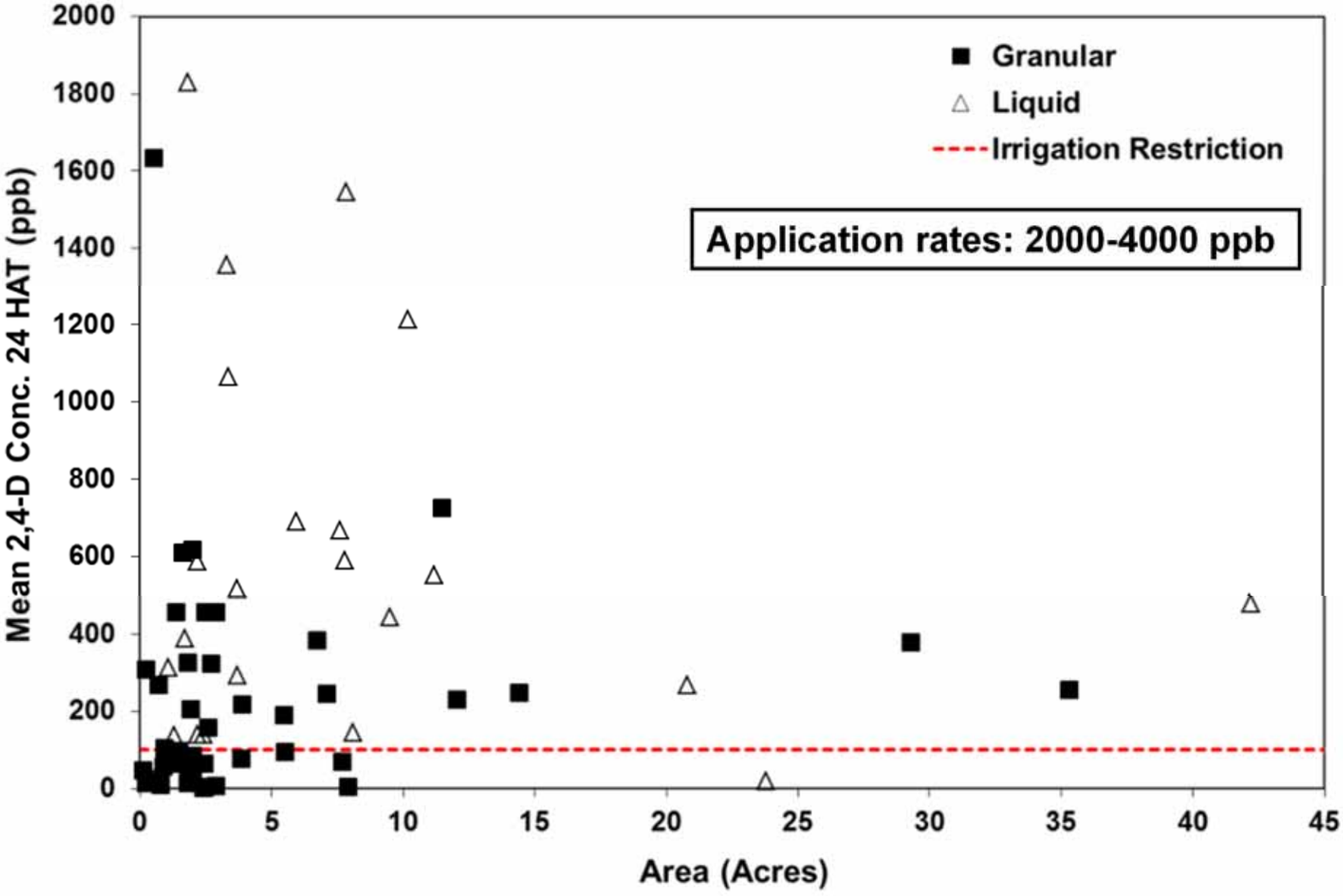
2,4-D Concentration/Exposure Time



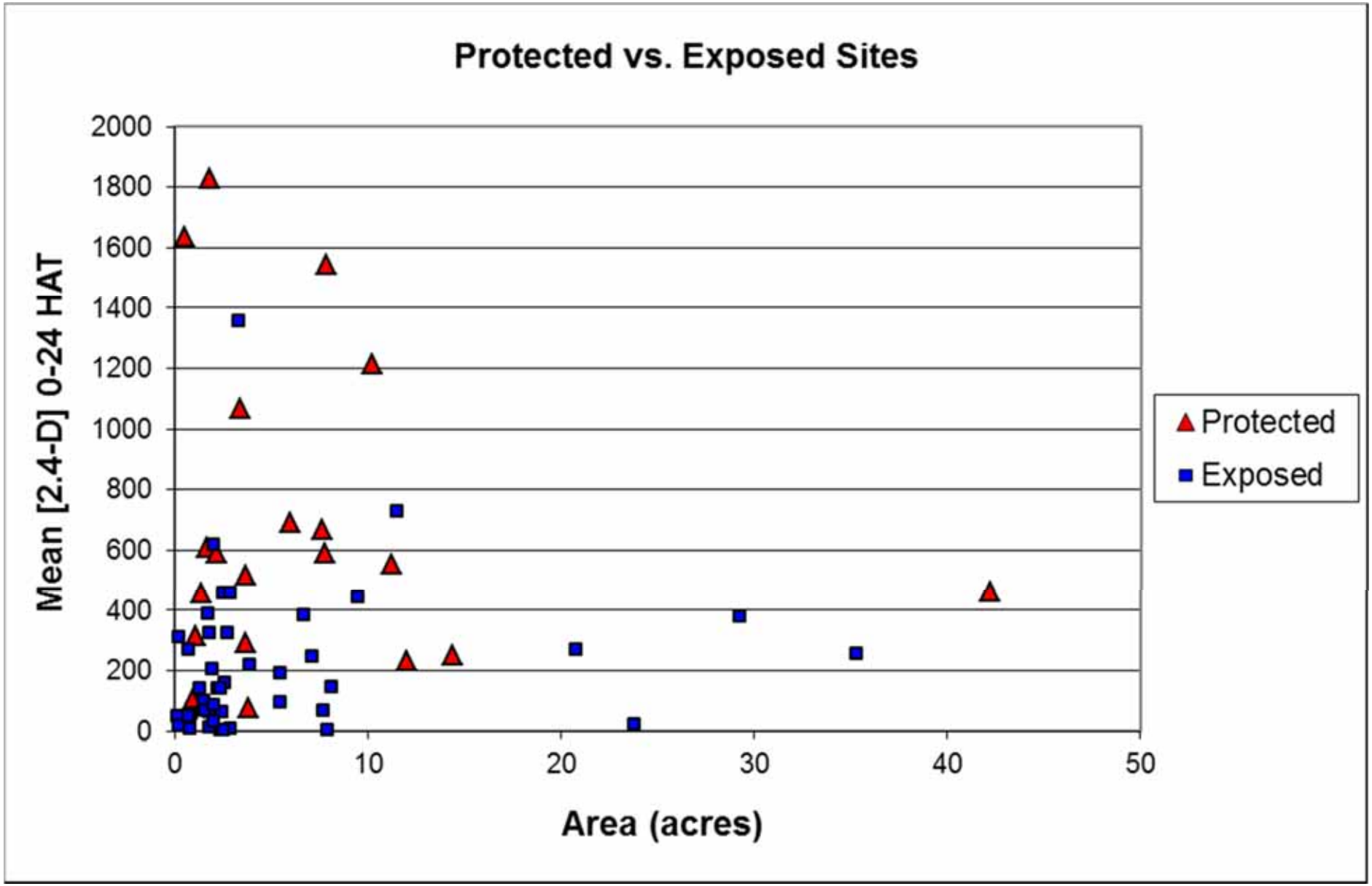
Recommended label rate:
2.0 – 4.0 ppm

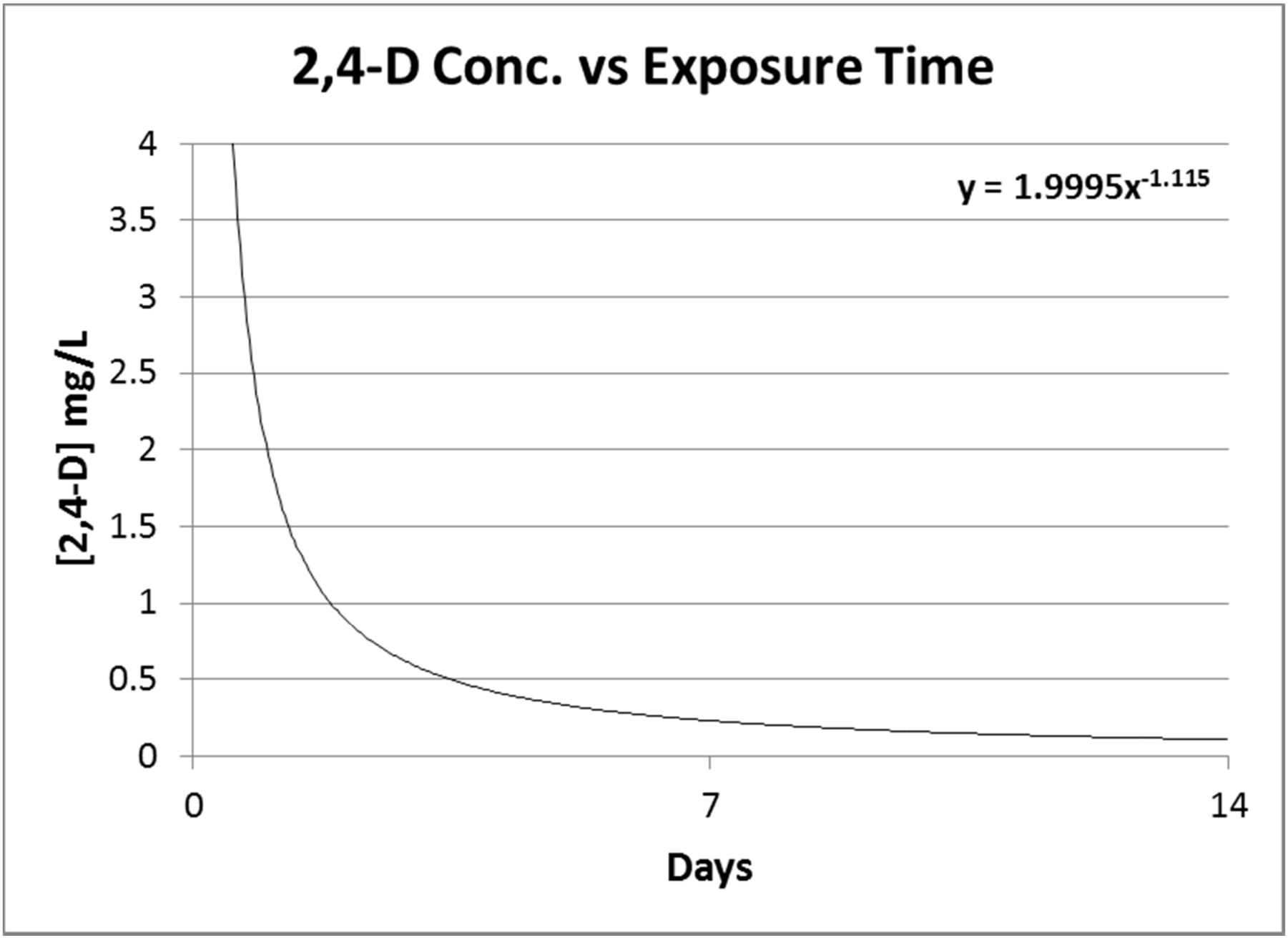
1.0 ppm = 1.0 mg/L = 1000 ppb

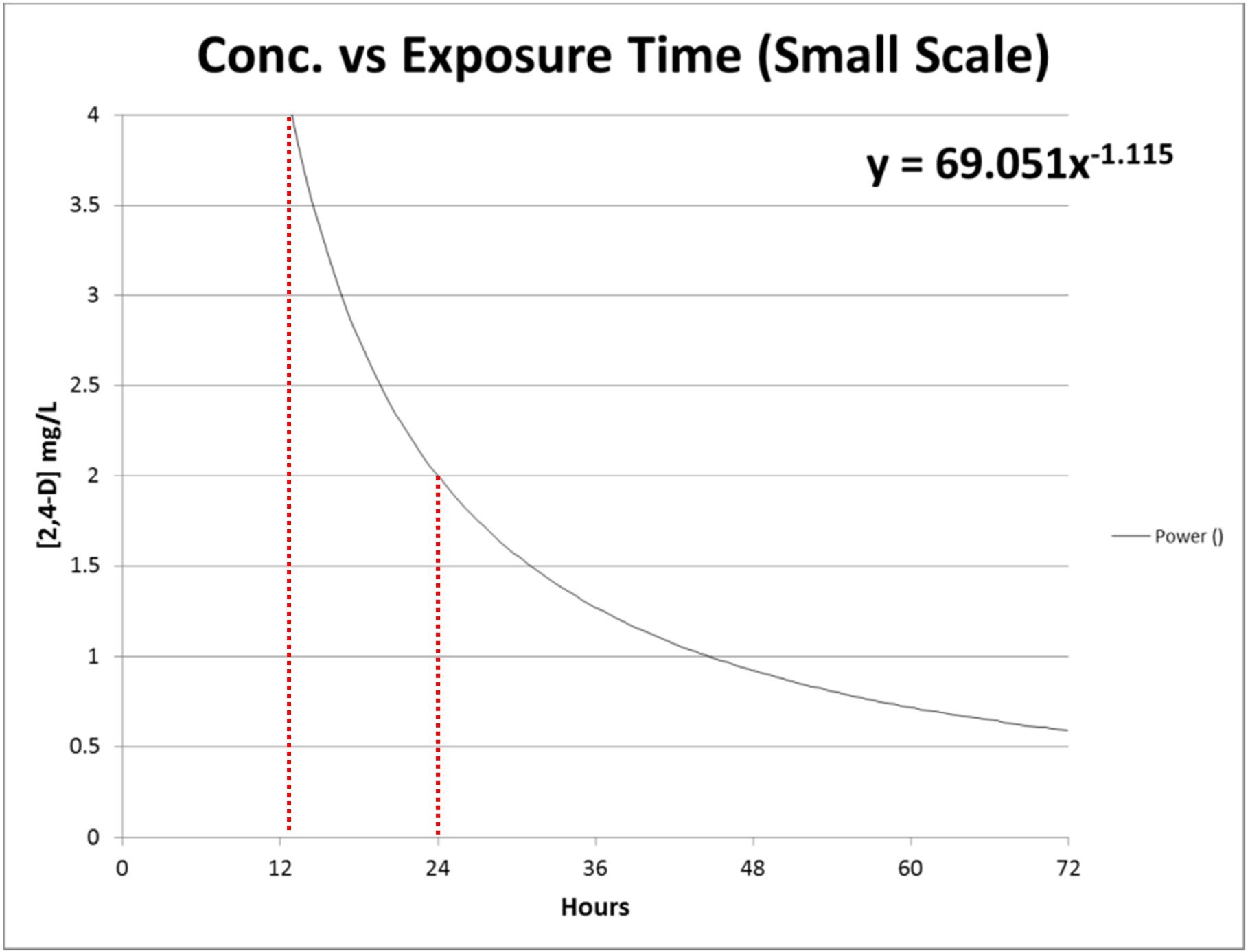
Small Scale Treatments

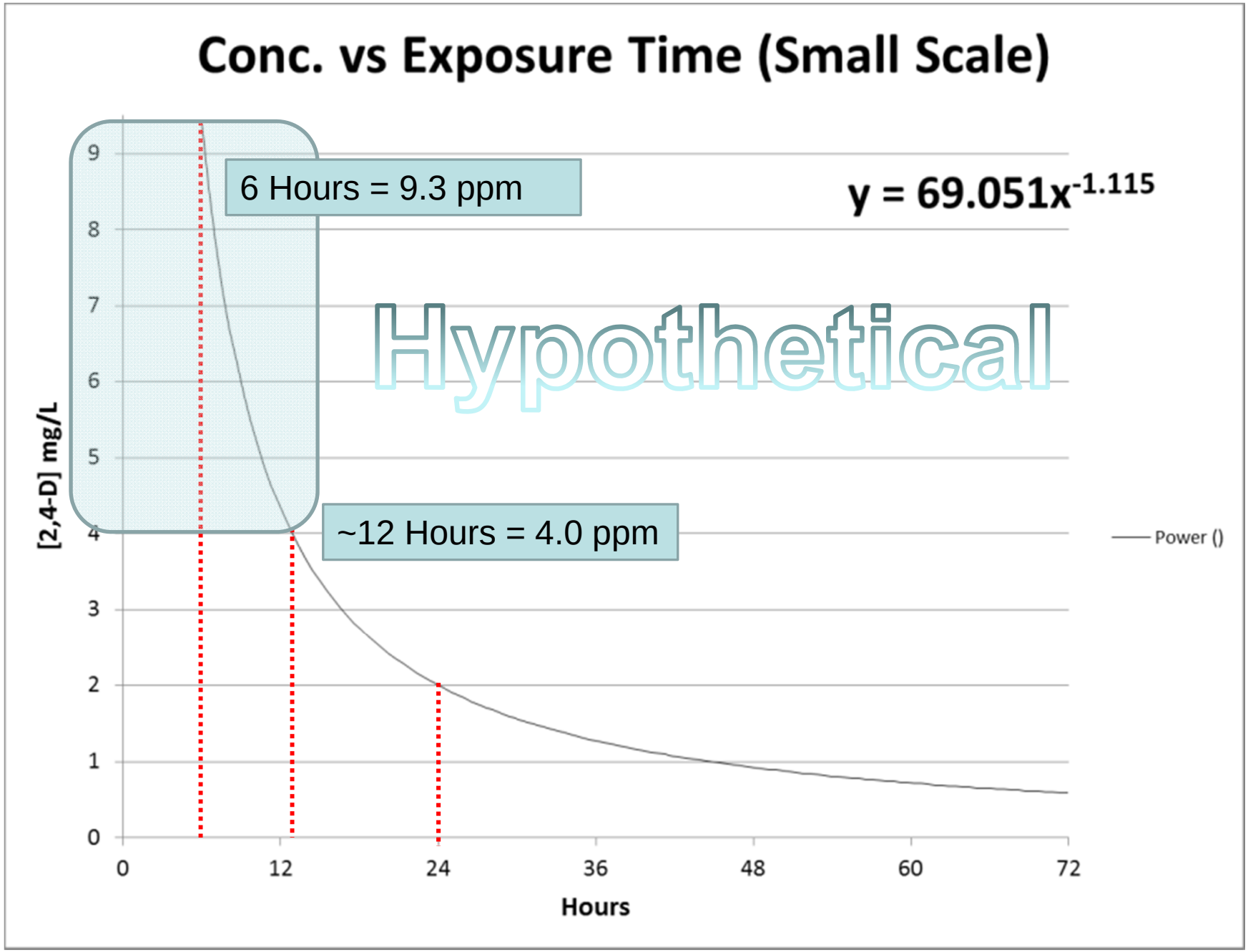


Treatment Site Location




2,4-D Conc. vs Exposure Time
y = 1.9995x-1.115
[2,4-D] mg/L
4
3.5
3
2.5
2
1.5
1
0.5
0
0
7
14
Days


Conc. vs Exposure Time (Small Scale)
y = 69.051x-1.115
[2,4-D] mg/L
Hours
Power ()
0
0.5
1
1.5
2
2.5
3
3.5
4
0
12
24
36
48
60
72


Conc. vs Exposure Time (Small Scale)
6 Hours = 9.3 ppm
y = 69.051x-1.115
Hypothetical
~12 Hours = 4.0 ppm
[2,4-D] mg/L
Power ()
Hours
0
12
24
36
48
60
72
1
2
3
4
5
6
7
8
9

Preliminary Findings

- Recommended label concentrations may not be applicable for whole lake or large scale chemical treatments
- Herbicide dissipation is rapid and large scale treatments can result in a whole-lake treatment if the scale of the treatment area is large compared to the overall lake volume
- EWM control looks promising, however short-term damage to certain native species may occur and long term effects on biotic and abiotic parameters is uncertain
- Small scale treatments are less predictable and are influenced by many different variables
- Herbicide monitoring is important, both to understand treatment efficacy, as well as ecological risks

Next Steps

- Continue monitoring long term EWM management lakes
- Continue evaluation and monitoring of the efficacy of large and small scale chemical treatments utilizing different application techniques and formulations
- Continue evaluation of direct and indirect impacts to native plant communities, water quality responses, and other organisms
- Further exploration of hybrid water milfoils and effectiveness of herbicide treatments
- Expand monitoring to other areas of the state
- Expand monitoring to curly-leaf pondweed projects

DISCUSSION

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