Current Distribution, Suitable Habitat, and Control of Common Valerian (*Valeriana officinalis* L.) in Wisconsin

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Common / Garden Valerian (*Valeriana officinalis* L.)

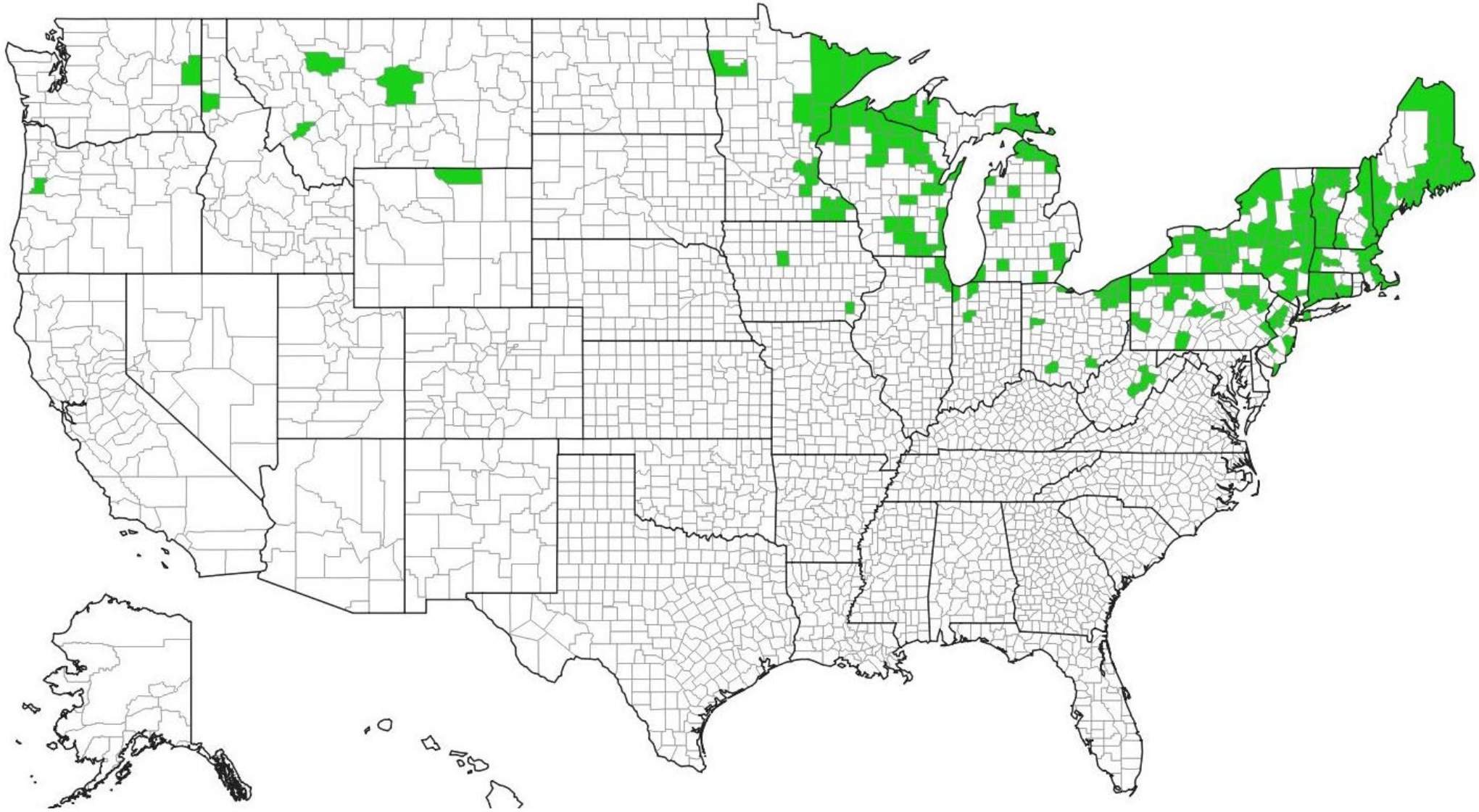
- Creeping herbaceous perennial
- Invades a range of habitats
  - Roadsides, grasslands, edges of forests
- Dominates areas but impacts are not known
- Regulated in Wisconsin
  - Restricted

Common / Garden Valerian identification

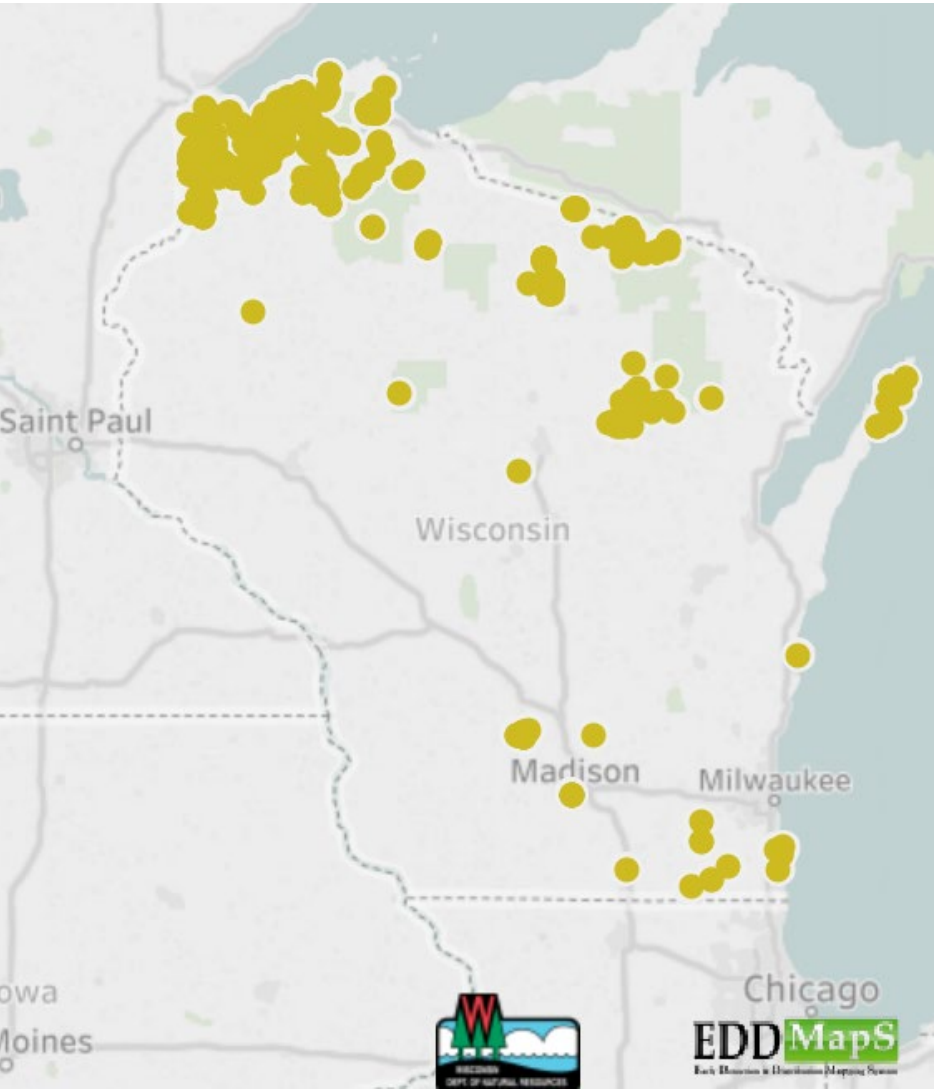
Several key characteristics make identification relatively easy

1. Flowers in mid-late spring (white umbels)
   - Unique flowers
2. Sweet smell when flowering
3. Opposite leaves (pinnately compound)

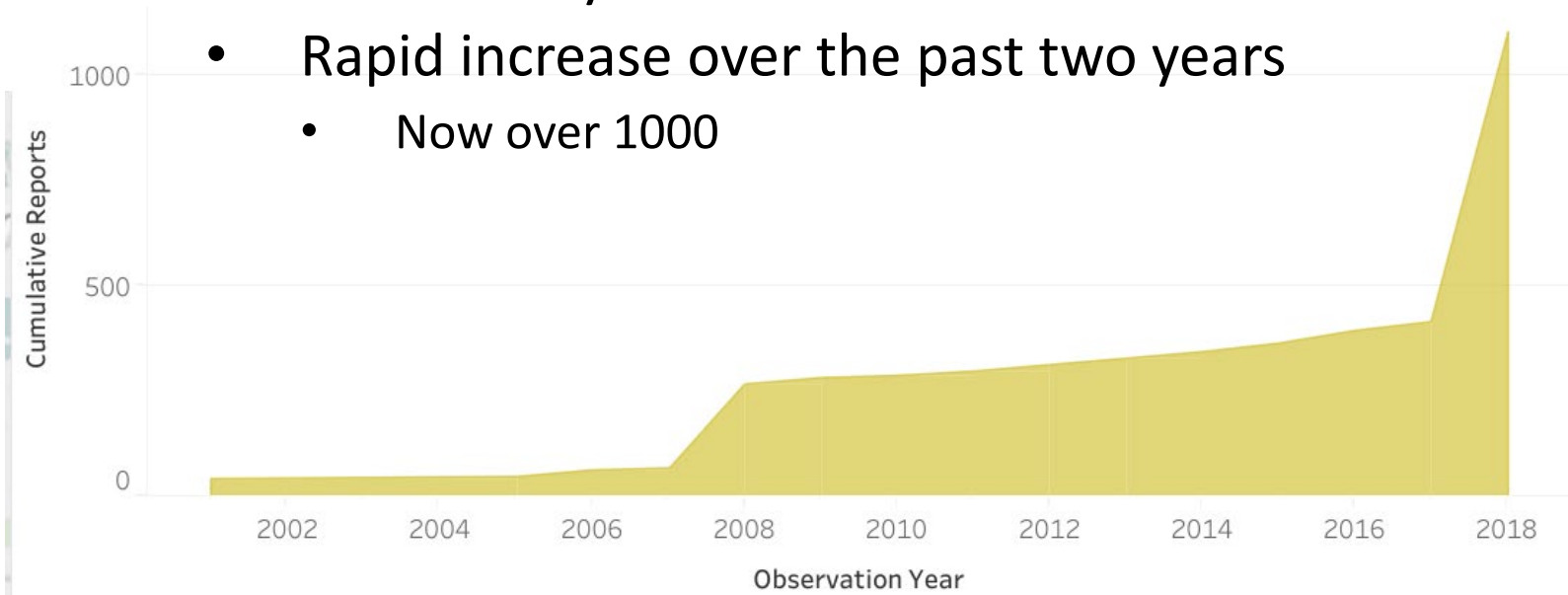
Common / Garden Valerian Distribution



Common / Garden Valerian Distribution in WI



- Largest populations in Northern WI
- Reports are increasing
  - Few in early 2000s
  - Rapid increase over the past two years
    - Now over 1000



Images taken from WISTIPP viewer

fyi.uwex.edu/wifdn

Questions driving research

1. Populations are expanding in northern Wisconsin but it is not known what the potential range and drivers are for this species.

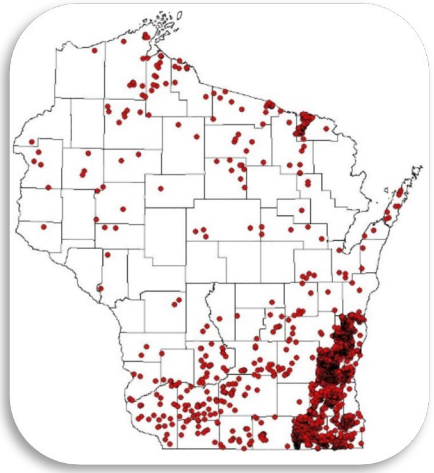
2. Frequent questions on control have been received, but no studies on how to control this species with herbicides are known.

Goals of this effort

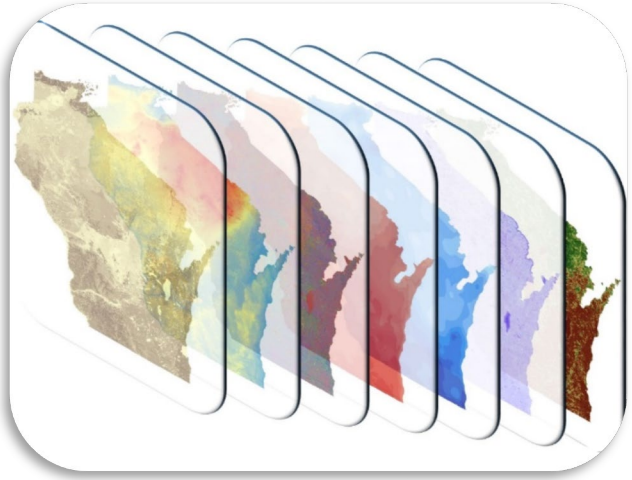
1. Develop habitat suitability models and use these to understand the potential range of distribution of garden valerian in Wisconsin and the drivers responsible for spread.

2. Screen herbicides commonly used in grasslands for activity on this species.

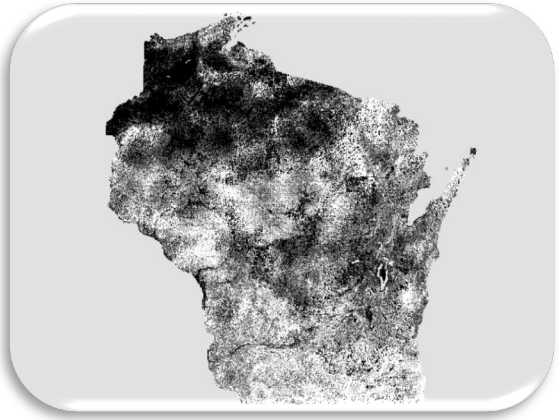
Habitat Suitability Methods



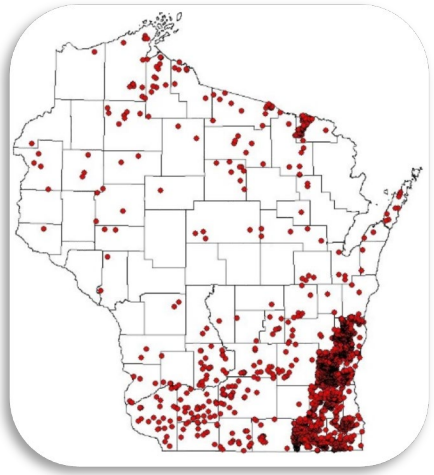
- Species occurrence records
- Extensive database

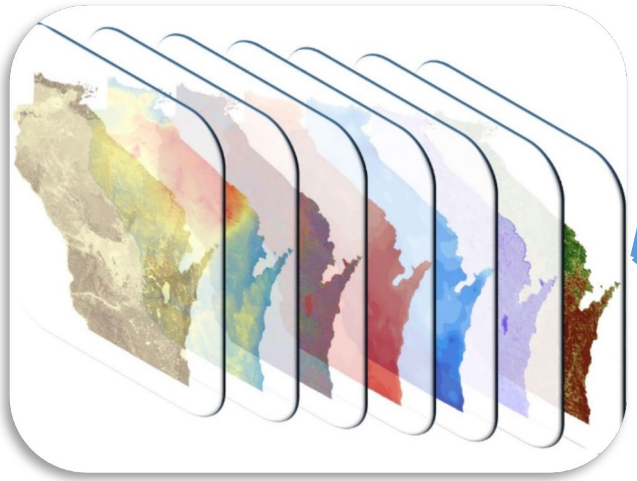


- Precipitation
- Temperature
- Soils attributes
- Distance to dispersal corridors
- Topographic attributes
- Vegetation indices
- **Generally accepted predictors from literature**



- Probability of suitable habitat





BRT

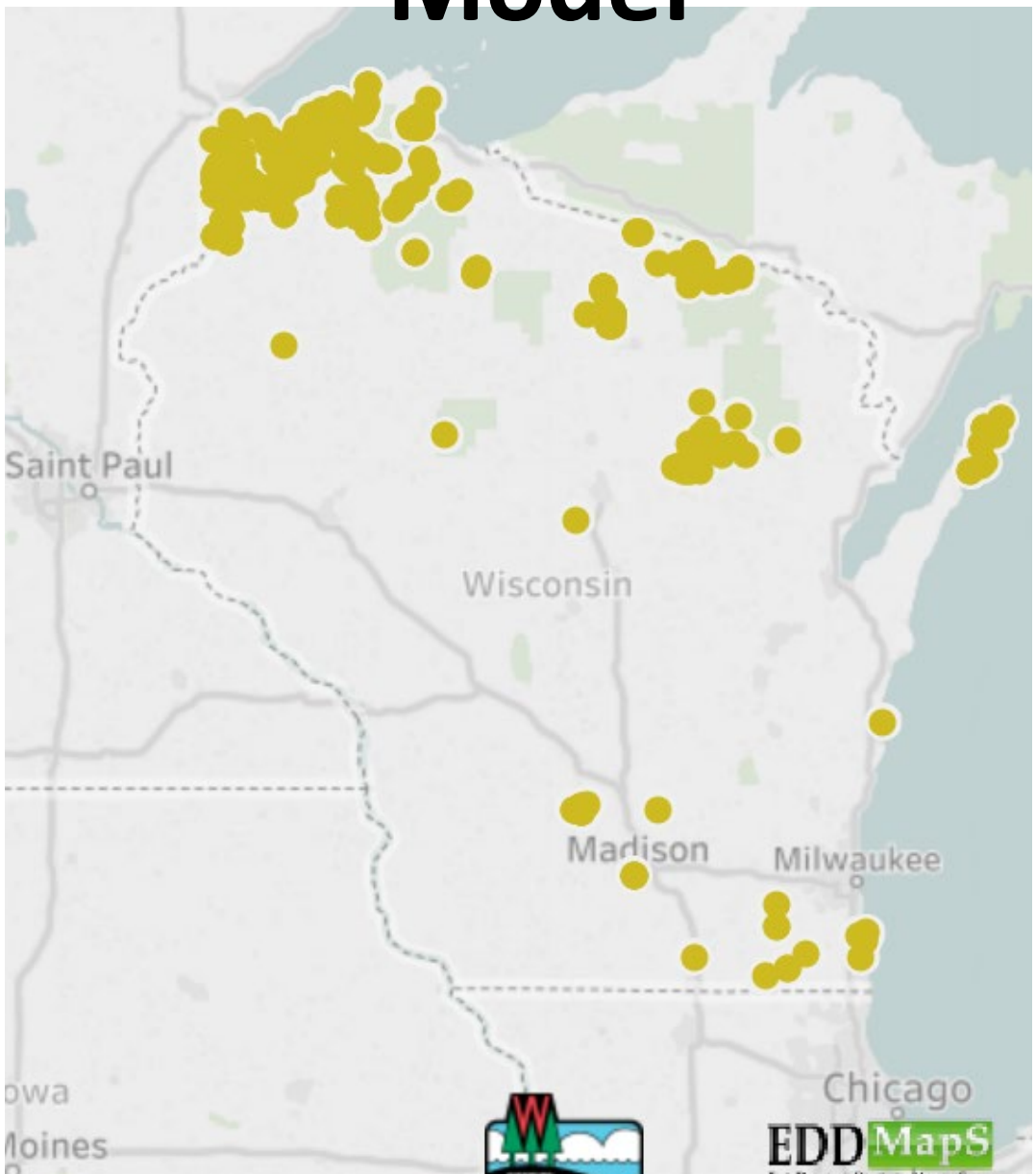
GLM

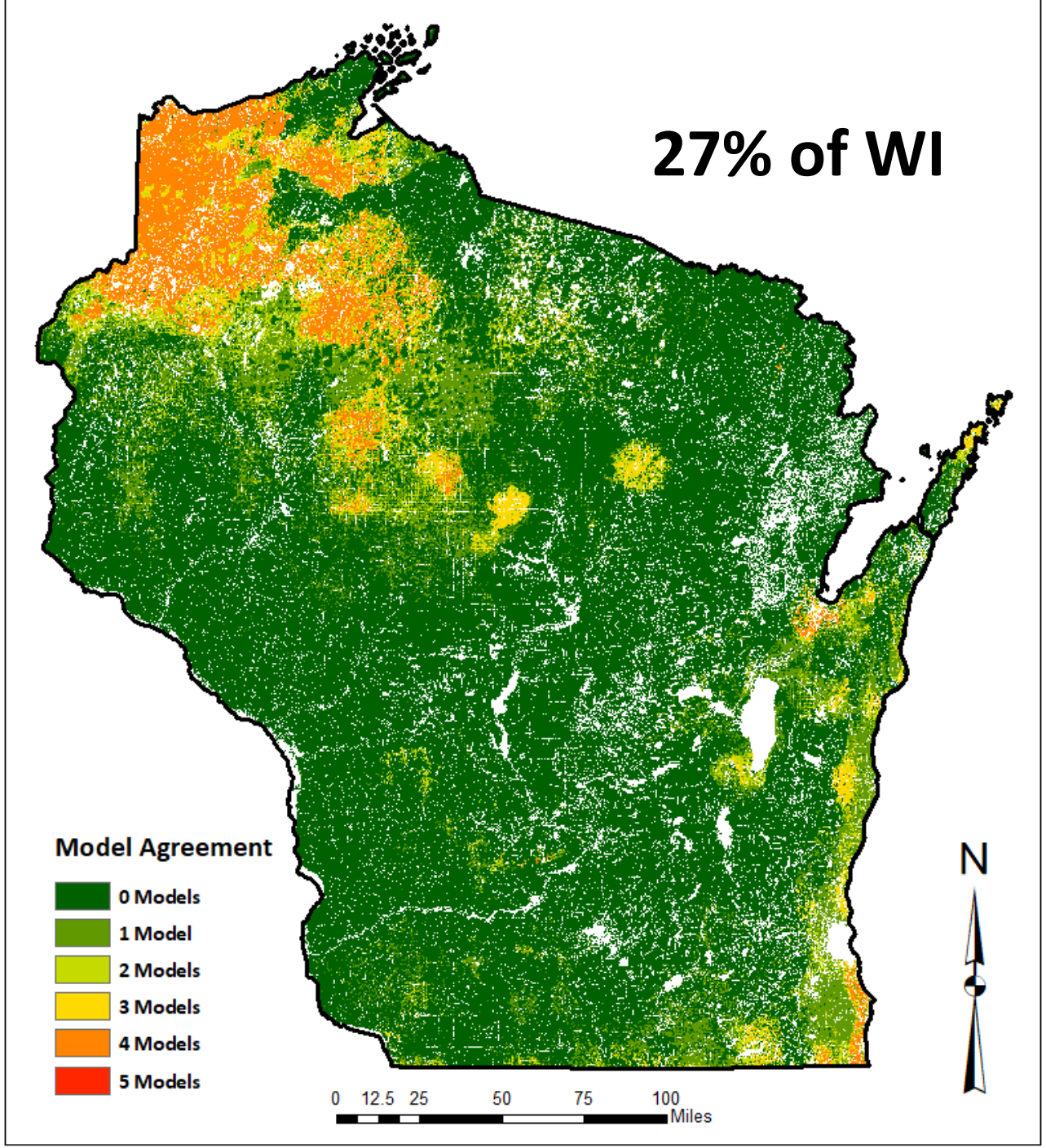
MARS

MAXENT

RF

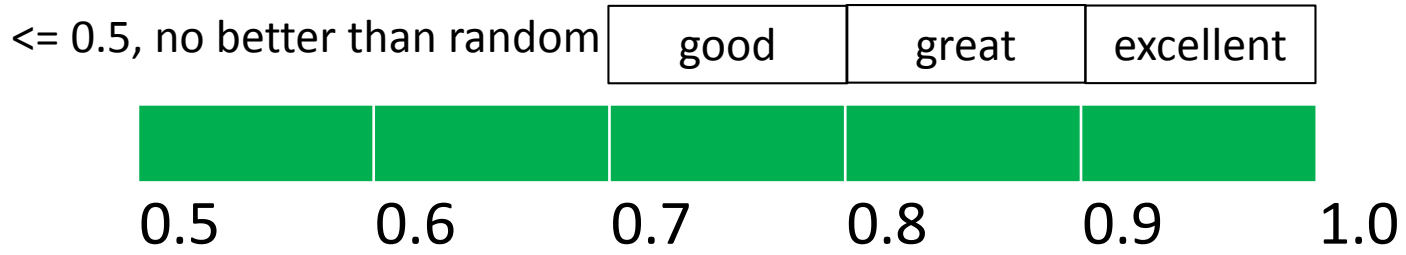
Habitat Suitability Model





Model Performance

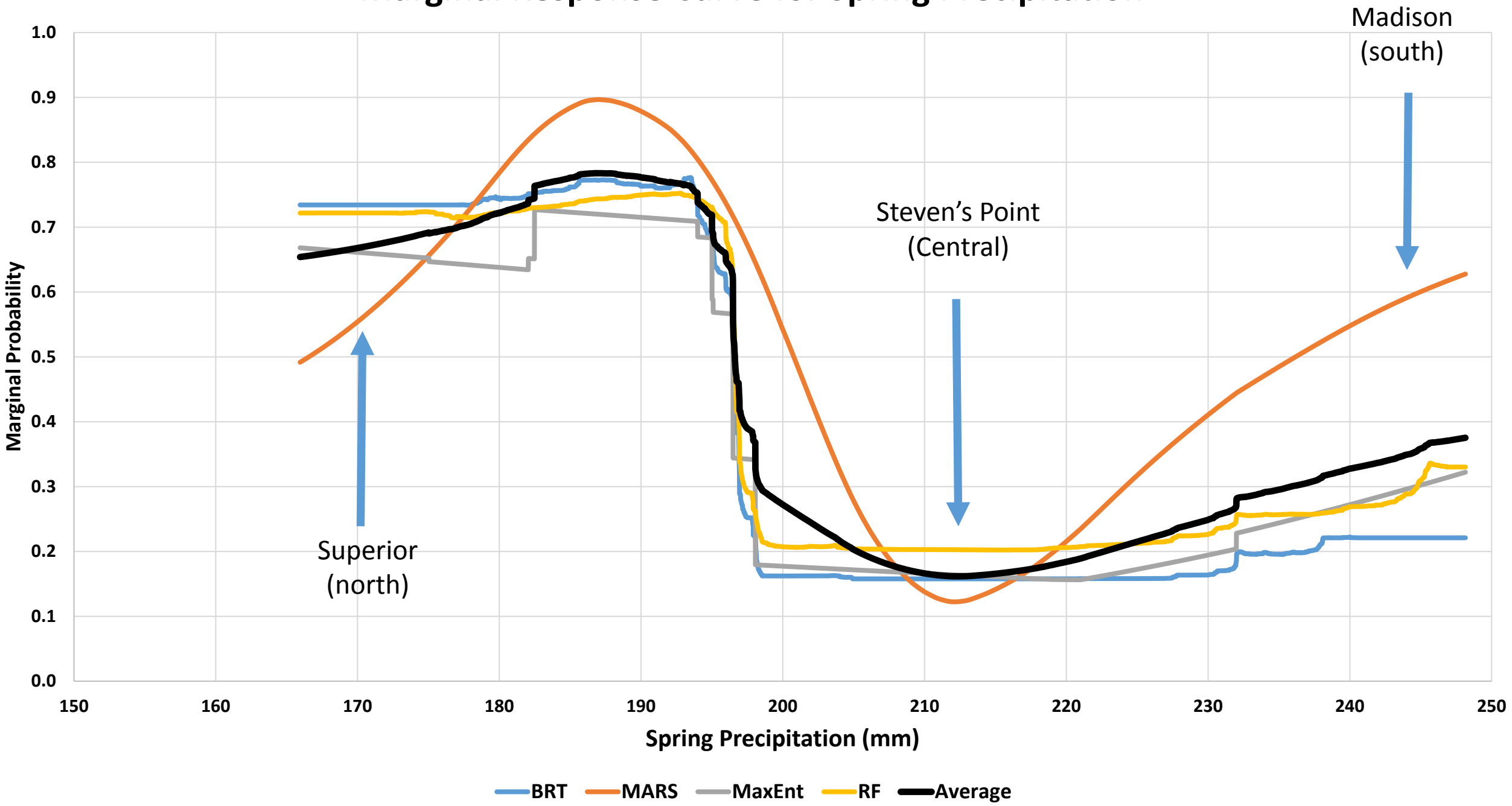
Evaluation Metric	BRT	MARS	MAXENT	RF	Average
AUC	0.95	0.94	0.96	0.94	0.95
Percent Correctly Classified (n=14)	87	85	91	88	88
Sensitivity	0.93	0.92	0.92	0.87	0.91
Specificity	0.87	0.85	0.91	0.88	0.88
True Skills Statistic	0.80	0.77	0.82	0.75	0.79
Cohen's Kappa	0.20	0.17	0.26	0.19	0.21
Binary Probability Cutoff	0.59	0.24	0.27	0.57	0.42

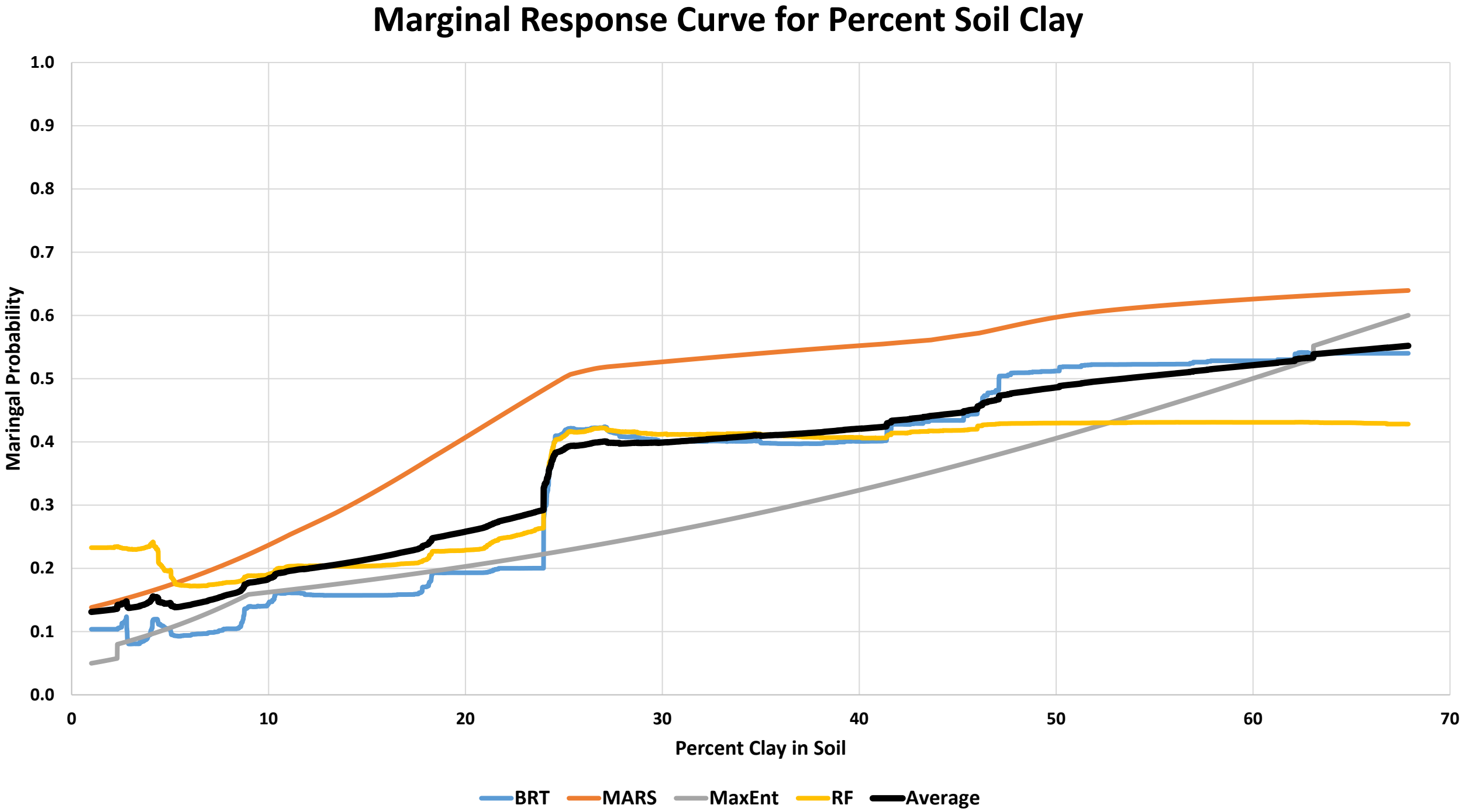


Hosmer and Lemeshow 1989

What predictors are driving the model?

Predictor	BRT	MARS	MAXENT	RF	Avg	RANK
Spring Precipitation	47%	38%	32%	36%	38%	1
Summer Precipitation	17%	23%	16%	8%	16%	2
% Clay	18%	9%	7%	12%	12%	3
Winter Minimum Temp	8%	2%	11%	9%	8%	4
Summer Maximum Temp	6%	0%	7%	6%	5%	5
EVI	0%	8%	5%	6%	5%	6
Winter Precipitation	0%	4%	8%	5%	4%	7
% Tree Cover	0%	6%	6%	5%	4%	8

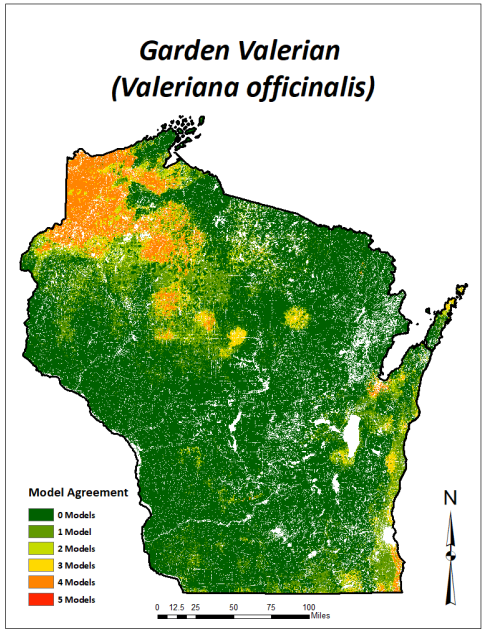

Marginal Response Curve for Spring Precipitation
Madison
(south)
Steven's Point
(Central)
Superior
(north)
Marginal Probability
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
150
160
170
180
190
200
210
220
230
240
250
Spring Precipitation (mm)
BRT
MARS
MaxEnt
RF
Average


Marginal Response Curve for Percent Soil Clay
Maringal Probability
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0
10
20
30
40
50
60
70
Percent Clay in Soil
BRT
MARS
MaxEnt
RF
Average

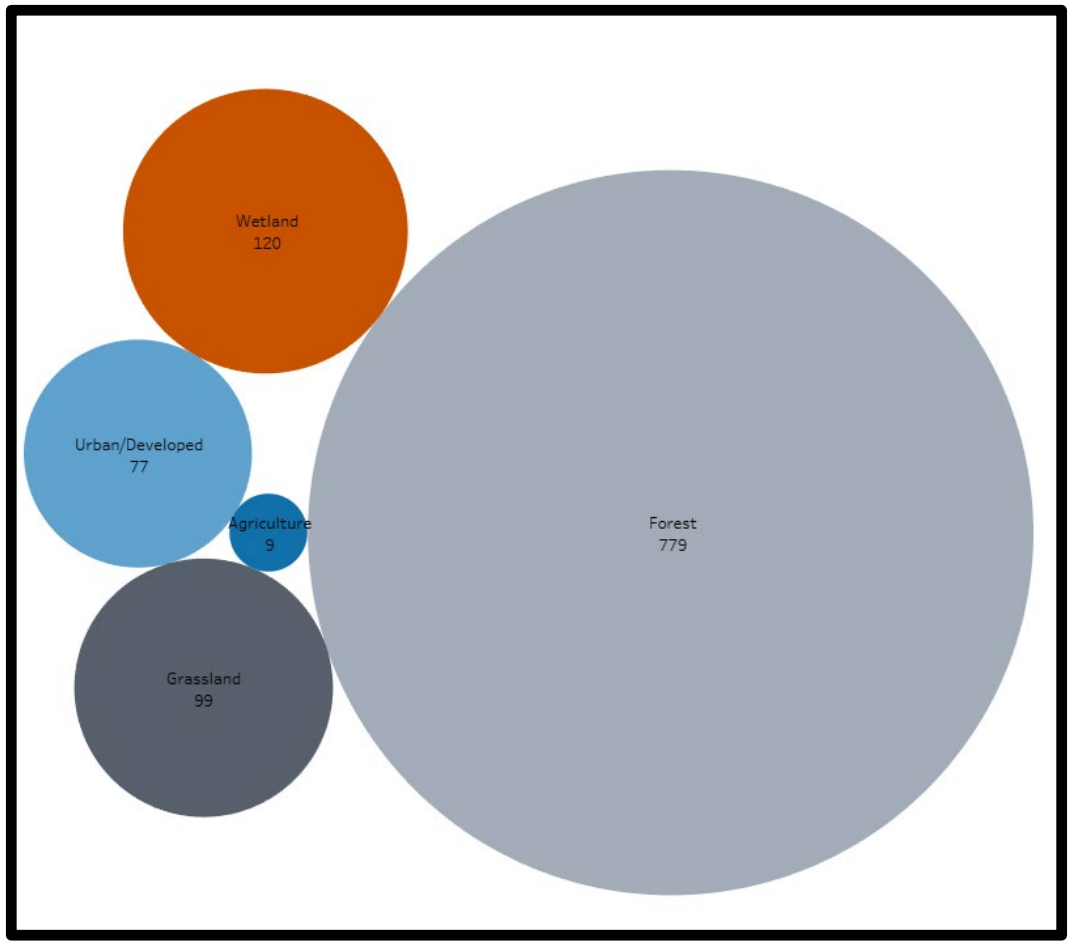
What landscapes/habitats susceptible

Ensemble model predicts **> 3 million hectares suitable in Wisconsin (26.7%)**

WISCLAND Level I	Hectares Suitable
Urban/Developed	155,185
Agriculture	754,139
Grassland	355,975
Forest	1,453,188
Wetland	638,413
Barren	1,691
Shrubland	1,577



# of points within each habitat



Herbicide Screening Methods

- Area mowed in summer, herbicides applied 9/12/17 in fall to resprouts
  - RCB with 4 reps; 3m x 9 meter plots,
  - Broadcast applied
- Visually estimated cover the following spring and summer
- ANOVA conducted
  - Mean separation P value < 0.10

Active ingredient	Herbicide	Rate (product)
2,4-D	0.95 lbs ae/A	2 pints/A
Aminopyralid	0.08 & 0.11 lbs ae/a	5 & 7 fl oz/A (Milestone)
Clopyralid	0.5 lbs ae/A	1.33 pt/A (Transline)
Dicamba	1.0 lbs ae/A	2 pt/A (Clarity)
Metsulfuron	0.375 oz ai/A	0.5 oz/A (Escort)
Triclopyr	1.0 lbs ae/A	2 pt/A (Remedy)
Aminopyralid + Metsulfuron	0.11 + 0.375 lbs active/a	3.3 oz/A (Chaparral)
Untreated Control	-	-

Effectiveness of Herbicides

% cover of Garden Valerian

Treatment	**9.5 MAT**		**12 MAT**	
Control	34	a	28	a
2,4-D 2 PT/A	17	b	20	abc
Clarity 2 PT/A	20	b	29	a
Escort 0.5 OZ WT/A	3	c	4	e
Remedy 2 PT/A	14	bc	16	bcd
Transline 1.33 PT/A	13	bc	13	cde
Chaparral 3.33 OZ WT/A	3	c	6	de
Milestone 7 OZ/A	17	b	25	abc
Milestone 5 OZ/A	16	b	16	bcd
***P*-Value**	0.01		0.06	

Conclusions

- Common/Garden Valerian has the potential for further spread in Wisconsin
  - Over 3 million hectares susceptible
    - forests, agriculture, grasslands, wetlands
  - Spring and summer precipitation as well as % clay in soil were major drivers (66%)

- Products containing metsulfuron provided the most consistent and long lasting control
  - Applied in the fall