# USING HABITAT SUITABILITY MODELS IN WISCONSIN: AN ENGAGED, ITERATIVE, AND COLLABORATIVE APPROACH

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MENU

nature COMMUNICATIONS



Article | OPEN

# Global threats from invasive alien species in the twenty-first century and national response capacities

Regan Early, Bethany A. Bradley, Jeffrey S. Dukes, Joshua J. Lawler, Julian D. Olden, Dana M. Blumenthal, Patrick Gonzalez, Edwin D. Grosholz, Ines Ibañez, Luke P. Miller, Cascade J. B. Sorte & Andrew J. Tatem

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Climate-change ecology
Ecosystem ecology
Invasive species

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## Abstract

Invasive alien species (IAS) threaten human livelihoods and biodiversity globally. Increasing globalization facilitates IAS arrival, and environmental changes, including climate change, facilitate IAS establishment. Here we provide the first global, spatial analysis of the terrestrial threat from IAS in light of twenty-first century globalization and environmental change, and evaluate national capacities to prevent and manage species invasions. We find that one-sixth of the global land

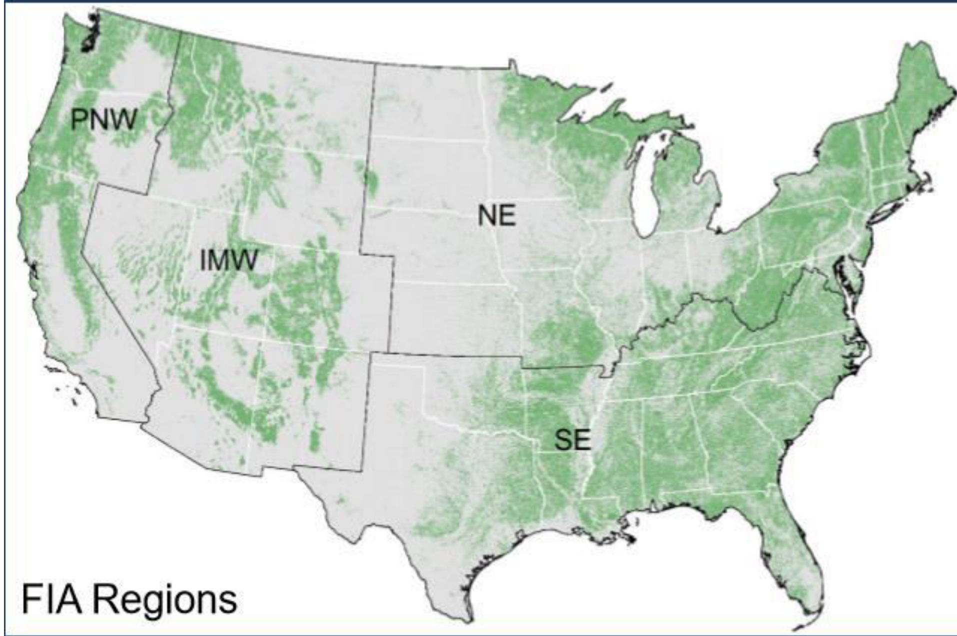
NeoBiota 24: 49–54 (2015)
doi: 10.3897/neobiota.24.8378
http://neobiota.pensoft.net

RESEARCH ARTICLE

NeoBiota
Advancing research on alien species and biological invasions

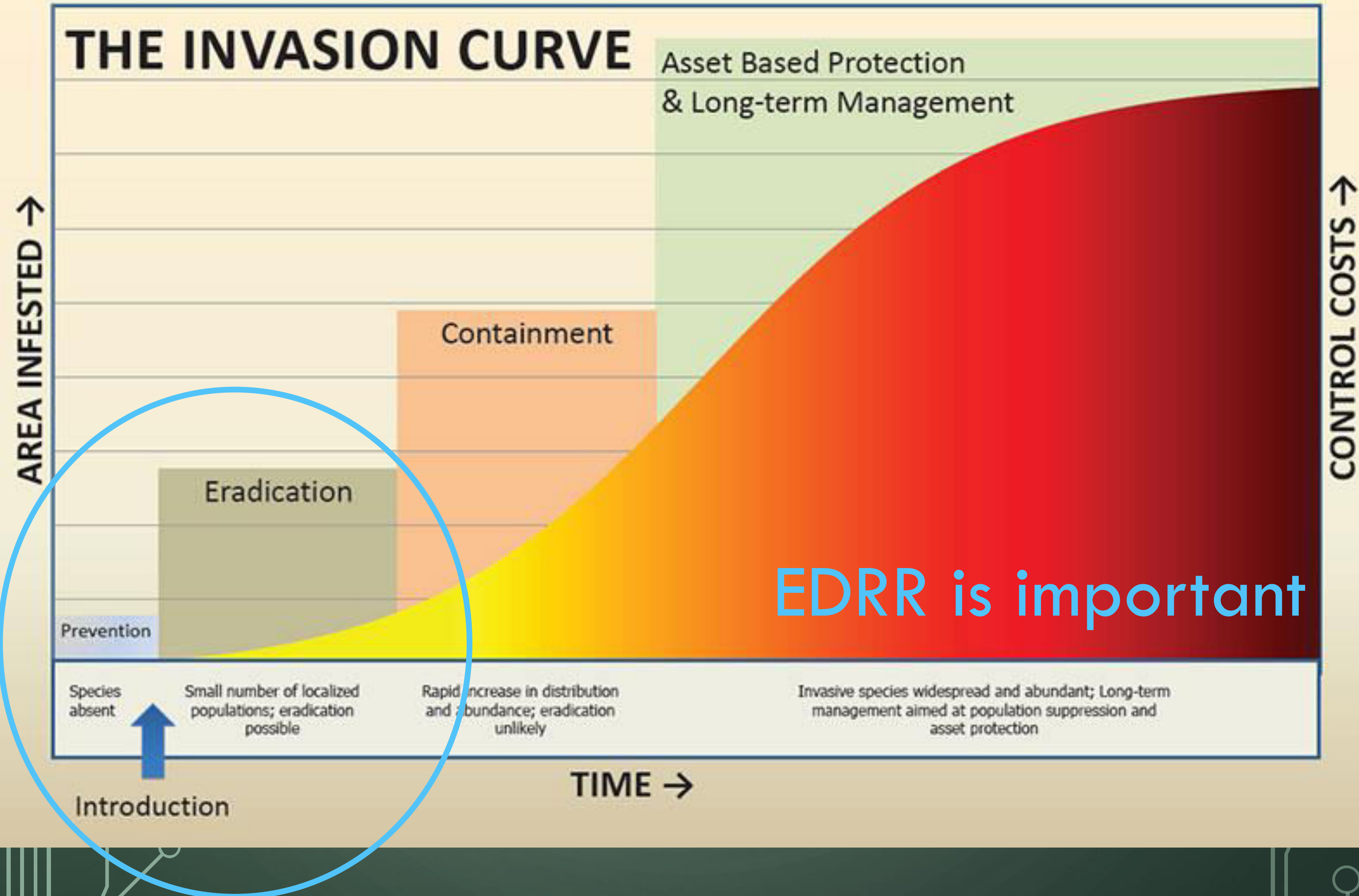
# A subcontinental view of forest plant invasions

Christopher M. Oswalt[1], Songlin Fei[2], Qinfeng Guo[3], Basil V. Iannone III[2], Sonja N. Oswalt[1], Bryan C. Pijanowski[2], Kevin M. Potter[4]



# LEARNING OBJECTIVES

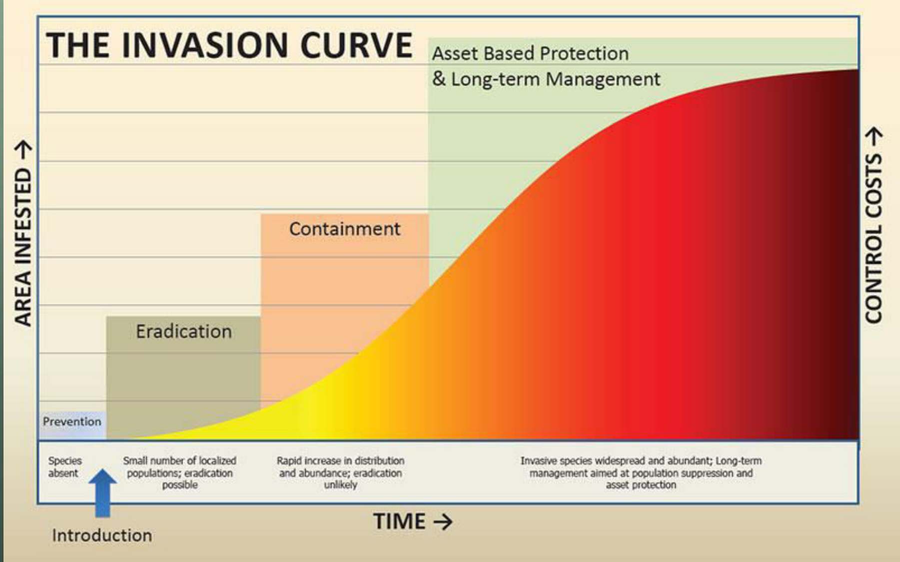
- Introduce habitat suitability models and their development
- Demonstrate how land managers can use models to detect species for survey efforts
- Exhibit benefits of modeling individual species to elucidate drivers of suitable habitat



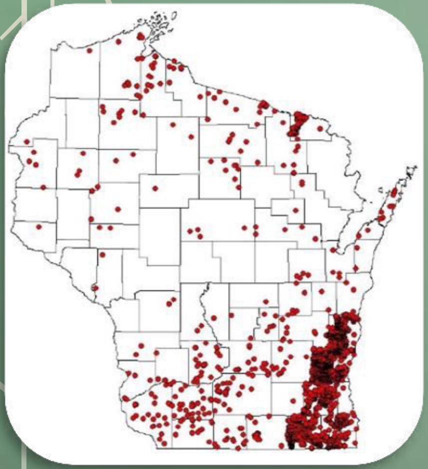

http://lakestewardship.blogspot.com/

# EARLY DETECTION & RAPID RESPONSE

- Identify species before they become well established
- In Wisconsin ~130 regulated invasive plants
  - May not always be possible to eradicate on large-scale
  - EDRR can assist with local efforts
- Can model suitable habitats across large landscapes



# HABITAT SUITABILITY MODELING



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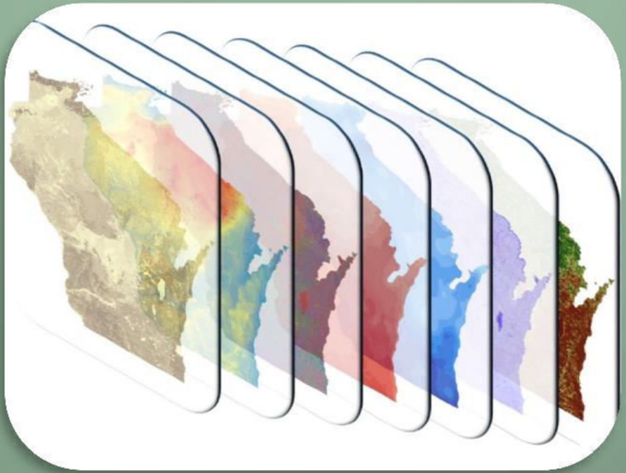

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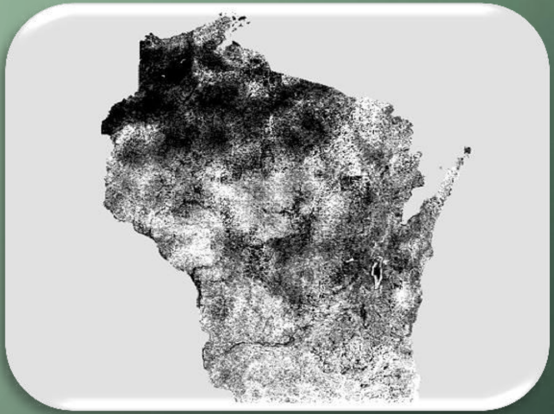
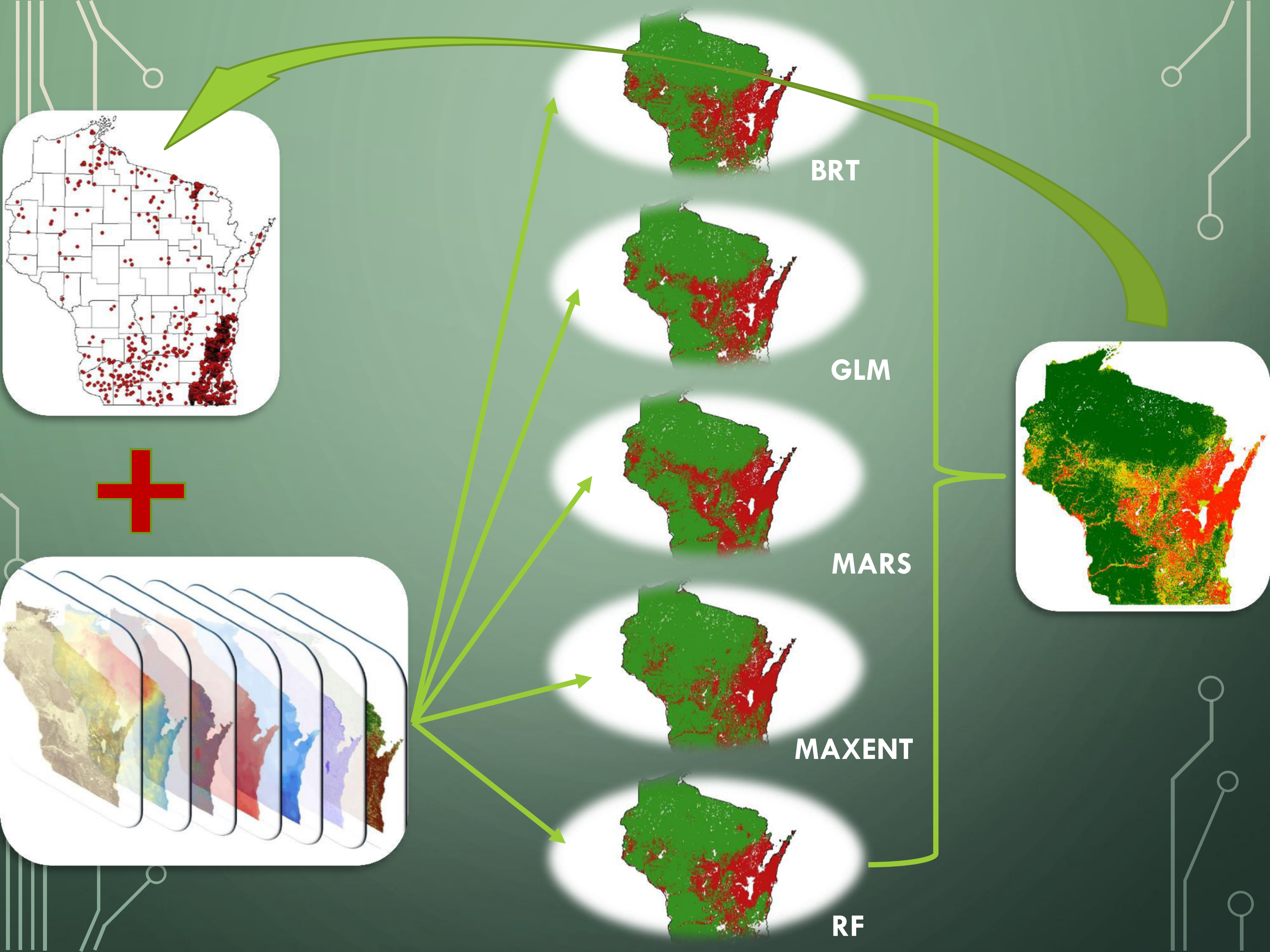


- Species occurrence records
- Extensive database

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


BRT
GLM
MARS
MAXENT
RF

# PROJECT OBJECTIVES

1) Create initial habitat suitability models for 21 invasives in WI
   - Develop initial priority species lists
   - Collect data by utilizing extensive network of citizen scientists
2) Improve habitat suitability models using new data
   - Improve priority species lists
3) Evaluate effects of climate change on habitat suitability
   - Determine vulnerable regions of WI

# PROJECT OBJECTIVES

1) Create initial habitat suitability models for 21 invasives in WI
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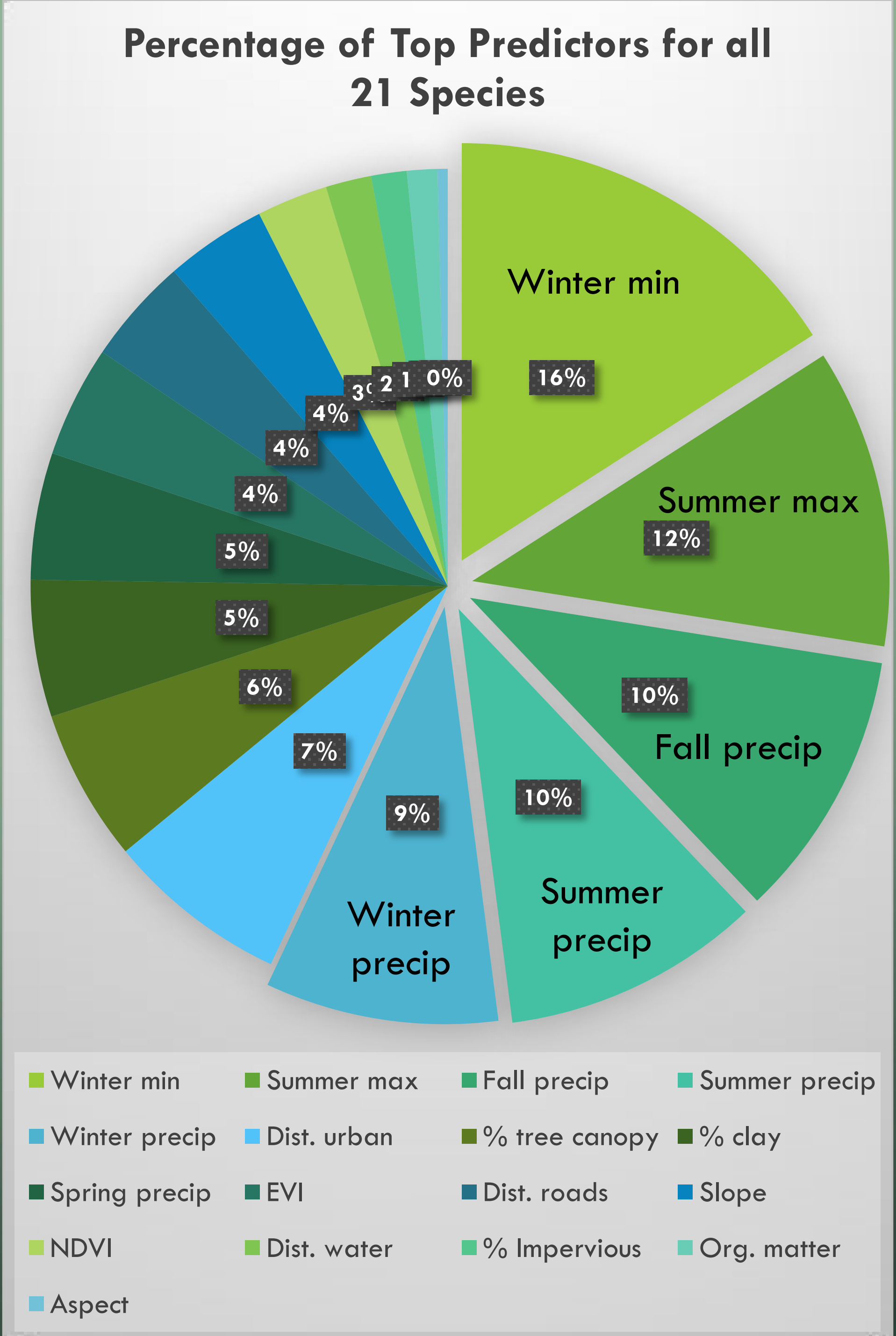
    - Improve priority species lists
3) Evaluate effects of climate change on habitat suitability
    - Determine vulnerable regions of WI

# RESULTS: TRENDS IN PREDICTORS

# SUMMARIZING MODELS – APPROACH

- Took top 5 predictors from each model for each species
  - Total possible 25 predictors
  - Some models eliminate predictors; could have fewer than 25 total
- Determined percentage of predictors within this top 5 cutoff
  - All species
  - Three habitat categories (full sun, forested, wetland)
  - Individual species


Percentage of Top Predictors for all 21 Species
Winter min
16%
Summer max
12%
10%
Fall precip
10%
Summer precip
9%
Winter precip
7%
6%
5%
5%
4%
4%
4%
2
1
0%
Winter min
Summer max
Fall precip
Summer precip
Winter precip
Dist. urban
% tree canopy
% clay
Spring precip
EVI
Dist. roads
Slope
NDVI
Dist. water
% Impervious
Org. matter
Aspect

| All species (21) | | |
| --- | --- | --- |
| **Variable** | **Models** | **Percentage** |
| **Winter min** | 81 | 15.9% |
| **Summer max** | 59 | 11.6% |
| **Fall precip** | 53 | 10.4% |
| **Sumr precip** | 51 | 10.0% |
| **Wint precip** | 46 | 9.0% |
| **Dist urban** | 36 | 7.1% |
| **%tree canopy** | 30 | 5.9% |
| **% clay** | 27 | 5.3% |
| **Spring precip** | 25 | 4.9% |
| **EVI** | 22 | 4.3% |
| **Dist roads** | 21 | 4.1% |
| **Slope** | 20 | 3.9% |
| **NDVI** | 14 | 2.8% |
| **Dist water** | 9 | 1.8% |
| **%impervious** | 7 | 1.4% |
| **Org matter** | 6 | 1.2% |
| **Aspect** | 2 | 0.4% |

| All species (21) | | |
| --- | --- | --- |
| **Variable** | **Models** | **Percentage** |
| **Winter min** | 81 | 15.9% |
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| **NDVI** | 14 | 2.8% |
| **Dist water** | 9 | 1.8% |
| **%impervious** | 7 | 1.4% |
| **Org matter** | 6 | 1.2% |
| **Aspect** | 2 | 0.4% |

| All species (21) | | | Full sun species (12) | | |
|---|---|---|---|---|---|
| Variable | Models | Percentage | Variable | Models | Percentage |
| Winter min | 81 | 15.9% | Winter min | 44 | 15.1% |
| Summer max | 59 | 11.6% | Summer max | 34 | 11.7% |
| Fall precip | 53 | 10.4% | Fall precip | 28 | 9.6% |
| Sumr precip | 51 | 10.0% | Sumr precip | 31 | 10.7% |
| Wint precip | 46 | 9.0% | Wint precip | 30 | 10.3% |
| Dist urban | 36 | 7.1% | Dist urban | 18 | 6.2% |
| %tree canopy | 30 | 5.9% | %tree canopy | 19 | 6.5% |
| % clay | 27 | 5.3% | % clay | 21 | 7.2% |
| Spring precip | 25 | 4.9% | Spring precip | 12 | 4.1% |
| EVI | 22 | 4.3% | EVI | 15 | 5.2% |
| Dist roads | 21 | 4.1% | Dist roads | 18 | 6.2% |
| Slope | 20 | 3.9% | Slope | 6 | 2.1% |
| NDVI | 14 | 2.8% | NDVI | 2 | 0.7% |
| Dist water | 9 | 1.8% | Dist water | 3 | 1.0% |
| %impervious | 7 | 1.4% | %impervious | 4 | 1.4% |
| Org matter | 6 | 1.2% | Org matter | 4 | 1.4% |
| Aspect | 2 | 0.4% | Aspect | 2 | 0.7% |

| All species (21) | | | Full sun species (12) | | | Forested species (6) | | |
|---|---|---|---|---|---|---|---|---|
| Variable | Models | Percentage | Variable | Models | Percentage | Variable | Models | Percentage |
| Winter min | 81 | 15.9% | Winter min | 44 | 15.1% | Winter min | 27 | 18.4% |
| Summer max | 59 | 11.6% | Summer max | 34 | 11.7% | Summer max | 22 | 15.0% |
| Fall precip | 53 | 10.4% | Fall precip | 28 | 9.6% | Fall precip | 15 | 10.2% |
| Sumr precip | 51 | 10.0% | Sumr precip | 31 | 10.7% | Sumr precip | 12 | 8.2% |
| Wint precip | 46 | 9.0% | Wint precip | 30 | 10.3% | Wint precip | 14 | 9.5% |
| Dist urban | 36 | 7.1% | Dist urban | 18 | 6.2% | Dist urban | 14 | 9.5% |
| %tree canopy | 30 | 5.9% | %tree canopy | 19 | 6.5% | %tree canopy | 11 | 7.5% |
| % clay | 27 | 5.3% | % clay | 21 | 7.2% | % clay | 4 | 2.7% |
| Spring precip | 25 | 4.9% | Spring precip | 12 | 4.1% | Spring precip | 1 | 0.7% |
| EVI | 22 | 4.3% | EVI | 15 | 5.2% | EVI | 2 | 1.4% |
| Dist roads | 21 | 4.1% | Dist roads | 18 | 6.2% | Dist roads | 5 | 3.4% |
| Slope | 20 | 3.9% | Slope | 6 | 2.1% | Slope | 10 | 6.8% |
| NDVI | 14 | 2.8% | NDVI | 2 | 0.7% | NDVI | 6 | 4.1% |
| Dist water | 9 | 1.8% | Dist water | 3 | 1.0% | Dist water | 1 | 0.7% |
| %impervious | 7 | 1.4% | %impervious | 4 | 1.4% | %impervious | 2 | 1.4% |
| Org matter | 6 | 1.2% | Org matter | 4 | 1.4% | Org matter | 1 | 0.7% |
| Aspect | 2 | 0.4% | Aspect | 2 | 0.7% | Aspect | 0 | 0.0% |

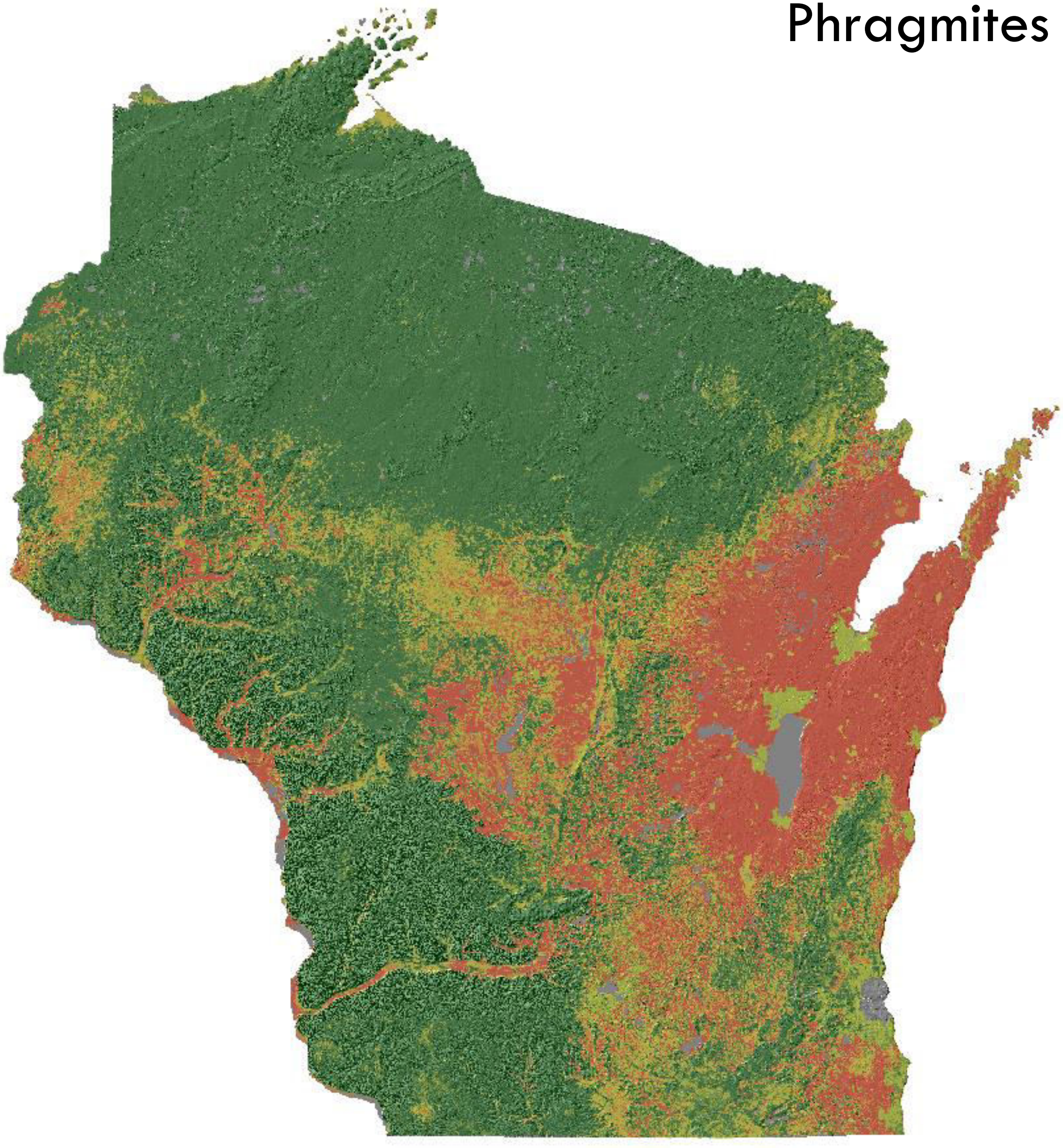
| All species (21) | | | Full sun species (12) | | | Forested species (6) | | | Wetland species (3) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Variable | Models | Percentage | Variable | Models | Percentage | Variable | Models | Percentage | Variable | Models | Percentage |
| Winter min | 81 | 15.9% | Winter min | 44 | 15.1% | Winter min | 27 | 18.4% | Winter min | 10 | 13.7% |
| Summer max | 59 | 11.6% | Summer max | 34 | 11.7% | Summer max | 22 | 15.0% | Summer max | 3 | 4.1% |
| Fall precip | 53 | 10.4% | Fall precip | 28 | 9.6% | Fall precip | 15 | 10.2% | Fall precip | 10 | 13.7% |
| Sumr precip | 51 | 10.0% | Sumr precip | 31 | 10.7% | Sumr precip | 12 | 8.2% | Sumr precip | 8 | 11.0% |
| Wint precip | 46 | 9.0% | Wint precip | 30 | 10.3% | Wint precip | 14 | 9.5% | Wint precip | 2 | 2.7% |
| Dist urban | 36 | 7.1% | Dist urban | 18 | 6.2% | Dist urban | 14 | 9.5% | Dist urban | 4 | 5.5% |
| %tree canopy | 30 | 5.9% | %tree canopy | 19 | 6.5% | %tree canopy | 11 | 7.5% | %tree canopy | 0 | 0.0% |
| % clay | 27 | 5.3% | % clay | 21 | 7.2% | % clay | 4 | 2.7% | % clay | 2 | 2.7% |
| Spring precip | 25 | 4.9% | Spring precip | 12 | 4.1% | Spring precip | 1 | 0.7% | Spring precip | 12 | 16.4% |
| EVI | 22 | 4.3% | EVI | 15 | 5.2% | EVI | 2 | 1.4% | EVI | 5 | 6.8% |
| Dist roads | 21 | 4.1% | Dist roads | 18 | 6.2% | Dist roads | 5 | 3.4% | Dist roads | 0 | 0.0% |
| Slope | 20 | 3.9% | Slope | 6 | 2.1% | Slope | 10 | 6.8% | Slope | 4 | 5.5% |
| NDVI | 14 | 2.8% | NDVI | 2 | 0.7% | NDVI | 6 | 4.1% | NDVI | 6 | 8.2% |
| Dist water | 9 | 1.8% | Dist water | 3 | 1.0% | Dist water | 1 | 0.7% | Dist water | 5 | 6.8% |
| %impervious | 7 | 1.4% | %impervious | 4 | 1.4% | %impervious | 2 | 1.4% | %impervious | 1 | 1.4% |
| Org matter | 6 | 1.2% | Org matter | 4 | 1.4% | Org matter | 1 | 0.7% | Org matter | 1 | 1.4% |
| Aspect | 2 | 0.4% | Aspect | 2 | 0.7% | Aspect | 0 | 0.0% | Aspect | 0 | 0.0% |

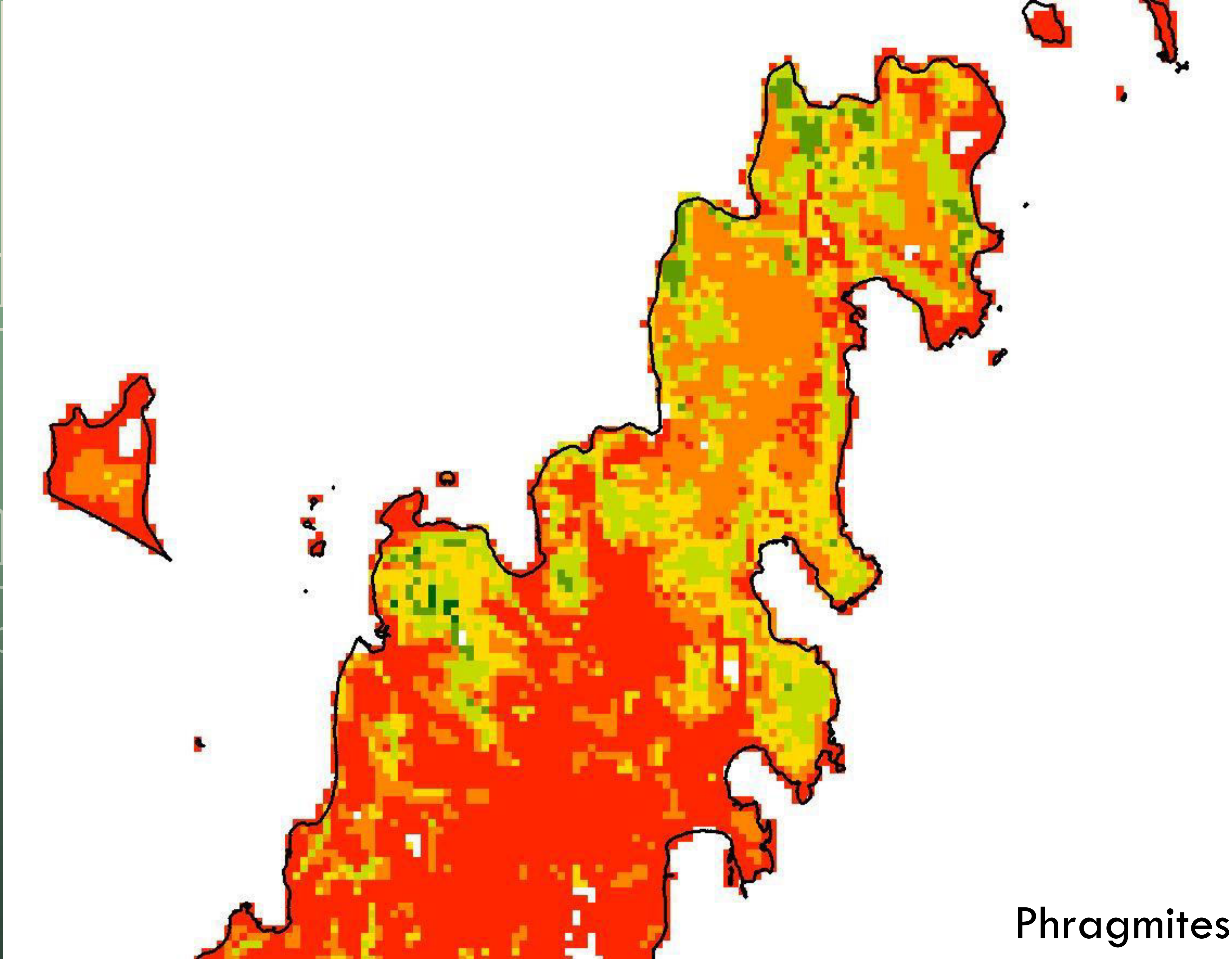
| Variable | Oriental Bittersweet | Spotted Knapweed | Crown Vetch | Teasels | Leafy Spurge | Knotweeds | Wild Parsnip | Reed Canary Grass | Black Locust | Tansy | Garden Valerian | Autumn Olive | Garlic Mustard | Japanese Barberry | Honeysuckles | Common Buckthorn | Glossy Buckthorn | Hedgeparsleys | Marsh Thistle | Purple Loosestrife | Phragmites |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Winter min | 25% | 4% | 17% | 20% | 8% | 20% | 12% | 20% | 5% | 20% | 16% | 17% | 21% | 20% | 17% | 20% | 12% | 20% | 17% | 4% | 20% |
| Summer max | 20% | 20% | 17% | 8% | 8% | 12% | 8% | 4% | 9% | 16% | 12% | 8% | 17% | 12% | 13% | 16% | 12% | 20% | 9% | 4% | 0% |
| Fall precip | 5% | 16% | 0% | 16% | 13% | 4% | 4% | 8% | 5% | 20% | 8% | 17% | 0% | 4% | 13% | 8% | 20% | 16% | 9% | 20% | 12% |
| Sumr precip | 10% | 4% | 8% | 16% | 13% | 12% | 20% | 4% | 5% | 4% | 16% | 17% | 4% | 0% | 22% | 8% | 12% | 4% | 22% | 0% | 12% |
| Wint precip | 10% | 16% | 17% | 0% | 8% | 0% | 0% | 20% | 0% | 20% | 20% | 13% | 17% | 16% | 9% | 8% | 8% | 0% | 9% | 0% | 0% |
| Dist urban | 0% | 0% | 8% | 4% | 13% | 8% | 4% | 16% | 0% | 4% | 0% | 17% | 21% | 0% | 4% | 12% | 20% | 0% | 9% | 8% | 0% |
| %tree canopy | 0% | 16% | 0% | 8% | 21% | 4% | 20% | 0% | 9% | 0% | 0% | 0% | 0% | 8% | 13% | 16% | 8% | 0% | 0% | 0% | 0% |
| % clay | 5% | 4% | 13% | 8% | 0% | 8% | 12% | 16% | 9% | 0% | 12% | 0% | 0% | 4% | 0% | 8% | 0% | 4% | 4% | 4% | 0% |
| Spring precip | 0% | 8% | 0% | 12% | 8% | 0% | 0% | 4% | 0% | 0% | 16% | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 9% | 20% | 20% |
| EVI | 0% | 12% | 0% | 0% | 0% | 0% | 8% | 8% | 18% | 16% | 0% | 0% | 0% | 4% | 4% | 0% | 0% | 0% | 0% | 20% | 0% |
| Dist roads | 0% | 0% | 21% | 0% | 0% | 8% | 12% | 0% | 23% | 0% | 0% | 4% | 0% | 4% | 0% | 0% | 0% | 16% | 0% | 0% | 0% |
| Slope | 20% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 5% | 0% | 0% | 0% | 21% | 12% | 4% | 4% | 0% | 0% | 0% | 0% | 16% |
| NDVI | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | 4% | 12% | 4% | 0% | 20% |
| Dist water | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | 5% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 0% | 0% | 0% | 20% | 0% |
| %impervious | 0% | 0% | 0% | 8% | 0% | 4% | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 4% | 0% | 0% | 0% | 4% | 4% | 0% | 0% |
| Org matter | 5% | 0% | 0% | 0% | 8% | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 0% | 0% | 4% | 0% | 4% | 0% | 0% |
| Aspect | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 9% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

| Variable | Oriental Bittersweet | Spotted Knapweed | Crown Vetch | Teasels | Leafy Spurge | Knotweeds | Wild Parsnip | Reed Canary Grass | Black Locust | Tansy | Garden Valerian | Autumn Olive | Garlic Mustard | Japanese Barberry | Honeysuckles | Common Buckthorn | Glossy Buckthorn | Hedgeparsleys | Marsh Thistle | Purple Loosestrife | Phragmites |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Winter min | 25% | 4% | 17% | 20% | 8% | 20% | 12% | 20% | 5% | 20% | 16% | 17% | 21% | 20% | 17% | 20% | 12% | 20% | 17% | 4% | 20% |
| Summer max | 20% | 20% | 17% | 8% | 8% | 12% | 8% | 4% | 9% | 16% | 12% | 8% | 17% | 12% | 13% | 16% | 12% | 20% | 9% | 4% | 0% |
| Fall precip | 5% | 16% | 0% | 16% | 13% | 4% | 4% | 8% | 5% | 20% | 8% | 17% | 0% | 4% | 13% | 8% | 20% | 16% | 9% | 20% | 12% |
| Sumr precip | 10% | 4% | 8% | 16% | 13% | 12% | 20% | 4% | 5% | 4% | 16% | 17% | 4% | 0% | 22% | 8% | 12% | 4% | 22% | 0% | 12% |
| Wint precip | 10% | 16% | 17% | 0% | 8% | 0% | 0% | 20% | 0% | 20% | 20% | 13% | 17% | 16% | 9% | 8% | 8% | 0% | 9% | 0% | 0% |
| Dist urban | 0% | 0% | 8% | 4% | 13% | 8% | 4% | 16% | 0% | 4% | 0% | 17% | 21% | 0% | 4% | 12% | 20% | 0% | 9% | 8% | 0% |
| %tree canopy | 0% | 16% | 0% | 8% | 21% | 4% | 20% | 0% | 9% | 0% | 0% | 0% | 0% | 8% | 13% | 16% | 8% | 0% | 0% | 0% | 0% |
| % clay | 5% | 4% | 13% | 8% | 0% | 8% | 12% | 16% | 9% | 0% | 12% | 0% | 0% | 4% | 0% | 8% | 0% | 4% | 4% | 4% | 0% |
| Spring precip | 0% | 8% | 0% | 12% | 8% | 0% | 0% | 4% | 0% | 0% | 16% | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 9% | 20% | 20% |
| EVI | 0% | 12% | 0% | 0% | 0% | 0% | 8% | 8% | 18% | 16% | 0% | 0% | 0% | 4% | 4% | 0% | 0% | 0% | 0% | 20% | 0% |
| Dist roads | 0% | 0% | 21% | 0% | 0% | 8% | 12% | 0% | 23% | 0% | 0% | 4% | 0% | 4% | 0% | 0% | 0% | 16% | 0% | 0% | 0% |
| Slope | 20% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 5% | 0% | 0% | 0% | 21% | 12% | 4% | 4% | 0% | 0% | 0% | 0% | 16% |
| NDVI | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | 4% | 12% | 4% | 0% | 20% |
| Dist water | 0% | 0% | 0% | 0% | 0% | 8% | 0% | 0% | 5% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 0% | 0% | 0% | 20% | 0% |
| %impervious | 0% | 0% | 0% | 8% | 0% | 4% | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 4% | 0% | 0% | 0% | 4% | 4% | 0% | 0% |
| Org matter | 5% | 0% | 0% | 0% | 8% | 0% | 0% | 0% | 0% | 0% | 0% | 4% | 0% | 0% | 0% | 0% | 4% | 0% | 4% | 0% | 0% |
| Aspect | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 9% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% |

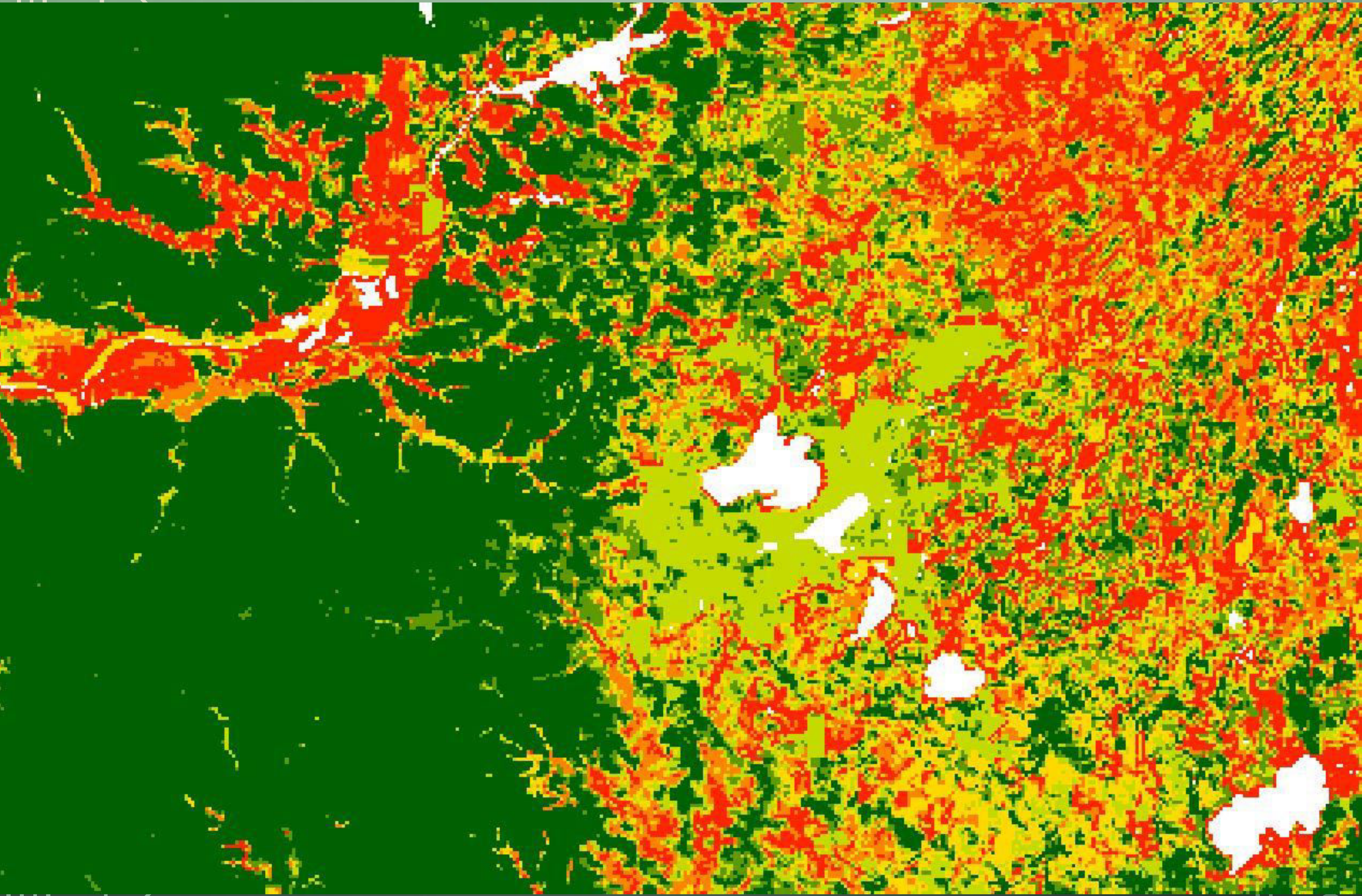
# RESULTS: MAP OUTPUTS

# Phragmites

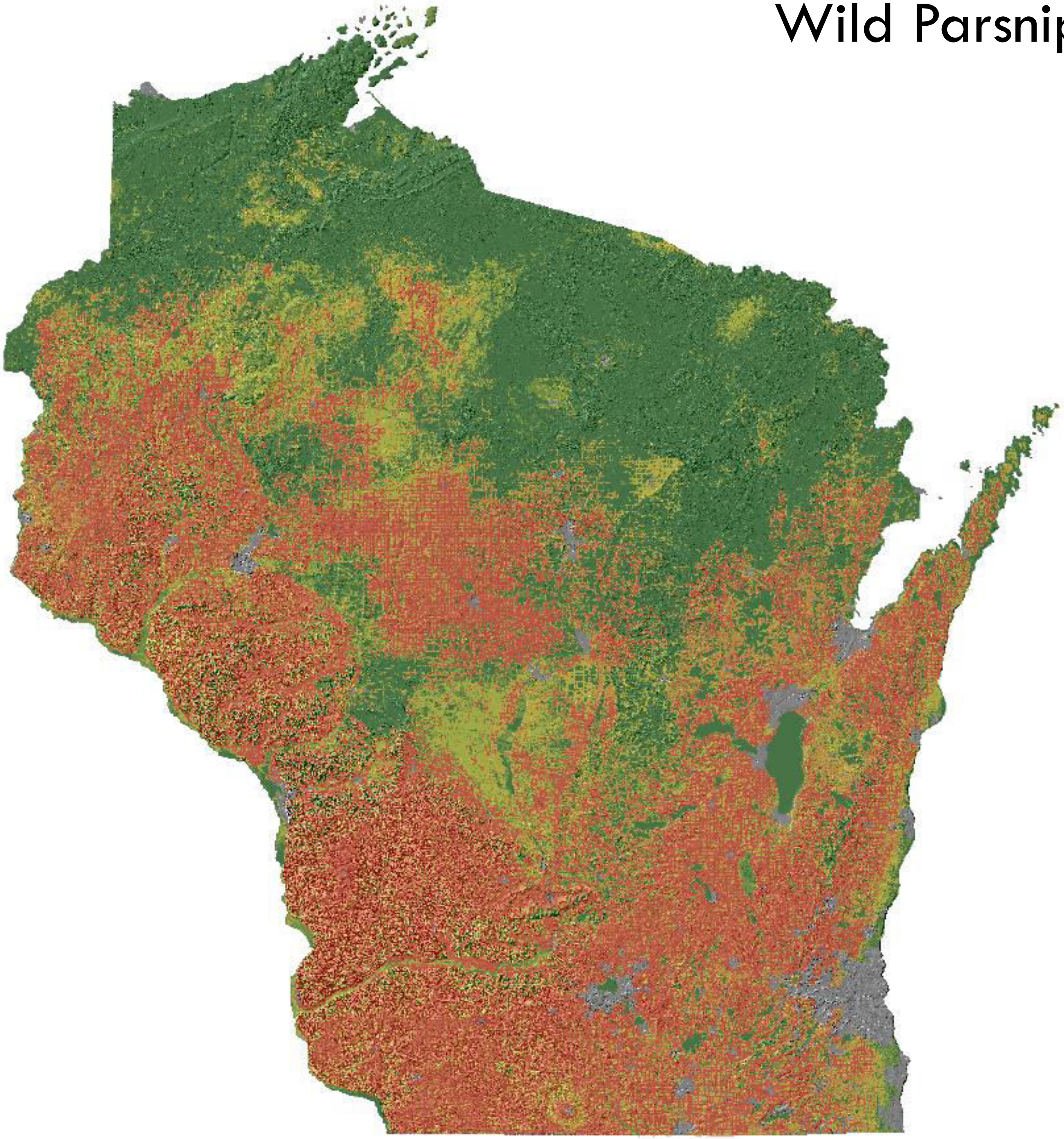



Phragmites

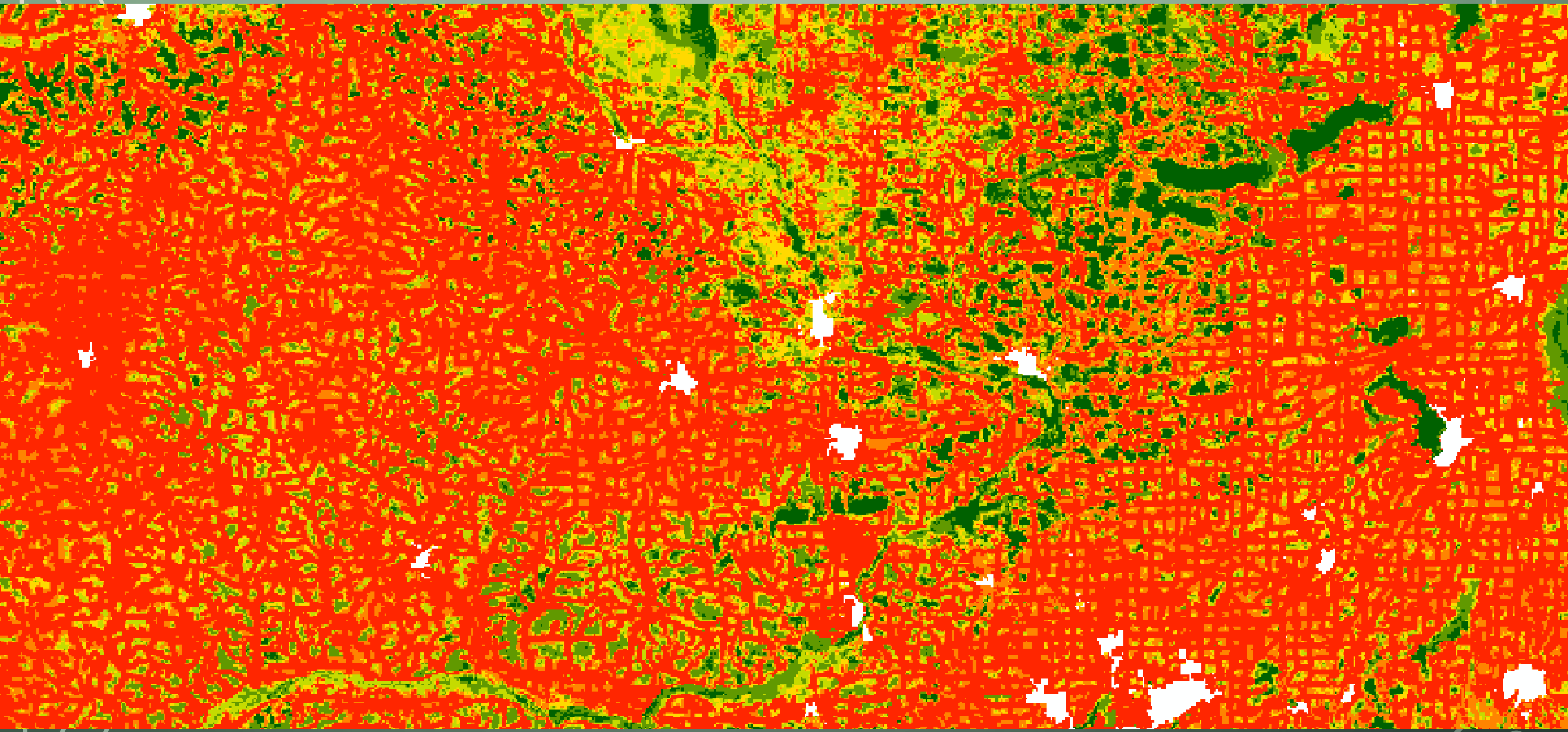
# Phragmites



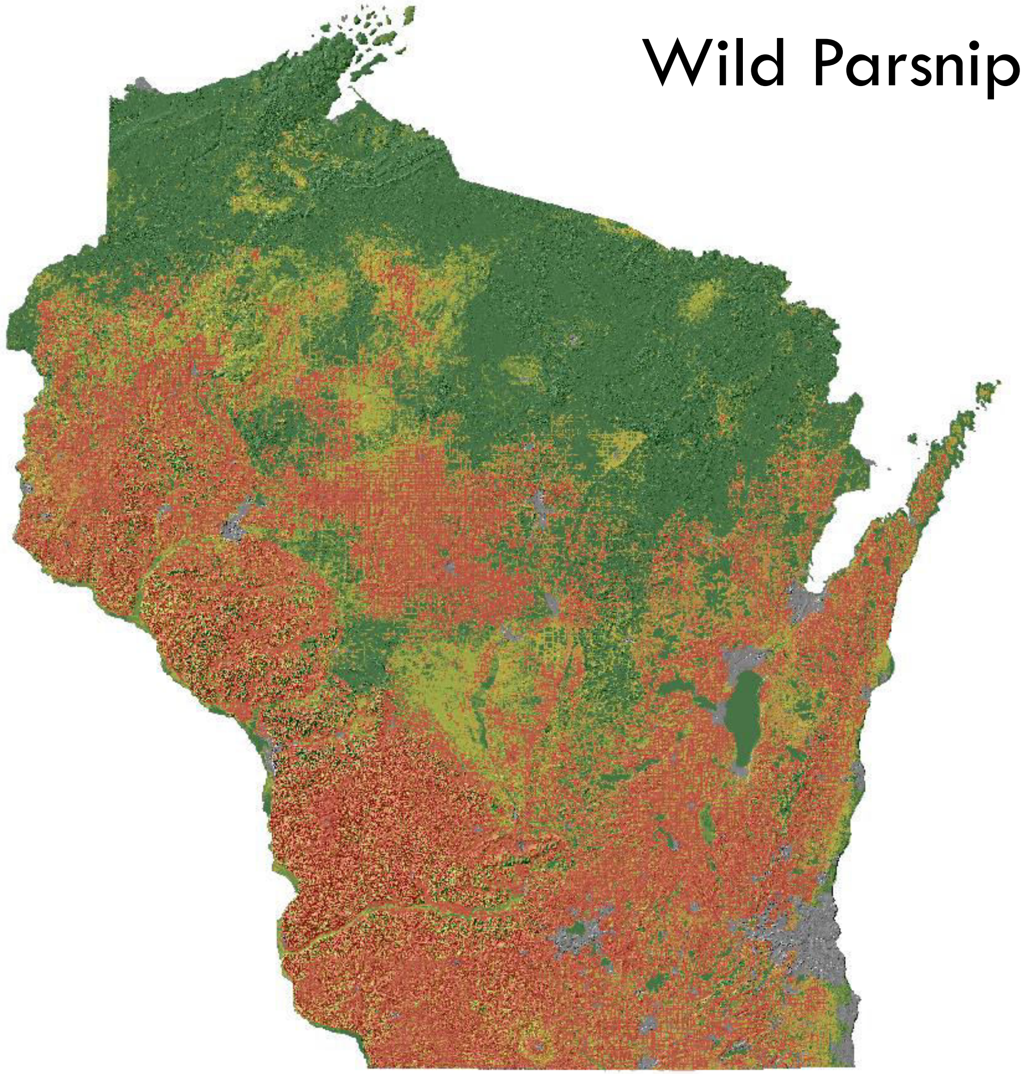
# Wild Parsnip



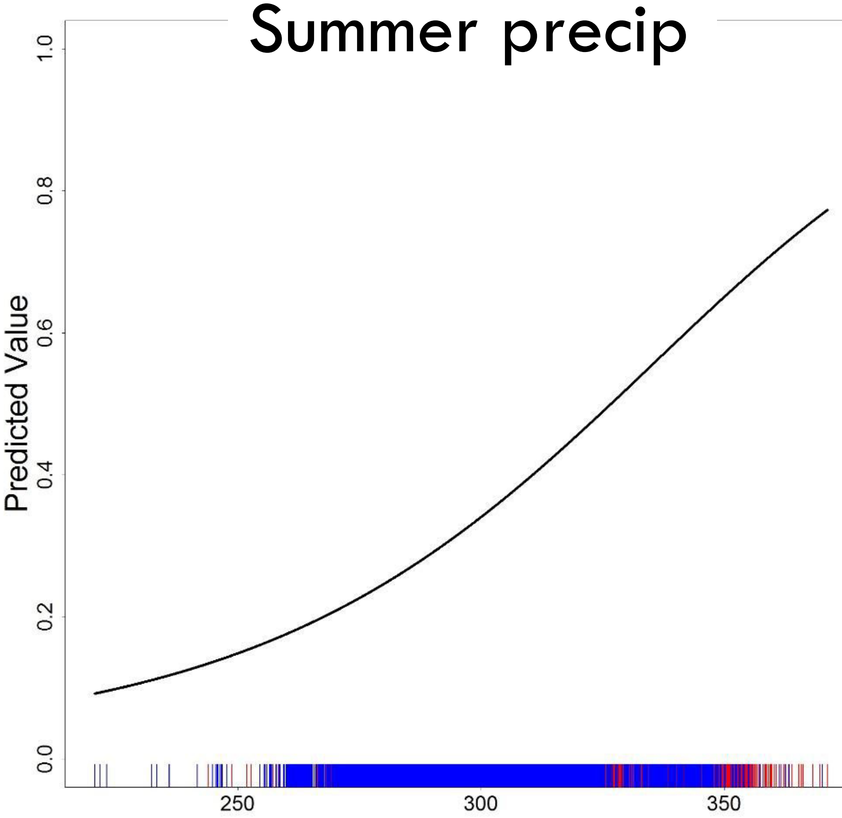
# Wild Parsnip



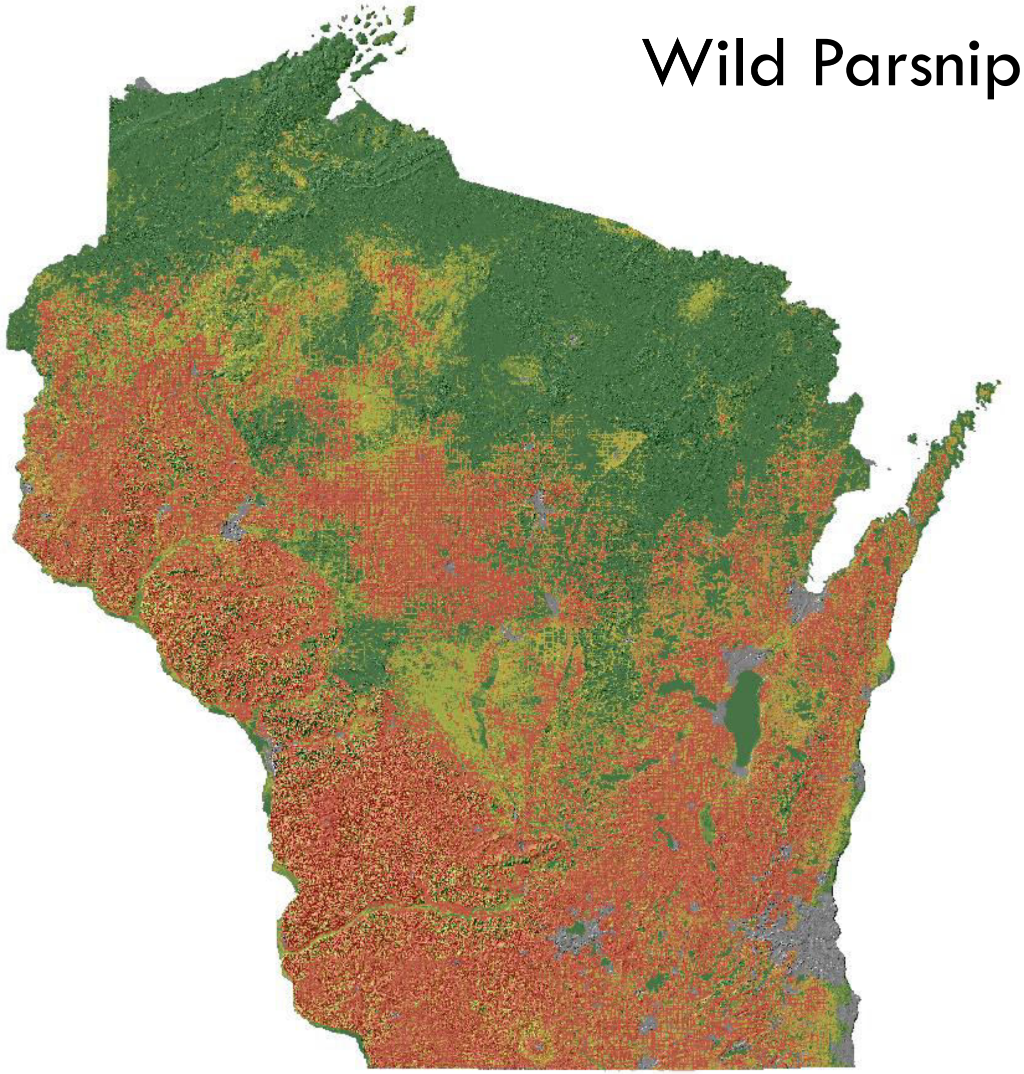
## Wild Parsnip



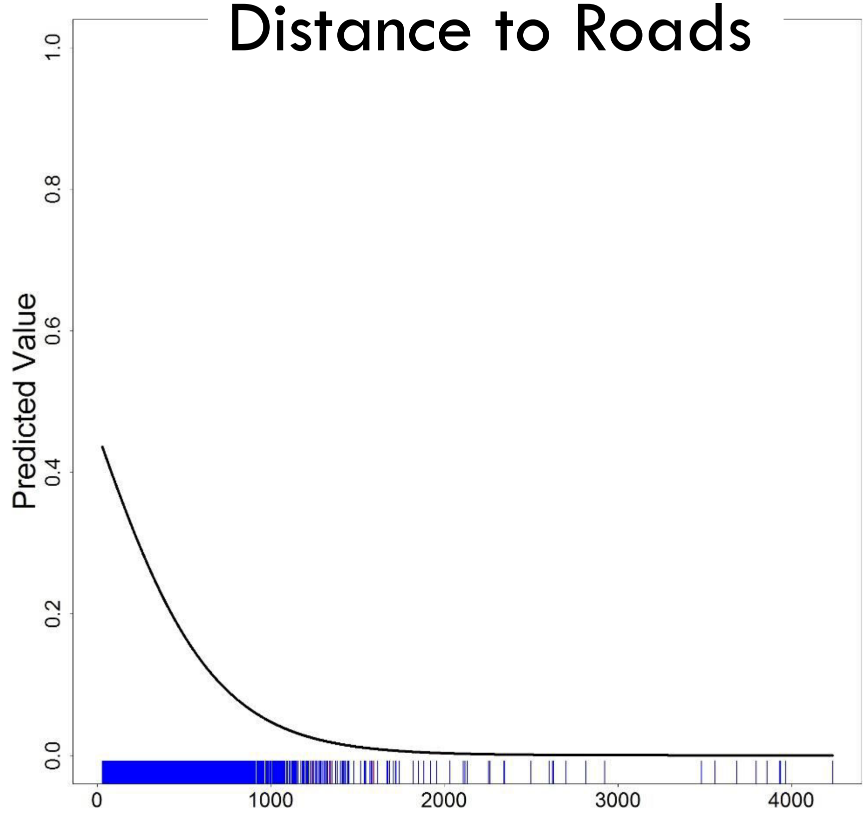
## Summer precip



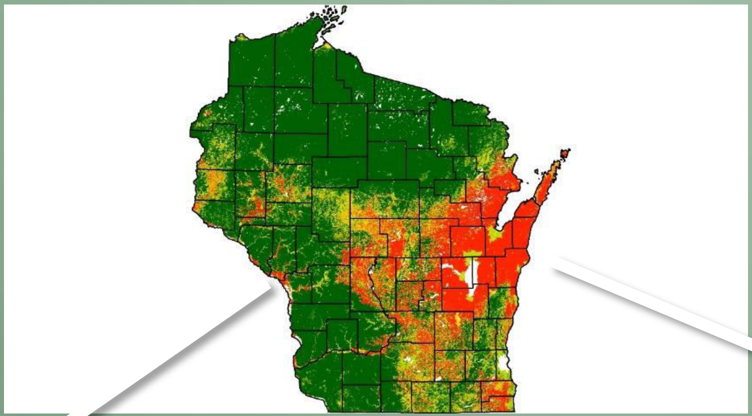
# Wild Parsnip

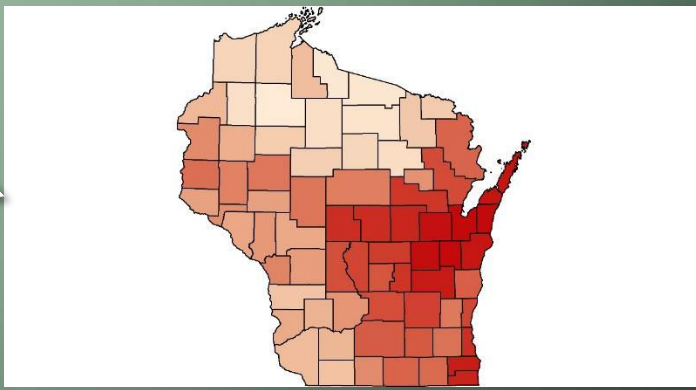


# Distance to Roads

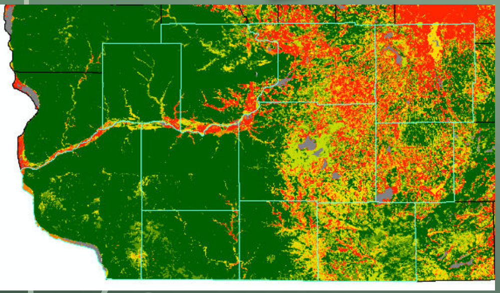


# PRIORITY SPECIES LISTS

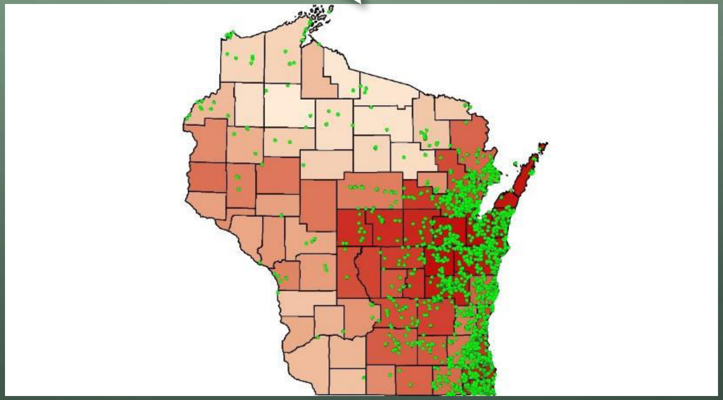




Percent of county deemed "suitable habitat"



Regional Analysis



Number of points per county

Priority Invasive Plant Li

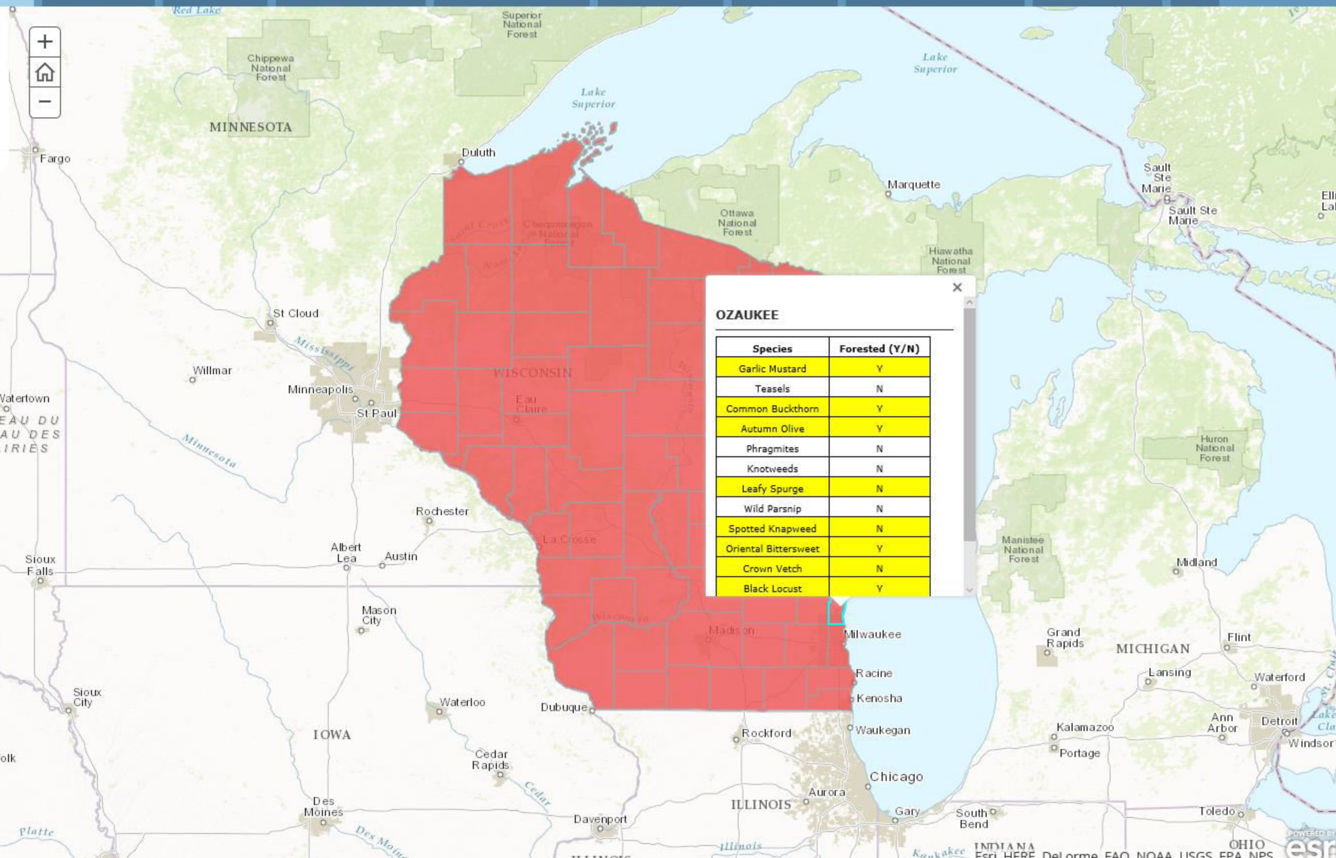
arcgis.com/apps/MapSeries/index.html?appid=2a07de63ab5341e3aaf4c57450bf0263

# Priority Invasive Plant Lists in Wisconsin

A story map

Prioritizing Invasive Plants | Regional Priority Lists | County Specific Priority Lists | Autumn Olive | Black Locust | Bush Honeysuckles | Common Buckthorn | Common Tansy | Crown Vetch | European Marsh Thistle | Garden Valerian

Click on your **county** to find out which invasive plant species are of greatest priority. Species listed in ***yellow*** have been identified as those with large areas of suitable habitat in the county, but very few, if any, species occurrence records are currently available. We are on the lookout for these species during this growing season. If you are interested in providing additional species occurrence records, or interested in knowing where suitable habitat has been identified for these 21 species in your area, please contact Niels Jorgensen (njorgensen@wisc.edu).




**OZAUKEE**

| Species | Forested (Y/N) |
|---|---|
| Garlic Mustard | Y |
| Teasels | N |
| Common Buckthorn | Y |
| Autumn Olive | Y |
| Phragmites | N |
| Knotweeds | N |
| Leafy Spurge | N |
| Wild Parsnip | N |
| Spotted Knapweed | N |
| Oriental Bittersweet | Y |
| Crown Vetch | N |
| Black Locust | Y |

# PROJECT TO DATE

- Priority species lists have been extended to >100 individuals and organizations within network
  - Emails
  - ESRI Story Map
  - Field days and other presentations
- >3000 occurrence records have been received
  - Individual reports
  - Bulk uploads

# SUMMARY

- Using citizen scientists and professionals we can compile an extensive database of occurrence records
  - This can be used to model invasive plants; develop priority lists
- Modeling individual invasive species has its benefits
  - Determine nuances of suitable habitat drivers; potential habitat distribution

# WHERE DO WE GO FROM HERE?

- Take new data points from stakeholders and volunteers and re-run models
  - Does more data improve ability to predict?
- Run models at finer scale (30m vs 250m)
  - Can more be learned from predictor layers?
- Field days to validate models with volunteers
  - Do models improve ability to detect?

# ACKNOWLEDGEMENTS


- Wisconsin DNR
  - Kelly Kearns, Jason Granberg
- EDDMapS contributors
- WIFDN members
- Citizen scientists who have contributed invasive plant data
- Mark Renz

# QUESTIONS?

NIELS JORGENSEN

NJORGENSEN@WISC.EDU

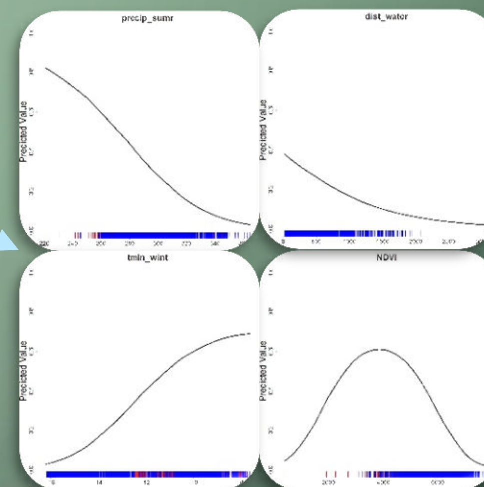
| Common Name | Scientific Name | Number of Presences |
|---|---|---|
| **Prohibited/Restricted Species (regulation varies depending on location in state)** | | |
| **European marsh thistle** | *Cirsium palustre* | 863 |
| **Bush honeysuckles** | *Lonicera* spp. | 3106 |
| **Phragmites** | *Phragmites australis* | 5462 |
| **Hedgeparsleys** | *Torilis* spp. | 453 |
| **Restricted Species** | | |
| **Garlic mustard** | *Allaria petiolata* | 2442 |
| **Japanese barberry** | *Berberis thunbergii* | 419 |
| **Oriental bittersweet** | *Celastrus orbiculatus* | 215 |
| **Spotted knapweed** | *Centaurea stoebe* | 5029 |
| **Teasels** | *Dipsacus* spp. | 1496 |
| **Autumn olive** | *Elaeagnus umbellata* | 152 |
| **Leafy spurge** | *Euphorbia esula* | 339 |
| **Knotweeds** | *Fallopia* spp. | 916 |
| **Purple loosestrife** | *Lythrum salicaria* | 1407 |
| **Wild parsnip** | *Pastinaca sativa* | 6906 |
| **Common buckthorn** | *Rhamnus cathartica* | 1029 |
| **Glossy buckthorn** | *Rhamnus frangula* | 675 |
| **Black locust** | *Robinia pseudoacacia* | 172 |
| **Crown vetch** | *Securigera varia* | 728 |
| **Tansy** | *Tanacetum vulgare* | 4340 |
| **Garden valerian** | *Valeriana officinalis* | 480 |
| **Reed canary grass** | *Phalaris arundinacea* | 2395 |

# PROJECT OVERVIEW

Build ensemble models

Develop priority lists

Engage stakeholders to collect new data



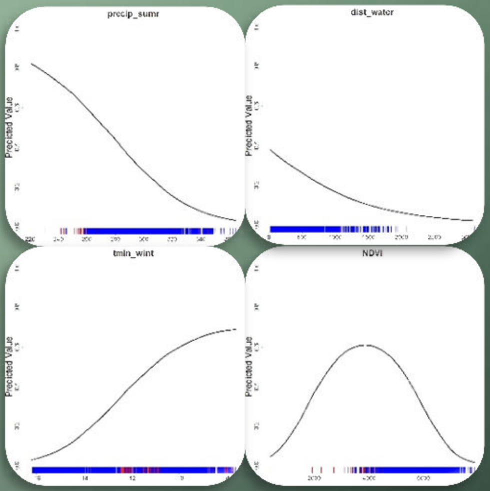

Investigate trends

# PROJECT OVERVIEW

Re-run ensemble models

Improve priority lists

Engage stakeholders to collect new data




Investigate trends

Climate change scenarios