SMART PREVENTION FOR EURASIAN WATERMILFOIL:
DESIGNING A WEB-BASED TOOL TO SUPPORT PREVENTION AND CONTROL

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Outline

• EWM status
• Ecological & social impact
• “Vulnerability”
• Occurrence models (where?)
  – Predicting occurrence, use of predictions
• Abundance models (how much?)
  – Predicting abundance, use of predictions
• Discussion & tool design
EWM is in 7% of Wisconsin lakes

On average, littoral cover is 20%

of 9285 lakes > 2.5 acres, 8630 don’t have EWM!
Eurasian watermilfoil
(Myriophyllum spicatum)
Ecological effects

- Landscape-scale studies
- Within-lake or small sample size studies
“EWM is a ‘matrix dominant, capable of co-existing with other species with no negative impacts on native cover” Trebitz & Taylor 2007

The results of our study are more consistent with EWM responding to environmental factors rather than engineering macrophyte communities…
Socio-economic effects

• EWM is a nuisance

• Property values are lower on EWM lakes

• Broad support for prevention and control

Eiswerth et al. 2000; Horsch & Lewis 2009; Olden & Tamayo 2014
Permit requests are increasing
Riparians:

“Is my lake at risk?”

“Do we need to preventatively monitor?”

“If it gets here, will it be a problem?”
NR Professionals:

“Where should I deploy monitoring resources?”

“Following invasion, should our response emphasize active management or passive observation?”
Limited resources!

Ideally, prevention actions are allocated to systems that have a high chance of experiencing an invasion and are also likely to sustain adverse effects:

Prioritize vulnerable lakes
Site-specific vulnerability

- Introduction: Which sites will be colonized?
- Establishment: Which sites will support a self-sustaining population?
- Impact: Which sites will be impacted?
- Vulnerability: Sites that are vulnerable to invasion

Vander Zanden & Olden 2008
Site-specific vulnerability

- Occurrence
- Occurrence
- Occurrence
- Abundance

Lower Priority Site

Sites that are vulnerable to invasion

Vander Zanden & Olden 2008
EWM Occurrence

Where is occurrence risk high?

Model gives us:

Occurrence Risk
(ranges 0 to 1)

Predicting EWM occurrence

Modelled estimates aren’t completely accurate, but are demonstrably better than guessing!

+ Road density (buffer)
+ Surface area
+ Max air temperature
+ Maximum depth

- Geology (%CaO)
- Annual temp range
- Dispersal (mean distance to source)

Non-significant:
Conductivity
Alkalinity
Soil erodibility
Watershed % urban
pH
Secchi depth
Watershed % ag

Modelled estimates aren’t completely accurate, but are demonstrably better than guessing!
After we predict likelihood of presence, we can map it.

When we use a probability of 0.417 to indicate “likely presence”, no more than 1% of predicted absences would be false absences.
Map of unininvaded lakes, with occurrence risk

Black: Less likely to have EWM
Colors: Likely presences, with low, medium and high risk of occurrence

N = 8630

Remember, ‘likely present’ is defined as modelled probability exceeding 0.417
EWM Abundance

Where might EWM attain high abundance?

Model gives us:

Predicted cover (ranges 0 to 100%)

657 Lakes (with plant...
Beta binomial model of abundance
Predicting EWM abundance

Abundance is harder to predict!

Models are statistically significant, explaining ~26% of observed abundance variation.

Drivers explain direction (+ or -) as well as shape (U-shaped or humped).

Precision submodel reflects variability in the response to the driver.

+ Max air temp
+ Conductivity
+ Soil erodibility
- Secchi depth
- Maximum lake depth

Variability
- CaO
- Soil erodibility
- Maximum lake depth
+ Secchi depth

Non-significant:
Dispersal Road Density
pH Alkalinity
Surface Area Temp Range
Watershed % urban or ag
How good are our predictions?

- Predicted cover
- Actual cover

$R^2_{adj} = 0.26$

Obs = $1.07 \times \text{Fit} - 0.01$

$p < 0.001$
How good are our predictions?

$R^2_{adj} = 0.26$

Obs = $1.07 \times \text{Fit} - 0.01$

$p < 0.001$
EWM Abundance

We can also map predicted abundance.

Model gives us:

Predicted cover (ranges 0 to 100%)
Example map & list

Black: EWM less likely
Colors: Abundance Risk Categories

N = 269 uninvaded lakes (with plant data)
Occurrence + Abundance = Vulnerability

<table>
<thead>
<tr>
<th>WBIC</th>
<th>Lake Name</th>
<th>County</th>
<th>Occurrence risk</th>
<th>Abundance risk</th>
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Putting it all together: Vulnerability matrix

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<tr>
<th>Presence</th>
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<th>Tier I</th>
<th>Tier II</th>
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<td></td>
<td>Low</td>
<td>28</td>
<td>88</td>
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N = 269
• Prevention applications
  – Monitor lakes with high occurrence risk
  – Monitor lakes with high occurrence & abundance risk

• Management applications
  – Active response when abundance risk is high
  – ‘Wait and see’ approach when abundance risk is low

• Hotspots for occurrence AND abundance?
Occurrence + Abundance = Vulnerability

High vulnerability = High priority?

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Other suitability models

- EWM
- Starry stonewort
- Zebra mussel
- Spiny waterflea
- Round goby
- Rusty crayfish
- Etc.
Acknowledgements