Our New Great Lakes Flora

... weeds, aliens, invasives...
Weeds: the New Flora of Wisconsin

Flora of Wisconsin
2570 total species

Michigan = 2717
Weeds: the New Flora of Wisconsin

Information source: Wisconsin State Herbarium
wisflora.herbarium.wisc.edu

Native species = 1889

*Arethusa bulbosa*
Dragon’s mouth

158 families  758 genera  2570 species

Introduced species = 681

*Alliaria petiolata*
Garlic mustard
Weeds: the New Flora of Wisconsin

Why are we (government, public, scientists, etc.) worried?

Why did the DNR force the Botany Dept in 2010 to dig up the Botany Garden pond that had *Nymphoides*?

Wisconsin State Journal, April 11, 2008
Weeds: the New Flora of Wisconsin

Weed: A plant species (or any organism) not in its normal geographic distribution, spread by human activities, and usually with some negative impact to humans and/or “native” flora/vegetation/fauna

What is a weed?

- introduction
- non-native
- naturalized
- alien
- invasive

*Centaurea maculosa*
Spotted knapweed
Although the Wisconsin Cranberry Association has labeled *Eutrochium maculatum* a weed as it decreases their profits!

What is *not* a weed!

*Eutrochium maculatum*
Joe-pye weed

Although the Wisconsin Cranberry Association has labeled *Eutrochium maculatum* a weed as it decreases their profits!
What is *not* a weed!

*Cirsium pitcheri*
Dune thistle
## Weeds: the New Flora of Wisconsin

### Wisconsin Legislated “Noxious” Weeds

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cirsium arvense</em></td>
<td>Canada thistle</td>
</tr>
<tr>
<td><em>Convolvulus arvensis</em></td>
<td>field bindweed</td>
</tr>
<tr>
<td><em>Euphorbia virgata</em></td>
<td>leafy spurge</td>
</tr>
<tr>
<td><em>Lythrum salicaria</em></td>
<td>purple loosestrife</td>
</tr>
<tr>
<td><em>Rosa multiflora</em></td>
<td>multiflora rose</td>
</tr>
</tbody>
</table>

"Every person shall destroy all noxious weeds on all lands which he shall own, occupy or control. The term ‘destroy’ means the complete killing of weeds or the killing of weed plants above the surface of the ground by the use of chemicals, cutting, tillage, cropping system, pasturing livestock, or any or all of these in effective combination, at such time and in such manner as will effectually prevent such plants from maturing to the bloom or flower stage.”
## Weeds: the New Flora of Wisconsin

### Wisconsin Legislated “Noxious” Weeds

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cirsium arvense</em></td>
<td>Canada thistle</td>
</tr>
<tr>
<td><em>Convolvulus arvensis</em></td>
<td>field bindweed</td>
</tr>
<tr>
<td><em>Euphorbia virgata</em></td>
<td>leafy spurge</td>
</tr>
<tr>
<td><em>Lythrum salicaria</em></td>
<td>purple loosestrife</td>
</tr>
<tr>
<td><em>Rosa multiflora</em></td>
<td>multiflora rose</td>
</tr>
</tbody>
</table>
**Weeds: the New Flora of Wisconsin**

**Wisconsin Legislated “Noxious” Weeds**

<table>
<thead>
<tr>
<th>Scientific Name</th>
<th>Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Cirsium arvense</em></td>
<td>Canada thistle</td>
</tr>
<tr>
<td><em>Convolvulus arvensis</em></td>
<td>Field bindweed</td>
</tr>
<tr>
<td><em>Euphorbia virgata</em></td>
<td>Leafy spurge</td>
</tr>
<tr>
<td><em>Lythrum salicaria</em></td>
<td>Purple loosestrife</td>
</tr>
<tr>
<td><em>Rosa multiflora</em></td>
<td>Multiflora rose</td>
</tr>
</tbody>
</table>
Weeds: the New Flora of Wisconsin

Wisconsin Legislated “Noxious” Weeds

*Cirsium arvense*  Canada thistle
*Convolvulus arvensis*  field bindweed
*Euphorbia virgata*  leafy spurge
*Lythrum salicaria*  purple loosestrife
*Rosa multiflora*  multiflora rose
**Wisconsin Legislated “Noxious” Weeds**

- *Cirsium arvense*  
  Canada thistle

- *Convolvulus arvensis*  
  Field bindweed

- *Euphorbia virgata*  
  Leafy spurge

- *Lythrum salicaria*  
  Purple loosestrife

- *Rosa multiflora*  
  Multiflora rose
Weeds: the New Flora of Wisconsin

Weeds can be ecological disruptive
— invasive cattail forming monospecific stands in Wisconsin
Weeds: the New Flora of Wisconsin

Invasive cattail spread from 1960s to 2000 (red contour) in two sites (Walworth County)

• (R) without normal water draw down
• (L) with normal water fluctuation
Weeds: the New Flora of Wisconsin

Weeds hybridize with native species - *Typha X glauca* cattail

- **Broad leaf cattail**
  *Typha latifolia*

- **Hybrid cattail**
  *Typha x glauca*

- **Narrow leaf cattail**
  *Typha angustifolia*
Weeds: the New Flora of Wisconsin

Weeds hybridize with native species - *Typha X glauca* cattail
Has purple loosestrife hybridized with closely related but native winged loosestrife (\textit{Lythrum alatum})?
Has purple loosestrife hybridized with closely related but native winged loosestrife (*Lythrum alatum*)?

Is this part of the recent (delayed) invasive nature of the weed?
How do you tell a weed?

1. Fossil evidence or its lack
2. Historical evidence of introductions
3. Probable means of introduction
4. Typical reproductive patterns
5. Disturbed habitats
6. Geographical distribution patterns
7. Genetic diversity
Weeds: the New Flora of Wisconsin

How do you tell a weed?

1. Fossil evidence or its lack

- are any of the cattails native to North America?
- Green River Eocene deposits of Colorado
- Holocene fossil pollen tetrads
Weeds: the New Flora of Wisconsin

How do you tell a weed?

1. Fossil evidence or its lack
2. Historical evidence of introductions
3. **Probable means of introduction**
4. Typical reproductive patterns
5. Disturbed habitats
6. Geographical distribution patterns
7. Genetic diversity

*Reseda lutea* (mignonette) from Mediterranean found “natively” in pristine Thomson Prairie west of Madison

Rock garden ornamental - via shoes?
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

1. Direct introduction
2. Agriculture
3. Ballast
4. Roads & pickles (salt)
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

1. Direct introduction
2. Agriculture
3. Ballast
4. Roads & pickles (salt)

*Kudzu introduced from Japan into SE U.S. for soil erosion control*
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

*Gypsophila* introduced into Great Lakes (now invasive on dunes) as “baby-breath” ornamental
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

*Heracleum mantegazzianum* (hogweed) introduced from southwest Asia (Caucasus) by gardeners

Hogweed: over 9 ft and looks like cow’s parsnip but bigger and with purple stem splotches; phototoxic!

The 2003 Guinness Book of Records recognizes Giant Hogweed as the largest weed in the world.
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

1. Direct introduction
2. Agriculture
3. Ballast
4. Roads & pickles (salt)

Agriculture basically came from Eurasia to North America

Many of our weeds are agriculture based

Few North American weeds in Eurasia
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

Three of the five Wisconsin state listed “obnoxious” weeds arrived with agriculture

*Convolvulus arvensis*
field bindweed

*Euphorbia virgata*
leafy spurge

*Cirsium arvense*
Canada thistle
Weeds: the New Flora of Wisconsin

American weeds in Europe – the empire strikes back

ragweed  smooth aster  pokeweed  lupine  evening primrose
smooth sumac  black locust

‘Neophytes’ in the upper Rhine valley near Heidelberg — first recorded after 1492

http://www.guenther-blaich.de/pflgs.php?par=kune&lan=e
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

1. Direct introduction
2. Agriculture
3. Ballast
4. Roads & pickles (salt)

Ballast (water now; soil/gravel before) used to stabilize ships is a major source of aquatic organisms and seeds
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

Lythrum salicaria
Purple loosestrife

Ballast plants

Myriophyllum

Centaurea maculosa
Spotted knapweed
Canals allowed early spread of *Lythrum salicaria* by 1880.
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

1. Direct introduction
2. Agriculture
3. Ballast
4. Roads & pickles (salt)

Salt used on roads or as brine (pickle factories) has brought in halophytic (salt loving) weeds from the Great Plains and East Coast

Muhlenbergia asperifolia (alkali muhly) from Great Plains first seen on de-iced roads in late 1930s
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

1. Direct introduction
2. Agriculture
3. Ballast
4. Roads & pickles (salt)

Railway yards, disturbed areas around brine wells, and medians of salted expressways; introduced from the East Coast and first collected in St. Clair Co. in 1910.

*Spartina patens*: salt-meadow cordgrass
Weeds: the New Flora of Wisconsin

Sources of weeds — “rogues gallery of exotica”

1. Direct introduction
2. Agriculture
3. Ballast
4. Roads & pickles (salt)

Coastal U.S. halophyte; introduced into SE Michigan and Wisconsin and spreading along salted highways

*Symphyotrichum subulatum*: saltmarsh aster
Weeds: the New Flora of Wisconsin

How do you tell a weed?

1. Fossil evidence or its lack
2. Historical evidence of introductions
3. Probable means of introduction
4. **Typical reproductive patterns**
5. Disturbed habitats
6. Geographical distribution patterns
7. Genetic diversity

Weeds often possess modified vegetative and sexual reproductive features as part of the “weed syndrome”
Weeds: the New Flora of Wisconsin

How do you tell a weed?

1. Fossil evidence or its lack
2. Historical evidence of introductions
3. Probable means of introduction
4. Typical reproductive patterns
5. Disturbed habitats
6. Geographical distribution patterns
7. Genetic diversity

Veronica beccabunga (water speedwell)
native to Europe
Weeds: the New Flora of Wisconsin

How do you tell a weed?

Historical herbarium specimens of *Veronica beccabunga* in North America
Weeds: the New Flora of Wisconsin

How do you tell a weed?

Historical herbarium specimens of *Veronica beccabunga* in North America
Weeds: the New Flora of Wisconsin

How do you tell a weed?

Historical herbarium specimens of Veronica beccabunga in North America
Weeds: the New Flora of Wisconsin

How do you tell a weed?

*Veronica beccabunga* (water speedwell) present distribution in Wisconsin (plus other 1982 & 2000 collections in Door Co.)
Weeds: the New Flora of Wisconsin

How do you tell a weed?

*Alliaria petiolata* (garlic mustard)
native to Europe
Weeds: the New Flora of Wisconsin

How do you tell a weed?

Garlic mustard distribution – 2006
(date for Wisflora maps)

Garlic mustard collections in U.S. herbaria

Typical collection pattern of weeds
Weeds: the New Flora of Wisconsin

How do you tell a weed?

Garlic mustard distribution - 2007
Garlic mustard distribution - 2008
Garlic mustard distribution – 2009-2017

First collection - 1938
< 1948
< 1958
< 1968
< 1978
< 1988
Weeds: the New Flora of Wisconsin

How do you tell a weed?

1. Fossil evidence or its lack
2. Historical evidence of introductions
3. Probable means of introduction
4. Typical reproductive patterns
5. Disturbed habitats
6. Geographical distribution patterns
7. Genetic diversity

Phragmites australis (common reed) native or invasive?

Both forms occur (and co-occur at this site) of the cosmopolitan common reed
Weeds: the New Flora of Wisconsin

How do you tell a weed?

Genotype network based on chloroplast DNA

Kristin Saltonstall – Yale University

Native North American genotypes are closely related and they are unrelated to the invasive form from the Old World.
Weeds: the New Flora of Wisconsin

How do you tell a weed?

Genotype network based on microsatellites – AJB 2012

Native North American genotypes are closely related and they are unrelated to the invasive form from the Old World.
Genotyping of common reed from herbarium specimens prior to 1910 indicates the widespread presence of 11 native genotypes and 1 southern genotype also seen in South America and Asia.
Genotyping of common reed from herbarium specimens prior to 1910 indicates the widespread presence of 11 native genotypes and 1 southern genotype also seen in South America and Asia.

A few populations scattered from Connecticut to Maryland prior to 1910 also exhibited the invasive genotype.
Genotyping of common reed from modern populations (both herbarium specimens after 1960 and extant populations) indicates the same distributions of genotypes
However, the **invasive genotype** has dramatically spread across North America since 1910.

Genotyping of common reed from modern populations (both herbarium specimens *after 1960* and extant populations) indicates the same distributions of genotypes.
However, the **invasive genotype** has dramatically spread across North America since 1910 & replacing native genotypes - what should be the state’s response?

*Phragmites australis* native or invasive?
Weeds: the New Flora of Wisconsin

Previous studies found no evidence of hybridization, although experimental hybrids could rarely be made with natives as maternal line.

2000 mile survey in E North America using microsatellites showed strong evidence of hybridization – in either direction.
A final thought:

Unlike some other threats such as logging or pollution, which in theory can be stopped and allowing native vegetation/flora to recover, alien invasions are self-sustaining once started and extremely difficult to reverse.