Online class via Zoom
Monday, March 29
7:00-8:00pm
Learn about plant conservatism and its use in evaluating the quality of plant communities.
Moreover, see how to obtain a professional evaluation of the conservation value of ecosystems.
Open to the public. Pre-registration required. $5 registration fee.
Learn more and sign up at goldenhillsrccd.org/plantID
Conservation of the Earth’s biodiversity is increasingly becoming vitally important and challenging to accomplish:
- pressure for economic development
- habitat degradation, fragmentation and loss
- debilitating effects of invasive species
- dwindling conservation dollars
- inadequate management
- pathogens and pollution
- unsatisfactory and ill-conceived policy
- human population pressure
- over consumption (harvests and hunting)
- general environmental illiteracy
- more science

Natural resource managers and conservationists must embrace efficient, adaptive and comprehensive strategies:

1: Identify conservation targets
2: Collect information and identify information gaps
3: Establish conservation goals
4: Assess existing conservation areas
5: Evaluate ability of conservation targets to persist
6: Assemble a portfolio of conservation areas
7: Identify priority conservation areas

# Plant Conservatism

Gerould Wilhelm and Floyd Swink, 1979


## Native species:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Mostly ubiquitous in a broad range of environments</td>
</tr>
<tr>
<td>5</td>
<td>Typify an advanced successional phase of a native community</td>
</tr>
<tr>
<td>10</td>
<td>Represent stable, near climax communities; high fidelity to a narrow range of environments</td>
</tr>
<tr>
<td>15</td>
<td>A 10 species that is also fairly rare in the region</td>
</tr>
<tr>
<td>20</td>
<td>Locally threatened or endangered</td>
</tr>
</tbody>
</table>

## Non-native species:

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0</td>
<td>Species that undermine quality, are poisonous/illegal, exhibit preemptive roles</td>
</tr>
<tr>
<td>0</td>
<td>Have little or no impact on the ecology of extant communities</td>
</tr>
<tr>
<td>&gt;0</td>
<td>Exhibit important roles in succession of novel communities, as wildlife food, or are interesting or showy</td>
</tr>
</tbody>
</table>
Plant Conservatism

A conservative species is defined as: “a species almost always restricted to intact ecosystems where ecological processes, functions, composition, and structure have not been (or minimally so) degraded/modified by human stressors.”

An intact ecosystem is defined as: “an ecosystem in which the composition, structure, function, and ecological processes are within their historic range of variability (i.e. historic = pre-Euro-Asian settlement).”

Rocchio and Crawford 2013 (Floristic Quality Assessment for Washington Vegetation)

Does plant conservatism work?

- plants are strongly tied to environment
- plant species composition of a community in an ecosystem reflects its condition (degraded or pristine)
- plants have evolved life history strategies that best serve them in their environment
- plant conservatism is beset by circularity
- plant conservatism is subjective
- rare species are biased toward high C-values
- species C-values are imprecise
  * acclimation

Early successional                                  Mid-successional                            Late successional

increasing favorable response to human disturbance

increasing requirement for natural, pristine environments

Given C-value = 3 → the presence of this species ≈ 30% probability the community where observed is a natural, pristine ecosystem

Anthropogenic disturbances       vs.       Natural disturbances

secondary succession
- fire
- windthrow
- bare soil (wallows, dens, gopher mounds)
- floods

primary succession
- sand dunes
- paleosols
R-selected → strategy is to colonize relatively fertile, disturbed sites, often early secondary successional environments

C-selected → strategy is to compete in relatively fertile, late successional sites

S-selected → strategy is to survive in stressful environments, often primary successional environments such as those stressed by abiotic factors such as low fertility, high temperature, or low moisture
Iowa Original Coefficients List Meeting Dates (4 days)
April 9\textsuperscript{th} – 12\textsuperscript{th}, 1999

1999 participants (l-r): Diana Horton, Deb Lewis, Daryl Smith, Gerould Wilhelm, Pauline Drobney, Mark Leoschke, John Pearson and Dean Roosa
Native vs. Non-native?
Original list → many native ruderals = 0
non-native species = 0 (by default)

Reevaluate the fidelity of species to pristine habitats
check vouchers, research databases

Assign a measure of confidence to each C-value
low, medium, high

Separate and discount observations from reconstructions

All native species have more value than non-native species
→ native species ≥ 1
## Iowa Coefficients of Conservatism

<table>
<thead>
<tr>
<th>Name (FNA)</th>
<th>Common name</th>
<th>Old CC</th>
<th>New CC</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Euphorbia marginata</em></td>
<td>Snow-on-the-mountain</td>
<td>0</td>
<td>4</td>
<td>H</td>
</tr>
<tr>
<td><em>Lythrum alatum</em></td>
<td>Winged loosestrife</td>
<td>3</td>
<td>6</td>
<td>H</td>
</tr>
</tbody>
</table>
### Iowa Coefficients of Conservatism

<table>
<thead>
<tr>
<th>Name (FNA)</th>
<th>Common name</th>
<th>Old CC</th>
<th>New CC</th>
<th>Confidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carex frankii</td>
<td>Frank’s sedge</td>
<td>8</td>
<td>5</td>
<td>L</td>
</tr>
<tr>
<td>Galium triflorum</td>
<td>Sweet-scented bedstraw</td>
<td>7</td>
<td>5</td>
<td>H</td>
</tr>
</tbody>
</table>

[https://www.minnesotawildflowers.info/](https://www.minnesotawildflowers.info/)
Distribution of Iowa Plant Species C-values

Original C-values
n = 1,488
\( \bar{y} = 6.04 \)

Revised C-values
n = 1,473
\( \bar{y} = 6.37 \)
Distribution of Adjustments made to Plant Species Conservatism

\[ n = 1,414 \text{ species} \quad \bar{y} = 0.355 \]
Application of Iowa Coefficients of Conservatism

Story County Sensitive Areas Inventory

1) Conduct field research on high and medium priority sites to delineate, map and identify extant ecosystems – a goal of 10,000 acres
2) Identify the plant species composition of ecosystems by compiling a quantitative list of the vascular plants (abundance with frequency)
3) Obtain data to characterize community structure and successional status of the ecosystems mapped (plant growth forms and sizes of woody plants)
4) Report anecdotal observations of other organisms, including fungi, invertebrates, and vertebrates
5) Map locations of imperiled and high conservative plant species
6) Provide assessment of ecosystem/vegetation conservation value
7) Assemble a Geographic Information System (GIS)
   * extant vegetation/ecosystems
   * topography
   * soils
   * native vegetation/ecosystems
   * historic land use
   * GLO vegetation

Story County Sensitive Areas Inventory – Quick Numbers
- field research 2017 to 2020 (most sites surveyed during a single visit)
- 1,450 hours of research (Tom Rosburg and Bill Norris)
- 138 sites surveyed, 717 plant communities/ecosystems mapped and inventoried
- 34,455 observations of plant species abundance in a specific community/ecosystem
- 800 plant species in 106 plant families
- 65 community variables calculated to convey measures of community/ecosystem condition
Macrosite and Sites For Field Survey in Story County, Iowa (2017-02-23)

Potential Natural Areas
Organized by Macrosite

Legend
Biodiversity Site Boundaries
Survey Priority: High, Medium, Special (Restorable) and

- H = High Survey Priority
- M = Medium Survey Priority
- L = Low Survey Priority
- S = Special Area - Restorable
- U = Quality to Be Determined

...
### Field Methods

#### Plant species abundance

<table>
<thead>
<tr>
<th>Frequency assigned in the field</th>
<th>Numerical absolute frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sparse</td>
<td>5</td>
</tr>
<tr>
<td>Locally Occasional</td>
<td>10</td>
</tr>
<tr>
<td>Sparse/Occasional</td>
<td>13</td>
</tr>
<tr>
<td>Occasional</td>
<td>20</td>
</tr>
<tr>
<td>Locally Frequent</td>
<td>30</td>
</tr>
<tr>
<td>Occasional/Frequent</td>
<td>33</td>
</tr>
<tr>
<td>Frequent</td>
<td>45</td>
</tr>
<tr>
<td>Locally Very Common</td>
<td>60</td>
</tr>
<tr>
<td>Frequent/Very Common</td>
<td>63</td>
</tr>
<tr>
<td>Very Common</td>
<td>80</td>
</tr>
</tbody>
</table>

#### Woody structure

<table>
<thead>
<tr>
<th>Structural Class</th>
<th>Size</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seedling/Sprout</td>
<td>&lt; 50 cm height</td>
</tr>
<tr>
<td>Shrub</td>
<td>50 to &lt; 200 cm height</td>
</tr>
<tr>
<td>Sapling</td>
<td>≥ 200 cm height and &lt; 5 cm DBH</td>
</tr>
<tr>
<td>Tree</td>
<td>≥ 5 cm DBH, record DBH to nearest 5 cm</td>
</tr>
</tbody>
</table>

green ash  20   sdl, shb, sap, 5, 20, 25, 45  
bur oak  20   60, 70, 75, 90, 100, 120, 130
Plant Conservatism

Revised scale of plant conservatism to incorporate the negative effect of invasive, non-native species to community quality.

http://www.illinoiswildflowers.info
https://www.minnesotawildflowers.info
Plant Conservatism Variables

1) Native Forb Mean Conservatism
2) Native Graminoid Mean Conservatism
3) Native Woody Mean Conservatism

4) Native Herbaceous Weighted Mean Conservatism
5) Native Woody Weighted Mean Conservatism
6) All Herbaceous Weighted Mean Conservatism
7) All Woody Weighted Mean Conservatism

8) Native High Conservative Richness (C-value ≥ 7)
9) Native Low Conservative Richness (C-value ≤ 2)
10) Percentage (%) Low Conservatism Native Ruderals

11) Exotic Herbaceous Negativity Index
    \[ = (\text{Nat Herb WM Cons} - \text{All Herb WM Cons}) \times \sqrt{\text{Total Exotic Herb Rich}} \]

12) Exotic Woody Negativity Index
    \[ = (\text{Nat Wood WM Cons} - \text{All Wood WM Cons}) \times \sqrt{\text{Exotic Wood Rich}} \]

13) FQI Native Species
14) Weighted FQI All Species

\[ \text{FQI} = \text{mean conservatism} \times \sqrt{\text{richness}} \]
Plant Richness Variables

1) Native Forb Richness
2) Exotic Forb Richness
3) Native Graminoid Richness
4) Exotic Graminoid Richness
5) Native Woody Richness
6) Exotic Woody Richness
7) IA Native/Story Exotic Richness
8) Total Native Richness
9) Total Exotic Richness
10) Total Richness

11) Native Richness Index
    \[
    \text{Native Richness Index} = \frac{\text{total native richness}}{\text{total exotic richness}}
    \]

12) Native Forb/Graminoid Richness Index
Plant Frequency Variables (Abundance)

1) Total Absolute Frequency % Native Forbs
2) Total Absolute Frequency % Exotic Forbs
3) Total Absolute Frequency % Native Graminoids
4) Total Absolute Frequency % Exotic Graminoids
5) Total Absolute Frequency % Native Woody
6) Total Absolute Frequency % Exotic Woody
7) Total Absolute Frequency % IA Native Story Exotic
8) Total Absolute Frequency % All Species
9) Percentage Relative Frequency % Native Forbs/All Native Herbs
10) Percentage Relative Frequency % Native Herbs/All Herbs
11) Percentage Relative Frequency % Native Woody/All Woody
12) Total Absolute Frequency % Native Annuals & Biennials
13) Total Absolute Frequency % Exotic Annuals & Biennials
14) Percentage Relative Frequency % All Herb Ruderal/All Herbs

15) Native Forb Frequency Index
   \[ \frac{\text{total native forb frequency}}{\text{total exotic forb frequency}} \]

16) Native Graminoid Frequency Index
   \[ \frac{\text{total native graminoid frequency}}{\text{total exotic graminoid frequency}} \]
1) Prairie Indicator Richness
2) Percentage Relative Frequency (%) Prairie Indicator Richness
3) Total Prairie Index
4) Prairie Index Score %

https://www.minnesotawildflowers.info/flower/wild-four-o'clock
Wetland Affinity Variables

1) Mean Native Forb Wetland Affinity
2) Mean Native Graminoid Wetland Affinity
3) Mean Native Woody Wetland Affinity
4) Mean Exotic Wetland Affinity
5) All Species Weighted Mean Wetland Affinity

<table>
<thead>
<tr>
<th>Affinity Status</th>
<th>Occurrence in Wetlands within the Region</th>
<th>Numeric Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obligate wetland</td>
<td>99% or more of the time</td>
<td>-5</td>
</tr>
<tr>
<td>Facultative wetland</td>
<td>67-98% of the time</td>
<td>-3</td>
</tr>
<tr>
<td>Facultative</td>
<td>34-66% of the time</td>
<td>0</td>
</tr>
<tr>
<td>Facultative upland</td>
<td>2-33% of the time</td>
<td>3</td>
</tr>
<tr>
<td>Obligate Upland</td>
<td>1% or less of the time</td>
<td>5</td>
</tr>
</tbody>
</table>
### Woody Structure Variables

1. Total Native Shrub Frequency
2. Total Exotic Shrub Frequency
3. Relative Percentage % Exotic Shrub Frequency/All Shrub Frequency
4. Total Shrub Frequency/Total Native Herb Frequency Index
5. Native Understory Richness-Structure
6. Exotic Understory Richness-Structure
7. Total Understory Richness-Structure
8. Native Understory Richness-Structure Index
9. Old Growth Index - Upland Dry-mesic Forest/Woodland
10. Old Growth Index - Upland Wet-mesic Forest/Woodland
11. Old Growth Index - Upland & Lowland Mixed Forest/Woodland
12. Old Growth Index - Floodplain Forest/Woodland
13. Total Native Old Growth Index
14. Old Growth Index - Exotic species

#### DBH (diameter at breast height) classes in cm

<table>
<thead>
<tr>
<th>DBH (diameter at breast height) classes in cm</th>
<th>Index Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 ≤ DBH &lt; 75</td>
<td>1</td>
</tr>
<tr>
<td>75 ≤ DBH &lt; 100</td>
<td>2</td>
</tr>
<tr>
<td>100 ≤ DBH &lt; 125</td>
<td>3</td>
</tr>
<tr>
<td>125 ≤ DBH &lt; 150</td>
<td>4</td>
</tr>
<tr>
<td>150 ≤ DBH &lt; 175</td>
<td>5</td>
</tr>
<tr>
<td>175 ≤ DBH &lt; 200</td>
<td>6</td>
</tr>
<tr>
<td>200 ≤ DBH &lt; 250</td>
<td>7</td>
</tr>
<tr>
<td>250 ≤ DBH</td>
<td>8</td>
</tr>
</tbody>
</table>
Old Growth Index

<table>
<thead>
<tr>
<th>Species</th>
<th>DBH measurements</th>
<th>Index Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Silver maple</td>
<td>55, 60, 90, 140</td>
<td>1+2+4 = 7</td>
</tr>
<tr>
<td>Hackberry</td>
<td>75</td>
<td>2</td>
</tr>
<tr>
<td>Am elm</td>
<td>35, 45</td>
<td>0</td>
</tr>
<tr>
<td>Honey locust</td>
<td>40, 65, 80</td>
<td>1+2 = 3</td>
</tr>
<tr>
<td>Basswood</td>
<td>80, 90</td>
<td>2</td>
</tr>
</tbody>
</table>

Floodplain Forest = 7
Mixed Forest = 5
Upland Rich Forest = 2

Total Old Growth Index = 14

<table>
<thead>
<tr>
<th>DBH (diameter at breast height) classes in cm</th>
<th>Index Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 ≤ DBH &lt; 75</td>
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<tr>
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<td>5</td>
</tr>
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<td>6</td>
</tr>
<tr>
<td>200 ≤ DBH &lt; 250</td>
<td>7</td>
</tr>
<tr>
<td>250 ≤ DBH</td>
<td>8</td>
</tr>
</tbody>
</table>
Overall Biodiversity Conservation Score

10 variables previously described are integrated to create a score standardized to a perfect score of 100

1) Percentage low conservatism       (0 to 10)

2) Percentage of the abundance (absolute frequency) of native herb species relative to the total abundance of all herbs       (0 to 10)

3) Native richness index       (0 to 10+)

4) High conservatism       (0 to 10+)

5) FQI for native species    (-0 to 10+)

6) Weighted FQI for all species     (0 to 10+)

7) Total exotic shrub frequency     (-0 to 10)

8) Prairie quality score     (0 to 10+)

9) Native old growth      (0 to 10+)

10) Wetland score reflecting the abundance of all wetland plants     (0 to 10)
## Overall Biodiversity Conservation Scores

Comparison among 5 communities at 5 different sites

<table>
<thead>
<tr>
<th></th>
<th>Doolittle Prairie</th>
<th>CS Grassland</th>
<th>Recon Prairie</th>
<th>Up Mix Forest</th>
<th>Wet Swale</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Percentage low conservatism</td>
<td>9.0</td>
<td>4.1</td>
<td>7.2</td>
<td>8.0</td>
<td>7.8</td>
</tr>
<tr>
<td>2) Percentage abundance native herb species</td>
<td>8.9</td>
<td>2.3</td>
<td>8.9</td>
<td>9.8</td>
<td>8.2</td>
</tr>
<tr>
<td>3) Native richness index</td>
<td>4.9</td>
<td>0.4</td>
<td>1.4</td>
<td>5.8</td>
<td>1.5</td>
</tr>
<tr>
<td>4) High conservatism</td>
<td>16.0</td>
<td>0.0</td>
<td>4.0</td>
<td>0.0</td>
<td>0.7</td>
</tr>
<tr>
<td>5) FQI for native species</td>
<td>17.3</td>
<td>3.9</td>
<td>8.8</td>
<td>8.7</td>
<td>6.3</td>
</tr>
<tr>
<td>6) Weighted FQI for all species</td>
<td>9.6</td>
<td>-2.2</td>
<td>5.3</td>
<td>4.4</td>
<td>3.1</td>
</tr>
<tr>
<td>7) Total exotic shrub frequency</td>
<td>10.0</td>
<td>8.5</td>
<td>10.0</td>
<td>6.7</td>
<td>10.0</td>
</tr>
<tr>
<td>8) Prairie quality score</td>
<td>11.8</td>
<td>0.4</td>
<td>3.5</td>
<td>0.0</td>
<td>0.4</td>
</tr>
<tr>
<td>9) Native old growth</td>
<td>0.0</td>
<td>1.2</td>
<td>0.0</td>
<td>1.6</td>
<td>0.0</td>
</tr>
<tr>
<td>10) Wetland score</td>
<td>4.4</td>
<td>2.5</td>
<td>2.9</td>
<td>3.8</td>
<td>8.5</td>
</tr>
<tr>
<td><strong>Total Conservation Score</strong></td>
<td><strong>91.7</strong></td>
<td><strong>21.1</strong></td>
<td><strong>52.1</strong></td>
<td><strong>48.8</strong></td>
<td><strong>46.4</strong></td>
</tr>
</tbody>
</table>
Highlights of Story County SAI Results

1) 49 plant species not included in Eilers and Roosa
   * 35 ecological
   * 12 taxonomic

2) 24 plant species represent new Story County records
   * 11 native (but 2 likely planted)
   * 8 native to Iowa but not Story County (poorly designed reconstructions)
   * 5 non-native

3) 9 plant species considered historic rediscovered
   * 8 native (but 2 may have been planted)
   * 1 non-native

4) 16 plant species on Iowa imperiled species list (E, T, SC)
   * 1 endangered (but clearly planted, blue giant hyssop)
   * 15 special concern (but 11 are insignificant, 4 ecologically important)
Prairie remnant
- Helianthemum bicknellii
- Cyperus filiculmis

Sedge meadow remnant
- Lysimachia terrestris
- Carex conoidea

Oak-basswood forest
- Actaea pachypoda
- Juglans cinerea