



Vegetation Diversity and Structure Forest Health Indicator Status and Preliminary Results

Bethany Schulz¹ and Andrew Gray, PNW Research Station



Introduction

The composition, diversity, and structure of vascular plants are important indicators of forest health. Plants are the source of primary production and the main determinant of habitat. Changes in vegetation can have cascading effects through an ecosystem. Changes in species diversity, structural diversity, and the abundance of nonnative species are common national concerns, and are part of the international criteria for assessing sustainability of forestry practices. The Vegetation Indicator (VEG) for the Forest Health Monitoring Program (FHM, now Phase 3 of FIA) was designed to assess these issues.

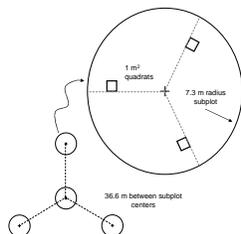
Methods have changed over the years as indicator advisors have strived to determine the most efficient process to collect sufficient and comparable data from the nation's diverse forest ecosystems. We summarize the status of the VEG indicator in terms of implementation, data quality, how data from recent methods compare, and how it can be reported.

Number of plots where VEG data has been collected through 2002

State	1999	2000	2001	2002
Delaware	27	22	19	19
Illinois			14	8
Indiana			12	6
Iowa			7	9
Kansas			8	6
Michigan		34	41	43
Minnesota			70	70
Missouri	1		36	32
Nebraska			4	5
New Jersey			9	6
New York		8	21	10
North Dakota			3	
Ohio			16	21
Oregon		30	62	
Pennsylvania		37	42	136
South Carolina				31
South Dakota			4	3
Utah			40	45
Wisconsin			34	32
Wyoming			18	

Basic Methods (2004)

- Species are recorded for the vascular vegetation on three 1m² permanently located quadrats on each subplot.
- The entire subplot is then searched for additional species. Each species is recorded, along with canopy cover abundance in three height layers. Ground variables are also recorded for each subplot.
- Only portions of the subplot in an "accessible forested condition" are measured



Data Quality

A repeatability study was conducted by the PNW Research Station. Two botanists collected data on the same 48 plots in Oregon. (Copies of abstract attached below)

Plant ID rates were similar for each botanist:	Agreement of plant ID's:
≈ 75% to species	-71% at subplot level
≈ 14% to genus	-67% at quadrat level
...with greatest problems in dry forest types where plants senesced by July	...with most differences attributed to plants ID'ed as closely related, usually to the same genus, and plants overlooked by one or the other botanist due to low abundance levels

Overall, agreement on overall species richness and numbers of introduced species was high, with correlation coefficients of 0.94 and 0.98, respectively.

These results are similar to other botanical monitoring studies.

Data Similarities and Differences of Recent Method Versions

Measure	1999-2000	2001-2003	2004
Species (spp) composition of plot	YES	YES	YES
Frequency (subplots and quadrats)	YES	YES	YES
Alpha	YES	YES	YES
Gamma	YES	YES	YES
Beta	YES	YES	YES
Total Foliar Cover by Layer	no	YES	YES
spp Abundance as Canopy Cover	Quadrats	Quadrats and subplot	Subplot
spp by Layer	2 quadrat layers	1 quadrat, subplot layer w/ max. foliage	1 quadrat, 3 subplot layers
Ground variables	Quadrat	Quadrat	Subplot
Non-forest land use (nflu) described	Up to 4 nflu recorded for Plot	Up to 4 nflu recorded for Plot	One nflu recorded per Subplot

Data analysis and reporting:

At the plot level:

Species composition, including

- Species identification
- Abundance as canopy cover
- Structure as canopy by height layer
- Distribution as frequency, based on # of quadrats and subplots where a species is recorded

This yields:

Species composition estimates species richness (alpha (α) = number of species)

Species abundance allows classification of plots into locally defined plant communities.

Structure allows for assessments of wildlife habitat and fuel profiles.

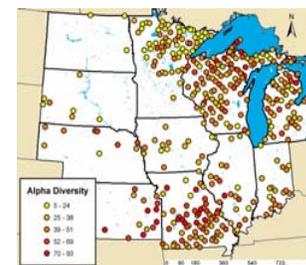
Distribution allows assessment of change over time.

...which enables us to make...

Population estimates (National, Regional, EcoProvince, post-stratified by forest type and stand-size class):

- Species composition estimates
- Average alpha (α)
- Gamma (γ = total number of species in area of interest), and
- Beta (β = γ/α), representing community "turnover"
- Mean stand structure based on foliar cover by height layer
- Community and individual species spatial distribution
- Trend correlation with other P3 indicators, mensuration (P2) data, and other ancillary environmental data.

Other ways to display results:



Classes of alpha diversity for North Central states. Based on 2001 and 2002 inventories. Map produced by Chris Woodall.

Distribution of most commonly encountered introduced species in North Central EcoProvinces for 2001 and 2002

Province 212 (154 plots)	Province 222 (153 plots)	Province 251 (53 plots)																																																																																																																																					
<table border="1"> <thead> <tr> <th>Genus, species</th> <th>common name</th> <th># plots</th> <th># subplots</th> <th># quads</th> <th>score</th> <th>% total score</th> </tr> </thead> <tbody> <tr><td><i>Hieracium aurantiacum</i></td><td>orange hawkweed</td><td>23</td><td>45</td><td>36</td><td>153</td><td>2.71%</td></tr> <tr><td><i>Solidum ulmaria</i></td><td>climbing nightshade</td><td>12</td><td>22</td><td>19</td><td>79</td><td>1.40%</td></tr> <tr><td><i>Rosa multiflora</i></td><td>multiflora rose</td><td>8</td><td>11</td><td>3</td><td>20</td><td>0.35%</td></tr> <tr><td><i>Rumex acetosella</i></td><td>common sheep sorrel</td><td>7</td><td>11</td><td>14</td><td>53</td><td>0.94%</td></tr> <tr><td><i>Poa compressa</i></td><td>Canada bluegrass</td><td>7</td><td>10</td><td>14</td><td>52</td><td>0.92%</td></tr> </tbody> </table>	Genus, species	common name	# plots	# subplots	# quads	score	% total score	<i>Hieracium aurantiacum</i>	orange hawkweed	23	45	36	153	2.71%	<i>Solidum ulmaria</i>	climbing nightshade	12	22	19	79	1.40%	<i>Rosa multiflora</i>	multiflora rose	8	11	3	20	0.35%	<i>Rumex acetosella</i>	common sheep sorrel	7	11	14	53	0.94%	<i>Poa compressa</i>	Canada bluegrass	7	10	14	52	0.92%	<table border="1"> <thead> <tr> <th>Genus, species</th> <th>common name</th> <th># plots</th> <th># subplots</th> <th># quads</th> <th>score</th> <th>% total score</th> </tr> </thead> <tbody> <tr><td><i>Rosa multiflora</i></td><td>multiflora rose</td><td>62</td><td>115</td><td>81</td><td>358</td><td>7.15%</td></tr> <tr><td><i>Quercus caroliniana</i></td><td>Queen Anne's lace</td><td>13</td><td>20</td><td>13</td><td>99</td><td>1.98%</td></tr> <tr><td><i>Solidum ulmaria</i></td><td>climbing nightshade</td><td>12</td><td>16</td><td>5</td><td>31</td><td>0.62%</td></tr> <tr><td><i>Lonicera maackii</i></td><td>Amar honeysuckle</td><td>10</td><td>16</td><td>13</td><td>55</td><td>1.10%</td></tr> <tr><td><i>Glechoma hederacea</i></td><td>ground ivy</td><td>9</td><td>22</td><td>33</td><td>121</td><td>2.42%</td></tr> <tr><td><i>Alliaria petiolata</i></td><td>garlic mustard</td><td>9</td><td>21</td><td>27</td><td>102</td><td>2.04%</td></tr> </tbody> </table>	Genus, species	common name	# plots	# subplots	# quads	score	% total score	<i>Rosa multiflora</i>	multiflora rose	62	115	81	358	7.15%	<i>Quercus caroliniana</i>	Queen Anne's lace	13	20	13	99	1.98%	<i>Solidum ulmaria</i>	climbing nightshade	12	16	5	31	0.62%	<i>Lonicera maackii</i>	Amar honeysuckle	10	16	13	55	1.10%	<i>Glechoma hederacea</i>	ground ivy	9	22	33	121	2.42%	<i>Alliaria petiolata</i>	garlic mustard	9	21	27	102	2.04%	<table border="1"> <thead> <tr> <th>Genus, species</th> <th>common name</th> <th># plots</th> <th># subplots</th> <th># quads</th> <th>score</th> <th>% total score</th> </tr> </thead> <tbody> <tr><td><i>Rosa multiflora</i></td><td>multiflora rose</td><td>27</td><td>50</td><td>32</td><td>148</td><td>10.16%</td></tr> <tr><td><i>Polygonum convolvulus</i></td><td>black bindweed</td><td>8</td><td>10</td><td>4</td><td>32</td><td>1.51%</td></tr> <tr><td><i>Morus alba</i></td><td>white mulberry</td><td>6</td><td>12</td><td>6</td><td>30</td><td>2.06%</td></tr> <tr><td><i>Taraxacum officinale</i></td><td>spreading hedgeparsley</td><td>6</td><td>7</td><td>7</td><td>28</td><td>1.92%</td></tr> <tr><td><i>Acrostichum minus</i></td><td>linear horsetail</td><td>5</td><td>10</td><td>6</td><td>26</td><td>1.92%</td></tr> </tbody> </table>	Genus, species	common name	# plots	# subplots	# quads	score	% total score	<i>Rosa multiflora</i>	multiflora rose	27	50	32	148	10.16%	<i>Polygonum convolvulus</i>	black bindweed	8	10	4	32	1.51%	<i>Morus alba</i>	white mulberry	6	12	6	30	2.06%	<i>Taraxacum officinale</i>	spreading hedgeparsley	6	7	7	28	1.92%	<i>Acrostichum minus</i>	linear horsetail	5	10	6	26	1.92%
Genus, species	common name	# plots	# subplots	# quads	score	% total score																																																																																																																																	
<i>Hieracium aurantiacum</i>	orange hawkweed	23	45	36	153	2.71%																																																																																																																																	
<i>Solidum ulmaria</i>	climbing nightshade	12	22	19	79	1.40%																																																																																																																																	
<i>Rosa multiflora</i>	multiflora rose	8	11	3	20	0.35%																																																																																																																																	
<i>Rumex acetosella</i>	common sheep sorrel	7	11	14	53	0.94%																																																																																																																																	
<i>Poa compressa</i>	Canada bluegrass	7	10	14	52	0.92%																																																																																																																																	
Genus, species	common name	# plots	# subplots	# quads	score	% total score																																																																																																																																	
<i>Rosa multiflora</i>	multiflora rose	62	115	81	358	7.15%																																																																																																																																	
<i>Quercus caroliniana</i>	Queen Anne's lace	13	20	13	99	1.98%																																																																																																																																	
<i>Solidum ulmaria</i>	climbing nightshade	12	16	5	31	0.62%																																																																																																																																	
<i>Lonicera maackii</i>	Amar honeysuckle	10	16	13	55	1.10%																																																																																																																																	
<i>Glechoma hederacea</i>	ground ivy	9	22	33	121	2.42%																																																																																																																																	
<i>Alliaria petiolata</i>	garlic mustard	9	21	27	102	2.04%																																																																																																																																	
Genus, species	common name	# plots	# subplots	# quads	score	% total score																																																																																																																																	
<i>Rosa multiflora</i>	multiflora rose	27	50	32	148	10.16%																																																																																																																																	
<i>Polygonum convolvulus</i>	black bindweed	8	10	4	32	1.51%																																																																																																																																	
<i>Morus alba</i>	white mulberry	6	12	6	30	2.06%																																																																																																																																	
<i>Taraxacum officinale</i>	spreading hedgeparsley	6	7	7	28	1.92%																																																																																																																																	
<i>Acrostichum minus</i>	linear horsetail	5	10	6	26	1.92%																																																																																																																																	

Pie charts represent average plot breakdown of plants recorded by status.

- Native spp
- Introduced spp
- No status (not ID'ed to spp)



Map showing Baileys Ecoregions that encompass the North Central region. Bailey, R. G., Avers, P. E., King, T., McComb, W. H., eds. 1994. Ecoregions and subregions of the United States (map). Washington, DC: USDA Forest Service. 1:7,500,000. http://www.fs.fed.us/colorimagemap/ecoreg1_provinces.html

¹ For more information, contact:
Beth Schulz
Indicator Advisor
USDA Forest Service
PNW Research Station
Anchorage Forestry Sciences Lab
3301 C Street, suite 200
Anchorage AK 99503
Phone: (907) 743-9424
Email: bschulz@fs.fed.us



A systematic inventory and monitoring of vascular plant species on P3 permanent plots across the country allows for more powerful inferences than are currently available based on different sampling approaches.