The Effects of Logging on Understory Plants
2007 Survey

by

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ACKNOWLEDGMENTS

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THE EFFECTS OF LOGGING ON UNDERSTORY PLANTS
2007 SURVEY

INTRODUCTION

Anishinaabe bands that signed the Treaties of 1836, 1837, 1842, and 1854 retain hunting, fishing, and gathering rights within lands ceded to the U.S. Government. These lands include present-day northern Michigan, Wisconsin, and Minnesota (Figure 1). The natural resources found on these ceded lands continue to play an important role in the Anishinaabe lifeway by providing food, medicine, utility supplies and ceremonial items. Plants, in particular, serve many different functions and remain inextricably woven into Anishinaabe culture (Meeker et al. 1994).

![Figure 1: Territories ceded to the U.S. Government in the Treaties of 1836, 1837, 1842 and 1854](image)

Many of these plant species occur within northern hardwood forests and have adapted to the environmental conditions existing under tree canopies. These “understory” plants often begin their seasonal growth during early spring while sunlight filters down through the still leafless deciduous trees. After the trees form a dense canopy of leaves, understory plants either set seed and wilt or continue growing under low light levels. Though canopy gaps form naturally by windthrow or individual tree mortality, commercial logging creates gaps to which understory plants may not be adapted.

Scientists have raised concerns regarding the impact of logging on understory plants and have emphasized the need for extensive research (Crow et al. 1994). Several studies have documented some of these impacts, such as an overall decline in understory species richness and
cover, while simultaneously showing an increase in non-native species (Metzger and Schultz 1981, Whitney and Foster 1988, Duffy and Meier 1992, Bratton et al. 1994, Crow et al. 1994). These studies, however, have been limited to comparative observations of logged versus unlogged sites and have been criticized for failing to distinguish logging impacts from pre-existing site differences (Johnson et al. 1993). Subsequently, scientists and other interested individuals have emphasized the need to conduct studies that document site conditions both before and after logging treatments. Furthermore, many of these previous studies focused on sites that had experienced clear-cut logging techniques rather than the selective-cut logging techniques that are currently most often prescribed in hardwood forests.

In response, staff from the Great Lakes Indian Fish and Wildlife Commission (GLIFWC) proposed a long-term study to be initiated before logging activities (specifically using selective-cut techniques) in order to address the need to document pre-existing site conditions unrelated to logging impacts. The USDA Forest Service recognized the merit of assessing selective-cut logging impacts to understory plants and agreed to work with GLIFWC staff to develop and implement this study on the Chequamegon-Nicolet National Forest.

The goal of this study is twofold: 1) to document selective-cut logging impacts to understory plants; and 2) to document if and how long understory plants recover to pre-logging conditions.

**Report Objective**

The objectives of this report are to report of survey work conducted in 2007 and summarize the data that were gathered.
METHODS

Study Sites

Four study sites, all with similar characteristics, were selected within northern hardwood stands on the Medford-Park Falls Ranger District of the Chequamegon-Nicolet National Forest (Figure 2). They all have a history of logging, but have had minimal disturbance since the 1920’s. Their vegetation composition has been classified as Acer-Hydropyllum habitat types (Kotar 1988), with the dominant tree species: sugar maple\(^1\), basswood, bitternut hickory, white ash and green ash (Table 1). Though all the sites have silty loam soils, one site (site 1) has the moderate to well drained soils associated with ice-walled lakes, while the remaining sites (sites 2-4) have the poor to moderate drained soils associated with ground moraines (Attig 1993, Keys Jr. et al. 1995).

\(^{1}\) Ojibwe and scientific names are listed in Appendix A
Table 1: Plot descriptions, Chequamegon-Nicolet National Forest Timber Information Management Database.

<table>
<thead>
<tr>
<th></th>
<th>Site 1</th>
<th>Site 2</th>
<th>Site 3</th>
<th>Site 4</th>
</tr>
</thead>
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<td>Compartiment number</td>
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<td>49</td>
<td>51</td>
<td>48</td>
</tr>
<tr>
<td>Stand number</td>
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<td>1</td>
<td>9</td>
<td>8</td>
</tr>
<tr>
<td>Stand area (acres)</td>
<td>93</td>
<td>86</td>
<td>62</td>
<td>140</td>
</tr>
<tr>
<td>Year of origin</td>
<td>1922</td>
<td>1914</td>
<td>1927</td>
<td>1926</td>
</tr>
<tr>
<td>Year of field survey</td>
<td>2003</td>
<td>1990</td>
<td>1990</td>
<td>1990</td>
</tr>
<tr>
<td>Forest type</td>
<td>Sugar maple - basswood</td>
<td>Sugar maple</td>
<td>Sugar maple - basswood</td>
<td>Sugar maple</td>
</tr>
<tr>
<td>Size-density class *</td>
<td>Sawtimber (≥ 70%)</td>
<td>Sawtimber (≥ 70%)</td>
<td>Sawtimber (≥ 70%)</td>
<td>Sawtimber (≥ 70%)</td>
</tr>
<tr>
<td>Basal area (sq ft/acre)</td>
<td>121</td>
<td>110</td>
<td>110</td>
<td>110</td>
</tr>
<tr>
<td>Average dbh (inches)</td>
<td>14</td>
<td>12</td>
<td>12</td>
<td>11</td>
</tr>
</tbody>
</table>

* Size-density class was calculated by the Forest Service using average dbh (diameter at breast height) and basal area values. Sawtimber is defined as a tree large enough to be sawed into lumber; for hardwoods, this means a tree with a dbh greater than 11 inches. Percentage values in parentheses represent stocking densities.

Study Design

Paired plots, treatment (to be logged) and control (to remain un-logged), were established at each study site. Each plot measured 50x90 meters (m), with the control plots having a 10 m buffer on all sides. A 90 m baseline marked with karsomite end posts delineated each plot (Figure 3).

Within each plot, data for understory plants were obtained from six fixed sampling points placed at random distances along each of seven 50-meter transects running perpendicular to the baseline at 0, 15, 30, 45, 60, 75, and 90 m (Figure 4). A one-square meter quadrat was placed at each sampling point, within which percent cover was recorded for each species present (Bonham 1989). Percent cover was estimated within specific categories using a modified Braun-Blauquet Scale:

- << 1%
- < 1%
- 1-5 %
- 6-25 %
- 26-50 %
- 51-75 %
- 76-100 %
Figure 3: Site 1, Control Plot

Figure 4: Plot Design - seven transects, measuring 50 meters each, were laid out every 15 meters along a 90-meter baseline. Data were collected within six randomly placed square-meter quadrats along each transect.
Treatment Activities

Treatment activities have been completed for all four sites (Table 2). These activities entailed selective logging with trees being hand felled, cut into logs and removed from the site by a forwarder (Figures 5 and 6).

Table 2: Treatment Schedule

<table>
<thead>
<tr>
<th>Site</th>
<th>Date of Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Winter 2002-2003</td>
</tr>
<tr>
<td>2</td>
<td>Winter 2003-2004</td>
</tr>
<tr>
<td>3</td>
<td>Winter 2005-2006</td>
</tr>
<tr>
<td>4</td>
<td>Summer 2005</td>
</tr>
</tbody>
</table>

Figure 5: Site 1, treatment plot
Forwarder removing logs

Figure 6: Site 1, treatment plot
Post-treatment conditions
At site 1, approximately 930 trees were felled, with the majority being basswood, sugar maple, and white ash (Figure 7). At site 2, approximately 240 trees were felled, the majority being white ash, sugar maple, and red maple. At site 3, approximately 95 trees were felled, the majority being red maple. At site 4, approximately 590 trees were felled, the majority being sugar maple and red maple.

Figure 7: Percentage of total felled trees by species and site
2007 Survey Work

During 2007, all sites were surveyed twice (spring and summer). Site 1 was sampled on May 24-25 and August 1-2. Site 2 was sampled on June 4-5 and August 7-8. Site 3 was sampled on June 5-6 and August 6-7. Site 4 was sampled on May 21-22 and July 30-31.

Data Summarization

Data were entered and summarized between May and July 2008.

Species richness (number of species) was calculated and graphed for each plot for each sampling period (spring and summer).

Species composition was characterized through frequency, mean percent cover and importance values for each plot for each sampling period. Frequency was calculated for each species by dividing the number of quadrats in which the species occurred by the total number of quadrats in each plot (42 quadrats), then multiplied by 100. Mean percent cover for each species was calculated by averaging the percent cover of that species over all the quadrats in which that species occurred in each plot. Because percent cover data were recorded using modified Braun-Blanquet categories, midpoint values for each of the categories were used for calculations.

The importance value for each species was calculated as the sum of that species' relative frequency and relative cover (modified by Cox 1976). Relative frequency for each species was calculated by dividing that species' frequency by the total sum of all the species' frequencies, then multiplied by 100. Relative cover for each species was calculated by dividing that species' mean percent cover by the total sum of all the species' percent cover, and then multiplied by 100.
RESULTS

Species Richness

During pre-treatment sampling, a total of 110 plant species were recorded within the sites (Appendix A).

Species richness ranged from a low of 40 species to a high of 63 species (Table 3, Figures 8 and 9). The lowest species richness occurred during the summer at the control plot at site 1 and the highest species richness occurred during the spring at the treatment plot at site 2.

<table>
<thead>
<tr>
<th></th>
<th>Site 1</th>
<th></th>
<th>Site 2</th>
<th></th>
<th>Site 3</th>
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<tr>
<td>Spring</td>
<td>42</td>
<td>53</td>
<td>58</td>
<td>63</td>
<td>59</td>
<td>61</td>
<td>45</td>
<td>49</td>
</tr>
<tr>
<td>Summer</td>
<td>40</td>
<td>52</td>
<td>59</td>
<td>52</td>
<td>61</td>
<td>58</td>
<td>51</td>
<td>59</td>
</tr>
</tbody>
</table>
Figure 8: Species richness for the 2007 spring sampling period.

Figure 9: Species richness for the 2007 summer sampling period.
Species Composition

Importance values were calculated to determine the overall status of a species within each plot. The control plot at site 1 showed a number of ephemeral forbs with high importance values during the spring sampling period (Table 4). In particular, spring beauty, wood anemone, wild leek and yellow trout lily had high importance values in spring, but not summer. Forbs that showed high importance values for both spring and summer included blue cohosh, fragrant bedstraw, Virginia waterleaf, Pennsylvania sedge and sharp-lobed hepatica. Ash seedlings also had high importance values for both the spring and summer sampling periods. Species that showed high importance values in the summer, but not spring, included currant, false melic grass, long-stalk sedge and wood fern.

The treatment plot at site 1 also showed a number of ephemeral forbs with high importance values during spring (Table 5). Spring beauty, wild leek and yellow trout lily had high importance values only in the spring. Forbs that showed high importance values for both spring and summer included enchanter's nightshade, fragrant bedstraw, lady fern, maidenhair fern, Virginia waterleaf and sharp-lobed hepatica. Ash seedlings also had high importance values for both the spring and summer sampling periods. Species that showed high importance values only in the summer included blue cohosh, hog peanut and Wood’s stiff sedge.

For the control plot at site 2, species that had high importance values only in the spring included big white trillium, jewelweed, spring beauty, yellow trout lily and wood anemone (Table 6). Forbs that showed high importance values for both spring and summer included common enchanter's nightshade, lady fern, and Wood’s stiff sedge. Ash and red maple seedlings also had high importance values for both the spring and summer sampling periods. Species that showed high importance values only in the summer included hairy wood sedge, long-stalk sedge, musclewood (seedlings), Pennsylvania sedge and sharp-lobed hepatica.

For the treatment plot at site 2, species that had high importance values only in the spring included big white trillium, maidenhair fern, spring beauty, wood anemone and yellow trout lily (Table 7). Forbs that showed high importance values for both spring and summer included jewelweed, Pennsylvania sedge and Wood’s stiff sedge. Ash and red maple seedlings also had high importance values for both the spring and summer sampling periods. Species that showed high importance values only in the summer included basswood (seedlings) brownish sedge, common enchanter’s nightshade, ironwood (seedlings) and sugar maple (seedlings).

For the control plot at site 3, species that had high importance values only in the spring included big white trillium, jewelweed, prickly wild gooseberry (currant) and wood anemone (Table 8). Forbs that showed high importance values for both spring and summer included interrupted fern, Pennsylvania sedge and raspberry species. Ash, red maple and sugar maple seedlings also had
high importance values for both the spring and summer sampling periods. Species that showed high importance values only in the summer included musclewood (seedlings), sharp-lobed hepatica, starflower and Wood's stiff sedge.

For the treatment plot at site 3, species that had high importance values only in the spring included big white trillium, prickly wild gooseberry (currant), sharp-lobed hepatica, spring beauty and wood anemone (Table 9). Forbs that showed high importance values for both spring and summer included jewelweed and lady fern. Ash, red maple and sugar maple seedlings also had high importance values for both the spring and summer sampling periods. Species that showed high importance values only in the summer included currant species, raspberry species, musclewood (seedlings), Pennsylvania sedge and speckled alder (seedlings).

For the control plot at site 4, species that had high importance values only in the spring included spring beauty, Virginia waterleaf, wild leek, wood anemone, yellow trout lily (Table 10). Forbs that showed high importance values for both spring and summer included maidenhair fern, sharp-lobed hepatica, stinging nettle, two-leaved miterwort and Wood's stiff sedge. Species that showed high importance values only in the summer included brownish sedge, fragrant bedstraw, hog peanut, lady fern and red maple (seedlings).

For the treatment plot at site 4, species that had high importance values only in the spring included spring beauty, wild leek, wood anemone and yellow trout lily (Table 11). Forbs that showed high importance values for both spring and summer included jewelweed, sharp-lobed hepatica, stinging nettle and Virginia waterleaf. Ash and sugar maple seedlings also had high importance values for both the spring and summer sampling periods. Species that showed high importance values only in the summer included fringed bindweed, Pennsylvania sedge, red maple (seedlings) and rough-leaved rice grass.
Table 4: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the control plot at site 1.

<table>
<thead>
<tr>
<th>Species</th>
<th>Spring</th>
<th></th>
<th></th>
<th>Species</th>
<th>Summer</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
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<tr>
<td>Spring beauty</td>
<td>15.4</td>
<td>100.0</td>
<td>12.1</td>
<td>Hepatica, sharp-lobed</td>
<td>19.4</td>
<td>95.2</td>
<td>8.5</td>
</tr>
<tr>
<td>Hepatica, sharp-lobed</td>
<td>13.6</td>
<td>90.5</td>
<td>9.9</td>
<td>Bedstraw, fragrant</td>
<td>16.0</td>
<td>50.0</td>
<td>14.6</td>
</tr>
<tr>
<td>Virginia waterleaf</td>
<td>13.5</td>
<td>66.7</td>
<td>17.0</td>
<td>Virginia waterleaf</td>
<td>15.6</td>
<td>69.1</td>
<td>8.7</td>
</tr>
<tr>
<td>Leek, wild</td>
<td>13.5</td>
<td>26.2</td>
<td>29.2</td>
<td>Sedge, Pennsylvania</td>
<td>13.2</td>
<td>16.7</td>
<td>18.6</td>
</tr>
<tr>
<td>Sedge, Pennsylvania</td>
<td>11.2</td>
<td>11.9</td>
<td>27.2</td>
<td>Ash sp. (seedlings)</td>
<td>12.9</td>
<td>66.7</td>
<td>4.8</td>
</tr>
<tr>
<td>Trout lily, yellow</td>
<td>9.8</td>
<td>66.7</td>
<td>6.9</td>
<td>Current sp.</td>
<td>11.3</td>
<td>19.1</td>
<td>14.5</td>
</tr>
<tr>
<td>Anemone, wood</td>
<td>9.8</td>
<td>64.3</td>
<td>7.4</td>
<td>Sedge, long-stalk</td>
<td>10.1</td>
<td>9.5</td>
<td>15.0</td>
</tr>
<tr>
<td>Ash sp. (seedlings)</td>
<td>8.7</td>
<td>64.3</td>
<td>4.5</td>
<td>Grass, false melic</td>
<td>9.4</td>
<td>4.8</td>
<td>15.0</td>
</tr>
<tr>
<td>Bedstraw, fragrant</td>
<td>8.4</td>
<td>42.9</td>
<td>10.2</td>
<td>Cohosh, blue</td>
<td>9.0</td>
<td>28.6</td>
<td>8.0</td>
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<td>Cohosh, blue</td>
<td>7.8</td>
<td>21.4</td>
<td>14.9</td>
<td>Fern, wood sp.</td>
<td>8.0</td>
<td>9.5</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Table 5: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the treatment plot at site 1.

<table>
<thead>
<tr>
<th>Species</th>
<th>Spring</th>
<th></th>
<th></th>
<th>Species</th>
<th>Summer</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
</tr>
<tr>
<td>Fern, maidenhair</td>
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<td>2.4</td>
<td>88.0</td>
<td>Fern, maidenhair</td>
<td>25.2</td>
<td>2.4</td>
<td>88.0</td>
</tr>
<tr>
<td>Leek, wild</td>
<td>16.7</td>
<td>28.6</td>
<td>58.5</td>
<td>Bedstraw, fragrant</td>
<td>17.2</td>
<td>97.6</td>
<td>24.2</td>
</tr>
<tr>
<td>Virginia waterleaf</td>
<td>16.5</td>
<td>92.9</td>
<td>33.4</td>
<td>Virginia waterleaf</td>
<td>12.3</td>
<td>83.3</td>
<td>12.2</td>
</tr>
<tr>
<td>Bedstraw, fragrant</td>
<td>11.3</td>
<td>83.3</td>
<td>15.3</td>
<td>Ash sp. (seedlings)</td>
<td>11.5</td>
<td>88.1</td>
<td>7.8</td>
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<td>Spring beauty</td>
<td>10.7</td>
<td>88.1</td>
<td>11.1</td>
<td>Hog peanut</td>
<td>10.4</td>
<td>57.1</td>
<td>15.3</td>
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<td>Ash sp. (seedlings)</td>
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<td>Hepatica, sharp-lobed</td>
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<td>73.8</td>
<td>7.5</td>
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<td>7.4</td>
<td>57.1</td>
<td>4.9</td>
</tr>
<tr>
<td>Trout lily, yellow</td>
<td>8.2</td>
<td>78.6</td>
<td>4.3</td>
<td>Fern, lady</td>
<td>6.0</td>
<td>9.5</td>
<td>17.8</td>
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<td>Fern, lady</td>
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<td>9.5</td>
<td>27.0</td>
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<td>5.4</td>
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<tr>
<td>Enchanter's nightshade sp.</td>
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<td>50.0</td>
<td>4.3</td>
<td>Cohosh, blue</td>
<td>4.9</td>
<td>16.7</td>
<td>11.2</td>
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</table>
Table 6: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the control plot at site 2.

<table>
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<tr>
<th>Species</th>
<th>Spring IV</th>
<th>Spring F</th>
<th>Spring MC</th>
<th>Summer IV</th>
<th>Summer F</th>
<th>Summer MC</th>
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<td>83.3</td>
<td>28.6</td>
<td>18.0</td>
<td>64.3</td>
<td>34.6</td>
</tr>
<tr>
<td>Ash sp. (seedlings)</td>
<td>11.6</td>
<td>88.1</td>
<td>12.2</td>
<td>15.9</td>
<td>97.6</td>
<td>10.8</td>
</tr>
<tr>
<td>Sedge, Wood’s stiff</td>
<td>11.1</td>
<td>57.1</td>
<td>24.9</td>
<td>11.1</td>
<td>78.6</td>
<td>2.6</td>
</tr>
<tr>
<td>Anemone, wood</td>
<td>7.8</td>
<td>54.8</td>
<td>10.3</td>
<td>7.1</td>
<td>7.1</td>
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<td>Maple, red (seedlings)</td>
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<td>69.1</td>
<td>2.7</td>
<td>7.0</td>
<td>7.1</td>
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<td>Trillium, big white</td>
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<td>10.1</td>
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<td>Enchanter’s nightshade, common</td>
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<td>45.2</td>
<td>9.8</td>
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<td>Spring beauty</td>
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<td>3.6</td>
<td>6.4</td>
<td>33.3</td>
<td>7.1</td>
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<td>Fern, lady</td>
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<td>26.5</td>
<td>6.2</td>
<td>28.6</td>
<td>8.8</td>
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<td>Trout lily, yellow</td>
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<td>47.6</td>
<td>5.4</td>
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Table 7: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the treatment plot at site 2.

<table>
<thead>
<tr>
<th>Species</th>
<th>Spring IV</th>
<th>Spring F</th>
<th>Spring MC</th>
<th>Summer IV</th>
<th>Summer F</th>
<th>Summer MC</th>
</tr>
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<tbody>
<tr>
<td>Fern, maidenhair</td>
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<td>2.4</td>
<td>88.0</td>
<td>16.6</td>
<td>54.8</td>
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</tr>
<tr>
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<td>12.1</td>
<td>69.1</td>
<td>32.3</td>
<td>13.5</td>
<td>88.1</td>
<td>3.3</td>
</tr>
<tr>
<td>Sedge, Wood’s stiff</td>
<td>10.9</td>
<td>61.9</td>
<td>28.7</td>
<td>12.5</td>
<td>76.2</td>
<td>7.1</td>
</tr>
<tr>
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<td>9.7</td>
<td>40.5</td>
<td>36.2</td>
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<td>38.1</td>
<td>26.1</td>
</tr>
<tr>
<td>Ash sp. (seedlings)</td>
<td>9.0</td>
<td>76.2</td>
<td>6.5</td>
<td>8.7</td>
<td>23.8</td>
<td>26.6</td>
</tr>
<tr>
<td>Maple, red (seedlings)</td>
<td>7.8</td>
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<td>3.3</td>
<td>8.4</td>
<td>47.6</td>
<td>7.7</td>
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<td>8.4</td>
<td>4.8</td>
<td>39.0</td>
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<td>59.5</td>
<td>6.6</td>
<td>7.9</td>
<td>2.4</td>
<td>38.0</td>
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<td>5.8</td>
<td>7.2</td>
<td>33.3</td>
<td>12.1</td>
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<td>6.2</td>
<td>9.5</td>
<td>24.3</td>
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Table 8: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the control plot at site 3.

<table>
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<th>Species</th>
<th>Summer</th>
<th></th>
<th></th>
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</thead>
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<td>F</td>
<td>MC</td>
<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
</tr>
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<td>Fern, interrupted</td>
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<td>2.4</td>
<td>88.0</td>
<td>Fern, interrupted</td>
<td>17.0</td>
<td>2.4</td>
<td>88.0</td>
</tr>
<tr>
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<td>83.3</td>
<td>18.2</td>
<td>Ash sp. (seedlings)</td>
<td>11.5</td>
<td>92.9</td>
<td>9.6</td>
</tr>
<tr>
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<td>85.7</td>
<td>8.9</td>
<td>Maple, red (seedlings)</td>
<td>10.7</td>
<td>95.2</td>
<td>3.8</td>
</tr>
<tr>
<td>Maple, red (seedlings)</td>
<td>9.1</td>
<td>95.2</td>
<td>3.8</td>
<td>Sedge, Wood’s stiff</td>
<td>9.7</td>
<td>14.3</td>
<td>42.9</td>
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<tr>
<td>Currant, prickly wild gooseberry</td>
<td>7.6</td>
<td>7.1</td>
<td>39.3</td>
<td>Maple, sugar (seedlings)</td>
<td>7.9</td>
<td>54.8</td>
<td>11.4</td>
</tr>
<tr>
<td>Maple, sugar (seedlings)</td>
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<td>54.8</td>
<td>9.7</td>
<td>Raspberry sp.</td>
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<td>52.4</td>
<td>11.0</td>
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<td>38.1</td>
<td>15.4</td>
<td>Musclewood (seedlings)</td>
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<td>14.3</td>
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<td>42.9</td>
<td>7.1</td>
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<tr>
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<td>52.4</td>
<td>6.9</td>
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Table 9: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the treatment plot at site 3.

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<th></th>
<th>Species</th>
<th>Summer</th>
<th></th>
<th></th>
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<tbody>
<tr>
<td></td>
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<td>F</td>
<td>MC</td>
<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
</tr>
<tr>
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<td>83.3</td>
<td>44.5</td>
<td>Ash sp. (seedlings)</td>
<td>12.9</td>
<td>95.2</td>
<td>9.8</td>
</tr>
<tr>
<td>Ash sp. (seedlings)</td>
<td>10.4</td>
<td>92.9</td>
<td>9.4</td>
<td>Maple, sugar (seedlings)</td>
<td>12.7</td>
<td>88.1</td>
<td>12.5</td>
</tr>
<tr>
<td>Maple, red (seedlings)</td>
<td>10.1</td>
<td>97.6</td>
<td>4.2</td>
<td>Maple, red (seedlings)</td>
<td>12.3</td>
<td>97.6</td>
<td>6.2</td>
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<tr>
<td>Maple, sugar (seedlings)</td>
<td>8.9</td>
<td>76.2</td>
<td>10.0</td>
<td>Jewelweed</td>
<td>11.4</td>
<td>64.3</td>
<td>18.4</td>
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<td>8.5</td>
<td>4.8</td>
<td>51.5</td>
<td>Fern, lady</td>
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<td>7.1</td>
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<td>61.9</td>
<td>11.7</td>
<td>Raspberry sp.</td>
<td>9.1</td>
<td>31.0</td>
<td>25.1</td>
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<tr>
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<td>9.4</td>
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<tr>
<td>Hepatica, sharp-lobed</td>
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<td>33.3</td>
<td>19.0</td>
<td>Sedge, Pennsylvania</td>
<td>6.8</td>
<td>38.1</td>
<td>11.0</td>
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<tr>
<td>Fern, lady</td>
<td>5.1</td>
<td>9.5</td>
<td>26.5</td>
<td>Currant sp.</td>
<td>6.4</td>
<td>11.9</td>
<td>22.2</td>
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<tr>
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<td>4.6</td>
<td>Musclewood (seedlings)</td>
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<td>15.8</td>
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Table 10: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the control plot at site 4.

<table>
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<tr>
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<th>Summer</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
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<td>Nettle, stinging</td>
<td>14.1</td>
<td>52.4</td>
<td>31.1</td>
</tr>
<tr>
<td>Spring beauty</td>
<td>12.9</td>
<td>92.9</td>
<td>12.5</td>
</tr>
<tr>
<td>Sedge, Wood's stiff</td>
<td>12.0</td>
<td>61.9</td>
<td>20.4</td>
</tr>
<tr>
<td>Trout lily, yellow</td>
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<td>92.9</td>
<td>8.5</td>
</tr>
<tr>
<td>Anemone, wood</td>
<td>9.4</td>
<td>71.4</td>
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</tr>
<tr>
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<td>9.4</td>
<td>31.0</td>
<td>22.0</td>
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<td>Hepatica, sharp-lobed</td>
<td>8.9</td>
<td>61.9</td>
<td>9.4</td>
</tr>
<tr>
<td>Virginia waterleaf</td>
<td>7.8</td>
<td>50.0</td>
<td>9.9</td>
</tr>
<tr>
<td>Fern, maidenhair</td>
<td>7.5</td>
<td>11.9</td>
<td>22.2</td>
</tr>
<tr>
<td>Mitrewort, two-leaved</td>
<td>6.9</td>
<td>47.6</td>
<td>7.4</td>
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</table>

Table 11: Importance value (IV), frequency (F) and mean percent cover (MC) for the species with the ten highest importance values calculated for the treatment plot at site 4.

<table>
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<tr>
<th>Species</th>
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<th></th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IV</td>
<td>F</td>
<td>MC</td>
</tr>
<tr>
<td>Spring beauty</td>
<td>14.7</td>
<td>95.2</td>
<td>13.5</td>
</tr>
<tr>
<td>Trout lily, yellow</td>
<td>13.4</td>
<td>92.9</td>
<td>10.1</td>
</tr>
<tr>
<td>Leek, wild</td>
<td>12.5</td>
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<td>22.7</td>
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<tr>
<td>Nettle, stinging</td>
<td>11.3</td>
<td>52.4</td>
<td>17.9</td>
</tr>
<tr>
<td>Jewelweed</td>
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<td>47.6</td>
<td>17.2</td>
</tr>
<tr>
<td>Maple, sugar (seedlings)</td>
<td>10.5</td>
<td>85.7</td>
<td>3.2</td>
</tr>
<tr>
<td>Hepatica, sharp-lobed</td>
<td>9.5</td>
<td>59.5</td>
<td>8.3</td>
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<td>Virginia waterleaf</td>
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<td>13.1</td>
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<tr>
<td>Anemone, wood</td>
<td>8.7</td>
<td>54.8</td>
<td>8.7</td>
</tr>
<tr>
<td>Ash sp. (seedlings)</td>
<td>8.4</td>
<td>61.9</td>
<td>4.9</td>
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</table>
SUMMARY

Treatments, entailing selective logging, had been completed at all the study sites by 2006. Post-treatment sampling occurred twice (spring and summer) at all the study sites in 2007. Data entry and analysis was completed in 2008.

Summarization of the data showed that there were a total of 110 species in all plots combined. Species richness within each plot ranged from 40 to 63 species, with the least occurring at the control plot at site 1 during the summer and the most occurring at the treatment plot at site 2 during the spring.

The species composition at all plots showed importance values for spring ephemerals decreasing in the summer. During the summer, grass and sedge species showed higher importance values. Ash seedlings had high importance values during both the spring and summer sampling periods for all plots except the control plot at site 4.
REFERENCES CITED


APPENDIX A
2007 SPECIES LIST
<table>
<thead>
<tr>
<th>English Name</th>
<th>Scientific Name</th>
<th>Ojibwe Name</th>
<th>Origin</th>
</tr>
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<td>Erechites hieracifolia</td>
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<tr>
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<td>Aster sp.</td>
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<td>Geum sp.</td>
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<td>Actea sp.</td>
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<td>Uvularia sessilifolia</td>
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<td>Ribes americanum</td>
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<td>Hickory, bitternut</td>
<td>Carya cordiformis</td>
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<td>English Name</td>
<td>Scientific Name</td>
<td>Ojibwe Name</td>
<td>Origin</td>
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<td>Maple, sugar</td>
<td>Acer saccharum</td>
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<td>Meadow rue, early</td>
<td>Thalictrum dioicum</td>
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<td>Mitrewort, two-leaved</td>
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<td>Nannyberry</td>
<td>Viburnum dentago</td>
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<td>Nettle, false</td>
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<td>Nettle, stinging</td>
<td>Urtica dioica</td>
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<td>Oak, Red</td>
<td>Quercus rubra</td>
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<td>Partridge berry</td>
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<td>Carex bromoides</td>
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<td>Sedge, brownish</td>
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<td>Sedge, curly-styled wood</td>
<td>Carex rosea</td>
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<td>Sedge, Dewey's</td>
<td>Carex deweyana</td>
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<td>Sedge, graceful</td>
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<td>Sedge, inland star</td>
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<td>Sedge, long-stalk</td>
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<td>Sedge, nerveless woodland</td>
<td>Carex leptonervia</td>
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<td>Carex woodii</td>
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<td>Smilax, cat briar</td>
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