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Abundances of northeastern Native American culturally important plants in contemporary
Adirondack Landscapes

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Abundances of northeastern Native American culturally important plants in contemporary Adirondack landscapes

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Abstract-

In contemporary landscapes culturally important plants may suffer in the absence of their ancestral caretakers, who shaped pre-colonial ecosystems via intentional burning, coppicing, plant propagation, and manipulation of species composition. Therefore, it is important to understand how culturally important plants occur generally in contemporary ecosystems sans traditional management. Given that 99.9% of contemporary forest is secondary, it is especially important to examine occurrences of culturally important plants in secondary forest. To address this issue, culturally important plants in old growth forests at the Huntington Wildlife Forest, New York, were compared to those found in burned and defoliated forests at Cranberry Lake Biological Station, New York. Herbaceous understory species were inventoried at all sites. Importance values for culturally important species were compared among old growth, burned, and defoliated forest using ANOVA. Importance values of culturally important plants were significantly different among old growth, burned, and defoliated sites. Highest species richness and highest importance values occurred in old growth forest. As disturbance was generally used to increase biodiversity and incidences of culturally important plants, this result may suggest that common disturbances and land use histories do not mimic conditions established by indigenous practices. This would have implications for the survival of culturally important plants that have suffered population decline, as well as for the survival of cultural traditions that depend on those plants.

Indigenous culture as ecological force: Disturbance as an agent of biodiversity and resource management

Commonly referred to as the “myth of the pristine,” conventional depictions of the pre-settlement landscape refer to pristine, virgin wilderness untouched by human hands. This depiction, however, is far from the truth (Denevan). Upon contacting and settling in North America, Europeans encountered a landscape that had been under continuous and intensive indigenous management for many thousands of years (Denevan 1992). Anthropogenic disturbance was employed for management purposes, resulting in a mosaic of various successional stages. This mosaic contained patches of abundant and high quality resources, as well as high biodiversity across the landscape due to the variety of adjacent ecosystem types.

Prescribed burning, coppicing, plant propagation, manipulation of species composition, hunting, fishing, and gathering plants used for food, medicine, building material, fiber, and basketry were practiced. To ensure a reliable source of subsistence, these practices yielded increased biodiversity, recycling of nutrients, decreased fuel loads, decreased competition from other plants, decreased effects of fungal or insect plant pathogens, and increased abundances of desired plants (Anderson 2005). They also increased the quality of resources by enhancing seed, fruit, or bulb production, increasing quantity and nutrient content of forage for wildlife, and enhancing desirable traits in raw materials (Kimmerer 2001, Anderson 1999, Anderson 2005). Such depth of human involvement in the landscape highlights the inseparability of ecosystem

ecology, and material and spiritual culture. The land was a living manifestation of culture, and everyday life a cultural manifestation of the land.

In light of the profound marriage of indigenous culture and the land upon which it subsists, it is clear that pre-settlement ecosystems cannot be comprehensively understood sans native influence (Kimmerer 2001). Designating a reference ecosystem without considering ecological implications of indigenous management would result in a reference ecosystem based on the “pristine myth”. However, when conservationists designate “pre-settlement conditions” as a reference ecosystem, indigenous worldviews and practices are often marginally considered. Hence, an integral force responsible for establishing and maintaining the pre-settlement conditions upon which restoration efforts are based is simply missing.

For example, fire was used by native people for purposes as diverse as maintenance of grasslands, regeneration of oak-hickory forests, and ease of mobility (Kimmerer 2001, Anderson 1999, Anderson 2005, Anderson 1996). Such mechanisms of disturbance were used to increase biodiversity by creating ecotones and a variety of habitat types of varying successional stages. Many plants important to native lifeways were also managed for with prescribed fire because of their adaptations for post-fire resilience. Fire also lessens competition from other species, recycles nutrients, increases light availability, and thins populations of plant pests and pathogens. The absence of fire over the past centuries, due to removal of indigenous people from their ancestral homelands, may be responsible for many changes in the landscape: reversion of prairies to woodlands, changes in species composition, increased stand homogeneity, and increased plant pathogens and diseases (Kimmerer 2001, Anderson 1996).

Removal of indigenous people, and the ecological forces they represented, may also be responsible in part for the population decline of culturally important species such as sweetgrass and beargrass (Shebitz 2005). A culturally important species is one whose body provides material for crafts, food, medicine, ceremony, or other cultural traditions. For example, the sweetgrass and beargrass studied by Shebitz (2005) are used for basketry in both eastern and western North America. Without these plants and the desirable raw material they provide, preservation of basket-making traditions and associated cultural knowledge are seriously threatened.

Land use history and culturally important plants

Such declines imply that conditions in the areas studied by Shebitz and others do not mimic indigenous management that would have historically produced culturally important plants such as sweetgrass in abundance. Contemporary anthropogenic disturbance may differ significantly from indigenous management practices in their extent and intensity, homogeneity, and mechanization. While disturbance was historically used to increase biodiversity and foster high abundances of culturally important plants, there may now be no forces creating conditions that perform these functions. Without such forces, populations of culturally important plants could eventually become threatened. Thus, it is important to understand how culturally important plants occur in contemporary landscapes so that they may be protected, along with the culture and knowledge associated with them.

The vast majority of contemporary forest is secondary—approximately 99.9% in Southern New England states (D’Amato et al. 2009). Therefore, to understand how culturally important plants occur on the landscape, it must be understood how they occur in secondary

forest. Between the 1860's and 1989, dominant forest cover shifted from old-growth hemlock and hardwood forest to secondary hardwood and conifer (White and Mladenoff 1994). The secondary forests have regenerated after a wide variety of disturbances, including agriculture, industrial fires, logging, and non-anthropogenic disturbance such as insect defoliation.

Much research has been conducted concerning differences in understory plant communities occurring in primary (defined as forest never cleared for agriculture) versus post-agricultural secondary forests (Flinn and Vellend 2005). Since European settlement, clearance for agriculture has drastically changed patterns of biodiversity across the Northeast (Vellend et al. 2007). In New York State, for example, forest cover went from nearly 100% in 1700 to about 40% in the early 1900's to about 65% in the 1990's (Smith et al. 2004). Biodiversity tends to be significantly lower in post agricultural forests than in primary forests (Vellend et al. 2007, Flinn and Vellend 2005, and Flinn and Marks 2007). Many native herbaceous understory plants appear to be restricted to primary forest, and do not colonize post-agricultural stands even decades or centuries after field abandonment (Vellend et al 2007, Flinn and Vellend 2005).

Vellend et al. conclude that this restriction, as well as lower diversity in post-agricultural forests is due to dispersal filters. Dispersal filters may stem from plants' adaptations to ecologically stable, continuous habitat rather than fragmented and fluctuating habitat. These adaptations may result in an inability to colonize post-agricultural forest (Flinn and Vellend 2005). Conditions in post-agricultural forest, such as lower levels of organic humus, carbon, and phosphorus, and homogenization of soil properties, may challenge proliferation of herbaceous understory plants (Flinn and Marks 2007).

In other parts of New York State, other disturbances account for clearance of land. While clearance for agriculture has not been a historically common source of disturbance in the

Adirondack region, logging and fires sparked by industrial machinery were common in the late 19th and early 20th centuries (Latty et al. 2004 Adirondack Park Agency), especially in 1902 and 1908 after severe droughts (Adirondack Parks Agency). As in the regions studied by Flinn et al. (2007 and 2005), secondary forest differs in habitat properties from relatively undisturbed stands. According to Latty et al., old growth forest soils in the Adirondacks have significantly more carbon and nitrogen than soils from forests that had been selectively logged and then burned about 100 years ago (Latty et al., 2004). McNeil et al. also predict significant differences in nitrogen cycling in clear-cut versus selectively cut Adirondack forest (McNeil et al. 2006). The lower carbon capital present in burned and logged sites may pose dispersal filters similar to those observed in post-agricultural forests.

A currently common source of disturbance is defoliation by the forest tent caterpillar (*Malacosoma disstria*). Approximately 1.2 million acres were defoliated in New York State, in which the forest tent caterpillar generally preferred sugar maple (Wood, 2009). The forest tent caterpillar can have significant effects on sugar maple health. It may cause increased susceptibility to *Armillaria* (Wargo 1972; Wargo and Houston 1974; Horsley et al. 2000; from Wood), crown dieback and sometimes mortality (Wood 2009). While literature detailing herbaceous response to fire is abundant, studies regarding herbaceous response to defoliation are more limited.

The Adirondack State Park offers unique opportunities to compare secondary versus old growth forest, as a variety of land uses are maintained in very close proximity. Large tracts of old growth are located within the same region as stands affected by both anthropogenic and non-anthropogenic disturbances. The Adirondacks were never permanently inhabited, but were used as a travel corridor and hunting grounds primarily by the Mohawk of the Haudenosaunee

Confederacy. As the Adirondack old growth was influenced minimally by indigenous people and post-settlement inhabitants, the old growth currently in the Adirondacks may be more similar to the old growth in New York State pre-settlement.

100-year old burned sites and sites recovering from recent defoliation by the forest tent caterpillar both constitute common disturbances in the Adirondacks. Both also differ from indigenous management. Though fire was used as a management tool, it was used frequently. Burned sites represent an infrequent disturbance. Though defoliated sites create small gaps in a hardwood canopy similar to patches created by indigenous disturbance, current ecosystem responses to disturbance may be different from pre-settlement responses. Defoliation as a disturbance operates within a food chain in which large carnivores are nearly absent. It is also not coupled with tending practices that would have been associated with indigenous management. While contemporary old growth forest may resemble pre-settlement old growth, contemporary disturbances do not resemble pre-settlement disturbance.

Research questions and goals

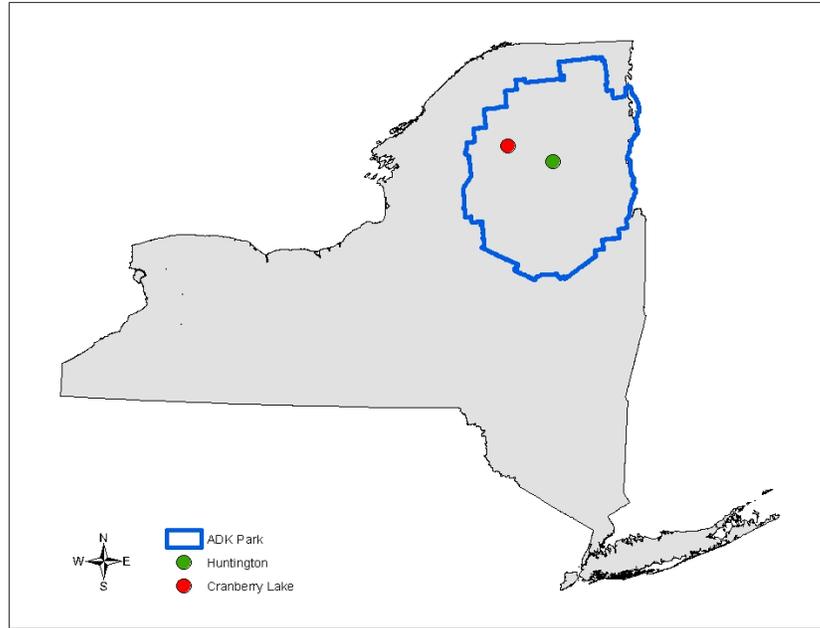
Disturbance was used by indigenous people to increase biodiversity and support the abundance and quality of culturally important plants. However contemporary secondary forest, which constitutes about 99.9% of total forest cover in Southern New England (D'Amato et al. 2008), may deviate markedly from conditions produced by indigenous disturbance regimes. Thus, in light of declines in populations of culturally important plants (Shebitz 2005), it is important to understand how culturally important plants occur on the landscape today. The Adirondack region is a favorable place to study old growth versus secondary forest, as relatively large areas of old growth occur in close proximity to a wide variety of secondary forest.

Motivated by the above points, the purpose of this study is to evaluate the occurrence of culturally important plants in herbaceous understory communities among various secondary versus old growth forest. To achieve this end, I will contrast the Importance Values of culturally important plants occurring in old growth forest stands, defoliated forest stands, and burned stands. Based on past research as well as fundamental differences between current and pre-settlement secondary forest, I hypothesize that burned and defoliated stands in the Adirondacks do not provide conditions established by indigenous disturbance regimes designed to support culturally important plants, and that old growth forest will have highest abundances of culturally important plants.

Sampling methods

Study Area—The Adirondack State Park in New York State

Elevation in the Adirondack region ranges from 150 to 1,220 m, with a few peaks higher than 1,500 m in elevation. The region has an average annual precipitation of 41.0", and an average temperature range of approximately 55°F (Jenkins 2004). The Adirondack State Park is a 2.5 million hectare mix of public and private property. The combination of mountains and lakes make the Adirondacks a distinct ecosystem unique to Eastern North America. It's forest is characterized as transition between north eastern deciduous and boreal forest. Management of forests is highly variable due to the wide variety of land uses (Jenkins 2004).



Map 1. Study site locations, Adirondack State Park NY

Site descriptions

Two facilities were utilized within the Adirondack State Park in New York State: the Cranberry Lake Biological Station near Cranberry Lake, New York, and the Huntington Wildlife Forest in Newcomb, New York. Two types of secondary sites, defoliated and burned, were studied at Cranberry Lake Biological Station, and primary sites were studied at Huntington Wildlife Forest.

Cranberry Lake Biological Station, Cranberry Lake, NY

Cranberry Lake is located on the Oswegatchie River in St. Lawrence County, New York, within the Northwestern portion of the Adirondack Park. Cranberry Lake is surrounded by fairly old forest existing on land that had never previously been farmed (Jenkins 2004). The biostation is surrounded by forest classified as wilderness by the Adirondack Park Agency. However, like

much of the Adirondacks, the entirety of the biostation was largely affected by logging in the 19th century.

The Cranberry Lake Biological Station (CLBS) is a research facility of the SUNY College of Environmental Science and Forestry (SUNY ESF). It is located on Barber Point, on the eastern shore of Cranberry Lake. The CLBS includes a wide range of habitats, from Northern hardwood forests to bog. Most of the forest is dominated by American beech (*Fagus grandifolia*), sugar maple (*Acer saccharum*), and yellow birch (*Betula alleghaniensis*). Other common hardwoods are white ash (*Fraxinus Americana*), black cherry (*Prunus serotina*), and red maple (*Acer rubrum*). Red spruce (*Picea rubens*), balsam fir (*Abies balsamea*), hemlock (*Tsuga canadensis*), white cedar (*Thuja occidentalis*), and white pine (*Pinus strobus*) are common conifers. The station also includes a plantation of white spruce (*Picea glauca*).

The CLBS contains secondary stands affected by a number of disturbances. Industrial operations in the early 1900's caused several fires. The CLBS also experienced two severe outbreaks of defoliation by the forest tent caterpillar (*Malacosoma disstria*). These outbreaks affected sugar maples, and resulted in easily recognizable characteristics: pure stands of sugar maples missing 1/2 or more of their canopies, and retaining their fine twigs. The presence of these characteristics on the CLBS indicates that a stand has been defoliated by the forest tent caterpillar between the years 2000 and 2008.

Huntington Wildlife Forest

The Huntington Wildlife Forest (HWF) is a research facility of SUNY ESF's Adirondack Ecological Center. It is located near the geographical center of the Adirondack Park, in the town of Newcomb, New York. The vegetation is transitional, and contains species typical of the

Northern hardwood forest to the south and the boreal forest to the north. The HWF consists of both undisturbed communities and managed forest stands. Forest types include northern hardwood, mixed conifer, and conifer; with American beech, sugar maple, red maple, and yellow birch being the dominant hardwoods. Red spruce, balsam fir, hemlock, white cedar, and white pine are common conifers. Hobblebush (*Viburnum alnifolium*) and American beech dominate the understory. In 1941, 971 acres of the HWF was designated a “natural area,” which was to represent natural conditions and processes in the absence of human manipulation. Several smaller pockets of primary forest also exist within the HWF (Demers and Breitmeyer 2008).

Field Vegetation Sampling

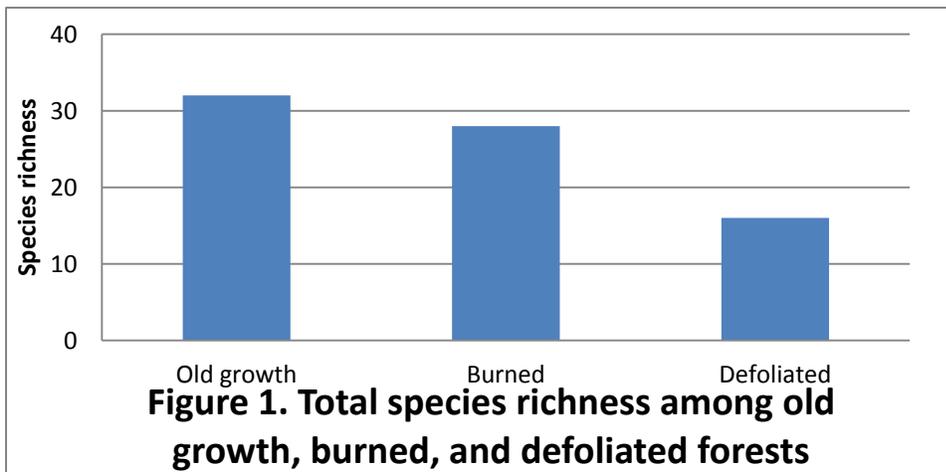
At CLBS, secondary forest stands were identified using a land-use history map. Three burned locations (burned in 1908) and three defoliated locations (defoliated between 2000-2008) were selected. Both forest types occurred on land that had housed logging operations in the 19th century. Defoliated stands consisted almost entirely of sugar maples, many of which were dead. The living trees tended to have 1/2-1/3 of their canopy remaining. Branches that had been stripped of leaves retained their fine twigs, indicating that they had been defoliated within the past 10 years. Using land-use history maps, two old growth forest stands were identified at HWF.

Within each burned and each defoliated location at CLBS, 3-4 sites were systematically established. At HWF, ten sites were systematically established at the two old growth locations. Each burned, defoliated, and old growth site contained six 1 x 1m plots. Within the 1 x 1m plots, the herbaceous plant communities were inventoried. Stem counts and cover classes for each

species were documented¹. Cultural importance (CI) of plant species present was determined using Daniel E. Moerman's *Native American Ethnobotany* (1998). If the plant was listed as being used by northeastern Native American nations, whether for medicine, food, material, or other purposes, it was considered culturally important. For each forest type, importance values² for every species sampled were calculated. Importance values of culturally important plants were summed. ANOVAs was used (with an α -value of .05) to compare importance values for culturally important plants among primary, defoliated, and burned forest.

Results

Species richness and species composition



42 herbaceous understory plant species occurred collectively in old growth, burned, and defoliated sites. 32 of those species occurred in old growth stands, 28 occurred in burned stands, and 16 occurred in defoliated stands (Table 1). Among plants occurring in old growth stands, hobblebush, shining club moss, sorrel, and woodfern had highest importance values (0.311, 0.205, 0.171, and 0.391, respectively). Among plants occurring in burned stands, Canada

¹ See appendix B.

² See appendix C.

mayflower, ground pine, shining club moss, and woodfern had highest important values (0.172, 0.117, 0.136, and 0.173, respectively). Highest importance values among plants in defoliated stands were possessed by hay-scented fern, Canada mayflower, and starflower (0.683, 0.081, and 0.044, respectively).

Table 1. Mean importance values for species occurring in old growth stands at the Huntington Wildlife Forest, burned stands at the Cranberry Lake Biological Station, and defoliated stands at the Cranberry Lake Biological Station

Cultural importance (Yes/No) ³	Species	Old growth	Burned	Defoliated
Yes	American fly honeysuckle	0.007		
No	aster spp.			0.002
Yes	blackberry		0.001	0.004
Yes	blueberry		0.020	0.005
Yes	bracken	0.002	0.013	0.030
Yes	bunchberry	0.014		
Yes	cinnamon fern		0.001	
Yes	Canada mayflower	0.041	0.172	0.081
No	erect woodland grass	0.004	0.002	0.020
No	European honeysuckle			0.034
Yes	false Solomon's seal	0.002		
No	false violet	0.003		
No	foamflower	0.032		
Yes	goldenrod		0.003	0.004
Yes	goldthread	0.034	0.032	
Yes	ground pine		0.117	
Yes	hobblebush	0.311	0.016	
No	hay-scented fern		0.005	0.683
Yes	Indian cucumber-root	0.025	0.043	
Yes	Indian pipe	0.006	0.001	
Yes	Jack-in-the-pulpit	0.014	0.003	0.014
Yes	mountain ash			0.003
Yes	New York fern	0.005		0.004
No	orchid spp.	0.002	0.005	
Yes	painted trillium		0.023	
Yes	partridgeberry	0.003	0.005	

³ Cultural importance determined according to Moerman, 1998

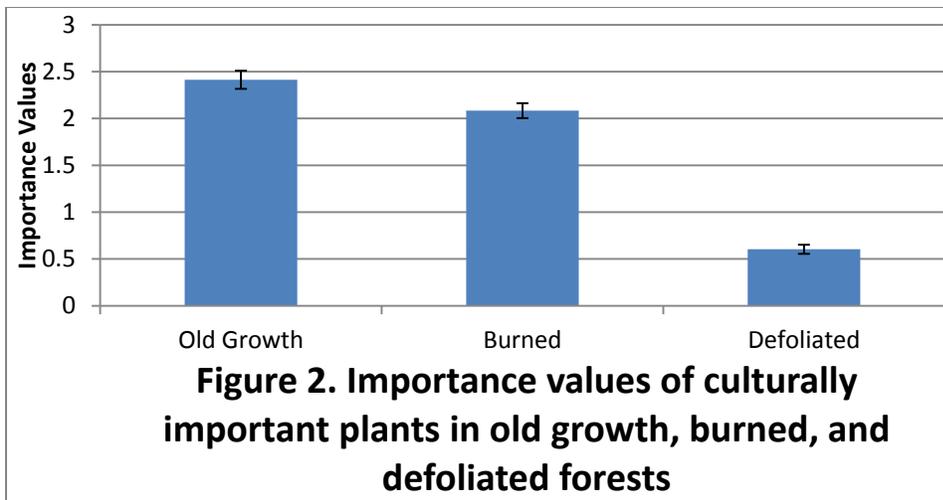
No	purple deadnettle			
Yes	raspberry		0.003	0.008
Yes	red trillium		0.001	
Yes	rock polypody	0.004		
No	sedge spp.	0.005	0.002	0.018
Yes	shining club moss	0.205	0.136	
Yes	Solomon's seal	0.051	0.091	
Yes	sorrel	0.171	0.011	
Yes	starflower	0.063	0.077	0.044
Yes	twisted stalk	0.025	0.001	0.003
Yes	violet spp.	0.017		0.006
Yes	wild sarsaparilla	0.013	0.022	
Yes	wintergreen		0.008	
No	wood anemone	0.010		
No	woodfern	0.391	0.173	0.024

ANOVA analysis

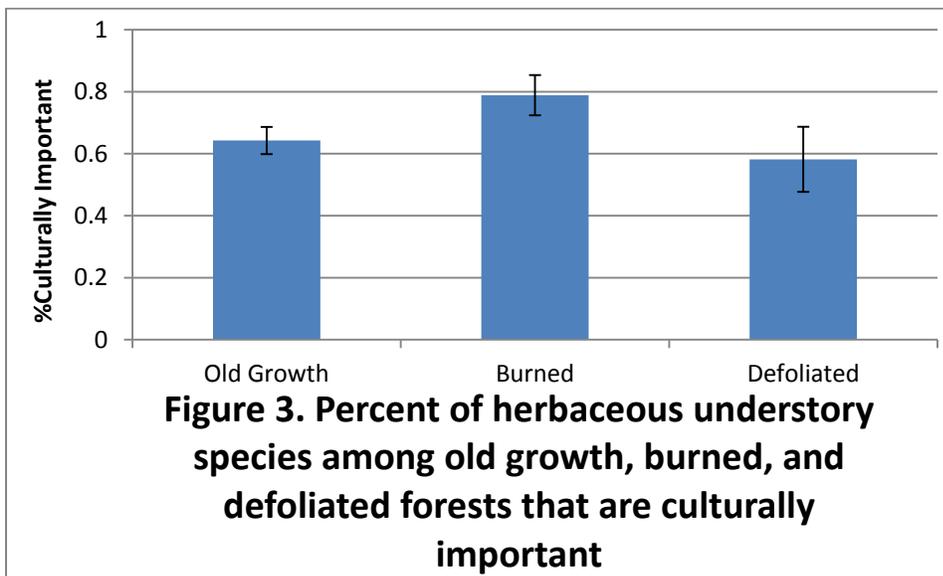
There was a significant difference in importance values of culturally important plants occurring among old growth, burned, and defoliated stands (at an α -level of .05, $p= 0.041$). Importance values in old growth forest were significantly higher than those in defoliated forest. Importance values in burned forest did not differ significantly from those in old growth or defoliated forest. However importance values in burned sites were considerably higher than those in defoliated sites, and considerably lower than those in old growth sites.

Table 2. Mean importance values (IV) for culturally important plants in old growth stands at the Huntington Wildlife Forest, burned stands at the Cranberry Lake Biological Station, and defoliated stands at the Cranberry Lake Biological Station

	ANOVA grouping (p-value 0.041)
Old Growth	A
Burned	AB
Defoliated	B



Burned sites had the highest percentage of herbaceous plants that are culturally important (78.86% culturally important), followed by old growth (64.25%), and finally defoliated (58.18%).



Abundances of culturally important plants

Disturbances studied did not appear to mimic indigenous disturbance regimes. Defoliation by the forest tent caterpillar resulted in small gaps in a hardwood canopy, surrounded by intact hardwood and mixed hardwood-conifer stands. Such gaps were similar to those that would have been established by indigenous use of fire among later successional stages. However, despite defoliated sites' superficial resemblance of disturbance patches created by indigenous management for the purpose of increasing abundances of culturally important plants, defoliated sites had significantly lower importance values for culturally important plants than old growth sites. Rather than supporting an abundance of culturally important species such as raspberries or sweetgrass, defoliated sites were dominated almost exclusively by hay-scented fern (a non-culturally important species).

This result suggests that factors present in indigenous management are missing in defoliated stands. One factor that may be missing is a human component of associated with the disturbance. Indigenous disturbances were traditionally coupled with tending practices or cultivation. Measures were taken to ensure the establishment of desirable plants in their preferred habitat. For example, Kimmerer's students established experimental plots nearly identical to the defoliated sites examined in this study. Small clearings in the canopy were created within a sugar-maple dominated stand, deer-fences were erected, raspberry and sweetgrass seeds were sown, and dense patches of raspberries and sweetgrass resulted (Kimmerer, personal communication 2011). Sowing seeds into their preferred habitat would give them a strong competitive edge over other plants that may have to disperse to the area

before colonizing it. Erecting a deer fence would also protect plants from herbivory. Hay-scented fern is not eaten by deer, which aids it in outcompeting plants that deer do forage. As deer populations are high due to extirpation of their predators, deer often depress abundances of their preferred foods, allowing non-preferred foods like hay-scented fern to dominate (Alpert 2000).

Though not significant, the difference between importance values of culturally important plants in old growth and burned sites was considerable. Burned sites also did not appear to mimic indigenous disturbance regimes. Though fire was used to maintain patches of berries and sweet grass in the northeast (Kimmerer 2001 and Shebitz 2005), burned sites exhibited lower abundances of culturally important plants than old growth forest⁴. This may be attributed to the fact that at the time of the fire the land was already being used for industrial logging, which may have influenced its response to disturbance. Another important factor that may have contributed to results is that the fire affecting burned stands occurred in 1908.

Frequent fire was utilized by indigenous peoples to check the progression of succession. Succession in the burned stands had already diminished the effects of fire that occurred over 100 years ago. As frequent fire is not a part of northeastern natural disturbance regimes, the forest had long since developed towards a typical climax community. This suggests that maintaining disturbance-dependent culturally important plants such as sweetgrass in Northeastern forest habitats would require the reestablishment of traditional management practices. It also supports the argument that elements present in indigenous management are missing from burned stands.

⁴ Raspberries and blackberries did occur in burned stands, though at relatively low abundances.

While contemporary disturbance does not mimic indigenous disturbance regimes, contemporary old growth forest may be quite similar to pre-settlement old growth. My results support this statement, as importance values of culturally important plants were significantly higher in old growth forest. Contemporary landscape changes may result in ecosystem responses different from those expressed by pre-settlement landscapes. Disturbances also lack repetition and tending practices traditionally associated with them. However, old growth forest today has been minimally influenced by human activity for hundreds of years. Therefore, conditions present in contemporary old growth forest should be relatively similar to those present in pre-settlement old growth. Consequently, communities of culturally important plants in current old growth may mirror those found in pre-settlement old growth; while communities of culturally important plants found in current disturbances do not.

Species richness

Defoliated and burned sites both had lower species richness than old growth forest. While disturbance as an indigenous management tool resulted in higher biodiversity across the landscape, it did not necessarily increase biodiversity within a single disturbance patch. It was the *mosaic* of various successional stages that gave rise to biodiversity. On the other hand, fire in forests of the coastal Northwest increases biodiversity (Hansen et al. 1991). Burned sites exhibited lower species richness than old growth forest. This may be due to the century of succession that has elapsed since the fire occurred at burned sites, making many immediate effects of fire obsolete.

Highest species richness associated with old growth forest concurs with the conclusions of research regarding understory plants in post agricultural versus primary forest. Higher diversity was found in primary sites, which were defined as stands never cleared for agriculture

(Vellend et al. 2007, Flinn and Vellend 2005, and Flinn and Marks 2007). Studies focusing on ancient and recent forests also found higher richness in understory communities of ancient forest (Peterken and Game 1984; Dzwonko and Loster 1989; Matlack 1994; Bossuyt *et al.* 1999; Singleton *et al.* 2001; Vellend 2004; from Flinn and Vellend 2005).

Percentage of herbaceous understory that is culturally important

Though species richness and importance values of culturally important plants were highest in old growth forest, percentage of herbaceous understory that was culturally important was highest in burned forest. High importance values in old growth may simply be due to its species richness. Defoliated sites had lower percentages of culturally important plants than burned or old growth, but percentages were highly variable. The herbaceous understory community that had existed prior to defoliation most likely persists beneath hay scented fern, though at low importance values. For example, after hay scented fern, Canada mayflower and starflower had highest importance values. Both of these species also occur in burned stands, which resemble pre-defoliation conditions. They most likely occurred in the understory prior to defoliation and remain there at low importance values.

Follow-up studies and limitations

The results of this study support the conclusion that burned and defoliated sites do not mimic conditions established by indigenous management. Further studies would be necessary to specify how different and why.

The methods utilized in this study also had limitations due to use of an encyclopedia to determine cultural importance of plant species. Firstly, to categorize plants as “culturally important” versus “culturally unimportant” would most likely be inaccurate from an indigenous point of view, as all plants are culturally important. All plants are intrinsically valuable due to

the innate knowledge the plants are capable of sharing with those who study them. As living beings they have the capacity to teach others about how to survive, how to contribute to the world and society, and how to relate to the land.

The academic nature of Moerman's Encyclopedia may also have biased it towards preferentially seeking to report plants of economic value, such as medicinal plants. All of the most abundant culturally important plants in all the forest types (hobblebush, Canada mayflower, Shining club moss, starflower, common wood sorrel, goldthread, and ground pine) were medicinal⁵. This may also be attributed to the need for high diversity of medicines relative to other uses. Ideally, cultural importance would be gauged by members of the culture in question.

Conclusions and implications

Despite limitations, this study's results began to answer some important questions. In support of my hypothesis, burned sites did not mimic indigenous disturbance as they were not recent. This response can be expected from other habitats that have experienced industrial exploitation, natural disturbance, and a century of recovery. Such landscapes largely define the Adirondacks which were heavily logged in the 19th century (New York State Adirondack Park Agency), and are similar to forests recovered from agricultural fields of the 19th and early 20th centuries. Current natural disturbance that is not frequent and systematic do not necessarily support high abundances of culturally important plants. Current disturbance also is not involved in a mosaic of disturbance patches that give rise to high-diversity ecotones.

Concurring with my hypothesis, defoliated sites also appeared to be unrepresentative of condition established by indigenous management due to changes in the food web and lack of tending practices. This study's results imply that though physical characteristics such as a small gap in a typical hardwood canopy were present, high species richness and abundances of

⁵ Common wood sorrel is both edible and medicinal.

culturally important plants does not necessarily occur. This points to the conclusion that restoration should not just restore species to an area but restore the ecological forces maintaining those assemblages.

Also in support of my hypothesis, old growth forest fostered particularly high abundances of culturally important plants. As old growth represents only 0.1% of the southern New England forests, it should be protected especially for its particularly high abundance of culturally important plants as well as its high species richness. It should be protected not only for its ecological value, but for the cultural value embedded within the rare plants and animals that reside there.

Indigenous land use provides a model for comprehensive sustainable management, promoting mutually beneficial coexistence of complex web of species as well as the production of utilitarian material. Revitalization of ecosystems and the revitalization of cultures that maintained and relied upon those ecosystems are mutually dependent. Furthermore, as neighbors of current indigenous nations, it is our responsibility to help heal the land as well as the cultures that have been nearly destroyed. Perhaps progress in this direction has been halted by the failure to recognize the interdependence land and culture. To heal the land is to heal the cultures of that land, and vice versa. To achieve such healing, we must restore not only plant species historically found here, but also ourselves and each other in relation to the land so that we may move forward together.

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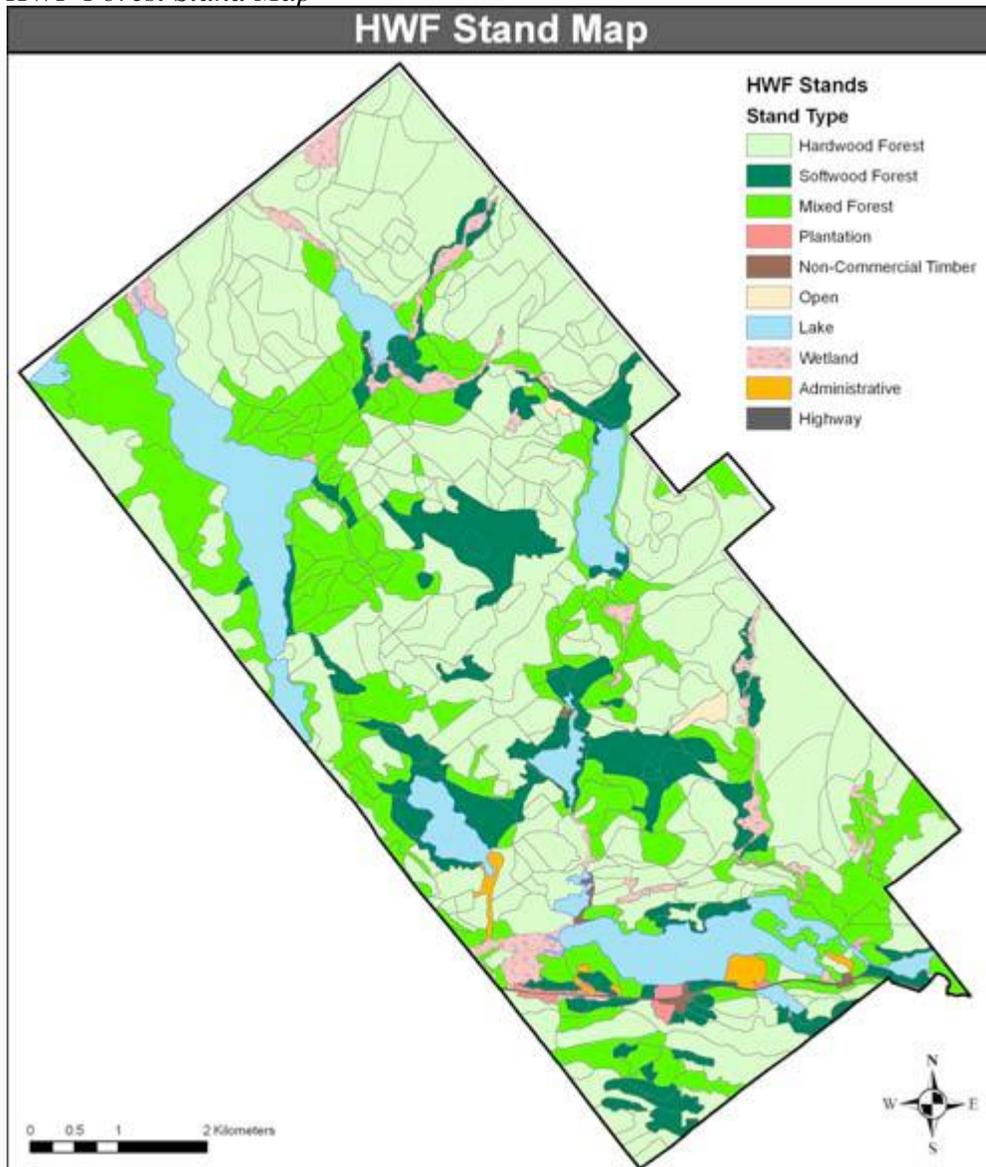
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Appendix

A. *HWF Forest Stand Map*



B. *Data Sheet*

Stand/habitat type: _____ Site #: _____ Sample quadrant: _____, _____

Plant species list:

Genus, species	Stem count

- For unknown species:
 - number and thoroughly document them (including habitat and substrate) via digital camera
 - Log the number in the “genus, species” column
 - Identify at a later time

C. Calculation of Importance Value

$$IV = \frac{\text{rel. density} + \text{rel. dominance} + \text{rel. frequency}}{3}$$

3

$$D_s = 1/\sum p_i^2$$

Where p_i is the frequency associated with each species (n_i), divided by the total number of individuals sampled.