EDWARD L. ROSE CONSERVANCY

Conservation Enhancements for a Living Landscape

2014-15 Conservation Activities

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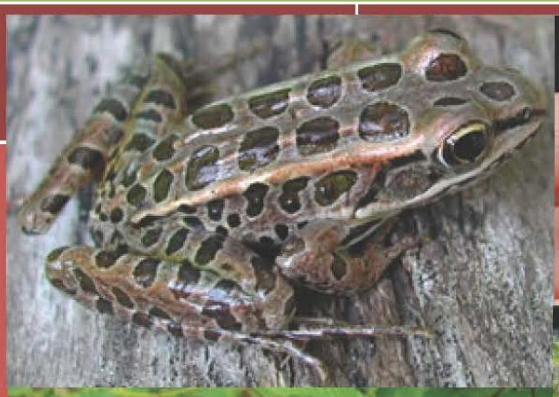
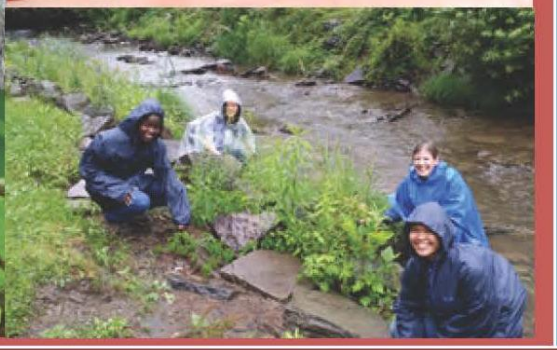




CORNELL UNIVERSITY

2014-15 Overview

In 2014 and 2015, the cooperative efforts between the Cornell Conservation Education and Research Program and the Edward L. Rose Conservancy focused on six overarching issues including:

1) Baseline data collection for amphibians and reptiles through participation in the Pennsylvania Amphibian and Reptile survey and the North American Amphibian Monitoring Program;
2) Continued expansion of forest inventory efforts at Greenwood Sanctuary and Highpoint Preserve;
3) Hemlock woolly adelgid monitoring, research and control;
4) Forest conservation and management;
5) Education and outreach to members and the public; and
6) Enhanced web site content and a Facebook social media campaign

Through biological inventories, we continue to increase the knowledge of natural communities on the Conservancy's fee-owned properties and in surrounding areas. Cornell undergraduate students were formally incorporated into inventory, monitoring and research activities through summer undergraduate internships funded by Cornell's Arnot Forest Internship Program and other sources of grant funding. In addition, Cornell students actively participated in outreach events for the public and led social media campaign efforts.

We thank the Edward L. Rose Conservancy and the Actus Foundation for funding our continued partnership.

Environmental Monitoring Programs

Pennsylvania Amphibian and Reptile Survey

The Pennsylvania Amphibian and Reptile Survey (PARS) was launched in 2013 with the goal of determining the distribution and status of all amphibians and reptiles throughout Pennsylvania. The project is a joint venture between the Pennsylvania Fish & Boat Commission (PFBC) and the Mid-Atlantic Center for Herpetology and Conservation (MACHAC), and relies on volunteers to find and document the locations for amphibians and reptiles. Amphibians and reptiles are important animals found in nearly every Pennsylvania landscape. Very little information about these animals has been collected through the years when compared to other groups of organisms. This is unfortunate as amphibians and reptiles are important indicators of the health of our natural places and the very presence of certain species can tell us much about an area.

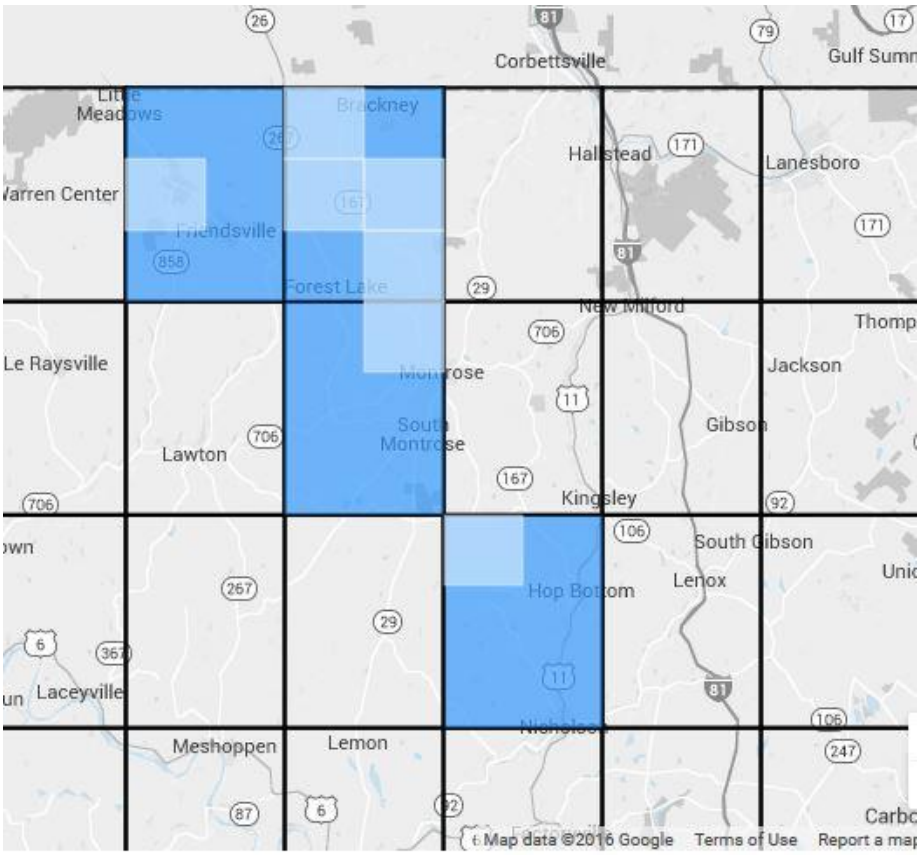
Figure 1: *Wood frog eggs and the Northern slimy salamander were detected during field surveys in 2014 and 2015.*

From 2013-2015, Cornell conservation team members, interns and Conservancy members (12 volunteers in all) conducted multiple amphibian and reptile searches on Conservancy lands (Figure 1) and elsewhere in Susquehanna County. We recorded twenty-two species (Table 1) and submitted 116 total location records (Figure 2) for the animals detected during these searches. We detected 22 of the total 34 species of amphibians and reptiles recorded thus far in Susquehanna County. Our data comprises over 14% of the total amphibian and reptile location records submitted by volunteers for all of Susquehanna County in 2015. However, Susquehanna County still remains one of the regions of Pennsylvania with the least number of PARS records and there are many areas that have not yet been surveyed. Therefore, it is important to continue amphibian and reptile surveys so that we may gain a better understanding of amphibian and reptile health in Susquehanna County.

Table 1*. Twenty-two species of amphibians and reptiles were detected during field surveys from 2013 to 2015. PARS survey blocks are based on United State Geological Survey (USGS) Topographic quadrangles. Each quadrangle is divided into 6 blocks.*

Species	2013	2014	2015	Number of Blocks Where Present
Spotted Salamander (*Ambystoma maculatum)*	X	X		2
American Toad (*Anaxyrus americanus)*	X	X	X	5
Common Snapping Turtle (*Chelydra serpentina)*			X	1
Painted Turtle (*Chrysemys picta)*			X	1
Dusky Salamander (*Desmognathus fuscus)*		X	X	2
Allegheny Mountain Dusky Salamander *(Desmognathus ochrophaeus)*	X	X	X	4
Ring-necked Snake (*Diadophis punctatus)*		X	X	2
Northern two-lined salamander (*Eurycea bislineata)*		X		1
Spring Salamander (*Gyrinophilus porphyriticus)*		X	X	2
Gray Treefrog (*Hyla versicolor)*	X	X		2
Milk Snake (*Lampropeltis triangulum)*			X	1
American Bullfrog (*Lithobates catesbeianus)*	X			1
Green Frog (*Lithobates clamitans)*	X	X		6
Pickerel Frog (*Lithobates palustris)*	X	X		1
Wood Frog (*Lithobates sylvaticus)*	X	X	X	4
Northern Water Snake (*Nerodia sipedo)n*			X	1
Red-spotted Newt (*Notophthalmus viridescens)*	X	X	X	4
Red-backed Salamander (*Plethodon cinereus)*	X	X	X	5
Northern Slimy Salamander (*Plethodon glutinosus)*	X	X	X	3
Spring peeper (*Pseudacris crucifer)*	X	X		4
Red bellied snake (*Storeria occipitomaculata)*			X	1
Garter Snake (*Thamnophis sirtalis)*	X	X	X	2

***Figure 2**. USGS quadrangles (dark blue) and blocks (light blue) where we surveyed amphibian and reptiles between 2013 and 2015. We surveyed 7 blocks within 4 quadrangles.*



Permanent Forest Inventory Plots at Greenwood Sanctuary and Highpoint Preserve

Our forests face a wide range of threats, from climate change and emerging diseases, to invasive plants and insects, to forest fragmentation. By establishing Permanent Forest Inventory (PFI) plots, valuable information can be gathered on species composition, species distribution, presence of invasive pests, and other forest health indicators, for both current analyses and future comparisons.

Methodology

Given that hemlock woolly adelgid has been found at Greenwood Sanctuary, the Longford Lake Property, and Highpoint Preserve, we focused our inventory efforts in 2014 and 2015 on forest plots dominated by eastern hemlock. These data will allow us to document the effects of hemlock woolly adelgid on local hemlock stands, changes in forest composition, and the efficacy of adelgid control treatments. Four new plots were inventoried at Highpoint Preserve in 2014, and three previously sampled plots were re-sampled in 2015. In addition, four new plots

were surveyed at Greenwood Sanctuary in 2014, bringing the total number of inventory plots to 16 at Greenwood and 21 at High Point (Figure 3). The PFI plot methodology (Appendix A) is based on protocols developed and implemented at Cornell University's Arnot Teaching and Research Forest. In addition to providing information on the current conditions, PFI plots will be used to monitor short- and long-term changes in forest health and composition.

High Point Preserve (left) and Greenwood Sanctuary (right) Permanent Forest Inventory Plots

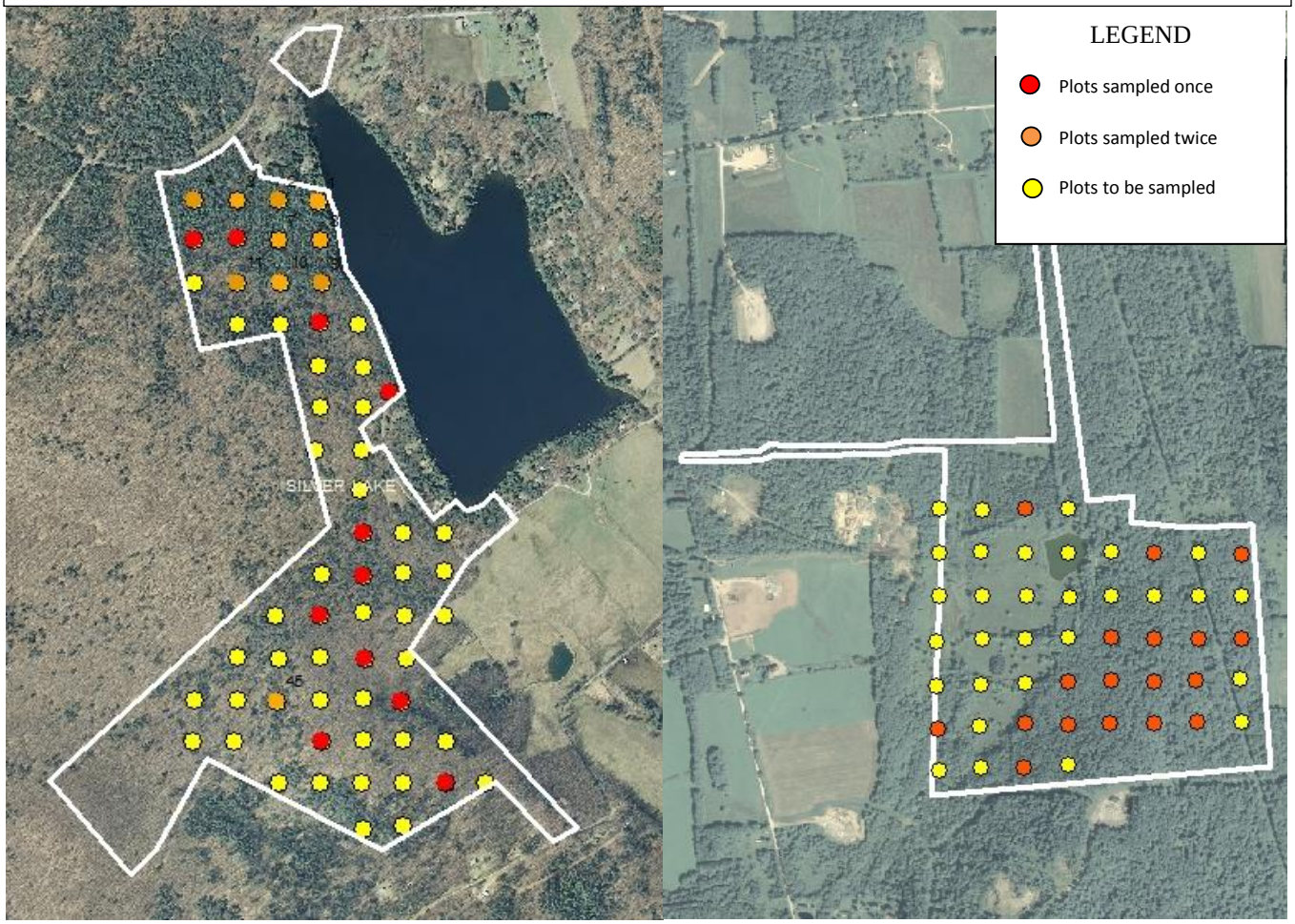


Figure 3. *A total of 21 plots have been sampled at Highpoint Preserve, and 16 plots have been sampled at Greenwood Sanctuary.*

Greenwood Sanctuary Overstory and Understory Tree Characteristics

In 2014, 160 overstory trees were recorded, measured, classified and tagged in four plots at Greenwood (Table 2). Sixteen species were present within the new plots, bringing the total recorded number of species to date to 21 (Table 3).

Table 2. *Overstory tree composition (percent) of PFI plots surveyed in 2014 at Greenwood Sanctuary; species comprising 10 percent or more of overstory trees in the plot are highlighted.*

Overstory Tree Species		PFI Plot Number			
Common Name	**Scientific Name**	**7**	**11**	**14**	**27**
American Basswood	*Tilia americana*	0.0	0.0	3.6	0.0
American Beech	*Fagus grandifolia*	3.4	0.0	0.0	2.6
American Hornbeam	*Carpinus caroliniana*	1.7	0.0	0.0	0.0
Black Cherry	*Prunus serotina*	1.7	2.9	0.0	0.0
Bitternut Hickory	*Carya cordiformis*	0.0	11.4	7.1	0.0
Eastern Hemlock	*Tsuga canadensis*	33.9	0.0	0.0	28.9
Eastern Hop Hornbeam	*Ostraya virginiana*	0.0	8.6	25.0	5.3
Eastern White Pine	*Pinus strobus*	0.0	8.6	0.0	10.5
Hawthorn	*Crataegus sp.*	1.7	0.0	0.0	0.0
Hickory Species	*Carya sp.*	0.0	0.0	0.0	5.3
Northern Red Oak	*Quercus rubra*	3.4	2.9	32.1	10.5
Quaking Aspen	*Populus tremuloides*	15.3	0.0	0.0	0.0
Red Maple	*Acer rubrum*	11.9	8.6	10.7	26.3
Shagbark Hickory	*Carya ovata*	16.9	14.3	7.1	2.6
Sugar Maple	*Acer saccharum*	3.4	11.4	10.7	7.9
White Ash	*Fraxinus americana*	5.1	31.4	3.6	0.0

Table 3. *All overstory tree species recorded in Greenwood PFI plots across all years; species comprising more than 10% of all trees present are highlighted.*

Common Name	**Scientific Name**	**Total # Recorded**	**% of Total Trees**
American Basswood	*Tilia americana*	3	0.34
American Beech	*Fagus grandifolia*	29	3.30
American Hornbeam	*Carpinus caroliniana*	7	0.80
Big-tooth Aspen	*Populus grandidentata*	2	0.23
Bitternut Hickory	*Carya cordiformis*	19	2.16
Black Birch	*Betula lenta*	150	17.08
Black Cherry	*Prunus serotina*	7	0.80
Eastern Hemlock	*Tsuga canadensis*	255	29.04
Eastern Hop Hornbeam	*Ostrya virginiana*	38	4.33
Eastern White Pine	*Pinus strobus*	8	0.91
Gray Birch	*Betula populifolia*	3	0.34
Northern Red Oak	*Quercus rubra*	38	4.33
Northern White Oak	*Quercus alba*	1	0.11
Quaking Aspen	*Populus tremuloides*	47	5.35
Red Maple	*Acer rubrum*	89	10.14
Red Pine	*Pinus resinosa*	4	0.46
Shagbark Hickory	*Carya ovata*	37	4.21
Sugar Maple	*Acer saccharum*	51	5.81
White Ash	*Fraxinus americana*	63	7.18
White Birch	*Betula papyrifera*	2	0.23
Yellow Birch	*Betula alleghaniensis*	25	2.85

Eastern hemlock, black birch and red maple are the three most abundant species in all plots that have been inventoried thus far. In the four new plots surveyed in 2014, dominant species comprising 10% or more of the trees in one or more plots include bitternut hickory, eastern hemlock, eastern hop hornbeam, white pine, white ash, northern red oak, red maple, shagbark hickory, sugar maple, white ash, and quaking aspen (Table 3).

At Greenwood, 12 different tree and shrub species were recorded in the understory of the plots inventoried in 2014 (Table 4). Ten of the 12 species growing in the understory of these plots were also observed growing in the overstory. Hop hornbeam, sugar maple and hickory were the most commonly observed species in the understory. Red maple, American beech, white ash and American hornbeam were also common.

Table 4. *Understory tree composition (number of trees) of PFI plots surveyed in 2014 at Greenwood Sanctuary.*

PFI Plot Number	American Beech	American Hornbeam	Eastern Hemlock	White Ash	Red Maple	Red Oak	Sugar Maple	Quaking Aspen	Eastern Hop Hornbeam	Hawthorn	Witch Hazel	Hickory spp
7	14	20	2	11	6	1	0	3	1	1	1	10
11	0	0	0	2	0	0	14	0	48	0	0	17
14	0	0	0	0	5	0	31	0	19	1	0	5
27	14	0	0	11	16	1	3	0	50	0	0	6
Total	28	20	2	24	27	2	48	3	118	2	1	38

High Point Preserve Overstory and Understory Characteristics

In 2014-15, 334 new overstory trees were recorded, measured, classified and tagged in four plots at High Point Preserve, and 276 trees were re-measured in three plots. Fifteen tree species were present within the new plots, and the cumulative total recorded number of overstory tree species at High Point is 15 (Table 5).

Table 5. All overstory tree species recorded in Highpoint PFI plots across all years; species comprising more than 10% are highlighted.

Common Name	Scientific name	Total # Recorded	% of Total Trees
American Basswood	*Tilia americana*	8	0.51
American Beech	*Fagus grandifolia*	174	11.06
American Dogwood	*Cornus florida*	2	0.13
Bitternut Hickory	*Carya cordiformis*	8	0.51
Black Cherry	*Prunus serotina*	27	1.72

Eastern Hemlock	*Tsuga canadensis*	584	37.13
Eastern Hop Hornbeam	*Ostrya virginiana*	3	0.19
Eastern White Pine	*Pinus strobus*	59	3.75
Northern Red Oak	*Quercus rubra*	1	0.06
Red Maple	*Acer rubrum*	258	16.40
Striped Maple	*Acer pensylvanicum*	2	0.13
Sugar Maple	*Acer saccharum*	190	12.05
Sweet/Black Birch	*Betula lenta*	125	7.95
White Ash	*Fraxinus americana*	30	1.91
Yellow Birch	*Betula alleghaniensis*	92	5.85

In the 2014/2015 plots, dominant species comprising 10% or more of the trees in one or more plots included eastern hemlock (all plots), American beech, red maple, black birch, and white pine (Table 6).

Table 6. *Overstory tree composition of new PFI plots at High Point Preserve; species comprising 10 percent or more of overstory trees in the plot are highlighted. Light blue plots were surveyed in 2014, darker blue in 2015.*

Overstory Tree Species	PFI Plot Number						
	2	**4**	**9**	**11**	**3**	**7**	**8**
American Beech	2.4	6.7	14.1	31.7	3.8	4.9	1.7
American Hornbeam	0.0	0.0	0.0	0.0	0.0	0.0	1.7
American Dogwood	0.0	0.0	1.3	0.0	0.0	0.0	0.0
Bitternut Hickory	2.4	1.1	1.3	0.0	0.0	0.0	0.0
Black Birch	8.2	2.2	12.8	31.7	1.9	0.0	0.0
Eastern Hemlock	60.0	58.4	37.2	11.0	28.3	46.9	63.8
Eastern Hop Hornbeam	0.0	0.0	0.0	0.0	0.0	1.2	0.0
Red Oak	0.0	1.1	0.0	0.0	0.0	0.0	0.0
Red Maple	27.1	19.1	9.0	9.8	24.5	32.1	25.9
Striped Maple	0.0	0.0	0.0	0.0	1.9	0.0	0.0
Sugar Maple	0.0	0.0	2.6	0.0	0.0	0.0	0.0
White Ash	0.0	0.0	1.3	0.0	0.0	0.0	0.0
White Pine	0.0	11.2	0.0	0.0	39.6	12.3	1.7
Yellow Birch	0.0	0.0	7.7	7.3	0.0	2.5	5.2

At High Point Preserve, eleven tree species have been recorded in the understory (Table 7). American beech and white ash were the most prevalent in the understory. The number of seedlings present in the plots varied, and very few have grown to sapling size in the plots sampled. Only 66 seedlings/saplings were documented in the seven plots most recently surveyed, and the majority of these seedlings and saplings were American beech. Low growth in the understory most likely results from a combination of relatively little sunlight reaching the forest floor and pressure from deer browsing.

Table 7. *Number of seedlings and saplings by species in all surveyed plots at Highpoint Preserve*

Plot Number	American Beech	Black Cherry	Eastern Hemlock	Red Maple	Sugar Maple	White Pine	Striped Maple	White Oak	Shagbark Hickory	Black Birch	Red Oak
1	10	0	51	16	0	2	0	0	0	0	0
2	1	0	5	0	0	0	0	0	0	0	0
3	7	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	1	0	0	0	0	0	0	0	0	0	0
6	1	0	1	0	0	0	0	0	0	0	0
7	3	0	0	0	0	0	0	0	0	0	1
8	0	0	0	0	0	0	0	0	0	0	0
9	12	0	0	0	0	0	1	0	0	0	0
10	5	0	0	0	0	0	0	0	0	0	0
11	33	0	0	0	0	0	3	0	0	0	0
15	0	0	0	0	40	0	0	0	0	0	0
20	2	0	0	0	19	0	0	0	0	0	0
25	10	0	0	5	10	0	1	0	0	0	0
30	1	0	0	0	4	0	4	0	0	0	0
35	2	0	0	0	80	0	0	0	0	0	0
40	5	0	0	0	13	0	302	0	0	0	0
42	5	1	0	0	9	0	2	0	1	0	0
45	12	0	0	5	2	0	14	1	0	0	0
45	42	1	5	10	8	0	39	0	0	46	0
50	20	0	0	20	75	0	6	0	0	0	0
55	0	0	0	100	100	0	0	0	0	0	0
Total	**172**	**2**	**62**	**156**	**360**	**2**	**372**	**1**	**1**	**46**	**1**

Wildlife and Forest Research

Salamander Abundance Survey at Greenwood Preserve

In 2014 and 2015, we collected data on forest amphibians at Greenwood, continuing data collection that began in 2012 with a study investigating the effects of natural gas pipeline development on adjacent forest salamander communities. The original study site was located in a hemlock stand that is currently infested with hemlock woolly adelgid. By continuing to monitor salamander abundance in this area, we hope to document any population changes that could occur as the result of hemlock mortality or treatment of hemlock trees.

To document salamander presence and abundance, natural cover surveys were conducted by walking slowly along each of four transects that began at the forest edge and extended 100m into the forest. All amphibians found on the surface or under cover objects (rocks, logs) within a 3-m wide strip centered on each transect were tallied. Fewer salamanders were found near the pipeline edge than further into the forest interior. Salamanders were especially low in abundance within the first five meters from the edge. More salamanders were found along transect 1, which occurs at the base of a steep slope and is likely to encompass an area with higher soil moisture.

We looked at the abundance of the two most common salamander species by year (2012-2015). The number of salamanders detected can depend upon a number of factors including summer temperatures and soil moisture levels. However, if several years' data indicates a declining number of salamanders, there is cause for concern. We did not detect any noticeable decrease in red-backed salamanders (Figure 5) over the years sampled. The number of red-backed salamanders fluctuated at specific distances from the forest edge but overall, the number of individuals detected did not change substantially since chemical treatment of hemlock trees in 2012 and 2013. Slimy salamanders, however, did seem to decline in 2015 (Figure 6). This is a cause for concern and continued monitoring over the next several years will uncover whether the decline was due to lower detection as a result of conditions (low soil moisture, high temperatures, etc.) during the time of sampling, or represents an actual decrease in the population.

***Figure 4**. Mean number of salamanders found at various distances from 2012-2015 along four transects.*

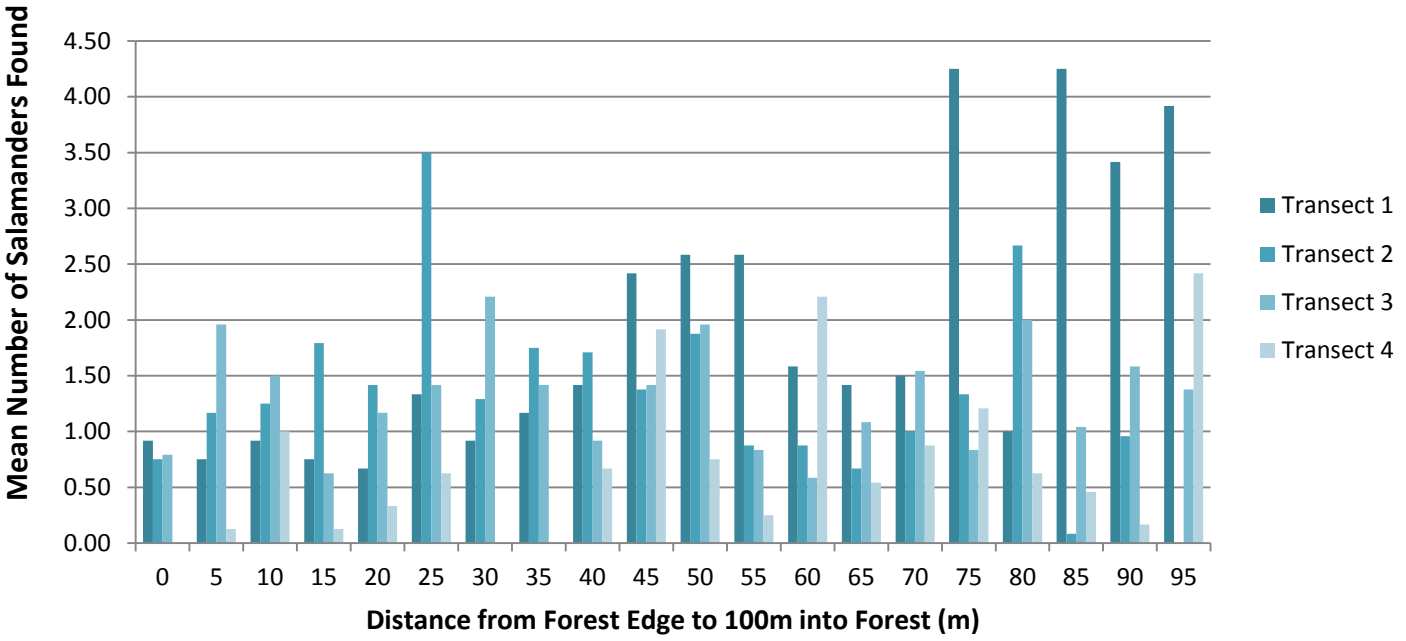


***Figure 5.** Total number of red-backed salamanders found at set distances from the edge during natural cover surveys from 2012-2015.*

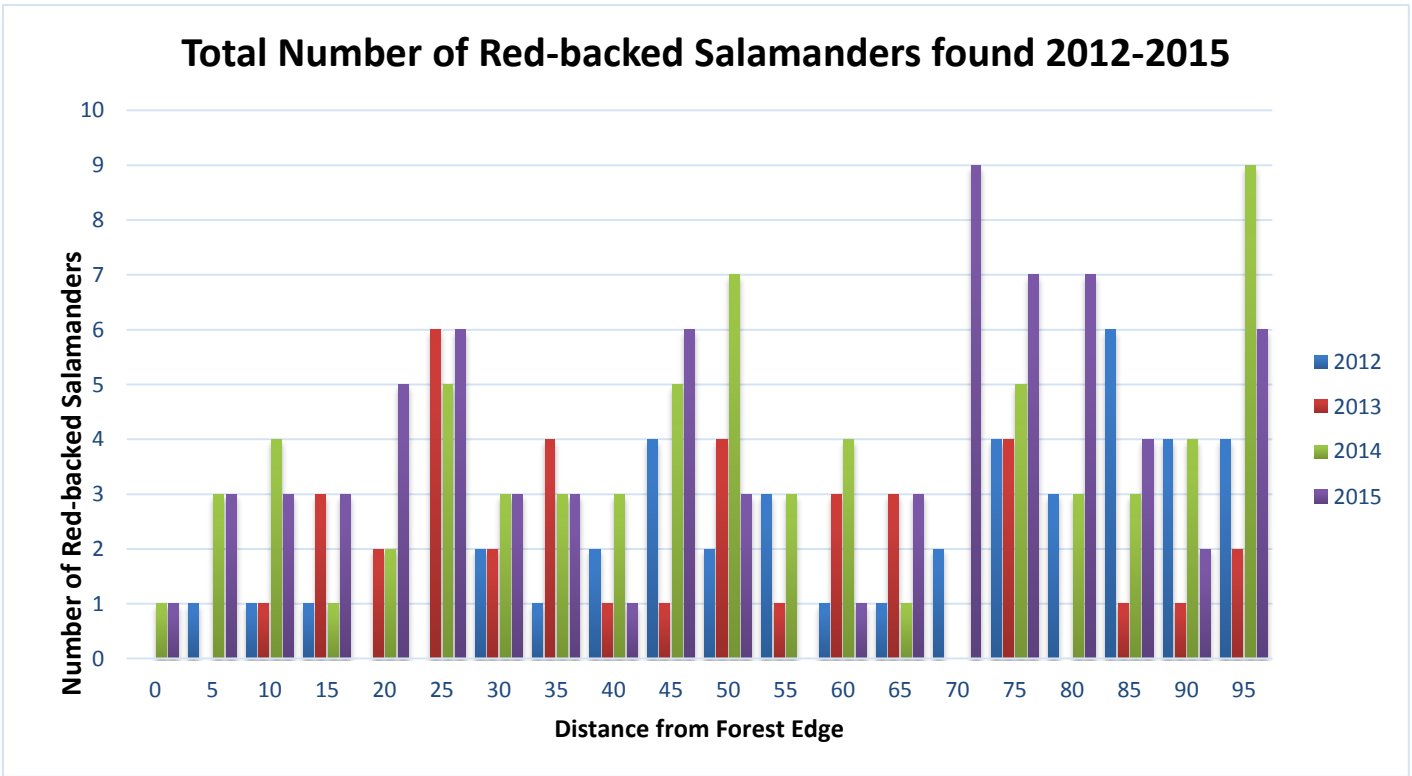
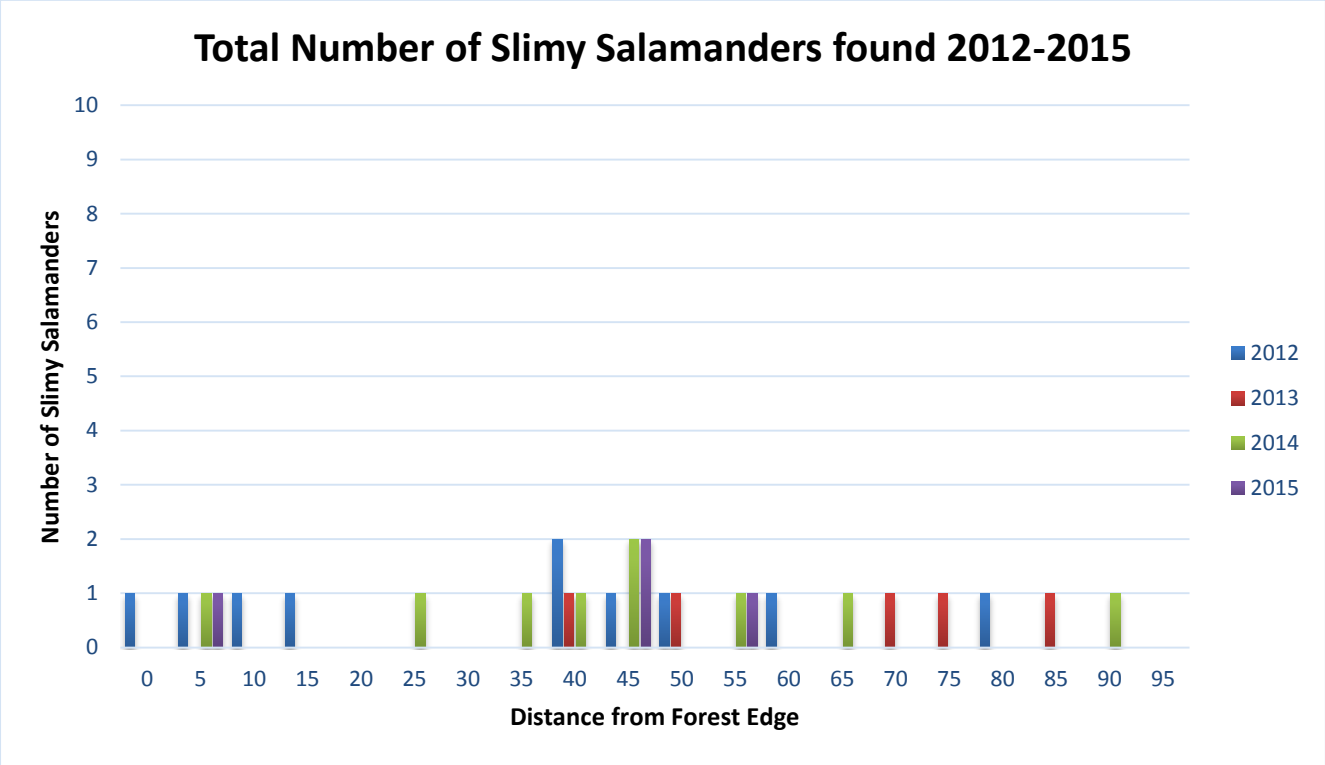


Figure 6. *Total number of slimy salamanders found at set distances from the edge during natural cover surveys from 2012-2015.*



Hemlock Woolly Adelgid Research, Monitoring, and Control

The very cold winters of 2013/2014 and 2014/2015 led to significant mortality of hemlock woolly adelgid at Greenwood Sanctuary. As a result, little evidence of eggs and the associated woolly covering was found during the summers of 2014 and 2015. Some untreated trees show signs of branch thinning due to past damage but their color and overall health are still adequate. Treated trees are doing very well, appear healthy and have an abundance of new shoots. We will continue to monitor and treat trees as needed to help ensure the perpetuation of this foundation species in Greenwood Preserve.

Cornell researchers, interns and Conservancy member volunteers surveyed High Point Preserve for hemlock woolly adelgid in 2014 and 2015. While levels remain low, there is increasing evidence that the adelgid is spreading within the Preserve. Several trees along the water's edge showed signs of heavier infestation in 2015. We will develop a treatment plan for Highpoint Preserve and recommend beginning treatment there in 2016.

In 2015, we resurveyed trees which were treated and trees which were not treated with dinotefuran in 2012 (all surveyed trees had been treated with Coretect tablets (imidacloprid). Five treated and four untreated hemlocks were resurveyed. The diameter at breast height (dbh) of the untreated trees increased by an average of 0.34 inches, while the dbh of treated hemlocks

increased by an average of 0.40 inches. Tree growth for treated and untreated trees was similar during this time period.

Deer Impact Assessment

Because white-tailed deer (*Odocoileus virginianus)* browse heavily on tree seedlings, deer overpopulation is currently one of the most critical threats to the regeneration of northeast forests. By selectively browsing on some species more than others, deer are changing the composition of the forest, in many cases facilitating the dominance of low preference species. This has widespread impacts on the ecosystem, especially affecting organisms that may depend on certain tree or herbaceous species for food, shelter and ecological services. Regeneration failure also makes forests vulnerable to establishment of invasive species.

At Greenwood, deer browsing impacts are moderate to heavy, and very few seedlings have been observed reaching heights of five feet or greater (the point at which they can be considered established or safe from deer browsing). However, there is a need for better vegetation impact data to more accurately inform deer browsing impacts at Greenwood. To address this need, we installed two sets of monitoring plots, one at Greenwood and the other at Highpoint Preserve, using a newly developed deer impact assessment protocol called AVID (Assessing Vegetation Impacts by Deer; developed at Cornell University, K. Sullivan). The data collected can help track changes in the health of the forest related to deer populations and can help guide restoration efforts such as fencing small areas to exclude deer, using tree tops as natural fences to prevent seedling browsing, or encouraging deer population reduction

Six monitoring plots were installed at both Greenwood and High Point preserves, and we collected data on the number and types of tree seedlings present. We also conducted a deer browse assessment on these seedlings by examining browse severity on the terminal bud of tree seedlings by species, and rating this browse on a scale of one to five. A rating of 1 was given to species with no evidence of browse, 2 meant that between 1-30% of the seedlings of a species were browsed, 3 meant that between 31-60% of seedlings were browsed and 4 meant that between 61-100% of seedlings were browsed. A rating of 5 was assigned to species where all the seedlings were severely browsed, or hedge-like, from current and past browsing. We also assessed wildflowers, another indicator of deer pressure, by recording the number of wildflower species present, the total number of wildflower stems, and the number of flowering stems.

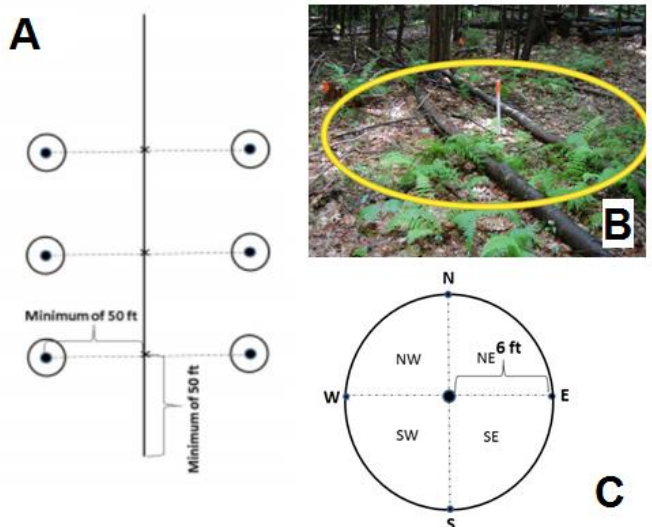


Figure 7. *Transect and plot setup for Deer Impact Assessment Protocol*

Highpoint Preserve had low seedling diversity and low seedling abundance (Tables 8 and 9), most likely because the site had a very dense, closed canopy (all six plots had canopy cover 75% or greater). Deer pressure may also be a contributing factor, since deer browse was observed in four of the six subplots. At Greenwood, there were quite a few small seedlings, but

relatively few saplings. This is typical for seedling recruitment, as relatively few trees actually make it to maturity. However, this difference in seedling height categories may also be driven by intensive deer browsing, as deer browse was observed in four of the six subplots at Greenwood.

***Table 8**. Number of seedlings in 6 subplots at Greenwood and Highpoint Preserve, divided into 1' to 3' and 3' to 5' height categories*

Site	Sum of Seedlings >1' < 3'	Sum of Seedlings >3' < 5'	Total Seedlings
Greenwood	100	23	123
Highpoint	9	4	13

***Table 9**. Number of Seedlings Found per Species at Greenwood and Highpoint Preserve*

Site	Number of Seedlings between 1' and 5'								
	Red maple	Sugar maple	Birch	White ash	American beech	Oak	Hop hornbeam	Black cherry	Aspen
Greenwood	**32**	8	2	**41**	0	2	**36**	2	2
Highpoint	4	0	0	0	9	0	0	0	0

When we surveyed the seedlings for deer browse, we found an average of 25% of species present in the Greenwood plots and 100% of the species present at Highpoint were browsed (Table 10). Average browse intensity was also higher at Highpoint (3.25) compared to Greenwood (1.35). However, fewer seedlings and species of seedlings were present at Highpoint, so any deer pressure is concentrated on those available individuals, whereas deer pressure may be more spread out at Greenwood.

***Table 10.** Summary of Seedling Browse Assessment Data*

Site	Plot #	Total Species Present	# Species Browsed	Average Browse Intensity in Plot (from 1 = no browse to 5 = most heavily browsed)	Percentage of Species Browsed (%)
Greenwood	1	6	3	1.86	50
	2	5	2	1.67	40
	3	5	3	1.60	60
	4	4	0	1.00	0
	5	4	0	1.00	0
	6	2	0	1.00	0
			Average Browse Intensity: 1.35		Avg % of Spp Browsed: **25%**
Highpoint	1	1	1	3.00	100
	2	1	1	2.00	100
	3	0	0	N/A	N/A
	4	2	2	4.00	100
	5	0	0	N/A	N/A
	6	1	1	4.00	100
			Average Browse Intensity: 3.25		Avg % of Spp Browsed: **100%**

Similar to seedlings, Highpoint Preserve had very few wildflowers and very few species of wildflowers present, most likely due in part to a closed tree canopy that prevents much light from reaching the forest floor. In contrast, Greenwood had a much greater number of wildflower stems, and averaged two wildflower species. The data we collected will serve as useful baseline data so that we can track changes in wildflower abundance and species abundance at Greenwood and Highpoint, and use these changes to estimate changes in deer browsing.

Education and Outreach

We continued to offer education programs and inform Conservancy members and the public about important and current conservation issues. We delivered several presentations at the Conservancy's Annual Meetings including a presentation on black bears and butterflies, and a presentation entitled, "Healthy Forests, Healthy Water" which highlighted the role of intact forests in determining water quality in nearby lakes and streams. We also emphasized the importance of lakeshore/streamside habitats and ways to create and manage those features to maximize water quality. We offered two classes at the Montrose Adult School, one on amphibians and one on reptiles, and encouraged participants to get involved with the Pennsylvania Amphibian and Reptile Survey. We made regular postings of current events and issues to the web site and initiated a new Facebook page for communication with members and the public. Finally, through the quarterly newsletter, we regularly provided members with information about current environmental issues.

Summary

Through our collaborative efforts in 2014 and 2015, we continued to expand and enhance our collective knowledge about the ecology of the Conservancy's fee-owned properties, the status of animal populations throughout the region, and the health of the overall landscape. We expanded biological survey, inventory, research and monitoring efforts, and addressed critical invasive species issues. We incorporated Cornell undergraduate students into all aspects of our work with the Conservancy, in an effort both to provide them with hands-on experience and to bring their skills and knowledge to bear on Conservancy-related issues.

Appendix A.
Permanent Forest Inventory Plot Methodology

Permanent Forest Inventory Plot Methodology

(Adapted in 2008 from methodology developed for Cornell's Arnot Forest)

Objective: Establish permanent plot samples throughout the forest to measure the change in various forest characteristics through time. Be able to describe changes in forest species composition, structure, health and habitat availability that result from natural forest dynamics and management practices.

Assumptions/Constraints: Plots will be established annually. Each point will be re-sampled every 5 to 8 years and allow an analysis of change through time. Some plots may be sampled more frequently to assess short-term forest dynamics.

Methods: Establish 10-15 plots per year, distributed among properties owned or managed by the E.L. Rose Conservancy in Susquehanna County, Pennsylvania. Plots will be numbered sequentially. Plot center is marked with a white 2.5-inch PVC pipe that is 5 feet long. A GPS unit will be used to record UTM coordinates. A "Permanent Plot Location Sheet" will be completed for each plot. This sheet will include written directions/map to the plot, a general description, and information about deer impact. Each plot will include:

- A fixed radius overstory plot (0.25 acres, 58.9 ft. radius) where all live trees $\geq$ 4" dbh will be tagged with aluminum numbered tags and aluminum nails at 12" above ground, and tallied by species, dbh, presence of cavities > 1" diameter, and crown class. DBH will be measured to the nearest 0.1 inch using a diameter tape located at the top of a 3.5' stick placed on the nail. Nails should face plot center. All dead trees will be tallied and diameter will be recorded.
- Within each overstory plot record elevation, aspect, % slope, slope shape, percent fern cover, and presence or absence of grass, seeps or wet areas, trails or roads, logs in water, perches, soft or hard mast species, rock piles, rock crevices, caves, and cavities in living or dead trees. Also make note of the presence or absence of accumulate litter on the forest floor, and note the presence or absence of forest pests including beech blight, hemlock woolly adelgid, and emerald ash borer.
- Within each plot, N/S and E/W lines transecting the diameter of the plot will be established to record the percent cover of coarse woody debris > 3" diameter at the point of their intersection with the transect. Record diameter at the intersection, condition, and whether bark is present.
- At the north and south cardinal directions on the edge of the overstory plot, establish sapling/ground layer plots having an 11.8' radius to equal 0.01 acres each. Subplot

centers should be marked with a 30" wooden stake and flagged. Record the number of woody stems by species in the ground layer (height of 4" – 54") and sapling/shrub layer (height > 54" up to 3.99" dbh) using decadal increments (1-10 by one; 11 to 100 by tens; 101+ by hundreds).

- Within each sapling subplot (11.8' radius), record presence or absence of the following herbs: sensitive fern, maiden-hair fern, Christmas fern, true ginseng, dwarf ginseng, blue cohosh, jack-in-the-pulpit, or trillium. Also record presence or absence of invasive species including garlic mustard, barberry, multi-flora rose, honeysuckle, or autumn olive, and the percent of inhibiting fern cover, percent of other fern cover, and percent grass and sedge cover.

List of Equipment Needed

1. PVC Pipe: preferably white 2.5" PVC pipe 5' long
2. Short wooden stakes
3. Blue spray paint (for the top of the PVC)
4. Tags for the pipe (the soft etch-able aluminum one work)
5. Round aluminum tree tags from Forestry Suppliers Co.
6. Multiple tape measures
7. Data sheets, pencils, and permanent marker
8. DBH tape
9. Hammer
10. Aluminum nails (aluminum makes it safe for loggers)
11. Small sledge hammer (to pound in stakes)
12. Flagging
13. Field guides if necessary

Definitions of Variables Recorded at Permanent Forest Inventory (PFI) Plots

Deer Impact: An estimate of the browsing pressure that deer are having on tree seedlings in the area of the sample plot. Code is as follows:
1= low pressure; 2= low/medium; 3= medium; 4=medium/high; 5= high
Travel Description: A narrative description of travel from the nearest permanent location or landmark.
Map: A hand sketch of the travel description.
Overstory Plot Size: The length of the plot's radius in feet. Typically 58.9' unless otherwise noted.
Sapling Plot Size: The length of the subplot's radius in feet. Typically 11.8' unless otherwise noted.
Seedling Plot Size: The length of the subplot's radius in feet. Typically 11.8' unless otherwise noted.
Aspect: The direction of the downward slope coded as: North, Northeast, East, Southeast, South, Southwest, West, or Northwest.
Slope: The calculated percent slope. Can be calculated in the field or from a topographic map.
Slope Shape: An visual estimation coded as: 1=convex; 2=linear; 3=concave
Topographic Position: Coded as: 1=Upland Plateau; 2=Upland Bottom; 3=Ridge Top; 4=Upper Slope or Shoulder; 5=Mid-slope; 6=Bench; 7=Lower Slope; 8=Bottomland/Flatland.

Riparian %: The percentage of the plot that characterized by stream channels, wetlands, floodplains, and immediately adjacent terrestrial ecosystems.
Seep: Enter either "present" or "absent" as to the presence of seeps or springs within or adjacent to the plot. A seep is a source of surface ground water without a well-defined point of origin. A spring has a well-defined point of origin. Seeps and springs may or may not have vegetation around them.
Streams: Enter "present" if perennial streams are within the stand or immediately adjacent to the stand.
Temporary Ponds: Enter "present" if any temporary or vernal pools are within or adjacent to the plot. Temporary ponds must be greater than 6 inches deep and greater than 1 square yard; water must be present for at least two months during the growing season. The exact month differs for each species that uses temporary ponds. Areas covered by a fine layer of silt and depressions filled with blackened leaves me serve as dry season indicators of temporary ponds.
Permanent Ponds: Enter "present" if any permanent ponds of lakes are within or adjacent to the plot. Permanent ponds are any size of depth, but larger is generally better; water must be present year-round, although the top layer can freeze.
Logs in water: Enter "present" if any downed logs are partially or wholly in a permanent water source.
High Perch: Enter "present" if any high exposed perches occur in the plot. A high perch is any live or dead tree that clearly towers above the canopy such as a supracanopy white pine, or a single tree or group of trees standing above ground vegetation such as a lone elm in a pasture or a snag in a clearcut.
Hard mast: Enter "present" if there are any plant species in or near the plot that provide hard mast such as acorns or hickory.
Loose soils: Enter "present" if there is soil that can be easily burrowed into.
Rock Piles: Enter "present" if there are any natural or man-made piles (rock walls), as long as they provide hiding places for small mammals, amphibians, or reptiles.
Rock crevices: Enter "present" if there are openings in the rocks that lead below the frost line.
Caves: Enter "present" if there are any caves or larger rock openings that lead below the frost line.
Live cavities: Enter "present" if there are any live trees in or near the plot with cavities at least 1" in diameter. This is collected in the overstory plot and may be determined from field data.
Dead cavities: Enter "present" if there are any dead trees in or near the plot with cavities at least 1" in diameter. This is collected in the overstory plot and may be determined from field data.
Coarse Woody Debris: Any fallen logs or trees that are longer than three feet and greater than three inches in diameter.
Condition: Coded as: 1=solid/good; 2=rotten/ poor
Species: For every tallied tree, enter the tree species using either the 3-digit forest survey code or the mnemonic abbreviation.
DBH: The diameter at breast height (typically four feet above the ground).

Crown Class: Determine the position of the tree crown using the following codes:

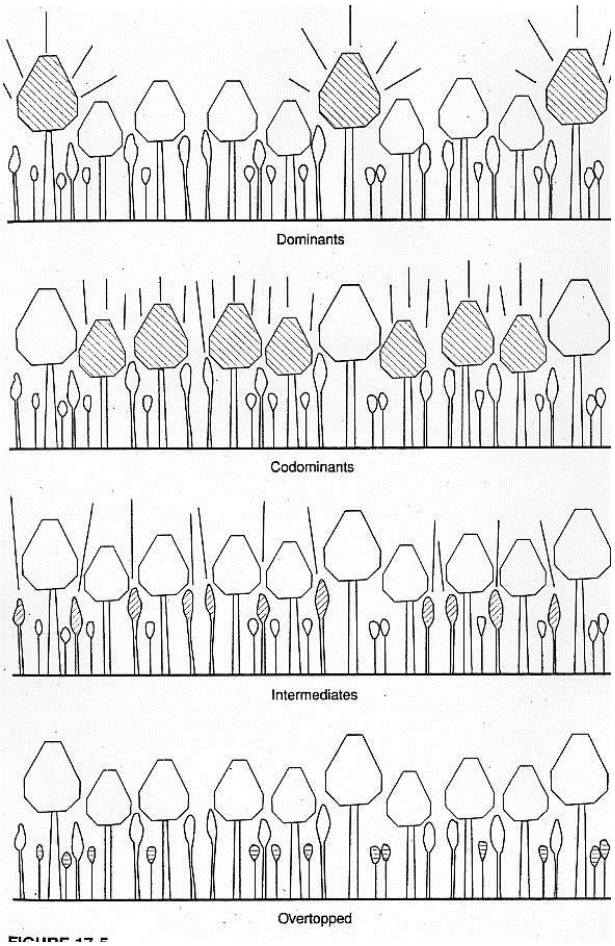
1= open grown- a tree that is free of competition and receives light on top and all sides of the crown as a result of a very heavy thinning or being in an isolated, open-grown position.

2= dominant- a tree with the crown extending above the general level of the main crown canopy and receiving full light from above and partly from the sides.

3=codominant-a tree with a crown forming the general level of the main canopy, receiving full light from above but little from the sides.

4=intermediate- a tree with a crown extending into the lower portions of the main crown canopy, but shorter than the codominants and receiving little direct light from above and none from the sides.

5=suppressed- a tree whose crown is entirely below the general level of the canopy and receives no direct light from either above or the sides.



Permanent Forest Inventory (PFI) Plot Data Sheet

Tally date _____/ _____/ _____ Page _____ of _____

PFI Plot Number _____ Tallied by_____

Overstory Plot Size (radius, ft)	58.9
Sapling/ Seedling Plot Size (radius, ft)	11.8

Elevation	
Aspect	
Slope	
Slope Shape	
Topo Position	
UTM Coordinates:	

Trail on Road (y/n)	
Riparian %	
Wetland %	
Adjacent water(y/n)	
Seep (p/a)	
Stream (p/a)	
Temp. Pond (p/a)	
Perm. Pond (p/a)	

Logs in water (p/a)	
High Perch (p/a)	
Low Perch (p/a)	
Soft Mast (p/a)	
Hard Mast (p/a)	
Rock Pile (p/a)	
Rock Crevice (p/a)	
Cave (p/a)	
Live Cavity (p/a)	
Dead Cavity (p/a)	
# of Snags	
Accumulate litter (p/a)	

Comments:

_____

_____

_____

_____

_____

Sapling/Seedling Plot Features

Indicator Species	North	South
Ginseng (p/a)		
Dwarf ginseng (p/a)		
Sensitive fern (p/a)		
Maiden-hair fern (p/a)		
Christmas fern (p/a)		
Trillium (p/a)		
Blue cohosh (p/a)		
Jack-n-the-pulpit (p/a)		
Invasive Exotics		
Garlic mustard (p/a)		
Barberry (p/a)		
Multi-flora rose (p/a)		
Honeysuckle (p/a)		
Autumn Olive (p/a)		
Inhibiting Fern Cover (%)		
Other Fern Cover (%)		
Grass and Sedge Cover (%)		
Soggy Ground (%)		
Surface Stone > 50% (y/n)		

Forest Health

Beech blight (p/a)	
Hemlock woolly adelgid (p/a)	
Emerald ash borer (p/a)	
Other:	

Coarse Woody Material

N-S Transect (117.8ft)			E-W Transect (117.8ft)		
Diam. (ft.)	**Cond. (1/2)**	**Bark (y/n)**	**Diam. (ft.)**	**Cond. (1/2)**	**Bark (y/n)**

PFI Amphibian Search Data and Wildlife Sign

PFI Plot Number _____ Tally Date _____/ _____/ _____
Tallied By _____ Page _____ of _____

Time of day			
Days since significant rain			
Litter moisture rating	Dry	Moist	Wet
Number of turn-overs (minimum 10)			

Species Name **Number Found**

1. _____ _____
2. _____ _____
3. _____ _____
4. _____ _____
5. _____ _____

Wildlife Sign / Special Features

_____
_____

Permanent Plot Location Sheet

PFI Plot Number _____ Tally date: ____/ ____/ _____
Tallied by _____ Page _____ of _____

Pictures _____ -_____

Plot Habitat Description	
Deer Impact	

Comments/ Travel Description:
_____
_____
_____
_____

Map / Directions

PFI Seedling-Sapling Sample Data Sheet

PFI Plot Number _____ Tally Date _____/ _____/ _____
Tallied by _____ Page _____ of _____

Subplot : 11.8′ radius
Seedlings: 4″-- 54″ tall
Saplings: 54.1″ tall -- 3.99″ dbh

North Subplot		
SPP	**#SDL**	**#SPL**

North (cont.)		
SPP	**#SDL**	**#SPL**

South Subplot		
SPP	**#SDL**	**#SPL**

South (cont.)		
SPP	**#SDL**	**#SPL**

PFI Overstory Tree Sample Data Sheet

PFI Plot Number _____ Tally Date _____/ _____/ _____

Tallied By _____

Tree #	Species	dbh	Cavity (y/n)	Crown class

Tree #	Species	dbh	Cavity (y/n)	Crown class