Champlain Valley

Clayplain Forest Restoration:

A Landowner's Guide

Middlebury College
Environmental Studies Senior Seminar
Spring 2003

Champlain Valley Clayplain Forest Restoration: A Landowner's Guide

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Introduction

Imagine a landscape cleared of forest—where once stood imposing oaks and stately pines, there are instead ragged stumps and gullies raging with murky brown runoff. Now envision hills blanketed by beech, birch, maple, and spruce, where deer and fisher are dappled by sun and shade within the shelter of thick forest. Both these past and present landscapes define the character of Vermont. The experiment of farming on the rocky, sloping soils of the region largely ended a century ago, leaving in its wake a landscape stripped, to a large degree, of its precious natural resources. However, with the cessation of this use and the emigration of human settlers has come the relatively rapid return of the forests. Year by year, species by species, much of the anthropogenic landscape of Vermont was reclaimed by the wild.

However, the "rewilding" of Vermont is not complete. While most of the hill farms are abandoned, the fertile clay soils of the Champlain Valley remain in agricultural production today. Here, the native clayplain forest, which includes oak, hickory, maple, elm, beech, hemlock, and white pine, as wells as native shrubs and herbs, has been replaced by corn, hay, and cattle in all but a few scattered patches. This species-rich ecosystem is distinct to the Champlain Valley region of Vermont, and its future existence depends on the fate of a handful of forest fragments that persist.

The Environmental Studies Program of Middlebury College in Middlebury, Vermont received permission from the College to restore a deforested clayplain fragment that, until recently, had been in agricultural use. Working in cooperation with the Champlain Valley Clayplain Forest Project (CVCFP), a group of students from the Environmental Studies Senior Seminar in the spring of 2003 undertook the task of restoring native clayplain forest to the site.

The CVCFP is a local organization that is involved in promoting stewardship, conservation, and research of the Champlain Valley's clayplain forest natural community. CVCFP is also working with willing landowners to restore clayplain forest to parts of its native range. To this end, the CVCFP works collaboratively with landowners, foresters, land trusts, and local, state, and regional agencies to "identify and champion the best stewardship, management, and conservation strategies" (Karlson and Lapin, 2001).

The students involved in this restoration worked intensively with the CVCFP in order to encourage the establishment of clayplain forest on former agricultural land. We worked to restore the field by planting native species of trees and shrubs. As this is one of the first efforts of its kind, we endeavored to create a replicable model of restoration for landowners who wish to reestablish a native community on clayplain land that was formerly farmed. It is important to remember that each ecosystem is unique in terms of both its natural history and history of land use, as well as its physical, biological, and geochemical characteristics. Therefore, each piece of land and its associated assemblage of species may respond differently under the varying starting conditions from which a restoration begins. It is also important to remember that restoration is a process, and that a successful process will work to perpetuate and/or restore the productivity, fertility, genetic diversity, ecological functions, and general health of clayplain ecosystems (Lapin, 2003b).

This Landowner Guide was written to supplement the CVCFP's "Champlain Valley Clayplain Forest: Natural History and Stewardship" booklet. It is an effort to document the planning, supplies, costs, and processes associated with a specific restoration project. The remainder of the Guide will address the following:

- Clayplain forest and its history in Vermont
- Descriptions of the parcel of land that was restored by the Environmental Studies Senior Seminar in the Spring of 2003
- Step-by-step documentation of the process of planning and implementing this project, including chronology, species, supplies, costs, planting techniques, and difficulties encountered
- An outline for future management of the process of restoration on this site

Clayplain forest was once the dominant land cover in Vermont's southern Champlain Valley. Through this restoration project and others like it, portions of the landscape may return to a state of natural health and equilibrium with respect to its native species and processes. We hope that this project, as well as the Landowner Guide, will serve as an inspiration and a model to those who wish to participate in the restoration and "rewilding" of Vermont.

Geologic History of the Southern Champlain Valley

“Clayplain” is an abbreviated name for “clay-soil lake plain,” the landform type that describes the region and its geologic history. The bedrock of the Champlain Valley consists mostly of limestones, dolomites, and calcareous (calcium-rich) shales. This bedrock sequence formed in a near-shore, shallow marine environment approximately 540-440 million years ago (mya). Over geologic time, the area was uplifted by a series of mountain building events, including the Taconic and Acadian Orogenies (440-430 mya and 400-350 mya, respectively). In more recent geologic time, the Champlain Valley was first glaciated, then inundated by water from melting ice as the glaciers retreated, resulting in the formation of proglacial Lake Vermont approximately 15,000 years ago. By 13,000 years ago, the combination of retreating ice, rising sea level, and depression of the crust from glaciers caused the lake basin to fill with marine water, forming the Champlain Sea. By 11,000 years ago, however, the inlet of marine water was closed, and precipitation and melting of snow filled the Champlain Sea with freshwater to create the present-day Lake Champlain. Clay and silt sediments that were deposited at the bottom of Lake Vermont and the Champlain Sea form the dominant parent material of the southern Champlain Valley soils. These soils are nutrient-rich because of the chemical composition of both the calcium-rich bedrock and the lake and marine deposits. The soils are predominantly somewhat poorly to well-drained clays; however, in some locations an overburden of sand exists where deltas or beach ridges may have formed in Lake Vermont or the Champlain Sea (Lapin, 2003a).

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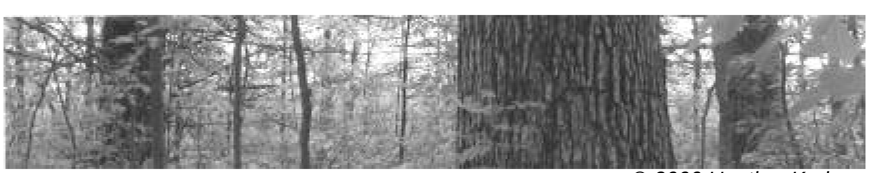
Natural History of Clayplain Forest in Vermont

Today, the Champlain Valley is dominated by agricultural lands supporting dairy cattle, corn, and hay. It is difficult to imagine what was here before European settlers began taking advantage of the fertile clay soils and working the land. But if we look closely at some of the remaining forest fragments among the fields and meadows, we can begin to piece together an idea of what Vermont's natural landscape looked like.

Small remnants of clayplain forest are all that remain throughout the entire Champlain Valley of New York, Vermont, and Quebec. Clayplain forest is distinct from the forests of the Green, Taconic, or Adirondack Mountains due to the warm valley climate, very high fertility of the clay soil, and moderate to poor soil drainage (Karlson and Lapin, 2001). The clayplain forest also serves as habitat for animal species, such as bobcat, wild turkey, deer, and gray squirrels; it once provided the Native Americans of this region with an abundant source of animal protein (Lapin, 2003a). The warmer climate, relative to the northern New England region, and the fertile, heavy clay soils set the stage for a forest ecosystem in the southern Champlain Valley that is more typical of lands to the south and midwest. The differences between the clayplain forest and surrounding forests are also the primary reason why clayplain forest has been so dramatically reduced relative to total forest area, for the qualities of the clayplain forest that make it unique also make it highly attractive for farming and settlement. "The allure of the fertile southern Champlain Valley lands for early settlers," writes Jan Albers, "can be seen in the fact that in 1820 Middlebury, located near the center of the region, was the largest settlement in Vermont, with a population of 3,170" (quoted in Lapin, 2003a).

Clayplain forest once covered over 220,000 acres in Vermont; however, it currently exists only in small parcels, often 20-30 acres in size (Karlson and Lapin, 2001). Although the parcels of clayplain forest are small they can still provide good examples of the species composition of the former, more extensive, clayplain forest. Oaks, hickory, maples, elm, ashes, beech, hemlock, and white pine still persist in remaining fragments, as well as a variety of small trees and shrubs (Karlson and Lapin, 2001). Additional information on species composition may be found in the "Restoration Planning" section of this guide; also, see the CVCFP's "Natural History and Stewardship" guide for further details.



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Restoration Site History and Description

The parcel of land chosen for this restoration project is owned by Middlebury College. It is located on the west side of campus, just south of the Recycling Center and modular homes along Route 125. The site is approximately 10 acres, and, at the start of the project, had a dense growth of grasses, sedges, and broad-leaved herbs. The field is bounded by forest on the east, south, and half of the west sides. There is also a wet, swampy area along a portion of the south side, drained by a wet swale that extends north and runs off the west side of the site.

Figure 1: Site map showing the boundaries of the planting area. Route 125 and the modular homes are located off the map, to the north.

The site has gently undulating topography with a high point in the southeast corner. The northwest corner is the lowest point. The woods along the east side of the parcel have a high prevalence of white pine, interspersed with other species, such as birch, maple, and red oak. The southern border is dominated by willow shrubs and the western side is bordered by a narrow finger of white pine woods.

Photograph of the planting area prior to restoration. Note the topographic variation, as well as the existing grassy vegetation. View is to the southeast.

Photograph of a planting area prior to restoration. Note the standing water. View is to the east.

The land has been leased out for farming by Middlebury College since 1965, when it was acquired from H. Blakely Harris, Jr. Harris, as well as his father before him, most likely used the land as a hayfield, after finding soils too wet for corn. The College then proceeded to lease out the parcel of land to a variety of people for agricultural use and kept it in the State Use Value Program from 1965 through 1997. After that it was removed from use value designation in order to be incorporated into Middlebury College's development plans.

Despite its agricultural history, the land was not considered very valuable for farming because it was so wet. A diversion ditch was dug in 1991 along the west side of the property to facilitate drainage; however, this did not help the drainage problem enough to make the land valuable to the lessees (Figure 2). Prior to the restoration, the land had been brush-hogged every fall, which prevented trees or shrubs from establishing.

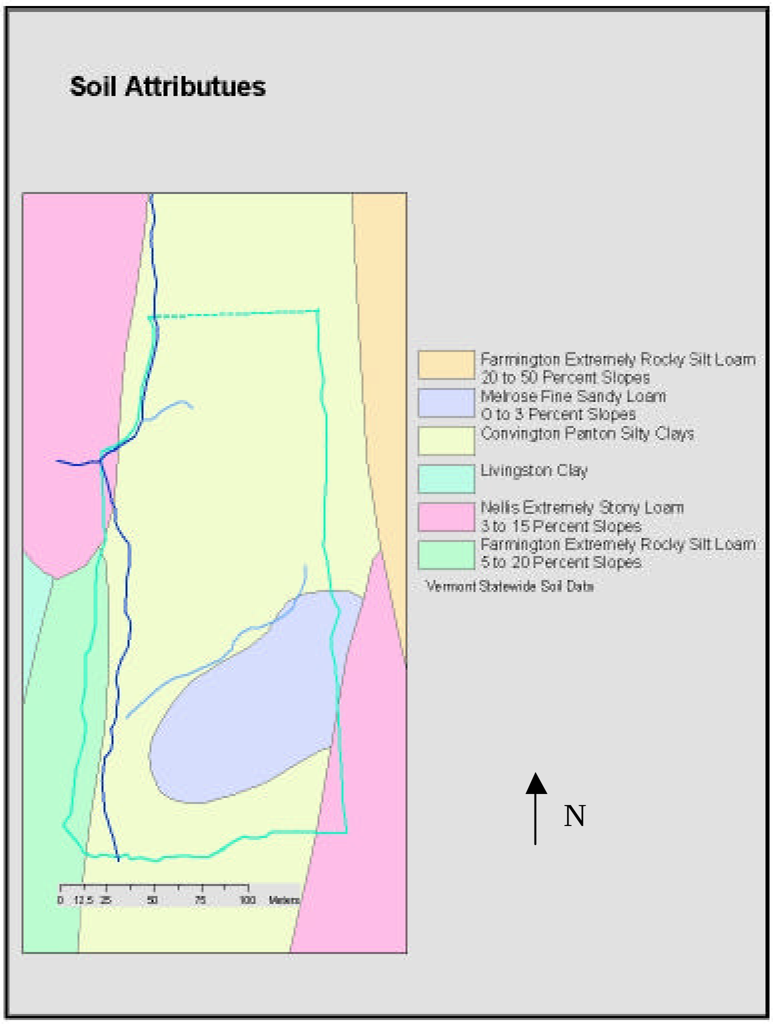


Figure 2: Soil map of the Harris Farm tree planting site.
Diversion ditch highlighted by dark blue line.

Restoration Planning

Choosing which species to plant

The number and species of trees and shrubs planted in the project were based on clayplain forest species composition research by Marc Lapin, a forest ecologist and the CVCFP coordinator. From his data on the relative abundance of each species, we determined the number of trees of each species required to stock to a target density of 250-280 trees and shrubs per acre (see Appendix A for species abundance and composition data). Some of the common clayplain species were unavailable in area nurseries and were therefore not able to be planted. We attempted to obtain local stock to the greatest extent possible, but we did use sources from New York, New Hampshire, Maine, and Pennsylvania due to limited availability of native Vermont stock. If time had allowed, we could have gathered seeds from existing clayplain fragments for the species we were unable to order (see Appendix B for a list of nurseries utilized and the species obtained from each).

Newly arrived trees and planting supplies.

Site mapping and planting decisions

Our planting process began with a simple survey of our restoration area. We made a rough map of the ten-acre area, to show wetter and drier parts of the field. Initial surveys also included reference to the county soil survey. We mapped the site based on moisture regime according to the following three planting zones:

Wet		**Intermediate**		**Dry**	
Site #	*Approx. Acres*	*Site #*	*Approx. Acres*	*Site #*	*Approx. Acres*
1	0.35	1	2	1	0.5
2	0.35	2	1	2	1
3	0.6	3	1.3	3	2

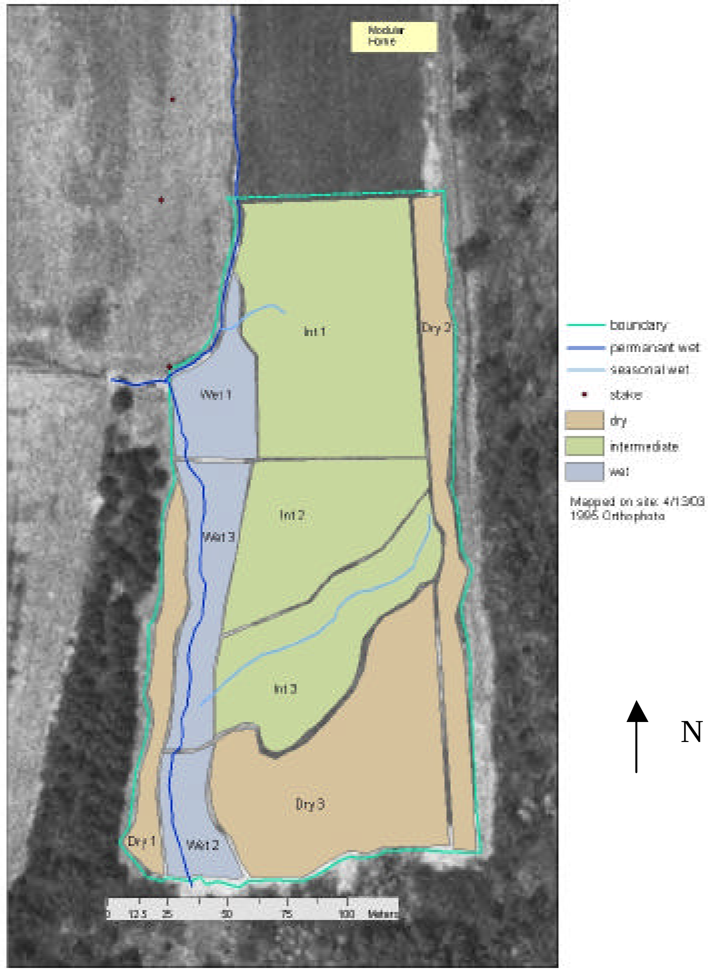
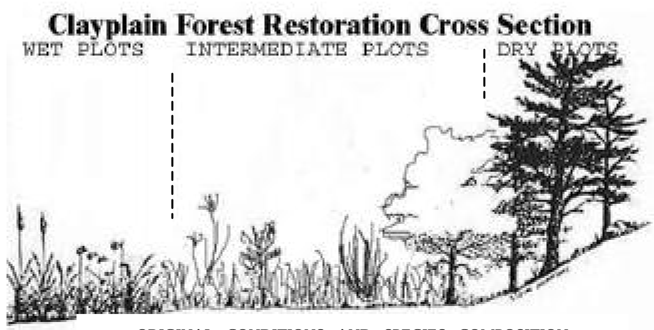


Figure 3: Division of the planting area into wet, intermediate, and dry sections by soil moisture regime.

In determining the placement of species, we also noted existing individuals of species we were trying to restore; for example dry site 2 had a high density of young white pine, so we chose to plant white pines in other areas of the plot. Once we had determined the basic moisture regime and topography of our plots, we could plan where to plant individual species (see Appendix C for a list of trees and shrubs planted). We focused on three main growth factors:

- Moisture
    - Clayplain species have varying moisture tolerances, ranging from those that grow only in well drained, sloping areas to species that can grow in almost perpetually flooded areas.
    - Often, the wettest areas are dominated by shrub species, although swamp white oak can also tolerate very wet areas.

- Light
  - Certain clayplain species are very shade tolerant, while others prefer bright sunlight. In general, early successional species are less shade tolerant than later successional species. Given the time constraints of the project, both early and late successional species were planted together even though it was an open field planting. The only species known to have poor shade-tolerant survivorship in open-field plantings is beech, so we did not include it in the plans.
- Herbivory
  - Certain species are more susceptible to deer and small mammal browse than others. Trees are often particularly susceptible when they are young, as deer can reach all of their branches. Protection from browse has been shown to greatly increase survival and growth of seedlings.
  - Tree shelters were placed around species we determined were most susceptible to browse. These shelters can be purchased from various nursery and environmental companies and can effectively prevent herbivory on very small trees. We targeted all oak species, as well as the hemlocks. Larger fenced-in deer exclosures can also be constructed, but exclosures are both more labor intensive and very expensive.



ORIGINAL CONDITIONS AND SPECIES COMPOSITION

Hydric Soils Water Depth 0' – 6'	Hydric Soil Characteristics	Hydric and Non-Hydric Soil Characteristics
Reed Canary Grass Hay	Milkweed Hay Queen Anne's Lace Smartweed Reed Canary-Grass Smooth Aster	White Pine Queen Anne's Lace Smartweed Milk weed St. John's-Wort Common Goldenrod Orchard Grass
NATIVE	SPEICIES	PLANTED
Gray Dogwood Red Osier Dogwood Swamp White Oak Silky Dogwood Red Maple Nannyberry	American Hornbeam Bur Oak Eastern Hemlock Downy Arrowood Nannyberry Red Oak Shagbark Hickory Sugar Maple Swamp White Oak Wild Chokecherry Witch-Hazel	Shagbark Hickory Sugar Maple White Ash White Pine White Oak Red Maple Witch-Hazel Eastern Hemlock Nannyberry

Figure 4: Representative cross-section of a moisture gradient (modified from New England Wetland Plants, Inc. website: www.newp.com) showing the associated original soil types and species of the planting site, as well as native species planted.

Restoration Supplies and Costs

Active restoration of a field or meadow to clayplain forest involves an initial purchase of trees and shrubs with which to revegetate your plot of land. The number of stems you will want to procure should be calculated on a per-acre basis (see Appendix A). Beyond the cost of the actual plants, it is possible to spend as much or as little on the process of restoration as you wish. Our restoration project was designed to be as cost-effective as possible, while promoting the health and survival of our plants. Presented here are lists of plants and planting supplies and their associated costs (see Appendix B for a list of species and the nurseries from which they were obtained).

Plants

Species	Cost per Tree	Quantity	Total Cost
Shagbark Hickory*	$7.00	30	$210.00
Nannyberry*	$6.50	25	$162.50
Wild Chokecherry*	$5.00	25	$125.00
Canadian Hemlock	$0.57	200	$114.57
Downy Arrowood	$0.80	50	$40.00
Red Osier Dogwod	$0.80	50	$40.00
Silky Dogwood	$0.80	50	$40.00
Gray Dogwood	$0.80	50	$40.00
White Ash	$0.45	200	$90.00
Red Oak	$0.60	200	$120.00
White Oak	$0.60	200	$120.00
Sugar Maple	$0.60	100	$60.00
Red Maple	$0.60	300	$180.00
White Pine	$0.16	250	$40.00
Swamp White Oak	$0.39	200	$78.00
Witch-Hazel	$0.42	100	$42.00
Bur Oak	$2.00	150	$300.00
American Hornbeam	$0.95	150	$142.50
*prices were greater for these species—seedlings received were of an older age class			
Total Plant Cost (including shipping)			**$2,178.32**

Note: Shipping costs will vary depending on shipping distance and quantity of plants ordered.

Planting Supplies

Item	Cost per Item	Quantity	Total Cost (including shipping)
Newspaper Mulch*	no cost	no cost	no cost
Compost*	no cost	no cost	no cost
Tree Shelters**	$1.25	750	$962.50
Hardwood Stakes**	$0.39	850	$356.50
Flagging	$1.00	6	$6.00
Planting Flats & Soil*	no cost	no cost	no cost
Total Supply Cost (including shipping)			**$1,325.00**

* Newspaper, compost, planting flats, and soil were supplied free of charge by the Middlebury College Recycling Center, Facilities Management, and Biology Department, respectively.

** We used 2' shelters; 3' and 4' shelters are also available at a slightly higher cost and afford longer protection to trees. Tree shelters and stakes were obtained from A.M. Leonard.

Items Supplied by Planters

- Shovels
- Wheelbarrows
- 5 gallon buckets (for watering)

View of tree shelters in site Wet 1.

Planting Techniques

When to Plant

The ideal time for planting trees is early in the spring, when the ground is very moist, such as April to mid-May. Earlier planting is preferred because it allows the trees to become established more quickly and avoids handling of plants during the sensitive stage of leaf flush (St. Lawrence Nurseries Planting Guide).

Site Preparation

Although no formal site preparation was undertaken in this project, it is worth considering in order to enhance survivorship and growth in initial years. Site preparation may include mowing or brush-hogging and disking to reduce competing vegetation. If exotic species are prevalent, it is advisable that they are cleared from the area as much as possible. Exotics control can be an intensive process – both The Nature Conservancy and the US Fish and Wildlife Service have much experience in this area and should be consulted (see Appendix D for contact information).

Digging the Hole and Planting

Trees should be left in the shade with their roots moistened and wrapped for protection from wind and sunlight while holes are being dug. A shovel or planting bar can be used to dig holes, which will vary in size and shape to accommodate the different sizes and shapes of the roots of the seedlings. The hole should be sufficiently large so that the entire root system is buried up to the 'root collar'— the point on the stem up to which the soil had been when the trees were previously planted at the nursery—without having to bend the roots to fit them in the hole. When refilling the hole around the roots of the tree, the soil should be broken up of any clods (which are typical in a clay soil) and firmly packed around the roots (Derleth, 2003; Hartline, 2003; St. Lawrence Nurseries Planting Guide). The most important thing is to ensure complete contact

Swamp white oak being inserted into a freshly dug hole.

of the soil with the roots. Planting techniques will vary with the restoration scale (size of area and number of stems planted) and the size of the nursery stock. When digging in clays, often the shovel can create flat, compressed, or 'shiny' surfaces as it cuts down through the soil. If this happens, these smoothed surfaces should be roughened or broken up. The rest of the hole can then be filled with the subsoil until the edges of the hole are even with the ground, and the seedling is at the center of a slight depression which will serve to help catch water for the tree (St. Lawrence Nurseries Planting Guide).

Preparing the Tree for Success

Once the tree is planted, one can lay a thick layer of newspaper around the stem of the seedling as "mulch." This will reduce competition for light and moisture with other plants (Hartline, 2003). Other materials, such as burlap or specialized bio- or photo-degradable brush mats, may also be used. Soil and/or compost can be put on top of the edges of the newspaper to keep it weighted to the ground. In larger scale plantings, this mulching process may not be practicable.

One can water the seedlings after they are planted, in order to hydrate the tree, compact the soil, and remove any air pockets (St. Lawrence Nurseries Planting Guide). This may also be impractical for a large planting. For species that are known to be grazed upon, bio-degradable tree shelters can be used to protect against herbivory, as well as sun-scalding. These shelters can be installed right over the planted seedlings and should be buried slightly into the soil and anchored with a stake (Hartline, 2003).

Installing a tree shelter over a seedling. Tree shelters are anchored into the ground with stakes. Newspaper and compost can be used in conjunction with tree shelters.

Future Management of Restored Plot

The key to plans for future management lies in the ability of the managers to maximize the potential for tree survival. This necessitates 1) ending any destructive practices, 2) restoring natural forces and processes, 3) controlling or limiting the influx of invasive exotic species into the restoration site, and 4) maximizing the success of reintroduced native species.

In order to maximize success we feel that the below actions should be carried out within the restoration site for at least the first three years after planting:

- *Keep vegetation down within a 2-5 foot diameter of trees in order to minimize competition from other species.* The utilization of brush mats can increase this success. One can purchase porous brush mats – which are expensive – or use organic mats of mulch, straw, and/or newspaper as suitable and economic replacements. One can also promote active measures for reducing competing vegetation in the form of brush hogging, weed whacking, raking, or other active weed control methods. Selective application of chemical herbicides can be effective, but the chemicals' possible impacts and side effects can be damaging and are therefore discouraged for the restoration site.
- *Identify threats to restoration and minimize impact.* These impacts can come in many forms ranging from natural to artificial. Only a few will be discussed, but these range from site to site and should be identified prior to the restoration project. Excessive herbivory, generally from the deer populations within Vermont, can cause severe problems for forest regeneration. Some steps can be taken to minimize this impact: 1) use tree shelters around susceptible seedlings, 2) plant the most prone trees away from areas bordered by woods, or 3) use deer fences to protect sprouting sites or the entire restoration area. Other threats can come from environmental/climate conditions such as drought, heat stress, and pestilence.

In addition to maximizing success, one must ensure that the trees are growing adequately by monitoring the site for changes. This can be done by:

- *Documenting initial plantings with a tree census and a detailed site map.* Recording the list of species and number planted is basic – a more detailed report could include the existing preconditions of the site and should include features such as soil maps and land-use history.
- *Monitor plantings by periodically checking growth, predation, and survivorship, noting the success of species within microhabitats of each plot.* It is here that one can decide if additional plantings are necessary through the analysis and determination of changes

and/or problems that have arisen in the years following the initial planting. This will be carried out on our site through the analysis of sample plots.

Future management of the clayplain forest restoration site should be a dynamic and inventive process that should expand from these guidelines. It is impossible to predict all of the possible problems or successes of our proposed management; therefore, the future management of the site should be considered an interactive experiment requiring the input of future generations of Middlebury College students and other community members. As problems arise, continued work will further knowledge for landowners concerning clayplain forest restoration. For the Middlebury College restoration site, cooperation between the College, campus groups (e.g. the Keepers and the Volunteer Services Organization) and academic departments (specifically Environmental Studies and Biology) will allow for the resolution of these future problems.

A field of tree shelters protecting swamp white oak seedlings.

Summary

Though originally proposed as an experimental case study, the Middlebury College and ES 401 clayplain forest restoration project is now largely concerned with success of planted species. This success is dependent on a knowledge of the terrain, species viability within microhabitats, correct planting practices, and continued management to enhance survivorship and growth. Though we attempt to address all four of these ideas in our Landowner Guide, the process is ever changing and will require unique action and management based on unforeseen and uncommon problems. In order to maximize the success of planted trees, future manipulation must occur in as limited and low-impact a manner as possible, allowing natural processes to become established on the site.

Top: Site flagging. Bottom: View to southeast of partially completed planting.

Acknowledgements

The Environmental Studies Senior Seminar would like to thank several people, without whom this project would not have been conceived, planned, or implemented. First, to Marc Lapin of the Champlain Valley Clayplain Forest Project, thank you for the invaluable knowledge, many hours, immeasurable patience, and abundant enthusiasm you have given us throughout this process. Also, thank you to Steve Weber, whose knowledge of the forest and the land helped us at every stage of the process, as well as to David Cunningham, Keith Hartline, and Eric Derleth for volunteering their planting knowledge and expertise. Thank you also to Professor Christopher McGrory Klyza, who helped to conceive and direct this effort, and especially to Diane Munroe, for the incredible time and effort put forth in planning this project, as well as the months of patience and direction she brought to us throughout its implementation.

*All photographs were taken by members of ES 401, except where noted.

Diane Munroe and Rita Vincello walking restoration site.

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Appendix A: Species Abundance and Composition

The table below shows the target density per acre of individuals of each species based on population research performed in multiple forest stands, and the resulting number of stems that were ordered for the restoration of a 10-acre plot.

Scientific Name	Common Name	Target #/acre*	Actual #/acre*
Acer rubrum	Red maple	26.5	30
Pinus strobus	White pine	20	25
Quercus alba	White oak	18	20
Quercus bicolor	Swamp white oak	13	20
Tsuga canadensis	Canadian hemlock	14	20
Quercus rubra	Red oak	16	20
Carya ovata	Shagbark hickory	19	3
Acer saccharum	Sugar maple	14	10
Quercus macrocarpa	Bur oak	5	15
Fraxinus americana	White ash	16.5	20
Carpinus caroliniana	American hornbeam	3.5	15
	Shrubs**	38	35

*Density of stems per acre. The "target" number is based on research values obtained by Marc Lapin. Actual numbers refer to the number of individuals we ordered.

**The number of shrubs ordered was determined by taking 15% of the total number of trees.

Appendix B: Nursery Information

Nursery	Address	Order	Latin Name
St. Lawrenc e Nurseries	Route 345	Shagbark Hickory	*Carya ovata*
	Potsdam, NY 13676	Nannyberry	*Viburnum lentago*
	(315) 265-6739	Wild Chokecherry	*Prunus virginiana*
	http://www.sln.potsdam.ny.us		
Western Maine Nurseries	1 Evergreen Drive - P.O.BOX 250	Canadian Hemlock	*Tsuga canadensis*
	Fryeburg, ME 04037		
	1-800-447-4745		
	http://www.westernmainenurseries.com/default2.html		
New Hampshire State Forest Nursery	Route 3	Downy Arrowood	*Viburnum recognitum*
	Boscawen, NH	Red Osier Dogwod	*Cornus stolonifera*
	(603) 796-2323 (Nursery Office)	Silky Dogwood	*Cornus amomum*
	http://www.nhnursery.com/	Gray Dogwood	*Cornus racemosa*
		White Ash	*Fraxinus americana*
NY Saratoga Tree Nursery	2369 Route 50	Red Oak	*Quercus rubra*
	Saratoga Springs, NY 12866-4738	White Oak	*Quercus alba*
	(518) 587-1120	Sugar Maple	*Acer saccharum*
	http://www.dec.state.ny.us/website/dlf/privland/nursery/treeshrub.html	Red Maple	*Acer rubrum*
		White Pine	*Pinus strobus*
Meadowview Nursery	5994 Byron-Holley Road	Swamp White Oak	*Quercus bicolor*
	Byron, NY 14422	Witch Hazel	*Hamamelis virginiana*
	(585) 548-9014		
Poultney-Mettowee / TNC	PMNRCD	Bur Oak	*Quercus macrocarpa*
	Box 209		
	Poultney, VT 05764		
	www.vacd.org/pmnrcd/index.html		
Musser Forests, Inc.	PO Box 340	American Hornbeam	*Carpinus caroliniana*
	Indiana, PA 15701-0340		
	(724) 465-5685		
	www.musserforests.com		
A.M. Leonard	www.amleo.com	Tree Shelters and Stakes	

Appendix C: List of Trees and Shrubs Planted and their Growth Factors

Common name	**Latin name**	**Type**	**Soil type**
American hornbeam	*Carpinus caroliniana*	Tree	Acidic
Bur oak	*Quercus macrocarpa*	Tree	
Canadian/Eastern hemlock	*Tsuga canadensis*	Tree	Highly acidic, coarse soils
Downy arrowood	*Viburnum recognitum*	Shrub	
Gray dogwood	*Cornus racemosa*	Shrub	
Nannyberry	*Viburnum lentago*	Shrub	Acidic/Neutral
Red maple	*Acer rubrum*	Tree	Tolerant of most soil types
Red oak	*Quercus rubra*	Tree	Well drained clayey or loamy soils
Red osier dogwood	*Cornus stolonifera*	Shrub	
Shagbark hickory	*Carya ovata*	Tree	Tolerant of most soil types
Silky dogwood	*Cornus amomum*	Shrub	
Sugar maple	*Acer saccharum*	Tree	Acidic
Swamp white oak	*Quercus bicolor*	Tree	Organic
White ash	*Fraxinus americana*	Tree	Acidic/Neutral, rich soil (high N)
White pine	*Pinus strobus*	Tree	Neutral sandy soil/low-med site quality
White oak	*Quercus alba*	Tree	Tolerant of most soil types
Wild chokercherry	*Prunus virginiana*	Shrub	Acidic, sandy, grainy
Witch hazel	*Hamamelis virginiana*	Shrub	

Common name	**Soil moisture index**	**Herbivory**	**Light**
American hornbeam	Intermediate/Wet, good drainage	Beaver	High shade tolerance
Bur oak	Wide range/not flooded	On acorns	Intermediate shade tolerance
Canadian/Eastern hemlock	Intermediate/Wet, good drainage	Deer browse	High shade tolerance
Downy arrowood	Intermediate, good drainage		
Gray dogwood	Wet		Shade tolerant
Nannyberry	Wide range/not flooded		Shade tolerant
Red maple	Wide range/likes extreme conditions	Deer browse	Intermediate shade tolerance
Red oak	Wet but well drained	Gypsy moth	Intermediate shade tolerance
Red osier dogwood	Wet	Deer browse	Full sunlight
Shagbark hickory	Wide range		Intermediate shade tolerance
Silky dogwood	Wet/will grow in poorly drained soil	Deer/rabbit	
Sugar maple	Intermediate/well drained	Deer browse/sensitive to salt	Very shade tolerant
Swamp white oak	Wet/poorly drained but not flooded	On acorns	Intermediate shade tolerance
White ash	Intermediate, good drainage	Deer browse/ ash yellows	Full sunlight
White pine	Dry/well drained	Deer browse/sensitive to salt	Intermediate shade tolerance
White oak	Intermediate		Intermediate shade tolerance
Wild chokecherry	Wet/well drained	Deer browse/tent caterpillar	
Witch hazel	Intermediate, good drainage		Intermediate shade tolerance

Appendix D: Restoration Resources

For a list of plant nurseries and contact information, please see Appendix B.

Funding

Natural Resource Conservation Service
Middlebury Service Center
68 Catamount Park, Suite B
Middlebury, VT 05753
(802) 388-6748

Williston Service Center
600 Blair Park Rd, Suite 800
Williston, VT 05495

Rutland Service Center
170 South Main St
Rutland, VT 05701
(802) 775-8034
www.nrcs.usda.gov

Partners for Fish and Wildlife Program
U.S. Fish and Wildlife Service
11 Lincoln St
Essex Junction, V T 05452
(802) 872-0629
http://partners.fws.org

Urban and Community Forestry
Vermont Department of Forests,
Parks & Recreation
Steve Sinclair
(802) 241-3673

Conservation Easements

The Nature Conservancy
Vermont Field Office
27 State St
Montpelier, VT 05602
(802) 229-4425
www.tnc.org

Middlebury Area Land Trust
P.O. Box 804
Middlebury, VT 05753
(802) 388-1007
malt@middlebury.edu

Vermont Forest Legacy Program
Land Acquisition Program
Agency of Natural Resources
103 South Main St
Waterbury, VT 05761
(802) 241-3697 or (802) 241-3682
www.state.vt.us/anr/fpr/lands/acquis.htm

Vermont Land Trust
8 Bailey Ave.
Montpelier, VT 05602
(802) 434-3079
www.vlt.org

Natural Communities/Rare & Threatened Species

Nongame and Natural Heritage Program
Vermont Department of Fish and Wildlife
Contact: Eric Sorenson
103 South Main St.
Waterbury, VT 05671-0501
(802) 241-3700
www.anr.state.vt.us/fw/fwhome/nnhp/index.html

Forestry

David Brynn
Addison County Forester
68 Catamount Park, Suite C
Middlebury, VT 05753
(802) 388-4969
david.brynn@anr.state.vt.us

Michael Snyder
Chittenden County Forester
111 West Street
Essex Junction, VT 05452
(802) 879-5694
michael.snyder@anrmail.anr.state.vt.us

Nate Fice
Rutland County Forester
317 Sanitorium Rd, W. Wing
Pittsford, VT 05763
(802) 483-2730
nate.fice@anrmail.anr.state.vt.us

Vermont Family Forests
P.O. Box 254
Bristol, VT 05443
(802) 543-7728
Fax: (802) 453-7729
www.familyforests.org

Champlain Valley Clayplain Forest Project

Marc Lapin, Coordinator
239 Cider Mill Rd
Cornwall, VT 05753
(802) 462-2514
www.clayplain.org