Trees Beyond Goderich

Final Report for the Canadian Tree Fund

Final Report	January 27, 2014

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Final Report

Trees Beyond Goderich: Disaster Relief through Reforestation

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Prepared by

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Cover Photos

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1. Sycamore tree with an infestation of tent caterpillars.

2. Rural 1 site, dominated by the invasive Dame's Rocket.

3. Volunteers plant large stock trees amongst fallen debris (Nov 2012)

4. Insect damage on Red Oak leaf.

Trees Beyond Goderich: Disaster Relief through Reforestation

Through 2013, the Huron Stewardship Council (HSC) and County of Huron partnered on a research project to study aspects of rural and urban woodlot restoration. Study sites were in areas of Huron County damaged by the 2011 tornado. Funding from the Canadian Tree Fund was essential for fulfilling these efforts, and was used to cover the HSC staff salary costs for field work, data management and analysis, and writing this final report.

You'll read in the following report that we have observed some interesting trends in our initial year of study. Subsequent years of data collection is pertinent to fully answer our research objectives. We hope that we will have the opportunity in the future to do further work with support from the Canadian Tree Fund.

- Rachel White
  Coordinator, Huron Stewardship Council

Trees Beyond Goderich: Disaster Relief through Reforestation

By Nick Courtney (County of Huron) and Rachel White (Huron Stewardship Council)

Introduction

Scientists have predicted that climate change will continue to threaten biodiversity in a number of ways. Rapidly shifting habitat conditions will likely impede population recovery, hinder migration and range extension, and lead to an overall loss of diversity (Hewitt, *et al*., 2011). In Ontario, by 2070, the average winter temperature is expected to increase from 4 to 7°C and summer temperatures will increase by 3°C. These changes are anticipated to affect the distribution, structure, function and productivity of Ontario's forests (Ministry of Natural Resources, 2011).

In addition to the imacts climate change will have on the biota of Ontario, extreme weather phenomena such as severe thunderstorms, high winds, and tornados are likely to increase in frequency and intensity (Seneviratne *et al*., 2012). In the summer of 2011, a tornado (rated F3 Fujita Scale) tore through Huron County from the town of Goderich inland 20 km. This event led to the destruction of over 220 acres of woodlot (N. Courtney, 2012, unpublished data). As a result, the 'Trees Beyond Goderich' project was created and implemented by the Huron Stewardship Council and County of Huron to restore damaged natural areas.

The strategy for woodlot restoration employed through Trees Beyond Goderich is to plant diverse, potted, large stock saplings in damaged woodlots. This complements regeneration that would naturally occur, increases biodiversity and resilience, allows us to study the feasibility of assisted migration of Carolinian species, and sustains the woodlots for future generations.

Underplanting of urban and rural woodlands is a relatively new field of research. Recent pressures such as Emerald Ash Borer have reduced the density of many woodlands to the point where underplanting is a viable option. Urban and sub-urban woodlands are particularly prone to invasive insect and disease pressure because of the proximity to foreign wood products and firewood movement that often introduces insect and disease events. Introducing more biodiversity into the tree cover increases resilience against insects and disease and creates a more diverse habitat.

Assisted migration is the intentional translocation or movement of a species outside of their historic ranges. The intent is to mitigate actual or anticipated biodiversity loss caused by anthropogenic climatic change (Hewitt, *et al*., 2011). Assisted migration (also known as assisted colonisation or managed relocation) is a conservation strategy that has been proposed to mitigate the effects of climate change on biodiversity (Lunt, *et al*., 2013; Loss, *et al*., 2011). The greatest hindrance of species survival in the face of climate change is not their capacity to adapt, but rather their ability to move across landscapes that lack connectivity and migration corridors (Vitt, *et al*., 2010). This study aims to determine whether selected species from the Carolinian Life Zone will be acceptable candidates for future planting and restoration efforts utilizing assisted migration in the County of Huron.

Various methods were used to protect the tree stock from natural pressures such as deer browse and girdling damage. Much of the research on tree guards has been carried out by the companies who develop these products, and much of it has taken place outside of North America. There is a great need for field research in this area.

The goals of this tornado restoration research project in Huron County were:

1. To monitor regeneration and restoration approaches in one urban versus multiple rural woodlots that were replanted as part of the tornado restoration effort
2. Studying the effectiveness of assisted migration of tree species from the Carolinian Zone beyond the historical northern limit by monitoring survival and tree health over time
3. Determine the efficacy of tree shelter products for preventing seedling/sapling deer browse in rural woodland plantings

Methods

Site Selection, Biodiversity

The Maitland River is naturally diverse due to its unique physical features such as limestone cliffs and cold water seeps. The Maitland River has a winding shoreline virtually undisturbed by development. The four woodlots selected for this study are in the Maitland River watershed and were heavily damaged by the tornado, with upwards of 90% of the forest cover removed. Each rural site (three in total; Rural 1, Rural 2 and Rural 3) was restored by underplanting seedlings and potted, large stock trees within a year and a half of the disaster. None of the sites received any site preparation or chemical weed control prior to planting. Rural 1 and Rural 2 sites were both planted in the fall of 2012. These sites were chosen for a more intensive study of assisted migration. The details of species selection is below. Rural 3 was planted with similar species in the spring of 2012.

The urban site (Urban 1) is also the site of ongoing restoration efforts. Very few trees in Urban 1 survived the tornado. The majority of damaged trees were chipped to create mulch that covered walking pathways and portions of the woodlot ground layer. The strategy of the urban woodlot restoration was to transform a woodlot that was previously cedar- and hard maple-dominated into an arboretum for the residents and visitors of Goderich to enjoy. A long list of tree and shrub species were planted, including some Carolinian species (Table 1). Baseline data (height, health, browsing pressure, insect damage, etc.) was collected for 11 Swamp White Oak (*Quercus bicolor* Willd.) saplings that were a similar size as other oaks in this study.

Qualitative assessments of the herbaceous layer were completed at all sites.

Assisted Migration

Three Carolinian species were selected for this study: American Sycamore (*Platanus occidentalis*), Tulip Tree (*Liriodendron tulipifera L.*), and White Oak (*Quercus alba L.*). Each of these species are greater than 25 km from their historic northern range limit. Red Oak (*Quercus rubra L.*) was selected as a control, since the species is native and common to the area. All four species were planted at Rural 1 and Rural 2 in fall 2012 as three gallon stock. Similar-sized White Oak and Red Oak were planted in Rural 3 in the spring of 2012.

An initial assessment was conducted to measure the individual tree heights, health status and planting quality followed by a secondary assessment that focused on only the tree health. Health was measured as the percent live crown (4 → 75-100%, 3 → 50-75%, 2 → 25-50%, 1 → 1-25%, 0 → dead). A final assessment was conducted after a 2 month period to determine each trees' growth, health status and survival. These variables were also collected in Rural 3 for White Oak and Red Oak.

Browsing and other natural stresses

The presence and extent of rodent and deer browse were noted (4 → browsing on 75-100% of the stems, 3 → 50-75%, 2 → 25-50%, 1 → 1-25%, 0 – no signs of browsing). Trees with tree shelters or fragrant dryer sheets (thought to repel deer), were compared to trees with no protection. Tree shelters were installed to random Red Oak, Tulip Tree, and White Oak trees at Rural 1 and Rural 2 the day the trees were planted (November 18 and 19, 2012). In Rural 1, dryer sheets were installed randomly on Sycamore trees on the same day then replaced on May 31, 2013. Tubes were installed in Rural 3 on Red Oak and White Oak on their planting day (May 12, 2012).

Observations of natural stresses such as the presence of insect damage, wilting, or leaning (present = 1; absent = 0) were also noted.

<u>Preliminary Results</u>

Biodiversity of ground layer

Common invasive species were found in all woodlots, such as Common Mullein (*Verbascum thapsus*; dominant in Rural 1), Dandelions (*Taraxicum* sp.; most common in Rural 2), Garlic Mustard (*Alliaria petiolata*), Burdock (*Arctium* sp.), and non-native Thistle (*Cirsium* sp.).

Even though the canopy cover of all woodlots changed dramatically after the tornado and the subsequent 'clean up' of fallen trees, remnant pockets of rare plant communities were found at Rural 1, Rural 3 and Urban 1. Species often found in rich woodland habitats were observed, including Bloodroot (*Sanguinaria canadensis*), Jack-in-the-Pulpit (*Arisaema* sp.), Wild Ginger (*Asarum canadense*; Rural 3), Wild Columbine (*Aquilegia canadensis;* common in Rural 1 but not found in Rural 2), Violets (*Viola* sp.), and others. Rural 1 and Urban 1, both riverside sites, retained remnant prairie fragments that are a common feature along the Maitland River, yet rare across the province.

Assisted Migration

The climate conditions in 2013 were ideal for newly planted trees, as the warm spring-fall months saw frequent rain events, followed by warm, humid days. Growth was calculated using the equation below, where *h* = height.

$$Growth\ (\%) = \frac{h_{final} - h_{initial}}{h_{initial}} \times 100$$

Preliminary results indicate that of the three Carolinian species, White Oak had the greatest average growth in height (34 %; n = 17), followed by Tulip Tree (11 %; n = 16), and Sycamore (9 %; n = 27). The native Red Oak had greatest growth overall, with an average of 55 % growth (n = 28). The growth in height of Red Oakes was significantly greater in Rural 1 and Rural 3 than in Rural 2, which had more poorly drained soil and high browsing pressure. There was no statistical difference between the growth of Tulip Trees or Sycamores at either site. All trees but one Red Oak survived.

Browsing and other natural stresses

Insect damage, wilting, and leaning were not significantly different between study species. Insect damage was the most severe in the summer and fall. Wilting was seen most often in the summer for all species. The greatest difference in natural stresses between species was browsing pressure. Browsing was observed to be most severe on Red Oak (a favourite of deer), and Tulip Trees. Both Sycamores and White Oaks had slight and moderate browsing, respectively. No browsing was observed on the Swamp White Oak at Urban 1.

Trees in shelters had statistically greater growth and less severe browsing pressure than trees without shelters (Figure 1). There was no statistical difference in browsing pressure or growth in trees with or without fragrant dryer sheets.

Discussion

In the first year of our study we observed some interesting trends when comparing urban and rural restoration strategies. The Urban 1 site had very little tree cover and was more exposed to wind and sun. The reduced cover and proximity to an urban centre could explain the apparent absence of deer and lack of browsing pressure. The Swamp White Oak trees showed signs of heat and drought stress mid-summer. As the woodlot arboretum at Urban 1 matures, an increase in tree cover will provide a better habitat for wildlife. All study species in the rural sites had high survivability and appeared healthy throughout the season, although significantly greater browsing pressure was observed.

Due to its fast growth and lack of natural predators (low browsing pressure), our preliminary results show that White Oak may be the best candidate species for assisted migration to the Goderich area of the County of Huron. These results were unexpected, since White Oaks are known to have slow to moderate growth and the species was moved the greatest distance from its historic range (approximately 40 km) compared to the other two species (25 km). Tulip Trees and Sycamores are typically fast growing species but exhibited the least growth during the study period. For Tulip Trees, this can be partly explained by intensive deer browsing.

Remnant plant communities may be at risk in tornado-damaged woodlots due to reduced canopy and increased exposure. It is to be expected that many invasive species have colonized the woodlots, considering the high degree of disturbance. Tree shelters appeared to increase growth and mitigate browsing of protected trees. The fragrant dryer sheets were not effective at protecting Sycamore trees from browsing. It is possible that altering the time of year the sheets are installed or changing the target species could show different results, though this will not be pursued further in this study.

It will be important to track the changes in these woodlots over time to monitor the survivability of non-native and native trees, the biodiversity of the ground layer and persistence of rare plant communities, and the ongoing effectiveness of tree shelters for protection and growth.

This project will have application to future restoration efforts in urban and rural woodlands following natural disasters such as tornados and downbursts, or the infestation of insects (e.g. Emerald Ash Borer) and spread of diseases (e.g. Beech Bark Disease). It is imperative that we continue to collect data over the upcoming years to capture growth trends over time.

Acknowledgements

Our thanks to the Canadian Tree Fund's Jack Kimmel Grant for providing the essential support that made this research possible. We thank the Parks Department of the Town of Goderich for their contributions to our research at the Maitland Cemetery woodlot. This project would not have been possible without the kind help from the rural landowners who gave us permission to access their land, provided information assistance, and showed inspiring dedication to protect and restore the natural environment.

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Tables and Figures

Table 1. List of trees and shrubs planted at four study sites in the Maitland River Valley, Huron County (Study site: UTM; Urban 1: N0445356, E4842577; Rural 1: N0449754, E4840667; Rural 2: N0452269, E4839571; Rural 3: N0450586, E4840553).

Common Name	Scientific Name	Urban 1	Rural 1	Rural 2	Rural 3
Autumn Blaze Maple	*Acer freemanii*	x			
Black Maple	*Acer nigrum*	x			
Red Maple	*Acer rubrum*	x	x	x	
Silver Maple	*Acer saccharinum*	x			
Sugar Maple	*Acer saccharum*	x			
Alder	*Alnus incana*	x			
Serviceberry	*Amelanchier canadensis*	x	x	x	x
Chokeberry	*Aronia melaocarpa*	x	x		
Yellow Birch	*Betula alleghaniensis*		x	x	
Clump Birch	*Betula papyifera*	x	x		
Blue Beech	*Carpinus caroliniana*		x		
Bitternut Hickory	*Carya cordiformis*				x
Pignut Hickory	*Carya glabra*		x	x	
Big Shellbark Hickory	*Carya laciniosa*			x	
Shagbark Hickory	*Carya ovata*			x	x
Hackberry Tree	*Celtis occidentalis*	x	x	x	x
Buttonbush	*Cephalanthus occidentalis*	x			
Katsura Tree	*Cercidiphyllum japonicum*	x			
Eastern Redbud	*Cercis canadensis*	x	x	x	
Alternate Leaf Dogwood	*Cornus alternifolia*	x	x		
Silky Dogwood	*Cornus ammomum*	x			
Kousa Flowering Dogwood	*Cornus kousa*	x			
Gray Dogwood	*Cornus racemosa*	x			
Red Osier Dogwood	*Cornus servicea*	x	x	x	
American Hazel	*Corylus americana*		x		
Green Ash	*Fraxinus pennsylvanica*	x			
Pumpkin Ash	*Fraxinus profunda*		x		
Kentucky Coffee Tree	*Gymnocladus dioicus*	x	x		x
Witchhazel	*Hamamelis virginiana*		x		
Cottonwood	*Hibiscus tiliaceus*		x	x	x
European Larch	*Larix dedicua*	x			
Tamarack	*Larix laricina*		x	x	
Spicebush	*Lindera benzoin*	x			
Tulip Tree	*Liridendron tulipifera*	x	x	x	x
Black Gum	*Nyssa sylvatica*		x		
Ironwood	*Ostrya virginiana*		x	x	
Ninebark	*Physocarpus opufolius*	x			
White Spruce	*Picea glauca*	x			
Red Pine	*Pinus resinosa*	x			
White Pine	*Pinus strobus*	x	x	x	x
London Plane Tree	*Platanus acerifolia*	x			
Sycamore	*Platanus occidentalis*	x	x	x	x
Trembling Aspen	*Populus tremuloides*		x	x	
American Plum	*Prunus americana*		x	x	
Black Cherry	*Prunus serotina*	x	x	x	
Choke Cherry	*Prunus virginiana*				x

Table 1 (continued).

Common Name	**Scientific Name**	**Urban 1**	**Rural 1**	**Rural 2**	**Rural 3**
White Oak	*Quercus alba*	x	x		
Swamp White Oak	*Quercus bicolour*	x	x	x	
Burr Oak	*Quercus macrocarpa*	x	x	x	x
Chinquapin Oak	*Quercus muehlenbergii*		x		
Pin Oak	*Quercus palustris*	x			
Pyramidal English Oak	*Quercus robur*	x			
Red Oak	*Quercus rubra*	x	x	x	x
Staghorn Sumac	*Rhus typhina*	x			
Peach-leaved Willow	*Salix amygdaloides*		x		
Black Willow	*Salix nigra*		x		
Elderberry	*Sambucus canadensis*	x			x
American Ash	*Sorbus americana*	x			
Ivory Silk Tree Lilac	*Syringa reticulata*	x			
Eastern White Cedar	*Thuja occidentalis*	x			x
Greenspire Linden	*Tilia cordata*	x			
Glenleven Linden	*Tilia flavescens*	x			
Hemlock	*Tsuga canadensis*				x
American White Elm	*Ulmus americana*	x	x		
Rock Elm	*Ulmus thomasii*		x		
Highbush Cranberry	*Viburnum trilobum*	x			
	Total	**45**	**34**	**21**	**15**

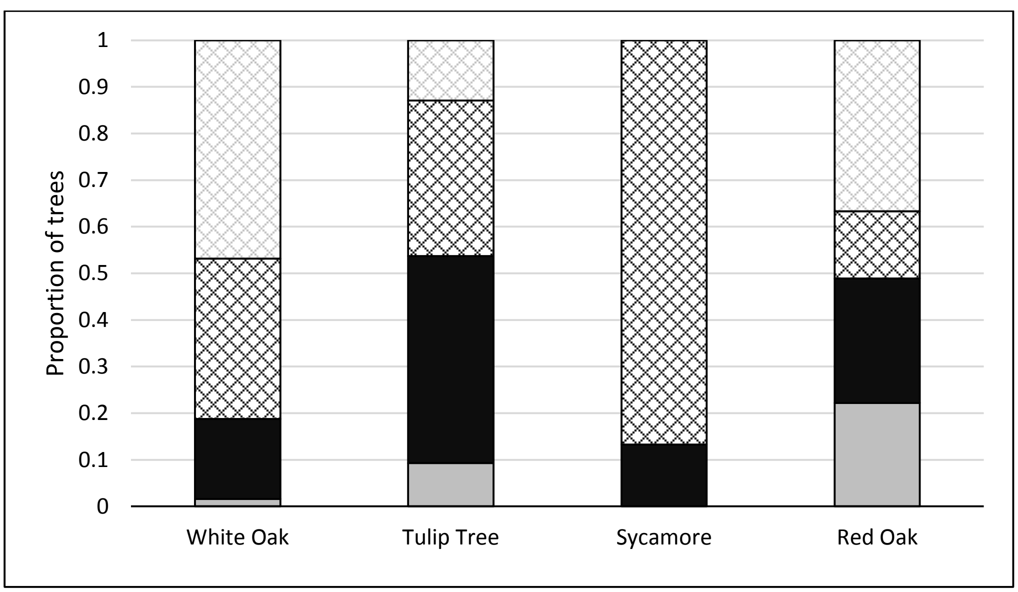

Figure 1. Comparing the proportion of browsed trees (solid bars) to unbrowsed trees (hatched), as well as trees with tube shelters (grey) and trees without tubes (black) at two sites in the Maitland River Valley (Rural 1, Rural 2 and Rural 3).