Pit and Mound Restoration: When a Tree Falls in Clear Creek Forest

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Abstract

Periodic windstorm disturbance is an important factor influencing microtopography in the forests of northeastern North America. A common characteristic of forested wetlands (swamps) is "pit-and-mound" microtopography, also referred to as "mound-and-pool" and "hummock-and-hollow". The result is a mound of soil and roots, which over time settles and decays into a mound for seedling establishment. Associated with the mound is a pit filled with water in the spring and leaves in the fall. The pit and mound microtopography increases plant diversity by increasing the range of moisture regimes in the community. During 2001, 2002 and 2003 at Clear Creek Forest in south western Ontario, the Nature Conservancy of Canada hired a heavy equipment operator to reproduce the pit and mound microtopography found in the adjacent forests in four agriculture fields totalling 68 ha (170 acres). This paper will describe the ecological basis behind pit and mound restoration and the design, methods for construction and planting techniques used. Also some general observations on the progress of this technique after two growing seasons will be shared This wetland restoration technique is limited to fewer then five projects in northeastern North America and the Clear Creek project is the first in Canada and the largest ever undertaken in northeastern North America.

Introduction

In southwestern Ontario the climate is moderate, the land is flat and the soils are rich, and this has resulted in a drastic alteration of the landscape in the past 200 years. In Chatham-Kent and Essex counties, the landscape has undergone a conversion of wetland from at least 80% of the landscape to less than 5% (Larson *et al.*, 1999). Many species of amphibians common in southern Ontario, like Wood Frog, are very rare in southwestern Ontario. The window for action in Ontario's far south is very short. without the protection of forest through tree cutting bylaws. Clearing and over-harvesting of timber are serious threats with very little of the remaining forests managed for old growth forest.

In 2000, two properties totaling nearly 318 ha (796 acres) located in Chatham Kent county, were secured by The Nature Conservancy of Canada (NCC). The securement and stewardship of the properties was due in large part to the generous support of the Province of Ontario and the Government of Canada. The movement to protect Clear Creek Forest started as a grass roots movement and was bolstered with a one million dollar grant from Environment Canada's Habitat Stewardship Program (HSP). The property is now co-managed by The Nature Conservancy of Canada and the Ontario Ministry of Natural

Resources-Ontario Parks through a partnership where parts of the property have been leased or transferred.

Clear Creek Forest is a focus area for Canadian species at risk (SAR). Some of the SAR the property is protecting are: American chestnut (*Castenea dentata*), Shumard's oak (Quercus shumardii), green dragon (*Ariseama dracontium*), lily-leaved twayblade (*Liparis lillifolia*), southern flying squirrel (*Glaucomys volans*), Acadian flycatcher (*Empidonax virenscens*), eastern fox snake (*Elaphe gloydi*) and monarch butterfly (*Danaus plexippus*). A portion of the HSP grant was dedicated to the stewardship of these species at risk, and many projects were completed. One of these projects was the pit and mound restoration, which is the topic in this article. There are sections of Clear Creek Forest which exhibit characteristics of older growth such as a diverse mixture of species and age classes, woody debris on the forest floor, snags, and pit and mound microtopography. The tree species growing in forested wetlands are typically shallow rooted and susceptible to tip-ups in strong winds (Barry *et al.*, 1996). The result is a raised mass of root and soil and an associated pit that often fills with water, however the duration of the water is usually ephemeral in these systems. As the root ball decomposes and the soil settles, a mound of varying size and shape is created.

The ephemeral pits are important for the breeding of amphibians, and the mounds are critical for allowing woody species to survive the seasonal flooding of the forest. It is also suspected that the mound plays a role in the establishment and rate of growth of the woody species by providing a sunny and aerated condition with abundant water and nutrients extracted from the pit. The nutrient rich pits are the result of plant material being trapped and accumulating in the pits. Over time, as the leaves break down a rich black muck soil is found in the pits and these nutrients feed the plants growing on the edge and on the mounds.

With the current level of interest in wetland restoration, pit and mound restoration may play a critical role in forested wetland re-creation. The poor state of wetlands and forests in the surrounding area, combined with the abundance of agriculture land on the property, provided an excellent opportunity to test the technique. The Nature Conservancy of Canada recognized that the idea presented was not pure restoration, since the abundance, size, layout of the pits and mounds that may have existed there naturally is extremely variable, poorly understood and difficult to reproduce. However, creating an older growth forest condition faster with wetland pockets for amphibians, while contributing to the scientific literature, were very motivating factors in adopting this technique at Clear Creek Forest.

The idea of using earth moving equipment to create pits and mounds is a recently developed technique that has its origin in several places. In desert ecosystems pits and mounds have been bulldozed to hold water and facilitate re-vegetation. In northeastern United States the technique has been used previously at the Great Cedar Swamp in Massachusetts and in Brentwood New Hampshire (Barry *et al.*, 1996). In 2001, Ontario resident Mathis Natvik presented the idea to the Nature Conservancy of Canada, following discussions with John Ambrose and Gerry Waldron, long-time proponents for Carolinian conservation.

From 2001 to 2003 pits and mounds were created on 170 acres of retired agriculture land using an earth mover with a large scooped blade, immediately following crop harvest. The size and orientation were varied to approximate the natural occurrence - the smallest pits and mounds were 15 square feet and about 100 per acre were created. These pits were shallow – about 6-8 inches at maximum depth. The mounds were 1 or 2 feet high at the time of creation. A large pond of about 60 square feet was created once every acre. A few deep permanent ponds were created, about 1 every 2-3 acres. The final stage was the plugging of the field tiles by finding the outlet, digging a section of the tile up and packing the hole with soil. The pits and mounds were created in November and left for the winter months to settle. This technique was used, verses artificially compacting the mounds with earth moving equipment, which has been suggested in other papers (Barry *et al.*, 1996). By spring the mounds had settled considerably and the pits are filled with water.

Trees indigenous to the forest were planted as one year old seedlings and seeds (Table 1). Approximatly 500 trees or seeds were planted per acre. The majority of the plantings were with tree seeds, with tree species uncommon in the area or difficult to establish via seed planted.

Table 1. *Summary of the tree species planted during the project.*

TREE SPECIES	AREA	REASON FOR PLANTING
American Chestnut Butternut Hackberry Red Oak Shagbark Hickory Tulip Tree White Oak	Mound.	These trees tolerate a well-drained soil. Many of these trees are uncommon at Clear Creek.
American Hazel Flowering Crab Flowering Dogwood Staghorn Sumac Serviceberry	Mound.	These shrubs prefer a well-drained soil, grow quickly and protect other trees around it by sheltering them from cold winds, hot sun and browsing animals. Their fruit is an important source of energy for wildlife. Also birds perched on shrubs introduce new plant s to the site via their droppings.
Bitternut Hickory Buttonbush Choke Cherry Cottonwood Pumpkin Ash Swamp Dogwood Shumard's Oak Spicebush Swamp White Oak Sycamore Willow Winterberry Holley	Edge of pit	These fast growing trees and shrubs provide food and cover for birds, mammals and insects.

To date the technique appears to be very successful in establishing a diverse mixture of plants in very difficult conditions. In only two years the structure of the pits and mounds has changed. They are vegetated and the shape and depth change as they continue to settle and fill in. By fall the leaves normally blown across the field are collecting and decomposing inside the pits. In 2001 and 2002 the summer was very dry, with virtually no rainfall in July and August and even early September, which makes the rain fall in spring extremely important. On a flat field the water quickly runs away and less gets absorbed into the soil. With the numerous pits and the clay soil the water is stored on the landscape longer and more of it is absorbed or up taken by the plants. The larger, deeper pits retain water year round, even in drought years. Frogs are commonly heard singing and tadpoles are swimming around by late April and May. Shorebirds and American woodcock have been attracted to the fields for breeding in the first year. Numerous insects are seen by early summer. A significant amount of the reforestation has been natural with maple (*Acer sp.*), cherry (*Prunus sp.*), dogwoods (*Cornus spp.*), walnut (*Juglans nigra*), oaks (*Quercus spp.*) and hickories (*Carya spp.*) seeding into the fields.

Conclusion

Not only has the technique been successful in establishing a diverse mixture of plants, natural and introduced, it has remained cost effective with other reforestation projects. The real cost per acre of the project works out to be $1,200. However, these costs can be significantly reduced through volunteer labour. A nearby conventional tree planting project (red ash and silver maple trees planted in rows) cost $1,500 per acre. To date there are no amphibians breeding on site, nor a diverse mixture of woody species. In conclusion, although pit and mound restoration appears to establish a richer diversity of plant species, encourage water retention and promote amphibian breeding within one year at Clear Creek Forest, the technique faces many challenges such as the frequency and size of the pits and mounds on clay vs. sandy soil:

- Does the technique improve tree vigor?
- Does the technique increase natural re- vegetation?
- Does the technique increase wildlife activity in the first year?
- What are impacts on natural processes?

These are important questions to have answered before the technique is implemented on a large scale. Through careful monitoring and documentation the work done at Clear Creek Forest will be able to provide some answers.

References

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