VEGETATION RESTORATION PLANNING AT SANDBANKS PROVINCIAL PARK

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Abstract

This paper presents the results of a study examining options for the restoration of agricultural land and old field located within Sandbanks Provincial Park to vegetation cover similar to what may have existed prior to European settlement. Restoration is intended to create regional landscape linkages and healthy core forest areas. The work completed to date provides an outline of proposed areas for restoration, a variety of conventional and experimental restoration techniques and a long-term schedule for implementation. Retaining some areas of open habitat in what historically was likely continuous forest cover remains one of the unanswered questions for long-term restoration.

Study Objectives

Prior to 1979 Sandbanks Provincial Park existed as two separate provincial parks: Outlet Beach Provincial Park and Sandbanks Provincial Park. The 1979 Master Plan for Sandbanks recommended that the two parks along with the intervening Crown lands be brought together into a single park (Figure 1). The land between the previous Outlet Beach and Sandbanks Provincial Parks is a mosaic of active agricultural lands (row crops and hay fields), abandoned agricultural lands reverting to old fields and young successional forests, hedgerows and woodlands (Figures 2 and 3).

This paper presents a restoration plan to restore former agricultural fields to a more natural state. Restoration should seek to decrease fragmentation of vegetation, increase core forest area and contribute to a regional vegetation and wildlife corridor.

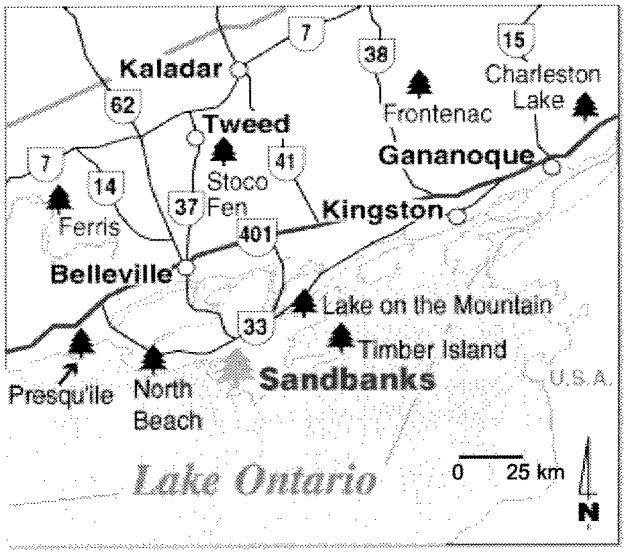
Proposed Restoration

The proposed restoration at Sandbanks represents new techniques in natural resource management. A flexible, patient, experimental approach that is reflective and adaptable is recommended to obtain the best results.

Restoration Goal

To restore former agricultural fields to vegetation cover similar to what may have existed prior to European settlement.

Figure 1. Location of Sandbanks Provincial Park (OMNR, 2004).



Restoration Objectives

- To create regional landscape linkages whereby restored areas of Sandbanks Provincial Park contribute to the ecological integrity both within and outside the park boundary;
- To create core forest areas by building on existing forested areas thereby increasing the amount of well buffered interior forest habitat and promoting an optimum ratio of forest edge to forest interior (optimum ratio is based on the edge to interior ratio for a circle);
- To prioritize restoration such that those areas most in need and/or that will provide the greatest ecological benefit are restored first; and,
- To adopt an experimental approach utilizing multiple restoration techniques and monitoring in an adaptive management framework.

The proposed restoration areas shown in Figure 4 are described in the following text. Also provided is a step-by-step restoration process, recommended planting stock, experimental restoration options and key elements required for monitoring.

Figure 2. *Existing land use and vegetation and Sandbanks Provincial Park.*

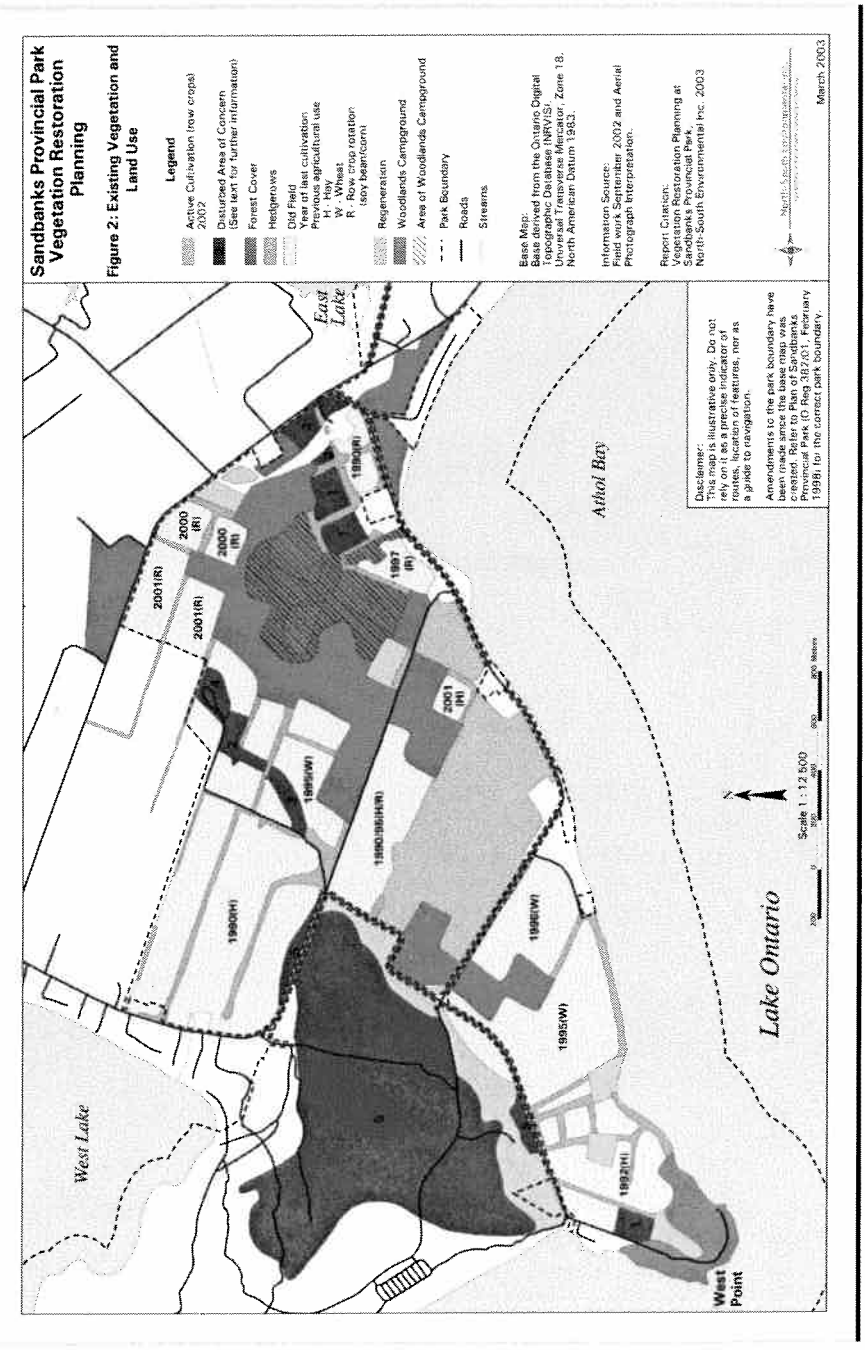


Figure 3. Typical agricultural and old fields within Sandbanks Provincial Park.

Description of Individual Restoration Areas

Intensive Restoration

Intensive restoration will be used to begin building on existing forest cover to create core forest and re-create both an east-west linkage between forests in Sandbanks and a north-south linkage to areas north of the park.

As the intensive restoration areas are intended to rapidly initiate the establishment of forest cover the techniques used are more aggressive involving a greater density of tree planting, a larger number of plant species, the use of ground mulch to suppress the growth of old field species and the use of a combination of restoration planting methods. Intensive restoration will rely on a combination of hedgerow establishment along the perimeter of restoration areas, the establishment of nucleation cells with pits and mounds, and matrix planting.

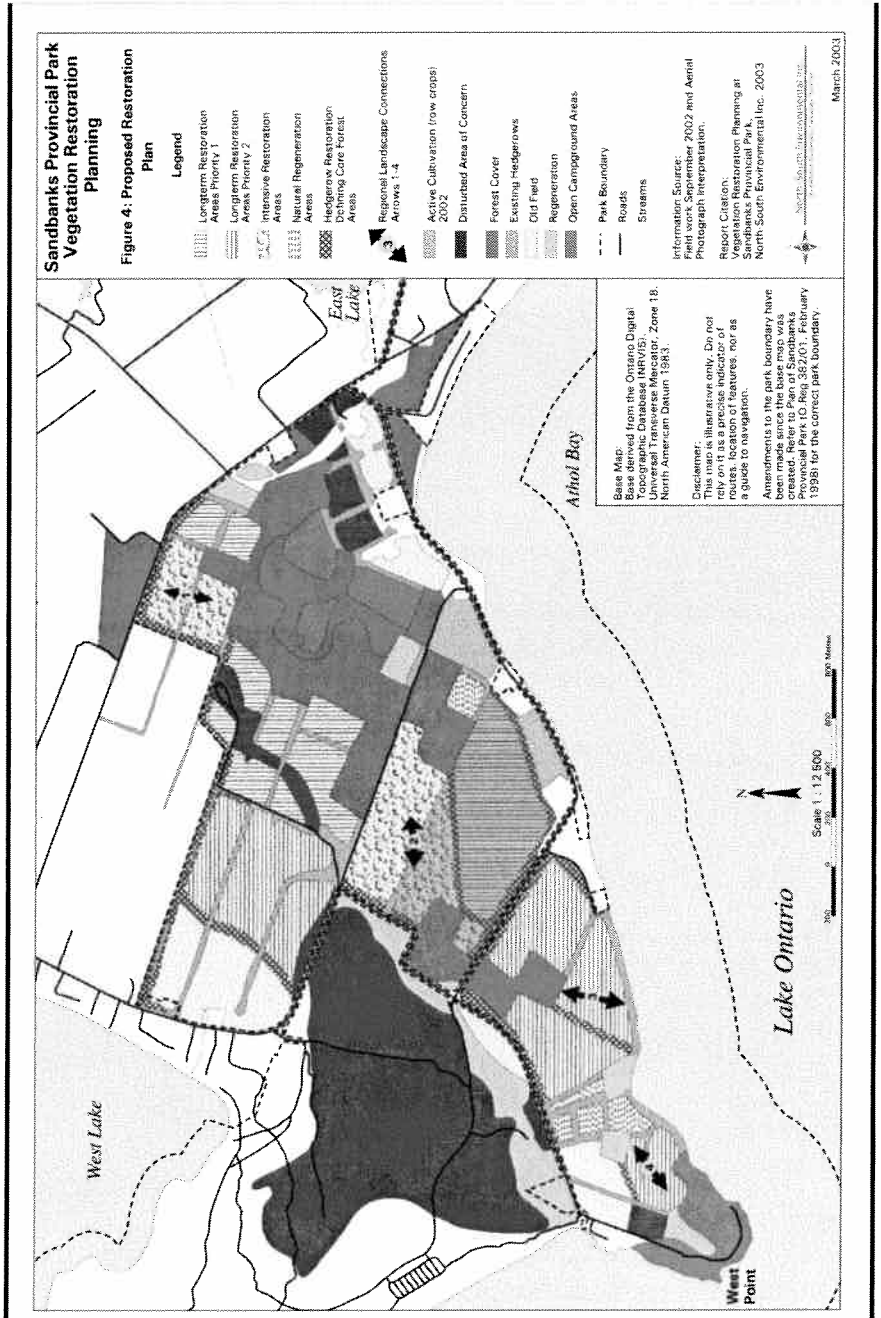
Long-term Restoration Areas Priority 1 and Priority 2

Long-term restoration areas are those where implementation will be carried out over a number of years in priority order. Priority 1 long-term restoration areas have been selected based on one or more of the following factors:

- the need to control invasive plants in order to re-establish a natural successional pathway for native species;
- the need to restore a substantial core forest area; and,
- enhancing the connection from the now isolated forest block at West Point north-eastwards.

Long-term restoration will rely on a combination of hedgerow establishment along the perimeter of restoration areas, the removal of invasive species where necessary and matrix planting to establish a tree canopy.

Figure 4. *Proposed restoration plan.*



Hedgerow Restoration

Hedgerows should be established sequentially to clearly delineate each phase of restoration, to quickly create linkages across the landscape, and to enhance restoration efforts through microclimate amelioration (wind, precipitation, sunlight) and seed capture (wind and animal dispersal).

Natural Regeneration Areas

Natural Regeneration Areas represent sites that currently exhibit a good degree of woody regeneration suggesting a closed canopy will develop. Natural regeneration areas provide a measure of natural regeneration processes, but will likely require management intervention to control invasive plants.

Step-by-Step Restoration Techniques

The restoration areas discussed above require some or all of the following steps for implementation. These steps are only intended to provide guidance for restoration; detailed planning will be required to prepare for site level work.

Step 1 – defining the area(s) to be planted:

The first step is to identify which portions of the areas identified in the restoration plan are to be planted (Figure 4). Area calculations should be made as these will be required to determine planting stock and equipment needs.

Step 2 – removal of exotic species (as required):

Several restoration areas have substantial growth of invasive plants:

- Disturbed Areas of Concern 1 (Figure 2) are invaded by European buckthorn (*Rhamrus cathantica*). These old-field areas do not possess positive natural attributes on which to base forest restoration. European buckthorn is a difficult invasive shrub to remove or eliminate. During the growing season in the year prior to the initiation of tree planting remove all European buckthorn by cutting stems close to the ground. Cut material should be burned on-site or completely removed from the site. Cut stems must be treated with a systemic herbicide to prevent re-sprouting. After one month re-visit the site to cut and treat any European buckthorn that have re-sprouted. After one week brush the site with a heavy-duty tractor drawn brush mower. Treat the entire site with herbicide to eliminate European buckthorn seedlings. Site is now ready to proceed to Step 3.

- Disturbed Areas of Concern 5 (Figure 2) are invaded by mature non-native trees (black locust and scots pine) that are creating a closed canopy forest. In these areas a phased removal of non-native trees will be required to permit under-planted or naturally occurring native trees to form their own closed canopy. Where new growth of non-native tree seedlings and saplings is observed, this should be removed to prevent competition with native trees.

Step 3 – clearing areas to be planted (as required):
Grass cover in fields will compete with restoration plantings. Mechanical means should be used to prepare sites for planting. In areas with well-established old-field vegetation this will require ploughing followed by discing. Areas more recently returned from active cultivation may only require discing.

Step 4 – creating pits and mounds (optional):
Agricultural land use modifies the natural topographic variation characteristic of forests. Dead trees that fall over in a forest create micro-topographic relief characterized by drier exposed tip-up edges, wet (even standing water) pockets, and exposed sub-soil. Using a backhoe or bulldozer pits, approximately 1 to 1.5 m deep and mounds with removed soil piled approximately 1 m high that are 3 to 5 m in diameter, can be made at the centre of each nucleation cell (see step 6) or randomly throughout areas of matrix plantings (see step 7). Pits and mounds should be created prior to tree and shrub planting after field clearing. As the pit and mound will result in somewhat drier soil environments on the mound and wetter conditions within the pit some consideration may be given to planting trees and shrubs to take advantage of these conditions [e.g., white birch (*Betula papyrifena*) and hickories (*Canya spp.*) on the mounds, yellow birch (*Betula alleghaniensis*) and green ash (*Fraxinus pennsylvanica*) within the pit].

Step 5 – establishing perimeter hedgerow:
By using somewhat more intensive restoration techniques hedgerows enhance restoration in adjacent areas. Hedgerows utilize faster growing species (see proposed planting stock below) and calliper stock trees (where possible) to more quickly establish a "presence" from which to derive ecological benefits. Trees are mechanically or hand planted in 3 to 4 rows spaced 3 m apart, with trees planted at 1.5 m intervals in a fashion that ensures staggering between rows. Between two of the rows of planted trees, potted or bare root shrubs are planted 1 m apart in a continuous line.

Step 6 – establishing nucleation cells (optional):
Restoration can benefit by planting groups called nucleation cells that provide a greater species diversity with various tree and shrub species and structural diversity using tall and short plants of different form (Daigle and Havinga, 1996). Because nucleation cells are groups of trees and shrubs they create their own enhanced micro-environment with protection from wind, greater shade, snow capture and greater visitation of animals that introduce seeds. Each nucleation cell should consist of 10 to 15 trees and 10 to 20 shrubs. As nucleation cells are intended to initiate the growth of other plants through seed rain and by attracting seed dispersers, calliper tree stock should be planted at a spacing of 2.5–3 m and potted shrubs should be planted in groups of 3 to 5 shrubs at 1 m spacing. The number of nucleation cells planted in an area will depend on the financial resources available. Optimally, nucleation cells should be planted so that the amelioration effects of one cell begin to overlap with other cells. This distance is calculated based on mature tree height (e.g., 10–15 m) and "fetch effect" (shading, wind speed reduction, snow capture, etc.), which is in the order of 5 to 10 times tree height. So, nucleation cells may be spaced 50 to 150 m apart.

Step 7 – establishing matrix plantings:
The most important transformation in restoration from field to forest is the establishment of a continuous tree canopy. This is accomplished through the planting of a large number of trees at close spacing throughout the restoration area. Given that rapid canopy closure is desired within the intensive restoration area, tree "whips" or saplings (bare root or 1 gallon potted) should be used. Trees should be planted in rows (mechanically or by hand) 3 m apart with trees 1.5 m apart along rows.

Step 8 – plant protection:
Planted trees and shrubs must have tree protectors. While solid tube protectors are preferred, plastic tree wrap may also be used. In nucleation cells and along hedgerows, 15-25 cm of bark mulch is spread on the ground to suppress the growth of old-field species. A ring of bark mulch may also be used around matrix plantings; however, plastic mulch is cheaper and easier to install.

Proposed Restoration Planting Stock

Plants native to the Sandbanks region should be used for all restoration. The best establishment and growth of plant material will come from locally derived and grown stock. Material of local genetic background will be best adapted to the environmental conditions of Sandbanks. It is recommended that a nursery be established by the park to grow stock for the many thousands of trees, shrubs and herbs that will be required over the long-term. Experience has shown that larger potted/balled tree and shrub stock is preferred over bare root material due to more rapid establishment and growth rates.

The tree and shrub species listed below are derived from information about the forests in the vicinity of Sandbanks Provincial Park (Bogart, 1928; Conger, 1819; Gibbard, 1973; Merritt, 1973; Norris and Cuddy, 1990; Richards and Morwick, 1948). A long list of candidate species has been selected for restoration in order to establish a seed source that facilitates the natural establishment of the mix of species ecologically adapted to the environment of Sandbanks. It is expected that over time different areas will develop different suites of species as those plants best adapted to the local conditions thrive and reproduce while other plants less well adapted to the conditions die out.

Experimental Restoration Approaches

Direct Seeding of Native Trees
An inexpensive method of restoration is to simply seed areas with selected tree and shrub species following minimal site preparation. The seed used would be derived from trees and shrubs growing in the Sandbanks region. Seed viability and seed pre-treatment will need to be determined for selected tree and shrub species.

While this method has not been widely tested, at least one experiment has shown that seeding with a mixture of 27 early-, mid- and late- successional trees and shrubs at a rate of 9.4 litres/ha for each species (253.8 litres/ha total) produced an average of 35,583

seedlings/ha (Cornett, 1999), indicating a closed canopy would form in the future. While the author suggests the results are preliminary some species relevant to Sandbanks performed much better than others, including dogwoods (*Cornus* spp.), green ash (*Fraxinus pennsylvanica*), oaks (*Quercus* spp.), common elderberry (*Sambucus canadensis*), and American elm (*Ulmus americana*).

Table 1. *Proposed tree planting stock for restoration.*

COMMON NAME	SCIENTIFIC NAME	N. CELLS	MATRIX	HEDGEROW
sugar maple	*Acer saccarhum*	x	x	x
yellow birch	*Betula allegenensis*	x	<	
white birch	*Betula papyrifera*	x	<	
blue beech	*Carpinus caroliniana*	x	<	
bitternut hickory	*Carya cordiformis*	x	<	
shagbark hickory	*Carya ovata*	x	x	
beech	*Fagus grandifolia*	x	<	
white ash	*Fraxinus americanum*	x	x	x
green ash	*Fraxinus pennsylvanica*	x	<	
butternut	*Juglans cinera*	x	<	
ironwood	*Ostrya virginiana*	x	<	
white pine	*Pinus strobus*	x	<	x
largetooth aspen	*Populus grandidentata*	x	x	x
trembling aspen	*Populus tremuloides*	x	x	x
black cherry	*Prunus serotina*	x	x	x
white oak	*Quercus alba*	x	<	
red oak	*Quercus rubra*	x	<	
basswood	*Tilia americana*	x	x	
hemlock	*Tsuga canadensis*	x	<	
elm	*Ulmus americanum*	x	x	x

x may be used in equal numbers with other selected species; < may be used in a ratio of 1:10 or less with other selected species.

Table 2. *Proposed shrub planting stock for restoration.*

COMMON NAME	SCIENTIFIC NAME	N. CELLS	MATRIX	HEDGEROW
staghorn sumac	*Rhus typhina*	x		x
Canada yew	*Taxus canadensis*	x		
round-leaved dogwood	*Cornus rugosa*	x		x
downy arrow-wood	*Viburnum rafinesquianum*	x		x
red-berried elder	*Sambucus pubens*	x		x
elderberry	*Sambucus canadensis*	x		x
maple-leaved viburnum	*Viburnum acerifolium*	x		x
chokecherry	*Prunus virginiana*	x		x
mountain maple	*Acer spicatum*	x		x
alternate-leaved dogwood	*Cornus alternifolia*	x		x

x may be used in equal numbers with other selected species

Should seed be available, areas of Sandbanks could be restored using the low cost direct seeding method. Recently abandoned agricultural fields would require little or no site preparation. Old fields should be ploughed and disked prior to direct seeding. Direct seeding may also be combined with matrix plantings to provide a greater tree cover, more rapid canopy closure, greater diversity and more random tree dispersion.

Native Coniferous Tree Nurse Crop

Throughout southern Ontario white pine (*Pinus strobus*) and red pine (*Pinus nesinosa*) have been used to cheaply and effectively restore degraded lands and stabilize slopes (e.g., Oak Ridges Moraine, pits and quarries, valley lands, etc.). Once these plantations establish a closed canopy, native deciduous vegetation begins to establish naturally as seeds are blown or carried into the site. With proper management, the coniferous "nurse crop" can be selectively removed (OMNR, 1996) and the native deciduous vegetation allowed to re-colonize the site.

The advantages of a native coniferous nurse crop are many:

- the cost of seedlings is very low (OMNR nursery production is well established);
- seedlings in tubes are easily machine planted over large areas;
- site preparation is minimal;
- seedling success is high due to drought tolerance and relatively little small mammal damage;
- rapid growth rates create a canopy in ten years; and,
- red pine does not re-seed (and so is not invasive) and white pine re-seeds very little.

Within Sandbanks, the establishment of a coniferous nurse crop could prevent degradation of some of the very large areas [degradation by the aggressive invasive species, i.e., European buckthorn (*Rhamnus catharticus*) and red cedar (*Juniperus virginiana*)] awaiting more intensive (and costly) restoration options. A nurse crop will enhance subsequent restoration efforts in old fields if managed properly.

Enhancement Plantings

As outlined above the initial phase of forest restoration focuses on the establishment of a tree canopy. Once this initial phase is completed, there will be relatively low biodiversity based on the limited suite of trees and shrubs selected for restoration. While it is expected that some new trees, shrubs and herbs will become established through natural dispersal mechanisms, some native species may require a very long time (hundreds of years) to become re-established in restored forests. Recent restoration work at Rondeau Provincial Park has shown violets dispersed by insects (e.g., ants) migrate into new suitable habitat at rates measured in a few meters per year.

Enhancement planting is a mechanism to speed up natural dispersal to more quickly increase native species biodiversity. Increased awareness of restoration and the use of native species have resulted in a greater availability of native plants from local nurseries. While cost may be prohibitive, introducing small numbers of plants long absent from the

ecosystem will provide greater opportunity for the long-term re-establishment of these species. Park programs can be built around enhancement plantings. For example, a park nursery could be established, local seed collected and seedlings grown. Volunteer programs could provide some labour to operate the nursery and plant stock during the summer months.

Monitoring

Vegetation restoration is a relatively new science. It is important therefore to examine the results of management intervention through monitoring. The outcome of specific actions should be reviewed to determine if they match original expectations. Unexpected events need to be recorded to determine what their relationship may be to the actions of restoration. Careful monitoring and data analysis will indicate what is working and what is not, leading to a refinement of the existing management actions or the initiation of new ones directed at achieving the original goal. Setting goals and objectives, implementing management actions, monitoring and perhaps refining subsequent actions is an "adaptive management" framework.

Below are three main areas at which monitoring should be directed. A comprehensive monitoring framework for restoration should be developed.

1. Measuring the successful growth of planted trees and shrubs each year, determining canopy closure, percent survival, and the causes of death by looking at deer browsing, small mammal damage, disease, impact of drought, and competition from other plants, etc.;
2. The success of restoration will be measured by natural increases in native species biodiversity, as measured by the incidence of new plants and animals in the restoration areas and analysis using the Floristic Quality Index; and,
3. Shaping the next steps in restoration such as the need to create gaps/openings in areas planted at close spacing to create tree canopy, and the need to undertake enrichment plantings.

Conclusion

The restoration plan is about bringing back natural forest cover to areas cleared for agriculture. The most important and achievable step is creating a closed tree canopy in old fields and agricultural lands. Once a tree canopy is established, the associated microclimatic and soil microenvironment changes that ensue create conditions that lead to the establishment of ever more "forest-like" conditions. This occurs as forest animals perceive these areas as habitat and begin to utilize them, and as forest plants become established through the natural dispersal mechanisms of wind, water and animals.

The proximity and availability of forest plants and animals will influence the rate at which the relatively simple human restored ecosystem becomes a complex natural forest ecosystem. There will be no shortage of "enhancement" opportunities for restoration ecologists.

In time natural processes will determine the suite of species ecologically suited to occupy the site.

References

Bogart, T. W. 1928. *An Ecological Study of the Sand Dunes of Prince Edward County, Ontario.* A dissertation submitted to the graduate faculty in candidacy for the degree of Master of Science, Department of Botany, The University of Chicago: Chicago, IL.

Conger 1819. *Report and Field Notes. Book 438.* Hallowell Township.

Cornett, M. 1999. Direct seeding: a promising hardwood forest restoration strategy (Minnesota). *Ecological Restoration,* 17(4): 230-231.

Daigle, J.M. and D. Havinga. 1996. *Restoring Nature's Place. A Guide to Naturalizing Ontario Parks and Greenspace.* Ecological Outlook Consulting and Ontario Parks Association: Schomberg, ON.

Gibbard, H.J. 1973. *An Ecological Assessment of Prince Edward County. With Special Reference to Sandbanks/Outlet Beach Area.* Internal OMNR draft report, incomplete.

Merritt, A. 1973. *Point Petre: An Evaluation of the Physical Outdoor Recreation Resources of the Former Department of National Defence Properties in Athol - South Marysburgh Townships, Prince Edward County, Ontario.* Honours B.E.S Thesis, University of Waterloo, Waterloo, Ontario.

Norris, T. and D. Cuddy. 1990. *An Evaluation of the Life Science Resources of Sandbanks Provincial Park.* Ontario Ministry of Natural Resources, Eastern Regional Office: Kemptville, ON.

OMNR (Ontario Ministry of Natural Resources). 1996. *Extension Notes. Managing Regeneration in Conifer Plantations to Restore a Mixed, Hardwood Forest.* Queen's Printer for Ontario: Toronto, ON.

OMNR (Ontario Ministry of Natural Resources). 2004. *Sandbanks Provincial Park.* Available: http://www.ontarioparks.com/english/sand-maps.html

Richards, N.R. and F.F. Morwick. 1948. *Soil Survey of Prince Edward County.* Report No. 10 of the Ontario Soil Survey, Experimental Farms Service, Dominion Department of Agriculture and the Ontario Agricultural College: Guelph, ON.