

Grand River Conservation Authority

Watershed Forest Plan

**A paper written by J. R. Irwin, at the request of Martin Neumann,
for inclusion in the GRCA Watershed Forest Plan**

SILVICULTURE

BACKGROUND

A discussion of silviculture in any forest plan must start with a discussion of what it is and what it is intended to accomplish. Firstly, it must not be confused with forest management. Forest management addresses the derivation of objectives for a forest. It answers the questions of why and how a forest will be managed and to what purpose. It is perfectly reasonable, in a forested area, to have forest management objectives that encompass everything from economic development to protection or no actual management, simply monitoring. Part of the planning process for a forest is to reconcile the various objectives for an area, resolve any conflicting objectives, and to integrate the objectives for varying uses. If forest management objectives are reached, that include the purpose of deriving income, then forest management can include the application of business principles, as well as technical forestry principles, to the management of the forest. The term forest management can be applied to an individual woodlot, or the forests of a geographic area such as a large tract of Crown land, or a watershed.

It must be remembered, that forest management cannot be carried out and objectives cannot be achieved, without an understanding of silvics of the species in the forest. Silvics encompasses how trees grow, including:

- soil, site, moisture and nutrient requirements,
- flowering, fruiting, seeding and regeneration characteristics,
- early stand growth and development, longevity,
- response to competition including competition for water and nutrients, light, and physical and chemical competition with other species, and within its own species,
- pathogens and insects, and predation from mammals.

It should be understood as well, that silvics is a science that is founded on ecological principles and the understanding of forest ecology, and how ecology influences forest establishment, development and decline. One key to the interrelationship between forest management and silvics, is that forest management objectives cannot be met that are inconsistent with the silvics of the species or the forest. For instance, to expect red pine to exist long enough to produce old growth on a calcareous site, is inconsistent with the silvics of the species and will result in a declining forest, long before even what could be expected as normal stand maturity.

The role of silviculture is to tie forest management and silvics together. Silviculture is the art and science of manipulating stand or forest establishment, stocking or density, composition and growth, throughout its life, and implementing programs to eventually guide its evolution into the

next forest, if this is to occur. The purpose of a silvicultural system is, therefore, to use the silvics of the particular species to develop a silvicultural system for the forest, that will meet the forest management objectives. The silvicultural system can be very intrusive into the natural forest evolution or development, or less intrusive, based on the species silvics and the particular objectives to be achieved.

One guiding principle of forestry is that management, and hence silvicultural systems, should have objectives whose achievement can be measured over the period of management. Forestry also has the advantage, when compared to other ecological sciences, that there is considerable economic return possible from forestry. This has resulted in the funding of extensive research over the years, that has added to the wealth of knowledge concerning silvics and silviculture. This research has been conducted by federal and provincial governments, as well as private industry.

HISTORY

Silviculture is a science that has been around for hundreds of years. In the fifteenth through eighteenth centuries, the great empires that were dependent on their navies; England, Spain and France, knew the importance of their forests for ship building timbers. In the New Forest in England, standard practice was to create earthen berms topped by wooden palisades. These would enclose areas to be regenerated to oak seedlings. The purpose of these structures, was to exclude deer that would destroy the young trees. Trees were not only harvested, but pollarded, cutting off only the larger limbs, to produce wood for ships, primarily ribs, without cutting the entire tree. Later, the tree itself would be harvested for planks.

In the new world, things were different. Early native populations in southern Ontario, primarily the Neutrals and Hurons, were agricultural societies who used fire, girdling, and other forest clearing, to maintain their fields and settlements. Stories are told of the large fields that were created, and that the original game of lacrosse was played on huge fields several miles wide. This was the period where large prairies occurred, maintained by periodic fire. Silviculturally, this disturbance had the effect of maintaining forest in various stages of maturity, from young regeneration, suitable for browsing of ungulates, to mature forest. The heavy use by the native peoples of local game, also served to keep vegetation predators in check, an alternative to the berms and palisades of medieval Britain. Although these peoples were not intentionally practising silviculture, the result was silvicultural, and resulted in positive effects to the forests in terms of maintaining the diversity of species, forest types and age classes.

In the mid seventeenth century, due to the conflict between France and England, the Iroquois, allied with the British, were encouraged to war against the Hurons, allied with the French. When the Hurons were displaced from southern Ontario, and the Iroquois returned to their home further south, the forests of Ontario began to recover and to encroach on the fields and prairies. This is the forest that was found by the early surveyors and settlers, essentially an unbroken forest, which had had approximately one hundred years, without significant disturbance, to mature. A forest of this nature had probably not existed for centuries before this time. It was an anomaly.

This native disturbance, as well as the original clearing by settlers, including clear-cutting and burning for charcoal and other forest products, resulted in the southern Ontario forests that we have today. The severe disturbance allowed trees, that require disturbance and full or partial light to regenerate: poplar, pine, oak, hickory, cherry, red and silver maple, and ash, to maintain themselves in the landscape. Subsequent logging has not always considered the effect of the logging on the retention of these species. In other words, our modern impact on forests has still been exploitive rather than silvicultural, and not planned to result in positive effects on the forests. In addition, our pattern of land clearing has resulted in a ballooning population of deer and other wildlife, that can preclude the regeneration of some species, particularly the oaks, which are a preferred browse species for deer. The result is that some species are being removed from our forests in logging, and are being replaced by other more shade tolerant species such as sugar maple and beech. We are losing some of the forest types that were once the more common forests in our area. We have not yet learned the lessons from the fifteenth, sixteenth and seventeenth centuries.

TODAY

In order to provide standards for managing the forests of Southern Ontario, "A Silvicultural Guide to Managing Southern Ontario Forests" was produced by the Ministry of Natural Resources in 2000. A considerable body of silvicultural knowledge and research exists in the United States, in similar forest types, on similar sites, that is not entirely recognized or included in the Ontario document, but which provides additional information on which to base forestry decisions. Although some of our forests are called Carolinian, foresters and environmentalists do not necessarily look to the U.S. for answers, and unfortunately, much of the Ontario research into hardwoods has been conducted on Crown Land in Central Ontario, not on private land in the south. Much of our current effort is focused on surveying "sensitive areas" and documenting the sensitive features, whether plants or animals. Our first response, the politically correct one, is to preserve these areas from impacts of activities that in many cases resulted in the richness of the flora and fauna in the first place. This could be viewed as a response based on the fear of causing some irreparable harm, rather than assuming the risk of a silvicultural intervention which would produce a positive affect on the forest or landscape.

An example of our current forest management dilemma is illustrated by the problems that arise between shade intolerants or mid tolerants, and shade tolerant species. Firstly, shade tolerant species such as sugar maple are prolific seeders, in seed years, and the seed and seedlings are not heavily preyed upon by wildlife to the point that seed and seedlings are not available for regeneration after a harvest. On the other hand, with a species such as oak, in normal years up to ninety percent of the seed can be rendered non viable by weevils. Only in a bumper seed year does enough seed survive to have any chance of germinating. However, predation by birds and mammals; jays, squirrels, mice, chipmunks, deer, turkeys, can also take a significant toll. Add to this that when the seed germinates, the seedlings are preyed upon by deer and rabbits. Consequently, some of the mid to shade intolerants are classed as trees with low regeneration potential. Even if the proper silvicultural harvesting system is implemented, the other seed and seedling problems can thwart regeneration efforts. The problem, in a nutshell, is that the more productive the site, the less likelihood of maintaining species such as oak. In Ontario, we may want to leave an oak, or oak - hickory forest, unmanaged, but depending on the site, the stand

may shift on its own to more shade tolerant species. Similarly, silvicultural compromising, by implementing a system such as selection of individual trees for harvesting, or a group selection, harvesting trees in small groups, on too productive a site, if perpetuating the oak is a management objective, is doomed to failure. A further problem is that where shade tolerants do not overcome the site, shrub understories such as dogwood, witch hazel, blue beech, and buckthorn, may preclude stand replacement. Those who argue that this succession is a natural phenomenon and should be allowed to occur, must be prepared to accept the loss, or at least a large reduction of this forest type, in our landscape. The bottom line, and this has been recognized in forestry circles for centuries, is that to manage and regenerate mid tolerants and intolerants such as oak and pine, is a very time consuming and costly venture, fraught with controversy and disappointments. Expensive and controversial treatments such as shelterwood cutting, clear cutting, herbicide applications, and prescribed fire, are the norm. Spending money on these treatments, without controlling wildlife predation of the trees, is similarly a waste of time and effort.

This whole issue of stand replacement is often clouded by the subject of forest diversity. Forest diversity can be looked at in an individual forest. This involves species diversity or species richness, i.e. the number of species present. It can also include structural diversity; the number of canopy layers, size class distribution, forest floor structure, or distribution of dead and downed trees. Forest diversity in a landscape context normally includes some consideration of forest and site types and their distribution. This can include the percentage of forest cover represented by individual forest types, their age classes and conditions. In a silvical context, one must consider the species associations in which tree species and forest types normally occur. For instance, many people are opposed to monocultures. However, this is the normal stand type in which some species, notably shade intolerants and some mid tolerants, occur. If some monocultures are lost through management or succession, then these species may be lost in the landscape. The lesson is, that in order to maintain some species or stand types in the landscape, it may be necessary to narrow the richness of the species in a local area, in order to maintain, silviculturally, a particular stand type that is in danger of loss in a regional context. For instance, in managing for oak and hickory, other species such as maple and ash, with a higher regeneration potential and therefore a competitive advantage, are discouraged in the silvicultural program. If all or most of these forests are in a mature age class, and in danger of loss through succession, then new, younger forests must be silviculturally re-established. This can only be successful on specific site types, and the trick is to know where these sites occur and why, to have the best chance of retaining these species associations in the watershed. Alternately, if a species type, such as pine, is normally lost over time through conversion or succession to hardwoods, then silvicultural programs must be adopted to discourage these hardwoods, or new pine stands must be constantly established. On the other hand, species richness should be encouraged in tolerant hardwood forests. In some cases, species richness has been reduced by removal of non commercial species such as beech, ironwood or hemlock, resulting in increased stress amongst the remaining trees.

THE WATERSHED

The implications of silviculture to the watershed can be summarized very simply. Acting on these implications is the hard part. Firstly, one must know what type of forests occur, where in

the watershed, why, and what has caused them to be there and in their current form and condition, and how are they evolving. The forests as they exist, are a result of past management and mismanagement. Some forests, due to past history, are not the most appropriate forests for the sites on which they occur. Underlying this history of management, is the history of glaciation and the surficial geology of the watershed, that has resulted in the current soils and drainage. This physical and social history has resulted in broad forest types that occur on features such as the Stratford till plain, the Waterloo Moraine, the Horseshoe moraines, the Guelph Drumlin Field, the glacial spillways and isolated kames and eskers, aeolian deposits, and lake sediments and beaches of old glacial lakes. Compounding these simple landforms are many areas where the original materials overly something else, which changes the normal growing conditions that might be expected on a particular site. Past history, including topography and disturbance has resulted in the forests of the watershed as we see them today.

We must see where our forests have been and where they are going, in order to determine our most appropriate actions. The natural tendency to replacement of shade intolerants and mid tolerants by shade tolerants must be recognized as a natural phenomenon, often aided by misguided management practices. By understanding the history and underlying soil strata, and the normal processes of succession, silvicultural systems must be chosen carefully, to meet management objectives that will not result in deterioration of the quality and quantity of the forests of the watershed. In some cases, what is currently needed are silvicultural programs that will result in forest restoration, and one must not make the mistake of discounting the quality of a forest based on its current degraded condition, if the site and species are conducive to natural or man-made restoration. Forests have been intentionally degraded by excessive harvesting and mismanagement, in order to remove barriers to residential development of these forests. This artificially degraded condition, which can be only a temporary condition, leads to permanent loss of the forest.

Based on this assessment of the forests and forest sites of the watershed, management objectives could be developed, in a forest plan, which would identify targets for the representation of various forest types, as well as for forest cover as a whole. This would include identifying where in the watershed these forest types are normally found, and what pressures exist in the area that affect their quantity and quality. Potentials could be identified for various management regimes in terms of economics and environmental quality. Goals for maintenance, restoration, replacement and management, could be set for the watershed as a whole, which could be recognized and incorporated into local plans. Recommended silvicultural systems and options, for each forest type, could be identified to meet various objectives. These would in effect become Best Management Practices.

Years ago, local landowners, through groups like the Huron District Woodlot Owners Association, convinced the Ministry of Natural Resources to implement the Woodlands Improvement Act (W.I.A.) program, and to fund agencies such as conservation authorities in forest management efforts. It is noteworthy that initial funding for this program came from the Agricultural Rehabilitation and Development Agreement between the federal and provincial governments. Under this program, these two levels of government assumed some of the cost of the more expensive silvicultural treatments: tree growing and planting, early tending and thinning often by girdling, rehabilitation of deteriorated stands such as Scotch pine jungles, and

expensive regeneration treatments in mid tolerant oak and pine stands. The W.I.A. program has been cancelled, leaving landowners with few resources to carry out these treatments that were formerly subsidized. The implications are, that older shade intolerant and mid tolerant stands are being harvested or are naturally succeeding to shade tolerants, and funding for establishing new forests, such as pine, has been reduced. Funding for expensive treatments in existing stands, such as underplanting, herbicide applications, or prescribed fire for regeneration or for control of invasive exotics, has similarly been reduced. Consequently, through lack of resources, we are in danger of losing some important forest types.

ACTION ITEMS

To counter the loss of forest type and quality, landowners must be encouraged to seek silvicultural systems that not only implement the best treatments for the individual landowner's forest, and meet the particular landowner's objectives, but recognize the forest's place and importance in a landscape context. The concept of best management practices with respect to forests is more comprehensive than for some other land uses, as what happens in an individual forest has wider landscape implications, both from a landscape diversity perspective, potential loss of tree and other species, and for other implications such as for water recharge. These wider implications must be borne in mind during the setting of management objectives for the watershed and for individual properties, in the making of land use decisions, and as a basis for the adopting of appropriate silvicultural systems.

Direct threats to our forests should be recognized and discouraged. These may range from development, clearing, over-cutting, over use by recreationists, use of forests for grazing, or encroachment by invasive exotic species.

We should look to the North-eastern United States for answers to our problems, and take advantage of the research and experience that is applicable to southern Ontario. The Ontario Ministry of Natural Resources has recently completed "A Silvicultural Guide to Managing Southern Ontario Forests". When taken in conjunction with the American experience, this publication provides standards to be applied by the professional community. The Extension Notes produced by OMNR have in the past addressed some silvicultural issues, but because they are targeted to the layman, they tend to be over simplified and in some cases create false expectations. What is needed is a series of good silvicultural guides or best management practices, with a fairly high content of technical material, aimed at the professional landowner, whether that be a non farming rural or urban landowner, or a farmer. This was done in the U.S. over twenty years ago, when the U.S. Department of Agriculture produced a series of management handbooks for the major forest types of the northeastern U.S. Nothing similar has been produced in Ontario. The opportunity exists to take publications such as; "A Silvicultural Guide to Managing Southern Ontario Forests", break it into its individual cover types and add the material that is relevant to a landowner, to make it into a series of comprehensive silvicultural guide for each of those stand types. The landowner would then have access to a "Best Management Practices" guide, with the specific information that applied to his property, to guide his decision-making and his silvicultural efforts.

Over the years, many landowners have managed their properties conscientiously and have kept records of their successes and failures. Some of these have been documented in the Land Stewardship Demonstration Areas Catalogue for southwestern Ontario which is available on a CD and on the internet. The availability of this type of information should be promoted through landowner associations, with perhaps self-guided driving tours being set up so landowners could talk to their neighbours about their experiences. Some of the lessons that should be highlighted in demonstration sites are:

- Side by side comparison of a woodlot managed for production v.s. one managed for old growth.
- Various Thinning regimes for hardwoods and conifer plantations.
- Plantation design and species mixtures.
- Plantation successes and failures.
- Sugar bush management
- Dollar returns for various management regimes.
- Prescribed burning for regeneration of shade intolerant species.
- Prescribed burning for control of invasive exotics
- Naturalization efforts.
- Logging practices
- Site history and potential
- Insects and diseases
- Windbreaks and shelterbelts
- Invasive exotics

Many local woodlot owners associations have formed in the last few years, and the members are taking advantage of the collective experience of a group of knowledgeable and dedicated landowners. These groups should be supported by the local community, the local forest industry, and local agencies.