USING IRREGULAR SHELTERWOOD SYSTEMS TO OPTIMIZE VALUE GROWTH IN SOUTHERN ONTARIO MAPLE FORESTS

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Extended Abstract -

Many shelterwood variants use even- and uneven-aged concepts to manage stands with complex/patchy structure. It can take a skilled practitioner to prescribe, apply, or discern the system or hybrid being used, (e.g., single tree selection (STS); thinning, continuous cover (CC), group selection, irregular shelterwood (IS), expanding gap; and/or extended irregular shelterwood (EIS). This presentation will discuss the southwestern Ontario situation, IS systems and their application and four case studies in exceptional stands with histories of good forest management (GFM).

IS (e.g., Femelschlag, Plenter systems) have been used worldwide for many years and are best documented in European literature (e.g., Troup, R.S. Oxford: Clarendon Press, 1928). Raymond *et al*. (2009) reviewed IS describing many applications, suggesting that the group of variants can be used to restore degraded forests and manage forests with irregular structure.

EIS and CC approaches scaled from individual tree to stand/woodlot have been used by the author to optimize/maximize value and volume growth while maintaining forest/ecosystem integrity and aesthetics. These approaches are particularly useful in managing heterogeneous stands of even-aged patches, influencing regeneration development with maturing upper-canopy over multiple stand entries, optimizing revenue over time. A simple example of CC would be converting a conifer plantation to natural forest, where regeneration is started, manipulated and released over a number of entries, resulting in scattered large conifers over a “natural” forest.

The author has used a combination of IS approaches as a primary strategy to manage private woodlands in southwestern Ontario since 1996. SW Ontario is an agricultural landscape with some excellent site quality, valuable hardwoods, and variable woodlot size, similar to much of the US Midwest. Upland forests are often dominated by sugar maple (*Acer saccharum*) (Mh), and lowland deciduous forests are often dominated by red or silver maple (*Acer rubrum/saccharinum*), and/or ash (*Fraxinus spp*). Most stands originated after historic heavy cutting or abandonment by agriculture, often resulting in complexes of even-aged patches, even in very small woodlots.

In upland stands with high-quality sawlog and veneer potential (e.g., Mh, red oak (*Quercus rubra*) (OR)), the IS approach can foster the development of trees with the highest value growth potential to optimize value growth over time. The author has estimated that the value growth for veneer-potential trees without height-limiting defects range from 15 to 25% per year for trees from 13 to 18 inches dbh. In general, managing these stands for income should focus on increasing the proportion of veneer potential trees and harvesting them as their grade-value growth declines.

The approach also works in lowland stands because they tend to have lower value species without a significant grade premium. In these situations, the approach emphasizes volume growth per tree (i.e., tree form and density) rather than grade. It can also be used in rehabilitating degraded upland forests, because diameter-limit distribution requirements do not apply, allowing the marker to focus on improving tree quality rather than STS requirements for retaining specific stem numbers for each diameter class. This also stimulates growth and development of vigorous regeneration.

Four case studies of sugar maple-dominated forests with a history of GFM are described below. Most GFM at the sites began in the 1980's through Ontario Ministry of Natural Resources (OMNR) extension programs.

GENERAL SITE DESCRIPTIONS

The four sites were sugar maple dominated; well-stocked with large, high-quality stems on excellent sites (Mh SI of 100 ft or higher at 100 years); have been well-managed and have owners with a positive stewardship approach. Stands 1 and 3 were over 80% sugar maple and Stands 2 and 4 were 60% Mh with Or, black cherry and other northern hardwood associates. Our initial entry used the CC approach with follow up entries incorporating an expanding-gap component. The stand densities went from 104-113 ft^2/acre (24-26 m^2/ha) to 83-91 ft^2/acre (19-21 m^2/ha).

Each entry considered biodiversity and the retention of important cavity trees. Each site had some trees with 20 meter or greater merchantable height (25-cm top). Income from the harvests was clearly dependent on earlier improvement thinning. Harvests in the eighties had established desirable regeneration through the stands. Table 1 provides summaries of the income from each woodlot, including Present Net Value in Cdn. and US dollars.

CASE STUDY 1

The woodlot is a 13-acre sugar maple forest with a patchy complex of three even-aged conditions; large older trees over sapling regeneration, even-aged small sawtimber, and single-aged sapling regeneration. It had been marked and harvested in 1980 and 1989 through OMNR extension programs and had very good growing stock.

W&A marked the stand in 1998, 2005 and 2018 using IS prescriptions; conducting canopy thinning/partial release cut in two-aged parts, improvement thinning/harvest in small sawlog areas, and expanding gap in openings with saplings. There has been excellent growth and overall grade improvement and patches of smaller trees have developed into a canopy of high-quality maple, many with veneer potential. The stand will be assessed in 2025 to plan for the next harvest. The nominal annual net return since 1998 was $494/acre/year Cdn.

CASE STUDY 2

Grandad purchased this 45-acre farm woodlot in 1912 and the family managed the woodlot with some advice from foresters till 1997. W&A began working with the owners in 1998 when the stand was a complex of single and two-aged patches, some with denser canopies and little regeneration to gaps overstocked with small saplings, and stages in between. Most areas were dominated by medium or very large (24-36 in. dbh) sawtimber and areas with significant components of higher concentrations of red maple, ash, or beech (*Fagus grandifolia*). The canopy included spectacular individual Mh, Or, and white pine.

A series of eight harvests were conducted using IS approaches between 1999 and 2018, three "comprehensive" harvests and five targeted entries (Table 1). The targeted entries included salvages of blowdown, beech, or ash. Three recent entries were to spread income and incorporated the expanding gap approach in some older openings. The nominal annual net return since 1999 was $434/acre/year Cdn. The woodland remains well-stocked with quality trees and will be reassessed in 2028.

CASE STUDY 3

This 17-acre farm woodlot was marked by the OMNR in 1982 (no information available). In 1999 the woodlot was primarily a two-aged stand, dominated by large sugar maple of exceptional quality (Figure 1) on a very productive site. There were some areas with scattered ash, beech, and Or.

W&A implemented comprehensive harvests in 1999 and 2020 and a smaller harvest in 2006 to clean up storm damage. The 2020 entry started some expanding-gap aspects. The nominal annual net return since 1999 was $520/acre/year Cdn. The woodland remains well-stocked with high-quality trees is scheduled to be reassessed in 2030.

Figure 1. Inspectors at Case Study 3 (2020) with long, clear logs with small hearts.

CASE STUDY 4

This 35-acre farm woodlot was marked by the OMNR in 1982 (no information available). W&A implemented harvests in 2004 and 2020. In 2004, the stand had large single-and two-aged patches on variable (i.e., some deep soils and others shallow to bedrock) but mostly very productive sites. Patches ranged from single-aged polewood/small sawtimber sections to two-aged with very large sawtimber over dense sapling regeneration. In many areas, seedling and sapling cohorts had developed after the 1982 harvest. The forest was dominated by good to excellent Mh, with an exceptional Or component. In the 2004 harvest, at the height of timber values, the Or averaged 482 bd ft/tree. Other species included ash, beech, and black cherry *(Prunus serotina).*

The two harvests were conducted using IS approaches and the nominal annual net return since 2004 was $432/acre/year Cdn. The woodland is scheduled to be reassessed in 2030.

Figure 2. Butt of awesome red oak at Case Study 4.

In Summary, commercial harvesting practices like high-grading or commercially clearcutting have left many forests with degraded growing stock and limited value growth potential. Applying any good forestry management strategy will improve forest/tree quality and value growth. However, the IS approach is particularly useful as a practitioner can place more emphasis on tending high-quality individual trees of all sizes; improving their immediate growing conditions and ecological or value potential, rather than focusing on balancing diameter distributions over the whole stand through STS.

The IS approach requires astute and intuitive planning and tree marking; and familiarity with felling/harvesting practices. Like STS, IS can provide for consistent forest cover and harvests over time. However, applying a STS approach (i.e, conforming to STS-diameter class guidelines) onto an even-aged structures can result in damaging, prematurely harvesting, or limiting the development of high-quality trees. Careful harvesting and monitoring with IS approaches can result in less damage to residuals, higher production of grade sawlogs and veneer, and less administration then STS. Targeted entries, to manage cohorts in even-aged patches/clusters within a stand, can foster the development of desired high-value trees (i.e, for timber value, wildlife habitat, diversity) by focusing on conditions in the particular patch, resulting in greater economic returns.

These exceptional returns from harvests are clearly the result of good historical management. W&A manages many woodlots on equally-good sites that have been depleted by commercial harvesting practices; many are recovering well with care over time. The subject woodlots remain well-stocked with high quality canopy trees and developing younger classes, and should remain similarly profitable in the future.

Table 1. Four case studies in southwestern Ontario woodlands, showing woodlot size, entry years, Nominal Return and Present Net Value (PNV) of annual and total revenue for each woodlot.

Case Study	Area (Acres)	Entries (years)	Nominal Annual Annual Return/acre **($Cdn/US)**	2021PNW ($/acre/year and Total revenue) $Cdn and $US (5% IRR) **$Cd/acre/yr & total**	**$US/ acre/yr & total**
1	13	1980, 1989, 1998 2005, 2016	$494/$396	$1,191 / $278,625	$956 / $223,776
2	45	1999, 2001, 2003, 2004, 2007, 2014, 2018	$434/$349	$ 818 / $699,098	$657 / $561,525
3	17	2000, 2006, 2020	$520/$418	$1,069 / $363,311	$657 / $291,707
4	35	2004, 2020	$432/$347	$ 860 / $511,528	$691 / $410,866

Literature Cited

Troup, Robert. 1928. Silvicultural Systems. Oxford: Clarendon Press. 212 p.

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