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 silvicultural system being used, (e.g., single tree selection (STS); thinning, continuous cover, group selection, irregular shelterwood (IS)/femelschlag; expanding gap; and/or extended irregular shelterwood). This presentation will discuss the SW Ontario situation, IS systems and their application and four case studies in exceptional stands with histories of good forest management practice.

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.

Extended Irregular Shelterwood and Continuous Cover (CC) approaches scales from individual tree to woodlot scales) have guided the author in in optimizing/maximizing 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 a maturing 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. This 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 saccarum*), and the most valuable lowland forests are dominated by red or silver maple (*Acer rubrum/saccharinum*), and/or ash (*Fraxinus sp*). 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., sugar maple, red oak (*Quercus rubra*)), 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 14 to 18 inches dbh. In general, managing these stands for income should focus on increasing the density of veneer potential trees and harvesting them as their grade-value growth declines.

The IS approach also works well in lowland stands (i.e., soft maple swamps), that are inherently even aged. However, because soft maple does not have a significant grade premium, the approach is used to maximize volume growth per tree (i.e., tree form and density) rather than grade. It is also works well in rehabilitating degraded upland forests, as diameter-limit distribution requirements do not apply because the marker can focus more on improving tree quality rather than STS requirements for retaining specified stem numbers for each diameter class. This may also stimulate growth or establishment of good-quality regeneration.

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

The four sites were well-stocked, with large, high-quality stems on very good to excellent sites, have been well-managed for many years and owners with a good-stewardship approach. Each entry considered biodiversity and retention of important cavity trees in particular. Each site had a reasonable number of trees with more than four 16-foot grade saw/veneer logs. Income from the harvests was clearly dependent on previous improvement thinnings as the stands developed. Harvests in the eighties and more recently established regeneration through most of the areas. Table 1 provides summaries of the income from each woodlot, including Present Net Value in Cdn. and US dollars.

Case Study 1: In 1998, Williams & Associates (W&A) began working with a 13-acre sugar maple forest in 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 similar 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 potential improvement and smaller patches have developed into a canopy of high-quality maple, many of veneer quality. 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 managed the woodlot themelves with some advice from forester's 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 little regeneration to canopy gaps overstocked with small saplings, and many in between. Some patches were dominated by medium or very large (16-100 in dbh) sawtimber and some had higher concentrations of sugar maple, ash, or beech (*Fagus grandifolia*). The canopy included spectacular individual red oak, sugar maple, and white pine.

A series of eight harvests were conducted using the IS approach 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, although no information was available regarding that entry. 1999 when the woodlot was primarily a two-aged stand, dominated by large sugar maple of exceptional quality (Figure 1) on a very productive site. In There were some areas with scattered ash, beech, cherry, basswood, hemlock and red oak

W&A implemented comprehensive harvests in 1999 and 2020 and storm damage was cleaned up in 2006. The 2020 entry started some expanding-gap aspects. The nominal annual net return since 1999 was $352/acre/year Cdn. The woodland remains remains well-stocked with high-quality trees of many size classes and the stand 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, although no information was available regarding that harvest. W&A implemented harvests in 2004 and 2020. In 2004, the stand had larger patches of single and two-ages 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 stand to two-aged with very large sawtimber over dense sapling regeneration. In many areas, seedling and sapling cohorts had developed after the 1982 harvest. These areas were dominated by sugar maple that varied from good to excellent, with an exceptional red oak component (Figure 2). In the 2004 harvest, at the height of timber values, the red oak averaged 482 bd ft/tree. Other species were scattered throughout including 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.

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.

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

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 Return **($Cdn/US)**	2021PNW of Annual and Total Revenue (5% IRR) **$Cd per year/total)**	**$US per year/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