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NORTHERN HARDWOODS RESEARCH INSTITUTE'S QUARTERLY NEWSLETTER

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NHRI'S SILVICULTURE PRESCRIPTION SYSTEM

PRESENTING NHRI's SPS 2.0!

NHRI's Silviculture Prescription System is a 5-step process that starts with the description of a stand and ultimately recommends specific treatments in forests dominated by hardwoods.

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THE IMPORTANCE OF ROBUST SILVICULTRE PRESCRIPTION SYSTEMS

Why executing the right prescription for a given stand matters!

Managing hardwood and mixed-wood stands requires well-planned treatments that not only improve existing trees but also regenerate desirable species. The successful recruitment of new cohorts of key tree species is vital to sustaining our resource. Better silviculture will lead to better productivity and a higher ratio of more valuable trees. We think that it is also directly compatible with other values and objectives such as habitat and ecosystem services. A thorough understanding of the relationships among species, site, environment, and climate – informing a sound silviculture framework – allows forest managers and landowners to balance timber production objectives with habitat and biodiversity values.

In short, better silviculture based on the best available science leads to healthier, more productive and more valuable forests. That is why our team has devoted so much energy, resources and brainpower to developing and mobilizing the Northern Hardwoods Research Institute's Silviculture Prescription System (NHRI – SPS 2.0).

Considering the current state of our forest, our efforts to develop the science and transfer the knowledge and tools to those who work in the field are more important now than ever before. For example, a preliminary review of 20 years of inventory data and re-measurements of permanent sample plots in the Maritime provinces indicates that:

- **Sugar Maple proportion is declining (- 20%).**
- **The proportion of large trees and sawlogs is declining.**
- **Poor quality trees have less sawlog recovery (30%).**
- **Many treated areas (>50%) in the past fail to meet regeneration expectations in the short term.**
- **Less than 25% of the plots studied meet expected stocking of desirable species.**
- **There is significant uncertainty regarding the expected future growth and regeneration.**

The good news is that through silviculture, these problems can be controlled, mitigated, and even eliminated, hence the NHRI - SPS 2.0. In the following pages we intend to present to you our revised and improved silviculture system. This important tool is the embodiment of all the science and field research that has been conducted at NHRI since our inception – as well as having synthesized knowledge from other jurisdictions. The implementation of our SPS 2.0 sits squarely at the junction of applied forestry research and field operations.

Before getting into the technical aspects of the NHRI – SPS 2.0, it is imperative to discuss the central objectives of our silviculture prescription system and the key forestry concepts underlying it that must be understood by those ultimately responsible for forest operations – managers, supervisors, contractors and operators.

THE IMPORTANCE OF ROBUST SILVICULTRE PRESCRIPTION SYSTEMS

Why executing the right prescription for a given stand matters!

THE DISCLAIMER

It is important to note that our silviculture prescription system focuses primarily on the objective of timber production. In that context users must keep in mind that other considerations and guidelines for wildlife habitat, conservation and diversity can override the NHRI SPS 2.0's recommendations. That being said, the system is structured in a way that makes it easy to incorporate various guidelines and ultimately translate them into work instructions, to be followed during operations, and implementation checklists that aim to ensure continuous improvement through post harvest follow-ups.

We decided not to explicitly incorporate wildlife habitat, conservation and diversity objectives directly into our prescription system due to the great diversity of guidelines, from one jurisdiction to the next, and their constantly evolving nature. As an example, here in northwestern New Brunswick most companies operate at some level within three different jurisdictions – Maine (USA), Québec (Canada) and New Brunswick (Canada). Field implementation of the NHRI SPS 2.0 has proven to us that this decision was wise, since incorporating guidelines from various jurisdictions has proven relatively easy by adding a few lines items to work instructions. More importantly, these guidelines are almost always aligned with the sound fundamental forestry concepts that form the foundation of our prescription system. Good silviculture equals sustainable forest management in the vast majority of cases.





*Photos by **Jennifer Amanda Cyr***

NHIR's SPS 2.0 - THE MAIN OBJECTIVES: IMPROVING SPECIES COMPOSTION, ACCEPTABLE GROWING STOCK AND GROWTH RATES

Species Composition

Currently, one of the biggest issues facing our hardwood forests is the undeniable change in species composition over time. It is happening at the expense of our prime tolerant hardwood species – Sugar Maple – which happens to be one of the most demanding in terms of site, environment, and climate conditions. Sugar maple can be severely impacted by drought, and by thawing-freezing cycles during the winter; it is highly sensitive with respect to moisture, temperature, and nutrients

A review of 20 years of inventory data and re-measurements of permanent sample plots in the Maritime provinces shows that, on average, the proportion of mature and commercial-size Sugar maple in our working forests has declined by more than 20 percent (Figure 2). This alarming trend seems to be mostly caused by relatively unsuccessful recruitment of new cohorts to promote seedlings and saplings into larger tree sizes.

THE IMPORTANCE OF ROBUST SILVICULTRE PRESCRIPTION SYSTEMS

Why executing the right prescription for a given stand matters!

In addition to a gradual increase in the proportion of Red maple (a species with limited potential to produce high-value timber products) in the mature strata, the gap in the regeneration layer is being filled by non-commercial species and American beech. While most non-commercial species will be curtailed as the canopy closes in, beech will continue occupying the gaps in the regenerating layers created as other species die. This problem is compounded by the fact that in northeastern North America, Beech bark disease has become one of the key drivers of hardwood stand dynamics. Not only has the proliferation of Beech changed the structure of stands, it has also modified the growth and yield patterns of hardwood-dominated stands.

This has important consequences for timber management objectives, as well as for species diversity. However, our results provide further evidence that this impact could be averted by the application of intensive harvesting regimes with high removal rates, to limit beech dominance over the more commercially valuable hardwood species. Given the close association between Sugar maple and American beech, management practices must be modified to prevent beech from dominating the canopy, especially on drier sites.

Beech management can be achieved by controlling conditions such as light availability, providing shelter to seedlings that are susceptible to sudden exposure, creating germination microsites for new seedlings to establish, and tending young trees of the preferred species. The NHRI silviculture prescription system (SPS) is one of several diagnostic tools that can be used to determine the most suitable treatments. Better silviculture will lead to better productivity and a higher ratio of desired species.

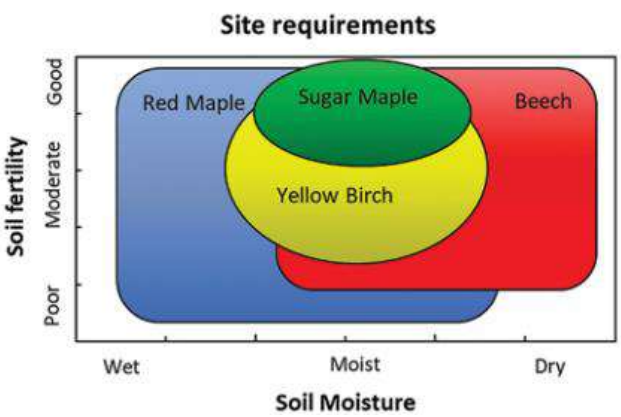


Figure 1. Site requirements for key hardwood species (adapted from Lee Allen, 2013)

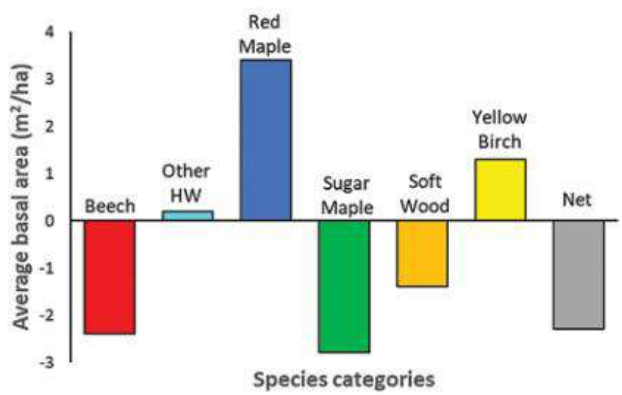


Figure 2. Change in upper canopy species basal area over two inventory cycles for selected areas in New Brunswick. Data shown represents average of data from Ecoregion 5.

Acceptable Growing Stock

Another important aspect of the sustainable production of high-value timber in hardwoods is the notion of quality. Foresters and silviculturists often use the terms “acceptable growing stock” (AGS) or “unacceptable growing stock” (UGS) to describe trees in term of species preference, health status, shape, form, and size. AGS comprises trees of species that have potential for high-grade products, with low risk of losing vigour and value, and of a certain geometry that will produce quality logs now or in the future.

It is generally accepted that, for hardwoods, timber value is driven by the proportion of high-grade products, such as veneer logs and prime or select saw logs. The value differential between these products and hardwood pulpwood or biomass can be almost ten-fold – more than five times the differential between high-grade and low-grade softwood products.

THE IMPORTANCE OF ROBUST SILVICULTRE PRESCRIPTION SYSTEMS

Why executing the right prescription for a given stand matters!

Because of past forestry practices, poor markets for low-grade products, and forest health issues, in our region today it is a rare occurrence to find stands with very high proportions of acceptable growing stock (more than two thirds AGS). When the right silviculture treatments and regimes are used, AGS trees with potential to continue increasing in value are left until subsequent re-entries – while UGS trees containing high-grade products, but at risk of deteriorating, are targeted for harvesting. Poor-quality trees that compete with future crop trees are also removed to achieve the desired density or basal area.

A tree classification system has been created to provide forest managers with objective ways to assess trees and to make silvicultural decisions. The system uses dichotomous keys to assign form (eight classes) and risk of losing vigour and value (four classes). Early adopters of the system in New Brunswick and Maine have found it is also of great value in making more accurate predictions with respect to growth and yield, product distribution, and internal decay

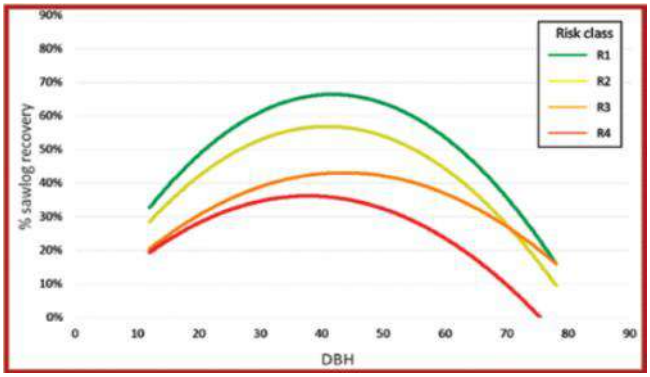


Figure 3. Relationship between risk class and proportion of sawlogs.

Figure 4. A very unhealthy sugar maple stand where more than ¾ of the trees are of unacceptable growing stock (UGS).

Growth Rates

The last element to consider is the productivity of the stand itself. Annual growth rates (periodic annual increments) in the range of 3-4 m3/ha of gross merchantable volume, or 0.3-0.5 m2/ha in basal area, can be sustained in our region. High stand productivity is maintained by removing unhealthy and older trees, and reducing competition on crop trees by releasing their crowns on at least two or three sides. It is a delicate exercise in balance, as releasing too much of the crown will, in most species, increase the likelihood of large branches developing.

Minimizing competition against crop trees is the first step towards healthy stands, but land managers must also pay attention to forest health issues such as pests and pathogens, climate-related damage, and browsing pressure from herbivores.

THE IMPORTANCE OF ROBUST SILVICULTRE PRESCRIPTION SYSTEMS

Why executing the right prescription for a given stand matters!

THE FOUNDATIONS OF NHRI's SPS 2.0

Concepts to remember when implementing harvest-based silviculture in mixed and hardwood forests!

When managing to generate value through the production of timber, it is becoming more and more important to base our silviculture prescriptions on sound biological concepts and theory. Planned activities to influence establishment, growth, composition, health, and quality of stands and trees are founded on a few key biological processes. Below, we will revisit seven very important notions that are in a sense the foundation of our treatment prescriptions, and more importantly, that must be communicated to those who do the actual work.

Concept #1: Trees of different species have different monetary values

Be aware of the great value difference from one species to another. Too many modern 'management guides' are quick to advocate practices that promote species richness first and foremost. Simply put, value is a result of the product mix of an assortment of trees and their respective values. For example, Red maple and beech only yield 5-10% saw logs and the value of lumber is half that of sugar maple and yellow birch that yield 20-25% saw logs. In combination, this represents a considerable 4-5-fold difference in value. Silviculture is the ideal tool to grow your species of interest and value for the woodlot.




Concept #2: Tree size has a direct impact on value and growth rate

Larger trees to a point, tend to have higher proportion of high-grade products. But, as a tree ages, it loses vigour and value. Larger trees (DBH > 50cm) add more discoloured wood volume than clear wood volume as they keep growing. Consequently, stem quality declines in larger trees. Saw log recovery diminishes and timber value/m3 sharply declines in trees larger than 45-50cm at breast height.

As a tree increases in diameter, so does its growth rate for diameter and basal area until it starts to peak. The threshold is dependant on many factors such a species and competition for resources but, the growth apex for our northern species occurs around 40-50 cm of DBH.

Barring other important ecosystem services objectives such as protecting habitat and diversity, land managers should aim to retain a relatively low proportion of large trees after treatment if they wish to sustain high growth rates for their stands.

Concept #3: Stand basal area and tree size in interactions, impact rates of stand and tree growth

The effect of tree size on growth rate is compounded when we consider the additive factor of stand competition. At least in the case of sugar maple and yellow birch, the more the stand is open, the higher the growth rate will be on residual trees.

This does not offset the notion that larger trees grow the least. The natural reflex to be on the safe side and leave more than enough basal area after treatment may not be the best thing to do. When deciding on the individuals to leave as crop trees, pay attention to this important notion.

THE IMPORTANCE OF ROBUST SILVICULTRE PRESCRIPTION SYSTEMS

Why executing the right prescription for a given stand matters!

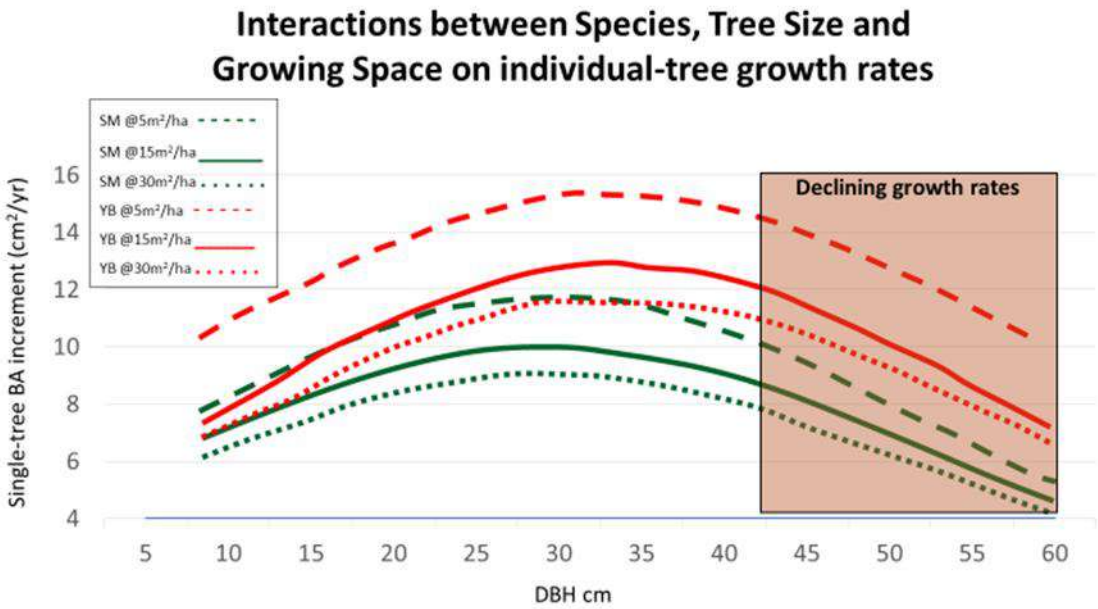


Figure 5. Interactions between Species, Tree Size and Growing Space on individual-tree growth rate .

Concept #4: For a given species, tree vigour and tree size interact to impact stand and tree growth rates

Considerable attention must be invested on assessing tree quality, health and vigour in order to determine the right silvicultural regimes. Tree health is an important element of quality and grade but very few jurisdictions systematically characterize trees for those features in their inventory. Vigour takes into account tree health as well as competition for light and other resources.

To maintain good growth rates requires a high proportion of vigorous trees and at harvest, unacceptable growing stock should be on top of the cut priorities.

Concept #5: Residual basal area impacts stand growth and regeneration dynamics

There is very strong evidence of a narrow range of residual basal area where growth of residual crop trees is optimal. In mixed and hardwood stands of our region, basal area growth can reach a high of 0.8m2/ha/yr. The ideal window for optimal stand growth is between 14 and 18 m2/ha. Leaving more basal area after treatment will cost in growth. Leaving not enough will deplete the growing stock and encourage the establishment of intolerant and pioneer species. Controlling the harvest intensity (percent basal area removed) is important in the recruitment of new cohorts of desired species.

Low residual basal area might also encourage the production of epicormic branches and encourage growth of existing ones thus reducing grade and quality. In those instances, leaving non-competing 'trainer-trees' will discourage that situation. As a rule of thumb, a target residual basal area of 16-20 m2/ha of trees larger than 10cm is appropriate for most partial cuts.

THE IMPORTANCE OF ROBUST SILVICULTRE PRESCRIPTION SYSTEMS

Why executing the right prescription for a given stand matters!

Concept #6: Crowns of crop trees, small and large, must be released

But simply reaching the target average basal area for in the stand is not adequate as a certain uniformity in the distribution of crop trees in needed. The crowns of crop trees need to be released by removing direct competition. This all gets a bit more complicated when using mechanical harvesting systems where extraction trails are a necessity.

Those trails need to be factored-in and the ratio of trails to green strip must be considered. In regulated treatments such as commercial thinnings and single-tree selection, the ratio in trails should be less than 25%. Furthermore, trees in the green strip should be evenly spaced, their crowns released from the edge of the trail to the extent of the boom reach.

Concept #7: Harvest season, system and trail network greatly impact the creation of substrate for germination and the establishment of regeneration.

In harvest-based silviculture treatments where one of the goals is to establish a new cohort of trees, timing of the treatment is critical. Late winter operations under a heavy snow cover are not likely to benefit from soil mixing from the tracks of the machines. Apart from that, plan your trail network accordingly to increase the number of seed germination beds.

Harvesting in the dormant season (fall and winter) when residual trees are less prone to mechanical damage is a good choice but not if the trees targeted for removal regenerate by means of root suckers and stump sprouts such as poplars, red maple and beech.

Figure 6. The choice of harvesting systems and trail pattern impact logging debris and germination substrates.

NHRI's SPS 2.0: An improved system to increase growth rates and improve quality of northern hardwoods and mixed stands.

In the end, sustaining our resource comes down to maintaining and growing an inventory of quality trees of the desired species, and practicing adaptive management. A thorough understanding of the relationships among species, site, environment, and climate – informing a sound silviculture framework – should go a long way in improving the sustained growth of our resource all the while ensuring that it increases in value by producing quality trees of desired species. In a nutshell that is the result we envision for stands where our silviculture prescription system will be implemented.

In the following pages we present a step by step guide to our new and improved silviculture prescription system in the hopes that those that have an interest for such a system will have all the required information to start implementing it as soon as possible; or even better, will contact us to share their feedback and obtain support in its implementation.

INTRODUCING NHRI's SPS 2.0

A simple and quick way to get the optimal prescription for your stand!

The NHRI's Silviculture Prescription System is a 5-step process that starts with the description of a stand and ultimately recommends very specific treatments in forests that are dominated by hardwoods.

The NHRI Silviculture Prescription System was introduced in 2015 and its implementation was gradually undertaken in various stands of all tenure types in New Brunswick. From these trials, several improvements were recommended and led to the re-design of the SPS. Version 2.0 of the SPS was completed in January 2020. Improvements brought to our original SPS include:

- Simplified framework;
- New nomenclature of silviculture systems to minimize confusion on two-aged/extensive systems (formerly called "Irregular Shelterwoods");
- More robust logic for treatment determination;
- Better instructions for implementation.

The following pages are meant as an introduction to the NHRI SPS 2.0, but also as a guide for experienced practitioners and users with limited silviculture experience and basic knowledge of forestry principles. It should serves much like an introduction and summary instruction manual aimed at getting started in applying the NHRI SPS as a silviculture tool.

If you are looking for more detailed information, or simply looking to learn more, about the NHRI's SPS 2.0 please don't hesitate to visit our website (www.hardwoodsnb.ca) where you will find detailed guides, videos and presentations on our silviculture prescription system and various other topics related to northern hardwoods and mixed forests silviculture.

NHRI's Silviculture Prescription System

SPS 2.0 - IMPLEMENTATION STEPS AND REQUIRED TOOLS

STEP #1
Define Stand Type

Use the master key to determine species composition and age class structre.

STEP #2
Determine Treatment

Run the treatment determination keys to get to a recommended prescription.

STEP #3
Review Silviculture Framework

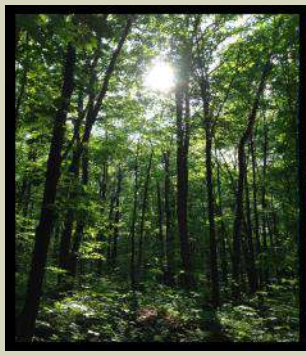
Consult silviculture framework and prescription tearsheets to ensure stand eligibility, management objectives & operational conditions are respected.

STEP #4
Provide Work Instructions

Communicate work instructions to operators and supervisors.

STEP #5
Monitor Performance

Communicate performance expectations by providing implementation checklists to field crews.



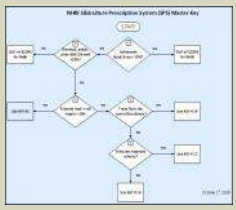
TOOL #1
Master Key

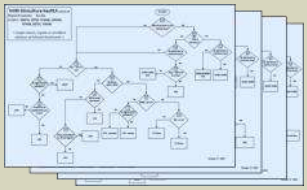
TOOL #2
Treatment Keys

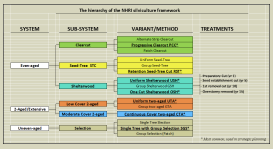
TOOL #3
Framework & Tearsheats

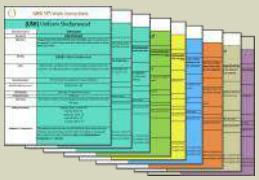
TOOL #4
Work Insructions

TOOL #5
Implementation Checklists









INTRODUCING NHRI's SPS 2.0

A simple and quick way to get the optimal prescription for your stand

The first thing anyone, whether a forestry expert or novice, should do before getting started with SPS 2.0 is to download the smart phone application. This is especially true if you have limited knowledge of forestry principles and silviculture techniques and/or have limited time at your disposal—but still very interested in obtaining a prescription for a given stand.

An updated mobile phone application is available for both I-Phone and Android devices. The App was designed with an easy to use interface through which you can rapidly obtain a prescription for a given hardwood stand. The user simply answers a sequence of questions about the characteristics of the stand which ultimately leads to the recommendation of a specific prescription. All that is left to do is to consult the silviculture framework and prescription tearsheets to ensure stand eligibility, management objectives and operational conditions are respected.

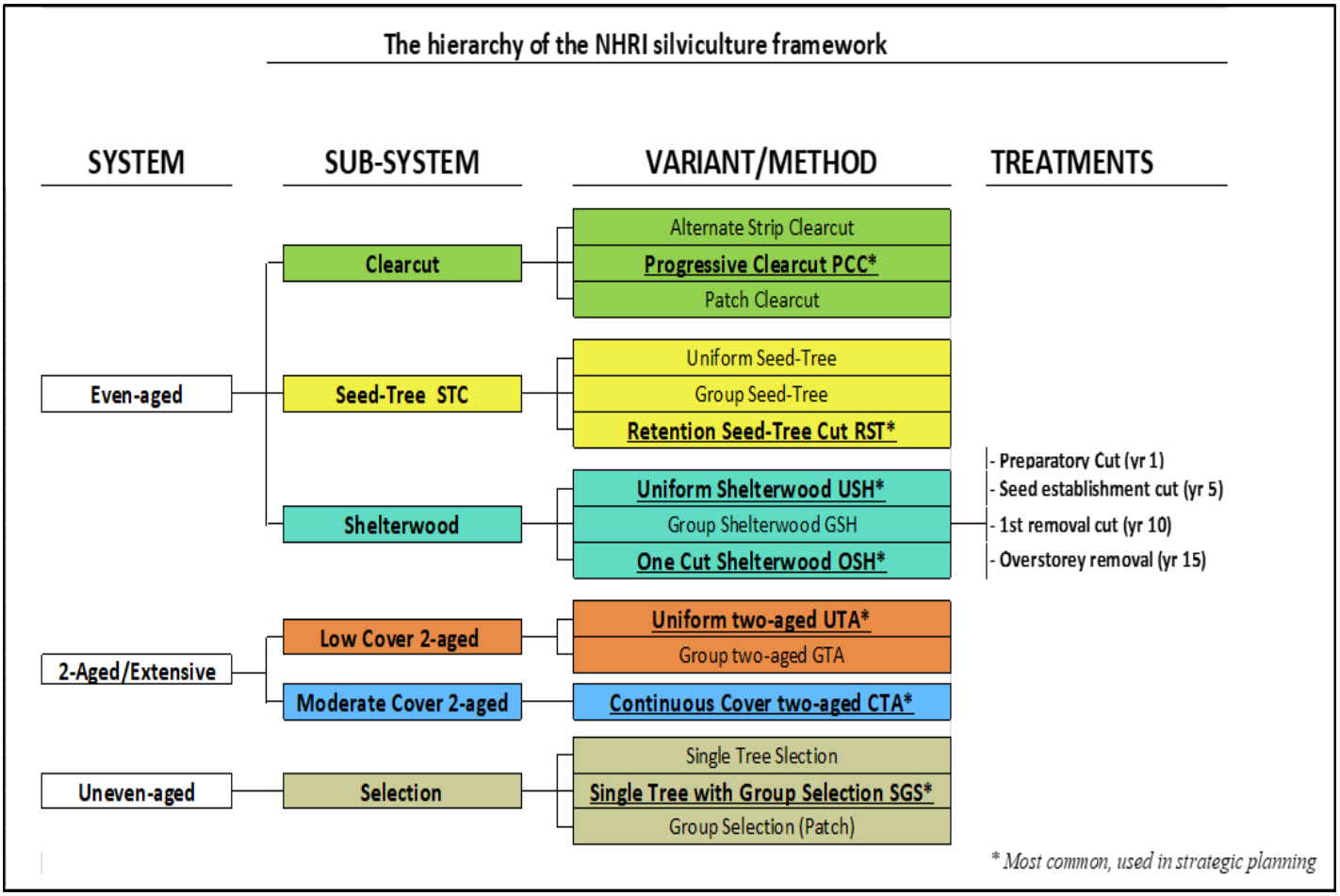
Downloading the App is easy!

- Click one one of the photos below
- Scan the QR code
- Search *"NHRI SPS"* in Apple App Store
- Search *"NHRI TOOLS"* in Google Play
- Visit our website @ www.hardwoodsnb.ca

BEFORE GETTING STARTED

Get familiar with NHRI silviculture regimes and key silviculture concepts!

In this guide, we provide useful information to help forest practitioners and managers implement NHRI's SPS 2.0; a silvicultural system designed to meet desired management objectives. Before you start implementing the system it is crucial to understand which silvicultural systems, sub-systems and their variants should be considered for a given stand. Below are the highlights of the six sub-systems stemming from the three primary forest systems, with a summary of their characteristics.



BEFORE GETTING STARTED

Get familiar with NHRI silviculture regimes and key silviculture concepts!

Even-aged systems

- Purpose is to create a new stand at once with all tree ages within 1/5 of a rotation (20 years);
- Relies on prompt establishment and survival of species of interests;
- For hardwoods, does not rely on artificial regeneration;
- Used where the characteristics of the existing stand and trees are not meeting expectations (species, quality, stocking, health) and, no small crop trees are present.

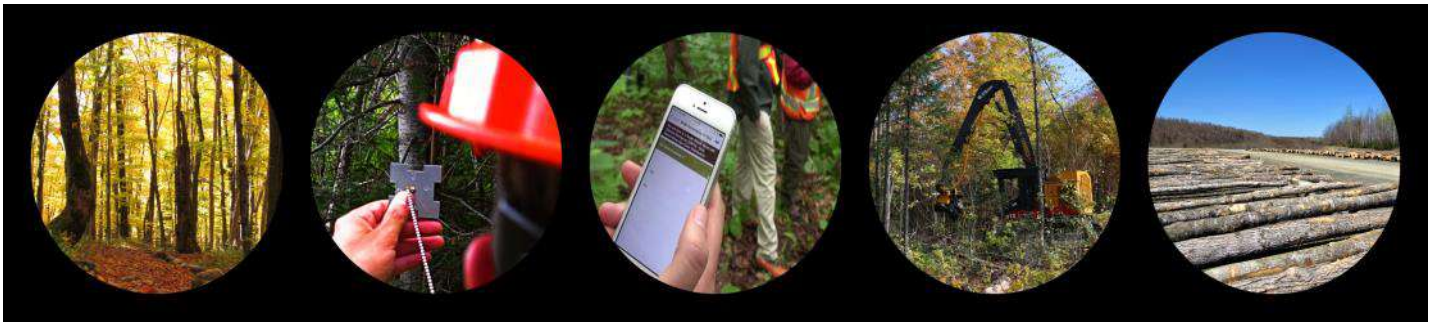
Uneven-aged systems

- Purpose is to maintain at least 3 age classes and continuous cover for a long-time horizon;
- Re-entries are aimed at fulfilling the 3 main silviculture objectives: regeneration, release and harvest;
- Relies on the cycling of one stratum into the next one where younger age classes require exponentially more trees than older ones;
- Used where the characteristics of the existing stand and trees are already adequate;
- Suited mostly for species of relatively high tolerance to shade.

Two-aged/extensive

- Purpose is to start with a 2-cohort structure but with options to change trajectory in the future;
- Treatments aim at establishing regeneration, tending smaller size trees and harvest large ones;
- Re-entries tend to be scheduled at longer intervals;
- In northeastern forests, could very well become the dominant silviculture system.

Popular treatments within this silviculture hierarchy are summarized in **APPENDIX 3—FRAMEWORK & PRESCRIPTION TEARSHEETS.**



STEP 1: DETERMINE STAND TYPE

Determine species composition and age class structure

When using the SPS, we start by determining broad species composition and age class structure using the Master Key. Our system applies to stands that comprise at least 30% hardwoods and is aligned with NB NRED's FUNA classification. Generally, a stand is characterized as a pure or mixed stand based on species composition. In pure stands, 70% or more of the main canopy is made up of a single tree species or group on a basal area basis; whereas, in mixed stands, none of the species occupy 70% or more of the main canopy.

According to natural stand dynamics theory, a stand develops in different phases ranging from stand initiation to an old growth stage. However, disturbances can move stand development backward or forward in the process, depending on type, severity and timing of the disturbances. A stand structure at a given time provides only a static picture of the dynamic stand development process. After a stand replacement disturbance, a new stand is initiated by shade intolerant or pioneer species. As the stand develops, mid-tolerant (or mid-successional) species will dominate the stand during stem exclusion and understory re-initiation stage. Tolerant (late-successional) species dominate the stand in old growth stage. Therefore, species composition and age class distribution are two important components of a stand structure.

Step one is conducted by navigating through the Master Key found in **APPENDIX 1—MASTER KEY**.

For more info on stand dynamics and disturbance, watch the following video on the NHRI YouTube Channel:

VIDEO: NHRI SPS: Trees from the same disturbance

The following table lists the **6 classes** used by the NHRI.

	# cohorts	# strata	# species
E1-regular (1-2 species)	1	<=2	1-2
E2- stratified mixture	1	>2	>=2
D1-regular and D2- irregular	2	2	>=2
M1-balanced	3	3	>=2
M2- irregular	3	3	>=2

STEP 1: DETERMINE STAND TYPE

Run the Master Key to determine species composition and age class structure

The purpose of the Master Key is to generally determine the species composition and age class structure of a given stand through a series of questions. Once users answer the questions they are referred to one of the four specific Treatment Determination Keys. Below is an explanation of the questions found in the Master Key (See **APPENDIX 1—MASTER KEY**).

Questions from the Master Key

Purpose of the Master Key questions s to refer to one of the four specific decision trees

#1: Is the proportion of Basal Area (BA) for softwoods > 70%?

Used to screen out (put out-of-scope) stands and FUNAs that belong to the softwood category in order to limit the SPS only to mixed wood and hardwood stand types.

#2: Is the proportion (BA) of hemlock+ cedar+ pine>30% OR softwoods >50%?

Its purpose is to tease out mixed stands that contain species having very specific silvicultural requirements. They are out of the scope of the SPS.

#3: Is the proportion of tolerant hardwoods + red maple > 70%

Used to assign silviculture treatments that are specific to tolerant hardwood stands and manage for high value. Silviculture prescriptions are different for those stands depending on the current age class structure.

#4: Are the merchantable-size trees originating from the same disturbance?

Used to determine if the trees that form the current stand are of the same cohort (+-20 years apart) and have an even-aged structure that is characterized by a bell-shaped distribution of diameters. Clues for determination include evidence from stumps, diameter distribution and historical records. Specific silviculture regimes apply to those stand structures.

#5: Are there only two separate cohorts/strata present?

Its purpose is to determine if the stand originated from two distinct disturbances. The diameter distribution is often bi-modal, and these age class structures have specific silviculture regimes. By default, stands that did not meet criteria for questions #4 and #5 are classified as multi-cohort or uneven-aged with at least 3 distinct cohorts. These stands are called uneven-aged and when of acceptable species composition and quality tend to be managed to maintain permanent cover.

STEP 2: DETERMINE TREATMENT

Run the Treatment Determination Keys to get to a recommended prescription

The next step is crucial to the formulation of prescriptions and necessitates the most work. A total of four determination keys were developed to diagnose the stand, or micro-stand, by looking at fine tree and stand inventory metrics. The keys were designed to mitigate where inventory information could not be absolute and to compensate for minor user errors and omissions in the process. Following is a brief explanation/background/rationale for the questions asked in the SPS keys introduced in **APPENDIX 2—TREATMENT DETERMINATION KEYS**.

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Questions from Treatment Determination Keys

#6: Determination of beech stand archetypes

Stands that contain beech must be assigned very specific treatments to prevent encroachment of beech in the understory that will materialize in a stand dominated by the species in the future.

It is generally considered an unacceptable growing stock due to its low timber quality caused by beech-bark disease rendering its products to be of very low quality and never attaining large size. Stands that contain 20% beech in the merchantable diameter class may contain beech in the mid- and understory. Therefore, there is the risk of beech dominating future stands if the right silvicultural prescriptions are not applied in current stands.

#6a: Is beech present in any of the canopy layer?

The presence of beech in the stand triggers a careful evaluation of if and where challenges may exist using traditional silviculture treatments.

#6b: Is the merchantable Basal Area of beech in the upper canopy > 10%?

Numerous studies have demonstrated that even low amounts of beech will lead to dominance in the long term when small gap harvesting is used. In cases when beech is present, bigger openings are to be prescribed.

#6c: Is beech dominant (visual assessment, more than a third) in middle and/or lower canopy layers?

From past activities, it may be that while beech was nearly eliminated in the upper canopy layers, the cut trees, from vegetative propagation (stump/root sprouts) generated a new cohort of beech. Perpetuating small gap cuts will accentuate the problem.

#6d: Is acceptable growing stock (AGS) > unacceptable growing stock (UGS) and at least 8 m2/ha of AGS? (concept is explained in more detail under question #8)

STEP 2: DETERMINE TREATMENT

Run the treatment determination keys to get to a recommended prescription

Questions from Treatment Determination Keys

#7: Basal Area thresholds for merchantable-size trees (>10 cm class)

Basal area (BA), a key forest stand descriptor, is estimated either using tree measurement data obtained from fixed area plots or using variable plot sampling (prisms, angle gauge, Relascope). It refers to the sum of cross-sectional area of trees (diameter at breast height ≥ 10 cm) per hectare that are alive at the time of measurement and, expressed in m2 ha-1 (or ft2 acre-1). It is an important measure of a forest stand because it takes into account both tree size and density and therefore, it is often the basis for forest management decision making.

BA serves as a measure of competition for individual trees because in closed stands, other things being equal, the greater the basal area, the greater the competition, and the slower the growth of individuals (see figure here below). Therefore, BA is linked with individual tree as well as stand growth.

Stocking is also better expressed in terms of BA than density because BA considers both tree size and density. It is, therefore, an efficient estimate of the standing stock (volume) of timber available in a forest stand. This helps implementing silvicultural treatments that are sustainable as well as feasible.

As an indicator of competition: BA serves as a measure of competition for individual trees because in closed stands, other things being equal, the greater the basal area, the greater the competition, and the slower the growth of individuals. Therefore, BA is linked with individual tree as well as stand growth. The stocking level expressed in basal area is useful to determine relative density (a measure of competition) that regulates growth but also, operability limits for feasible operations (since B.A. is closely correlated to volume and easier to determine rapidly).

For more info on basal area, watch the following video on the NHRI YouTube Channel:

VIDEO: NHRI SPS: Basal Area

STEP 2: DETERMINE TREATMENT

Run the Treatment Determination Keys to get to a recommended prescription

Questions from Treatment Determination Keys

#7: Basal Area thresholds for merchantable-size trees (>10 cm class)

#7a: Is Basal Area >18 m2/ha?

The purpose of this threshold in multi-cohort (uneven-aged) stands is to separate low basal area stands because they were recently treated and on the right path vs. that are losing value and require remedial silviculture.

#7b: Is Basal Area>20 m2/ha?

Stands that have not attained that threshold but are dominated by AGS should continue to increase (ingrowth + growth). When the proportion of UGS is greater but there is adequate regeneration, treatments to protect and release are prescribed. When UGS are dominant and regeneration is not adequate, starting over with even-aged treatments is recommended.

#7c: Is Basal Area>24 m2/ha

For stand improvement treatments with high residual basal area, there is a relatively high starting basal area requirement. If a third of the stand must be removed and the minimum residual basal area should be 16 m2/ha, the pre-treatment level must be higher than 24 m2/ha. Furthermore, treatments such as single/group selection are also expensive to execute, and a reasonable amount of volume must be available.

#8: Proportions (for merchantable Basal Area) of acceptable growing stock (AGS) and unacceptable growing stock (UGS)

The most common method to designate quality of standing trees is the AGS/UGS system. Acceptable growing stock consists of vigorous trees of desired species and of good quality that can continue to grow (or at least not stagnate) and will not lose value and health in the near future or at least until the next entry. Unacceptable growing stock possess one or several of the opposite characteristics. High proportion of AGS will help maximize the growth of residual trees and improve the quality of the residual and future stands. The determination of AGS/UGS is done using species, form and risk with tables and determination keys from the Tree Classification System for New Brunswick (Pelletier et al. 2016). Because of a general lack of objective criteria to determine AGS or UGS and that most tree grading systems look at current product content or only health, the NHRI decided to create a tree classification system that uses species, tree form and risk of losing vigor to assign AGS/UGS. A summary is presented in **APPENDIX 6—TREE CLASSIFICATION SYSTEM & AGS/UGS MATRIX**.

VIDEO: NHRI SPS: Tree Classification System

STEP 2: DETERMINE TREATMENT

Run the Treatment Determination Keys to get to a recommended prescription

Questions from Treatment Determination Keys

#8: Proportions (for merchantable Basal Area) of acceptable growing stock (AGS) and unacceptable growing stock (UGS)

In the Silviculture Prescription System, the following questions allude to ratios of AGS/UGS:

#8a: Is the proportion of AGS ≥ proportion of UGS?

A simple ratio to determine if most merchantable trees are in AGS or UGS categories from basal area summaries. It is a quick way to rapidly determine the overall quality potential of the stands. When at least half of the stand contains acceptable growing stock, there are more silviculture options.

#8b: Is the proportion of AGS > UGS in pole size, small and medium trees (10-38 cm)

Often, large trees of poorer quality will skew ratios based on basal area. This ratio looks specifically at the tree classes that would be retained after some treatments

#8c: Are there AGS in pole-size trees?

The presence of quality trees of the desired species in the 10cm – 20cm range will discourage the use of even-aged treatments where all trees will be harvested within 20 years and small trees with potential for sawtimber will not develop. Arbitrarily the minimum number of pole-size AGS should be around 100/ha.

#8d: Is the proportion of AGS ≥ 60%?

Sophisticated treatments of the uneven-aged system such as single-tree/group selection require stands with a high proportion of quality trees at the beginning because of the high residual density after treatment. Those stands must already meet a high basal area level at the outset (24m2/ha).

#8e: Is the proportion of AGS ≥ 40%?

As in question #8d, treatments that aim at perpetuating and maintaining cover require a moderate amount of quality trees to allow flexibility during implementation.

#8f: Are there at least 10 m2/ha of AGS in tolerant hardwoods?

This threshold is to determine if there is enough quality in order to consider more elaborate treatments like continuous cover two-aged and commercial thinning in mixed hardwood stands where composition and stocking does not allow to consider a selection system.

#8g: Presence of AGS in tolerant hardwood poles and saplings

This question is meant to avoid use of even-aged treatments where all trees will be harvested within 20 years and small trees with potential for sawtimber will not develop. Arbitrarily the minimum number of pole-size AGS should be around 100/ha.

STEP 2: DETERMINE TREATMENT

Run the Treatment Determination Keys to get to a recommended prescription

Questions from Treatment Determination Keys

#9: Is regeneration adequate?

This is a very important element of silviculture diagnostic where the presence of acceptable regeneration will lead to treatments that release and/or protect what is establish. Criteria foe determination include species composition (species of interest), stocking (>1500 well distributed saplings/ha) and health (vigorous, low competition and not browed).

#10: Are quality pole-sized trees present?

This question is to decide if there are enough quality pole-sized trees (AGS) to opt for a low residual extended regime that will maintain the over a long horizon (UTA) vs. one that will remove them within 20years before they produce sawtimber.

#11: Is there presence of over-mature or of low vigor trees?

The presence of old and unhealthy trees will lead to the recommendation of a treatment with high removal intensity such as a uniform shelterwood cut.

#12: Is the quadratic mean diameter ≤ 20 cm?

In quality stands with an even-aged structure, the potential for commercial thinning should be investigated. However, when trees are too large, commercial thinning treatments are not recommended.

#13: Is base to live crown on crop trees > 4 m?

When a commercial thinning is prescribed in quality tolerant hardwoods, we must be careful where live limbs are low on the stem to release to a point where it will encourage the production of epicormic branches and the maintenance of live branches for a long period.

For more info on this subject, watch the following video on the NHRI YouTube Channel:

VIDEO: NHRI TOOLS: STAND DENSITY MANAGEMENT

STEP 2: DETERMINE TREATMENT

Run the Treatment Determination Keys to get to a recommended prescription

Questions from Treatment Determination Keys

#14: Are poplars and intolerant hardwoods ≥ 30% of the basal area?

In those instances, partial harvest will likely exacerbate the vegetative propagation of poplars and dramatically increase the proportion in the stand. To learn more on the subjects of tolerance to shade and the presence on intolerant hardwoods in the upper canopy please refer to the following videos on the NHRI YouTube Channel:

VIDEO: NHRI SPS: Tolerance to shade

VIDEO: NHRI SPS: Overmature strata and patches of IH and Fir

STEP 3: REVIEW PRESCRIPTIONS

Ensure eligibility, objectives and operational conditions are respected

Review: Silviculture Framework & Prescription Tearsheets

Once a treatment/regime is identified in Step 2 the user should use diligence and verify the validity of findings during Step 3.

At this stage it becomes very important to do a sensitivity analysis for the answers provided for the questions raised in the keys. For example, it is possible that in cases where the stand conditions were around the arbitrary thresholds, answering another way may lead to a recommendation for treatment/regime that is better suited.

It is also imperative that users revise the selected treatment/regime for eligibility, objectives, operational considerations etc. by reviewing the **NHRI'S Silviculture Framework** and the **Prescription Tearsheet** for the treatment in question (see, **APPENDIX 3—FRAMEWORK & PRESCRIPTION TEARSHEETS**). The Prescription Tearsheets are simple and concise but contain a wealth of very useful information meant to ensure that you apply the right silviculture treatment to your stand:

- System
- Sub-system
- Stand Eligibility
- FUNA Structure
- Treatment Objectives
- Treatment Description
- Desired Outcomes
- Key Success Factors
- Operatial Coonsiderations (Harvest System, Season, Trail Network, etc.)
- Implementation Instructions
- Additional Considerations
- Getting Started
- Etc.

STEP 4: PROVIDE INSTRUCTIONS/CUTTING ORDERS

Communicate work instructions to operators, supervisors and contractors

The 4th step consists of communicating instructions to operators, supervisory personnel and contractors. Within the NHRI SPS 2.0 each treatment has matching **Work Instructions** (see, **APPENDIX 4—WORK INSTRUCTIONS**) which include: the selection of a trail network, recommended harvesting system, residual BA or cover targets and cut priorities/pecking orders by species, quality and size groups. We also highly recommend that key success measures and targets be formulated on a block-specific work order. It is very important to communicate the order of implementation of the treatment correctly:

A. When possible use the recommended harvesting system and season of operation;

B. Implement the recommended trail network—varies by treatment;

C. Reduce stand density as per the treatment target. ***Aim for the high end of the range but allow for variation within the stand;***

D. Use the cut priorities and cutting instructions to attain the target basal area;

- Acceptable Growing Stock (AGS)
  - Low risk and good form sugar maple, yellow birch, red oak <48cm
  - Other trees of good health and form
  - Quality pole and medium sized trees of interest
  - Saplings of desired species in good health
- Unacceptable Growing Stock (UGS)
  - Deteriorating health
  - High risk of losing health and value
  - Poor form
  - Low value species (beech, fir, poplar, white birch)
  - Multiple stems from sprouts
  - Fir > 15cm
- Optional UGS
  - Ash (because of Emerald Ash Borer)
  - Butternut (Because of butternut canker)
  - Spruce > 40cm

E. Other considerations;

- When releasing crop trees, leave some non-competing 'trainer trees 'to prevent the production of epicormic branches.
- Leave a few large and very large trees of desired species but in deteriorating health, and without high grade potential that do not compete with crop trees for the production of seedlings. IMPORTANT: modify BA threshold upwards accordingly to prevent high grading of the stand.

STEP 5: PERFOMANCE MONITORING

Communicate performance expectations to implementation crew

The final step consists of communicating performance expectations to the implementation crew. Checklists have been developed to that effect and can be found in **APPENDIX 5—IMPLEMENTATION CHECKLISTS**. The checklists developed by NHRI can be customized to fit your management objectives and operational reality. NHRI's SPS **Implementation Checklists** are divided into the following performance monitoring items:

- General Information
- Stand Eligibility
- Trail Pattern/Planning
- Desired Short-Term Outcomes
- Assessment

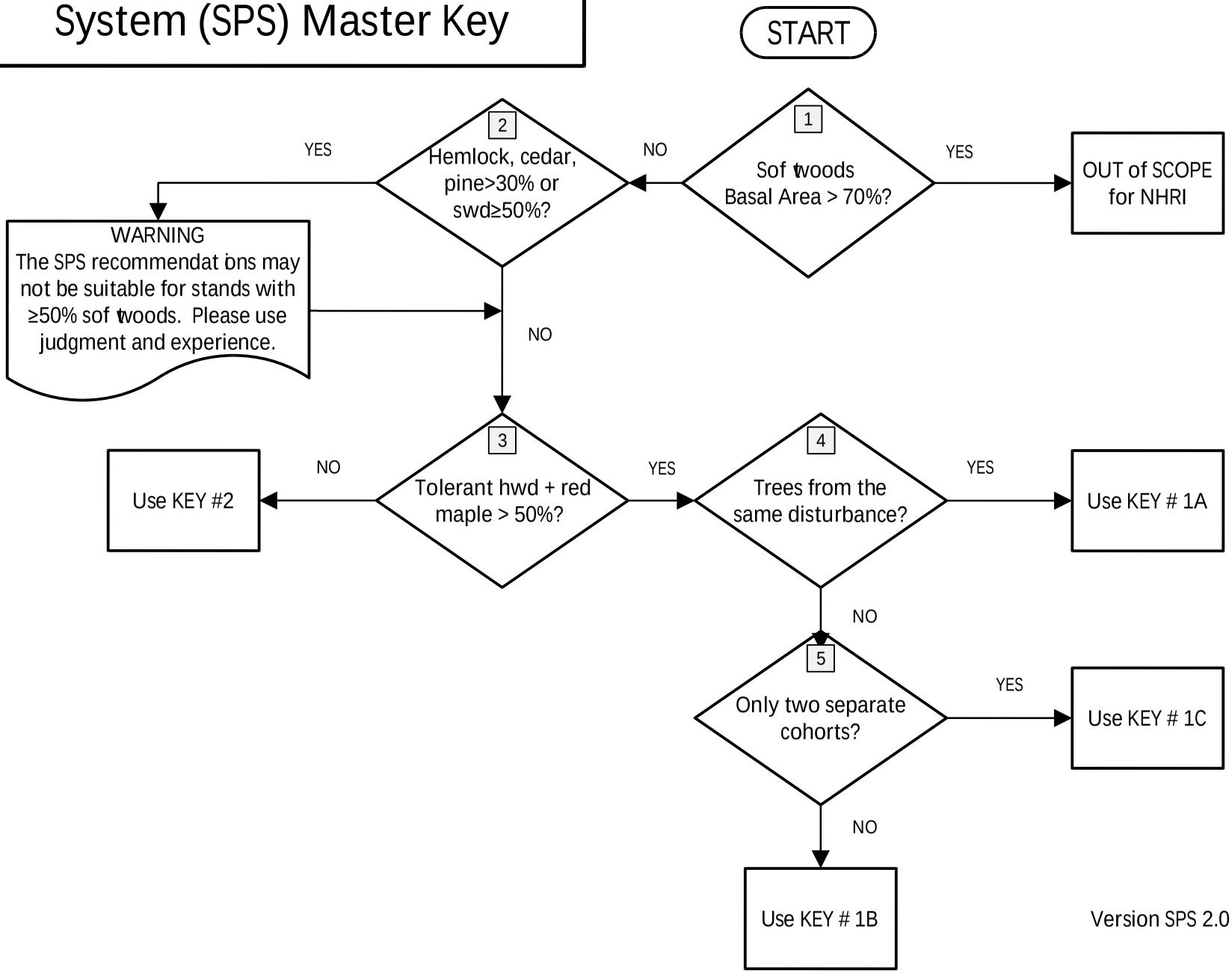



Appendix I

SPS Implementation Tools

Master Key

NHRI Silviculture Prescription System (SPS) Master Key



Version SPS 2.0 (Jan. 2020)

Appendix II

SPS Implementation Tools

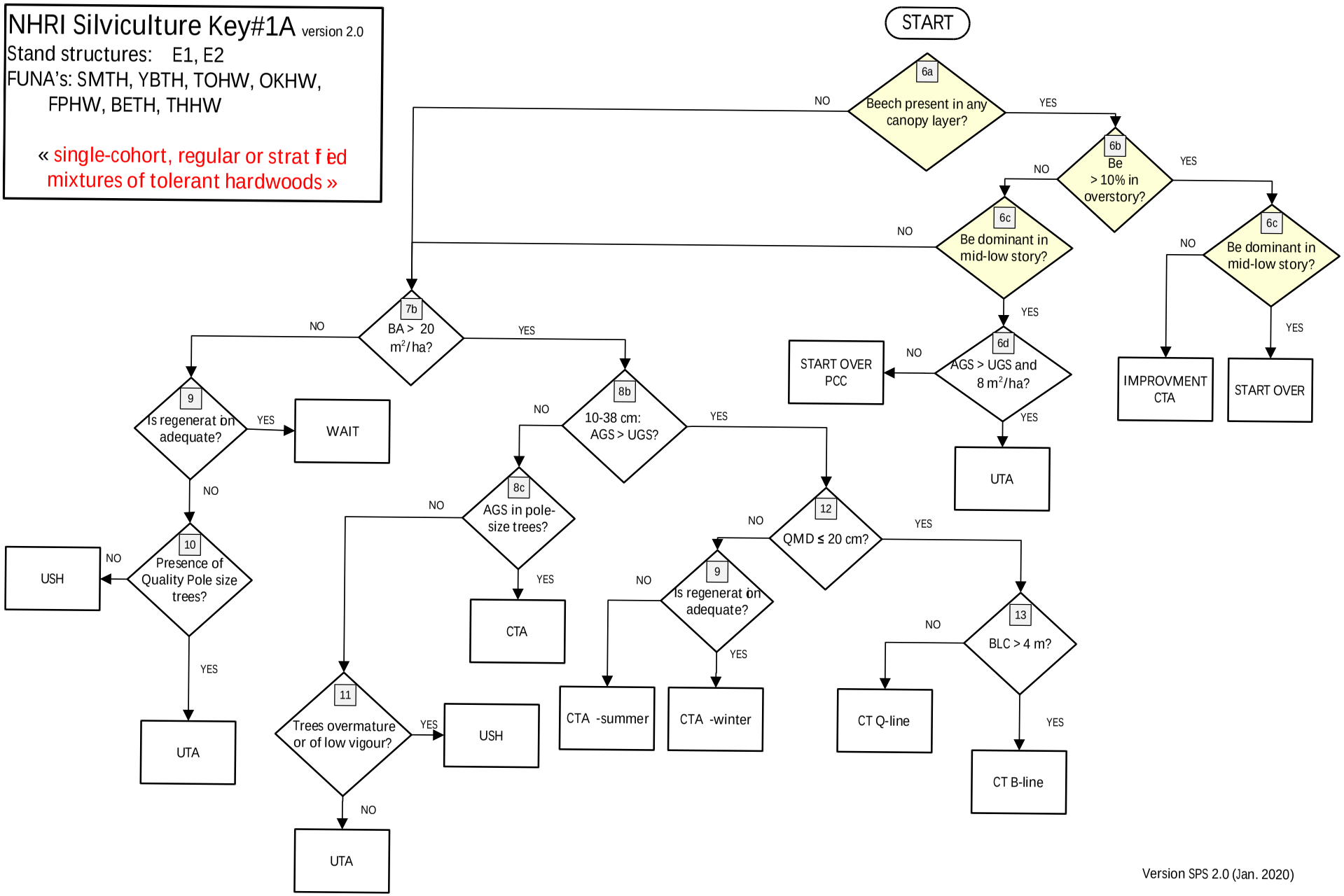
Treatment Keys

NHRI Silviculture Key#1A version 2.0

Stand structures: E1, E2

FUNA's: SMTH, YBTH, TOHW, OKHW, FPHW, BETH, THHW

« single-cohort, regular or stratified mixtures of tolerant hardwoods »



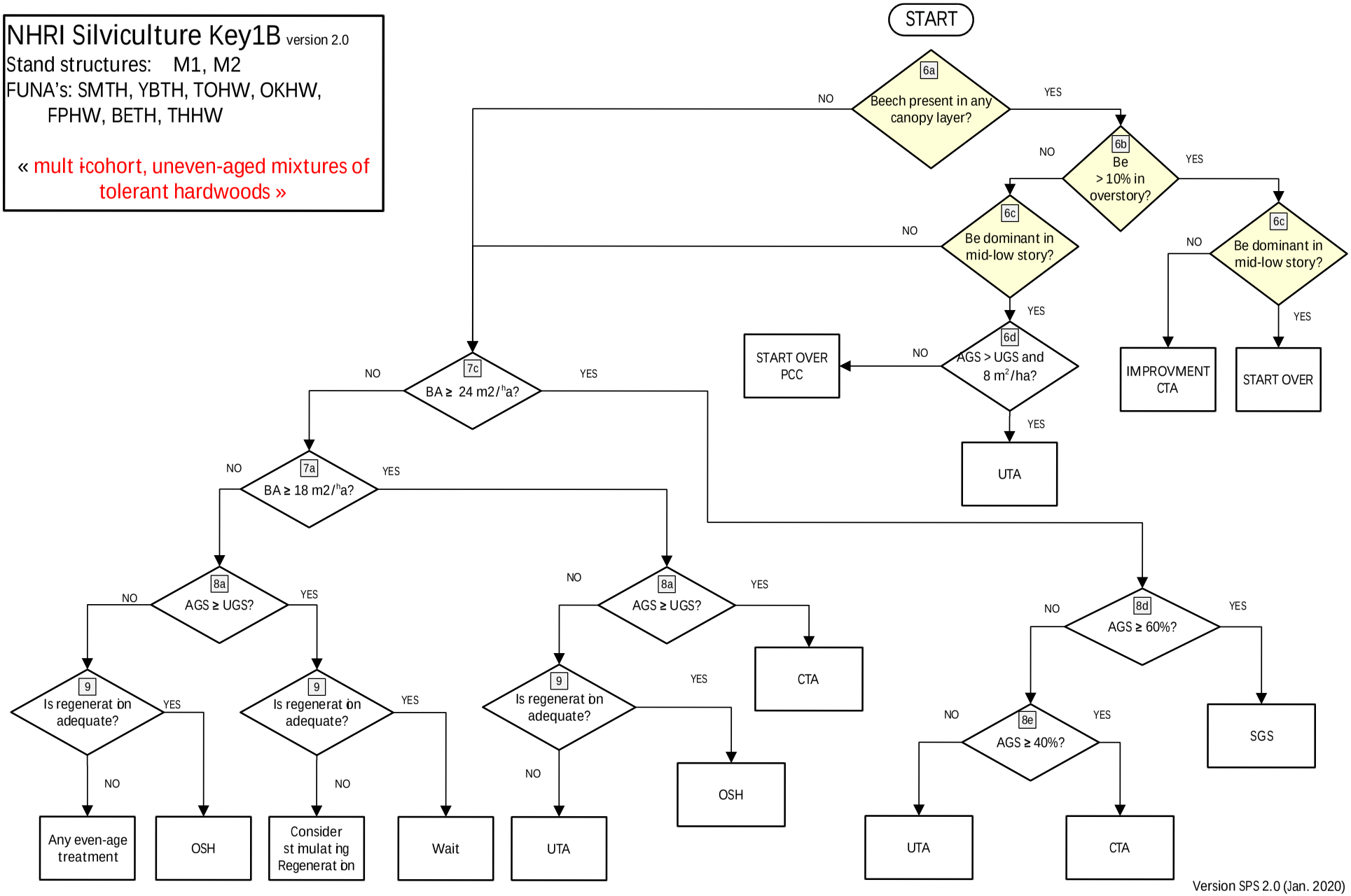
Version SPS 2.0 (Jan. 2020)

NHRI Silviculture Key1B version 2.0

Stand structures: M1, M2

FUNA's: SMTH, YBTH, TOHW, OKHW, FPHW, BETH, THHW

« multicohort, uneven-aged mixtures of tolerant hardwoods »



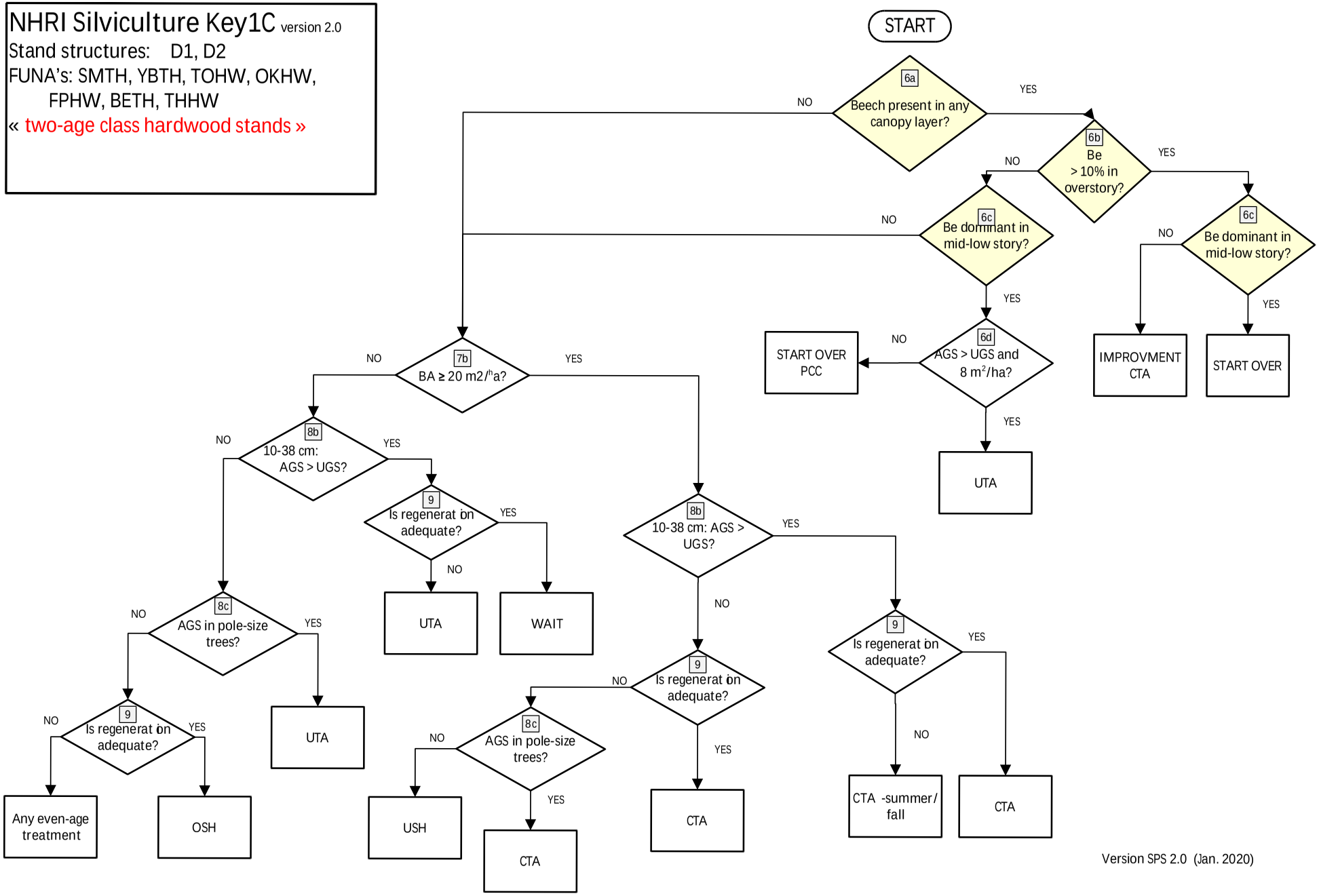
Version SPS 2.0 (Jan. 2020)

NHRI Silviculture Key1C version 2.0

Stand structures: D1, D2

FUNA's: SMTH, YBTH, TOHW, OKHW, FPHW, BETH, THHW

« two-age class hardwood stands »



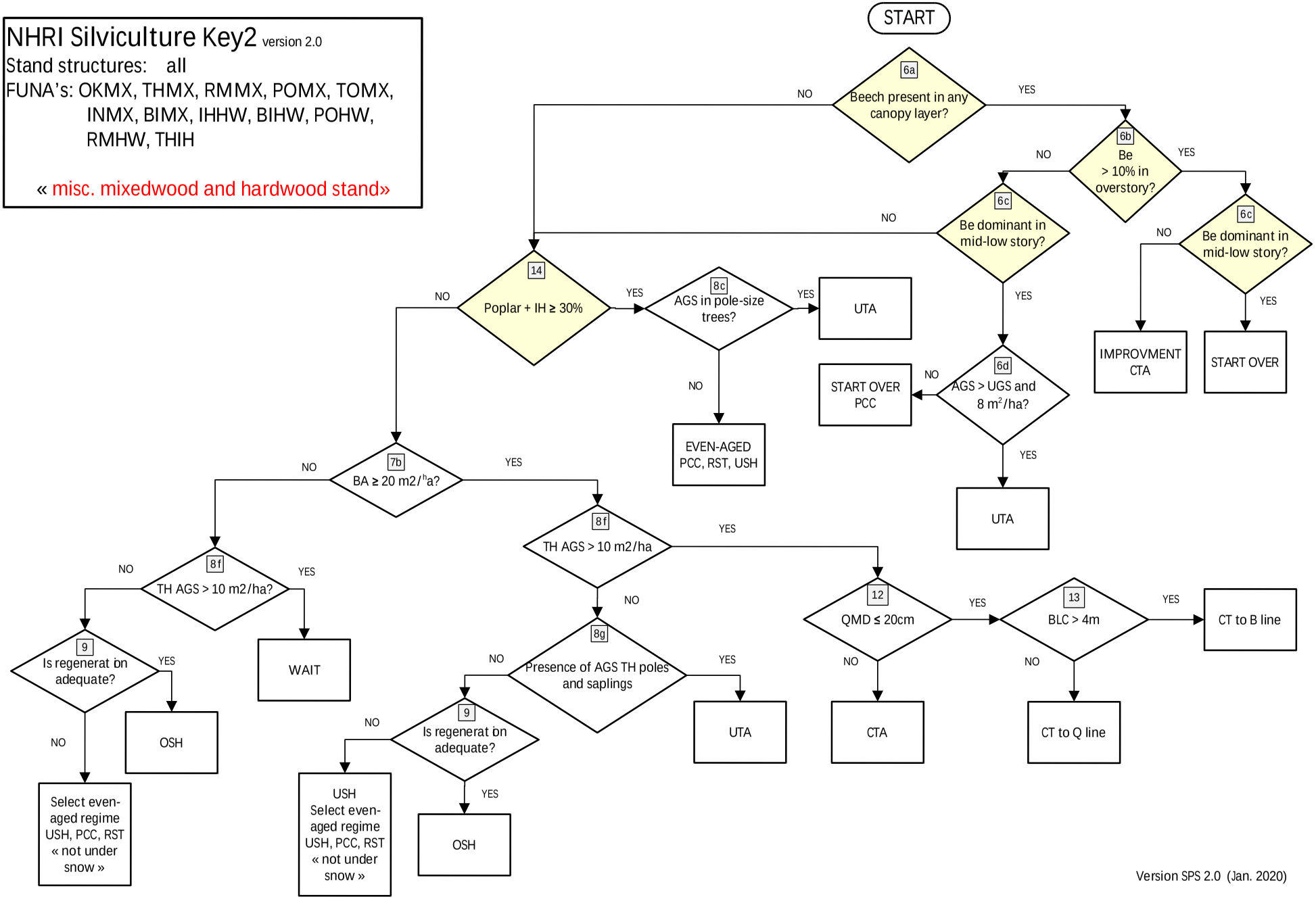
Version SPS 2.0 (Jan. 2020)

NHRI Silviculture Key2 version 2.0

Stand structures: all

FUNA's: OKMX, THMX, RMMX, POMX, TOMX, INMX, BIMX, IHHW, BIHW, POHW, RMHW, THIH

« misc. mixedwood and hardwood stand»



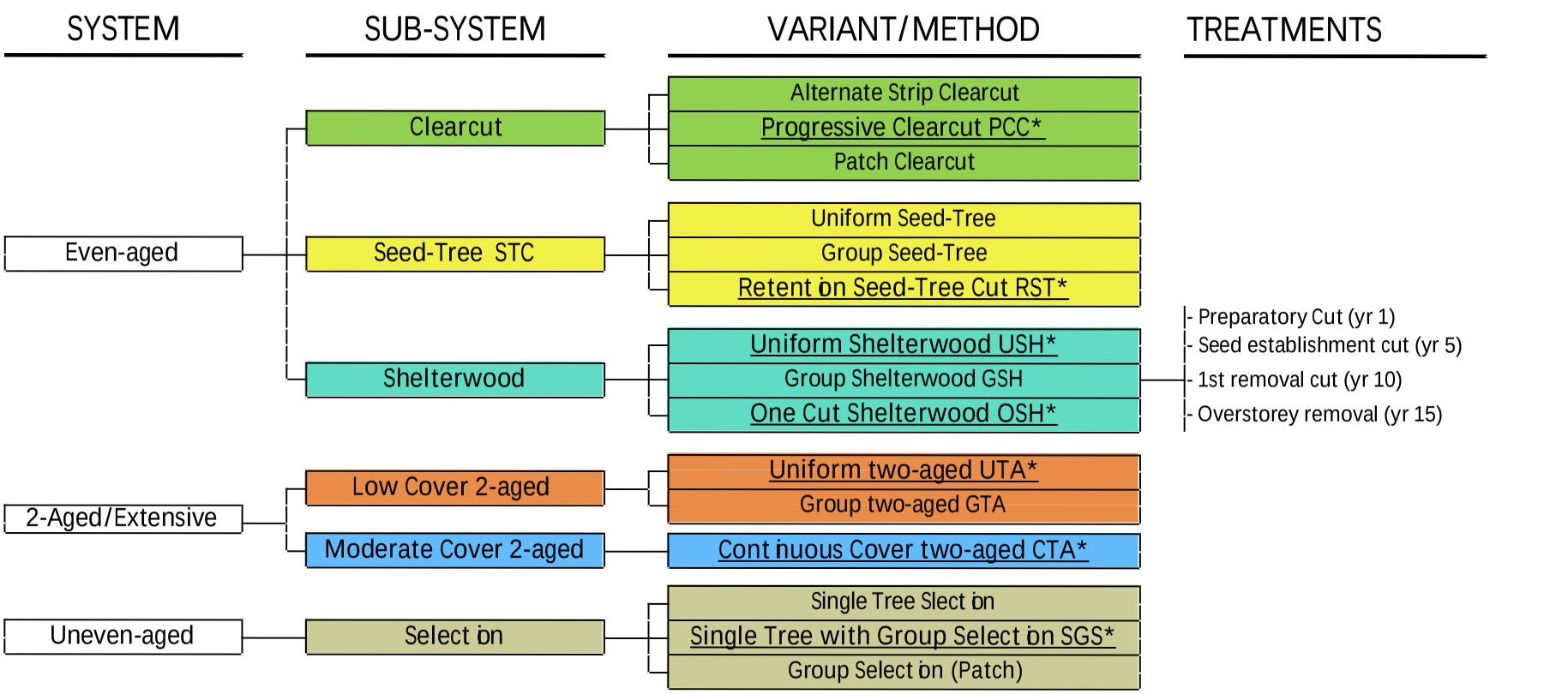
Version SPS 2.0 (Jan. 2020)

Appendix III

SPS Implementation Tools

Framework and Tearsheets

The hierarchy of the NHRI silviculture framework



** Most common, used in strategic planning*

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

Variant/Treatment:

PROGRESSIVE STRIP CLEARCUT

System: **EVEN-AGED**

Sub-system: **Clearcut**

PCC

Stand Eligibility

- **FUNA:** BETH, THIH, THMX, INHW
- **Structure:** all but M1 & M2 (except for BETH)
- Presence of trees of desired species and quality to provide seeds
- Species that require some protection from exposure to regenerate successfully
- Mature to overmature development stage
- Poor quality stand and/or low stocking
- Even distribution of trees within stand
- Lack of pre-established regeneration
- Low probability of competition by aggressive interfering plants

Treatment Objectives

This process of regeneration brings together cuts that include harvesting all or almost all merchantable stems in a stand (90 to 100% of the merchantable volume) within 20 years. This sub-system removes most or all merchantable trees from the stand in three or more operations and subsequently regenerates an even-aged stand. The regeneration is obtained from natural seeding from adjacent stands, harvested trees, advance regeneration or artificial sources (planting or direct seeding). It is important to adjust the size of the areas cut based on the distance over which the seeds are disseminated.

The general factors to consider before implementing clearcut are:

- High percentage of mature and unhealthy trees
- Presence of seed trees of desired species
- Seedling characteristics of desired species (i.e. need some shelter for establishment and survival)
- Suitable seedbed and growing conditions
- Site preparation if required
- Existing and potential competition from undesired vegetation

Description

The stand is removed using series of strips harvested over three or more entries, usually covering an equal area on each occasion. This method may be chosen to reduce water fluctuations, windthrow, erosion and to offer some shelter.

Depending on the width of the strips and the orientation and protective effect of the adjacent trees, this pattern can favor regeneration of intermediate shade-tolerant species like yellow birch, American elm and basswood (American linden) and better control of invasion by competition. The alternate uncut strips are removed within a period of time not exceeding 20% of intended rotation (<20 years).

- If possible, orient the strips northwest to southeast so that residual trees can protect regeneration from high light intensity while allowing seed dispersion by wind.
- Cut strips should be perpendicular to the prevailing winds to promote even seed distribution.
- Understand shade tolerance of the desired species (wider strips for less shade-tolerant species and vice versa).

Desired Outcomes

Immediate	Mid-term	Long-term
• Creation of progressive strips in the stand. • Creation of germination beds • Abundance of seeds for germination • Adequate soil exposure • No site damage • No valuable trees at risk left standing	• Recruitement of new cohort of desired species • Low competition by interfering plants • Good seedling survival • Low tree mortality	• Full stocking of seedlings and saplings • Low competition and High relative stand density to allow for quality development • Stand ready for intermediate silviculture

Key Success Factors

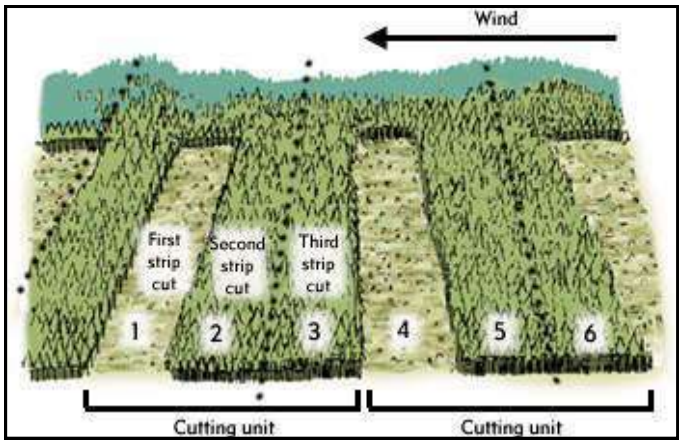
- Strip pattern adjusted to the species of interest
- Planned on good seed years
- Strips oriented to maximize seed dispersion

IMPLEMENTATION
PROGRESSIVE STRIP CLEARCUT

PCC

Operational Considerations

	Prefered	Tolerated	Avoid
Full Tree System	X		
CTL System		X	
Leaves Off	X	X	
Frozen Ground		X	



https://www.for.gov.bc.ca/hfp/training/00014/varclear.htm#clear

Getting Started

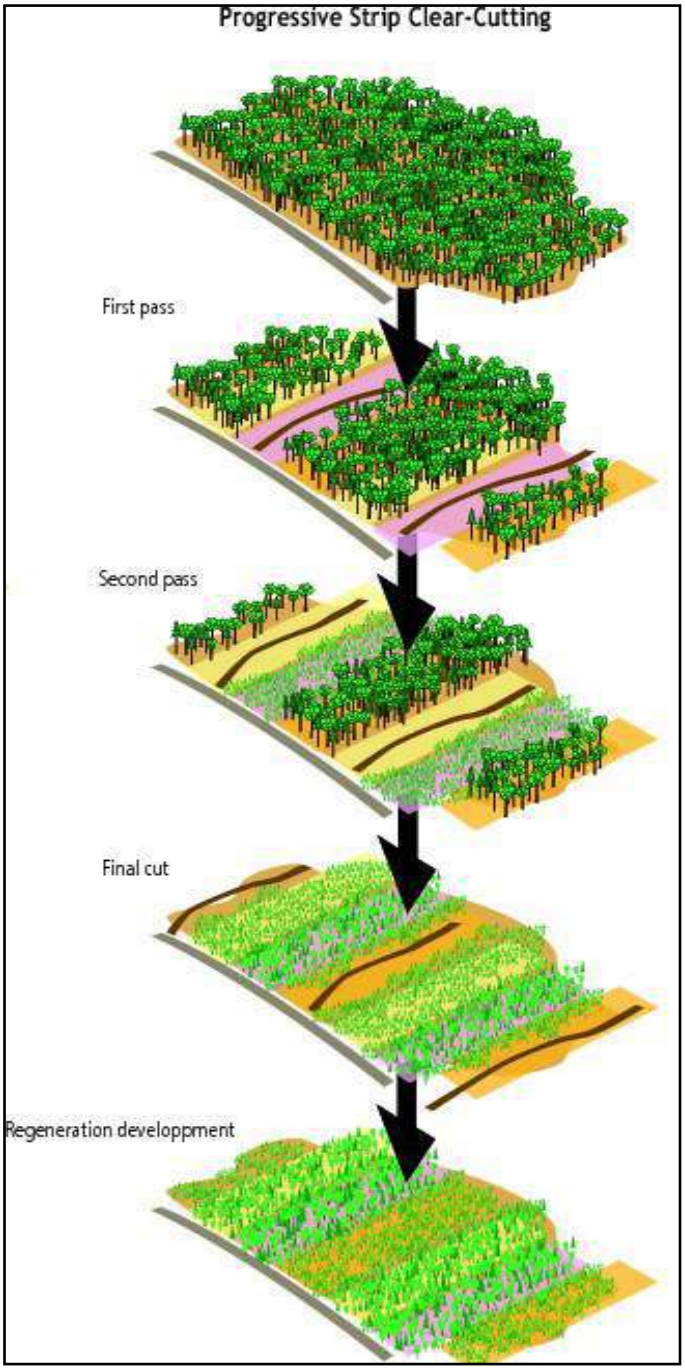
- Select the # of strips required (function of # entries desired)
- Plan treatments in a good seed year and in the proper season
- Determine the right strip width according to species (see table below)
- When possible, orient strips so that they are mostly perpendicular to dominant winds but avoid prolonged direct light (NW or SE)
- Schedule the next re-entries so that the entire area is covered in less than 20 years (i.e. years 1, 10, 20)

Implementation Instructions

Residual Density in Selection Strip:	5 m2/ha
Cut Priority:	Cut all merchantable trees >22cm and maintain/release AGS in pole size trees and saplings when present
Cutting Instructions:	Year 1: : establish first strip Year 10:: cut 2nd strip Year 20: cut final strips Width: 1.5 x tree height (20-30 m average width depending on tree height)

Additional Considerations

- Put emphasis on the creation of seed germination beds.



Source: CERFO

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

Method/Treatment:

RETENTION SEED-TREE CUT

System: **EVEN-AGED**

Sub-system: **Clearcut/seed tree**

RST

Stand Eligibility

- **FUNA:** BETH, THIH, TOHW, THMX
- **Structure:** all but M1 (except for BETH)
- Presence of trees of desired species and quality to provide seeds
- Species that do not require some protection from exposure to regenerate successfully
- Mature to overmature development stage
- Poor quality stand or low stocking
- Even distribution of trees within stand
- Lack of pre-established regeneration
- Low probability of competition by aggressive interfering plants

Treatment Objectives

In this process, a few well-distributed seed-trees establish regeneration when all the other trees have been cut. This process is used to optimize the distribution of seeds spread by the wind.

Spacing between seed-trees left on the cut-over area varies based on the species and size of the trees (Table 2). If seed-trees are dispersed, the quantity of seed-trees to be preserved is determined by calculating the area that each tree can seed, adding a risk factor to cover any losses of seed-trees and converting the resulting area into density of trees by hectare.

Seed-trees can either be harvested a few years after the original cut when regeneration is established or be left for longer (reserve cutting or reserve seed-tree; réserve de semenciers) to produce timber of larger size. They can be harvested during the first thinnings of the regenerated stand or even during final cutting depending on the risk of causing damage to seedlings and saplings.

Description

This system leaves individual seed-trees or clusters of seed-producing trees in a clearcut mainly to provide regeneration . The trees excluded from harvesting to supply seeds for the next crop should be of good quality and vigorous. They are generally too far apart to affect the microclimate or shelter the new regeneration. Seed-tree cutting involves up to two steps: a seed cut and a removal cut and has the following variants:

Uniform Seed-tree: Individual trees are excluded from harvesting and are generally distributed evenly throughout the harvested area. Seed trees are harvested in the future.

Group seed-tree: Clusters of seed trees are left in groups or strips throughout the harvested area. The distribution of the groups of trees excluded from harvesting could be uniform or irregular to maximize seed dispersal of the desired species. The seedf dessimination distance is an essential consideration for determining distances between patches or groups of seed trees. Clumps are later removed.

Seed-tree with reserve: Individual and patches of trees that are left to meet long-term objectives such as visual landscape management and special wildlife habitats rather than to regenerate the stand.

Desired Outcomes

Immediate	Mid-term	Long-term
• Acceptable amount of quality seed trees throughout the block • Creation of germination beds • Abundance of seeds for germination • Adequate Soil exposure • No site damage	• Recruitement of new cohort of desired species • Low competition by interfering plants • Good seedling survival	• Full stocking of seedlings and saplings • Low competition • High density to allow for quality development • Stand ready for intermediate silviculture

Key Success Factors

- Number and distribution of seed trees planned according to requirements of species of interest.
- Planned on good seed years
- Soil exposed to generate seed germination beds

IMPLEMENTATION
RETENTION SEED-TREE CUT

RST

Operational Considerations

	Prefered	Tolerated	Avoid
Full Tree System	X		
CTL System		X	
Leaves Off	X	X	
Frozen Ground		X	

Getting Started

- Select the amount and distribution of seed trees according to the requirements of species of interest)
- Decide on the variant to use
- Plan treatments in a good seed year and in the proper season
- Determine the right tree spacing according to species (see table below).
- Schedule the next re-entries so that the removal of seed trees does not damage regeneration (i.e. < 2m)

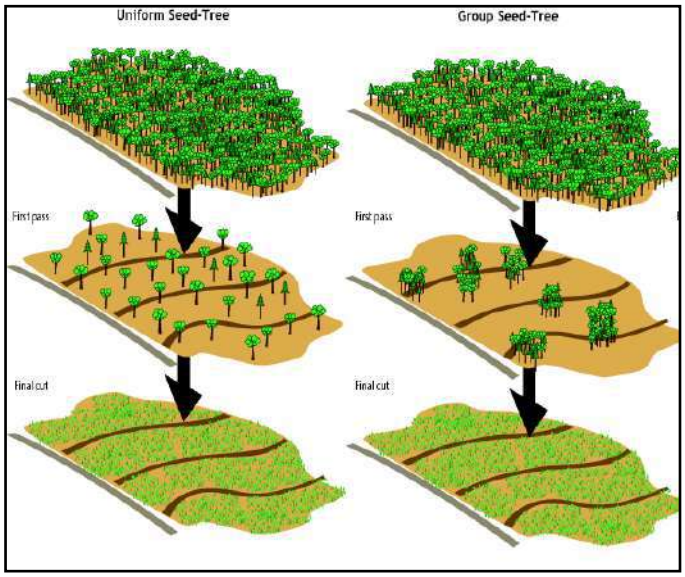
Average Distance of Dissemination of Seeds by Species
(Source: *Guide Sylvicole du Québec*)

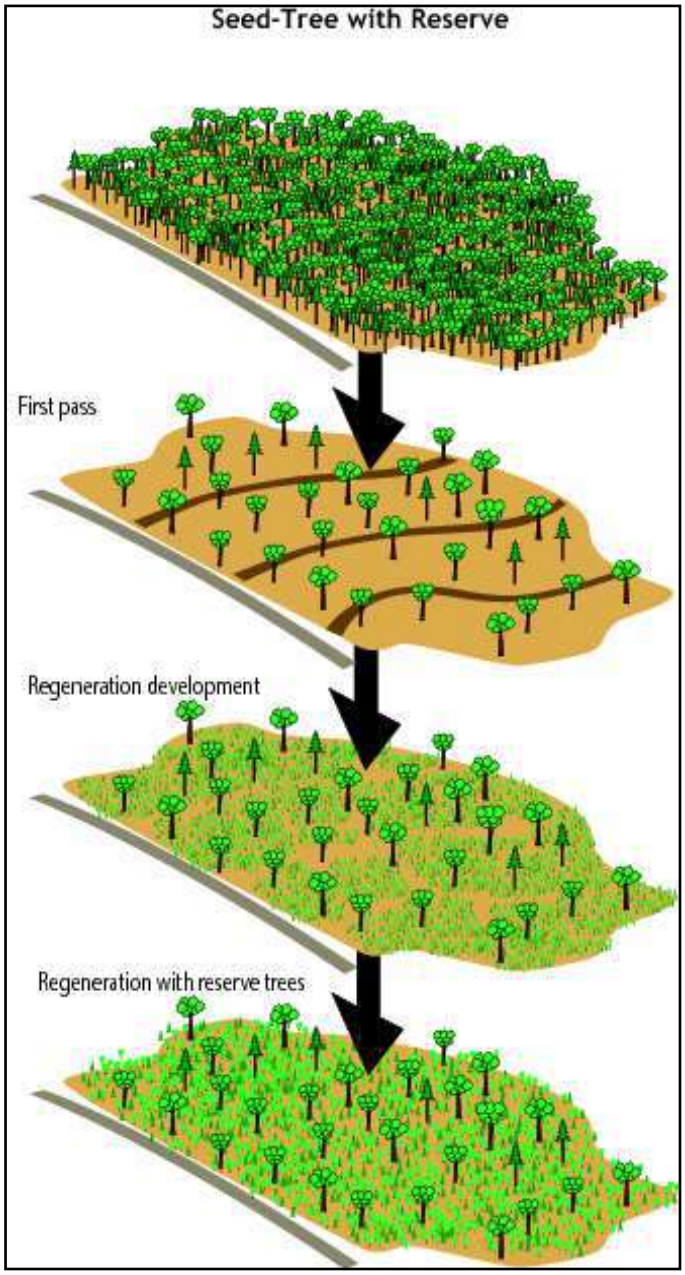
Distance of Dissemination (m)			
Hardwoods		**Softwoods**	
Trembling Aspen	Several km	White pine	1H*
White birch	< 60	Jack pine	2H*
Yellow birch	> 100	Balsam fir	25-60
Red maple	> 100	Black spruce	50-80
White ash	140	Red spruce	< 100
American elm	< 450	White spruce	20-30
Basswood	< 150		

*H=tree height

Implementation Instructions

Residual Density in Selection Strip:	10—20 seed trees/ha
Cut Priority:	Cut all merchantable trees >22cm and maintain/release best AGS in pole size trees and saplings and/or trees capable of producing seeds
Cutting Instructions:	Year 1: cut but retain seed trees





Source: CERFO

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

Variant/Treatment:

UNIFORM SHELTERWOOD

System: **EVEN-AGED**

Sub-system: **SHELTERWOOD**

USH

Stand Eligibility

- **FUNA/Structure:** all except quality SMTH-M1 and YBTH-M1
- Presence of trees of desired species and quality to provide seeds
- Species that require some protection from exposure to regenerate successfully
- Mature to overmature development stage
- Poor quality stand or low stocking
- Even distribution of trees within stand
- No quality pole-sized and small trees

Treatment Objectives

The shelterwood system removes the overstory in a series of harvest entries to regenerate the stands understory. The number of residual trees vary from one area to another depending on tree species, tree structure (diameter, height, and crown width), slope, and aspect.

This system is recommended for long-lived shade tolerant species and in poor quality stands made up of least 30% of long-lived and shade tolerance species.

The general considerations in the application of the shelterwood system are:

- Overstory condition (risk, form, structure and composition)
- Density of seed trees in the stand
- Site suitability to desired species
- Presence, abundance, and size of established regeneration of desired species
- Seedbed or site preparation
- Potential competition from undesirable vegetation.

Description

The system is implemented in 1 to 4 stages, each with specific objectives and characteristics:

- preparatory cut is optional if there is a need to improve the vigor of prospective seed-bearing trees
- a seed or regeneration cut is undertaken to remove 30-70% of the canopy, taking into consideration the species's shade tolerance and site conditions
- optional removal cuts may then be used to release well established regeneration from overstory shade
- final cut (overstory removal) is done to remove most or all of the remaining canopy

All cuts must be undertaken within a 20 year cycle to ensure the establishment of a single cohort (<1/5 of a rotation). Intermediate silviculture treatments such as commercial thinning will normally be required.

Desired Outcomes

Immediate	Mid-term	Long-term
• Creation of openings in canopy • Creation of germination beds • Abundance of seeds for germination • Adequate Soil exposure • No site damage	• Recruitement of new cohort of desired species • Sheltered seedlings by residual trees • Good seedling survival • OSR planned before regeneration is too tall	• Full regeneration and sapling stocking • Low competition by residual trees • High density to allow for quality development

Key Success Factors

Seedling establishment cut

- Adequate mineral soil exposure
- Planned on a good seed year
- Even distribution of residual trees

Overstory removal (as above +)

- Timed when regeneration is established but < 2m tall
- Snow cover preferred

IMPLEMENTATION
UNIFORM SHELTERWOOD

USH

Operational Considerations

	Prefered	Tolerated	Avoid
Full Tree System	X		
CTL System		X	
Leaves Off	X	X	
Frozen Ground			X
High Trail Footprint (>20% ratio)		X	

Getting Started

- Plan treatment in a good seed year and in the proper season (spring, summer, fall)
- If possible, use a harvesting system that will prepare germination substrates (MFT or CTL plus scarification)
- Determine the right residual Basal area target for desired species (8-10 m2/ha)
- Decide if a preparatory cut is needed to make seed trees more vigourous
- Design appropriate trail pattern (5-6m wide and 15-16m center to center)
- Establish a pecking order for removal as per below
- Schedule the next re-entry (OSR when regeneration is < 2m tall)

Implementation Instructions

Residual Density in Selection Strip:	8-10 m2/ha
Cut Priority:	Cut all trees >48cm, trees with high grade products at risk and those from the UGS group
Cutting Instructions:	saplings (<10cm) : protect AGS small (10-22cm): 1/3 medium (22-38cm): 1/2 large (38-48cm): 1/1 very large (>48cm): all

Seedling establishment cut *(courtecy CERFO)*

Regeneration established and ready for OSR

Saplings approx. 20 yrs. After OSR ready for CT

Additional Considerations

This treatment is about starting a new stand within 20 years, so lower than usual emphasis is put on protecting crop trees. Rather put emphasis on creating seed beds. SCHEDULE THE FINAL TREATMENT (OSR) WHEN REGENERATION IS ESTABLISHED BUT < 2M HIGH

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

Variant/Treatment:

ONE-CUT SHELTERWOOD (OSH)

System: **EVEN-AGED**

Sub-system: **SHELTERWOOD**

OSH

Stand Eligibility

- **FUNA/Structure:** all except quality SMTH-M1 and YBTH-M1
- Presence of trees of desired species and quality to provide seeds
- Mature to overmature development stage or poor quality stand or low stocking
- **Already established regeneration that does not require shelter any longer**
- Regeneration is not so tall that it risks being damaged during harvesting (<2m height)

Treatment Objectives

The shelterwood system removes the overstory in a series of harvest entries to regenerate the stand under the shelter. The number of residual trees vary from one area to another depending on tree species, tree structure (diameter, height, and crown width), slope, and aspect.

This system is recommended for long-lived shade tolerant species and in poor quality stands made up of least 30% of long-lived and shade tolerance species.

The general considerations in the application of the shelterwood system are:

- Overstory condition (risk, form, structure and composition)
- Density of seed trees in the stand
- Site suitability to desired species
- Presence, abundance, and size of established regeneration of desired species
- Seedbed or site preparation
- Potential competition from undesirable vegetation.

Description

The purpose of this overstory removal treatment is to liberate regeneration that has been established as a result of previous treatments (sometimes by accident) or through the process of stand dynamics notably in stratified mixture single cohort stands. It is typical of even-aged systems but can also be part of two-aged systems.

It is conducted when seedlings no longer require protection or shelter by a partial canopy. Its timing is critical as to not damage regeneration while we make growth resources available to the new cohort.
The harvest is conducted with a priority on large trees of commercial size, unacceptable growing stock and trees at risk of loosing products and value. It is a good practice to keep and protect small trees with potential to grow quality products (AGS) but it is important to maintain a low residual basal area. In cases where there is a large proportion of small quality trees to maintain, a two-aged system may be more appropriate.

The subsequent treatment in a one-cut sub-system is likely to be a pre-commercial or a commercial thinning.

Desired Outcomes

Immediate	Mid-term	Long-term
• Release of established regeneration of desired species • Adequate stocking of healthy regeneration • No site damage • Maintenance of small quality trees	• Good seedling survival • High stocking and low competition on saplings of desires species (>2000/ha) • High vigour and quality of regeneration • Free-to-grow saplings and small trees of desired species	• Full stocking (between A and B lines of stocking diagram) of commercial species • High AGS/UGS ratio

Key success factors

- Timed when regeneration is established but < 2m tall to minimize harvesting damage
- Timed with snow cover if possible
- Carefull planning of trail pattern and choice of harvesting system to minimize damage to regeneration

IMPLEMENTATION

ONE-CUT SHELTERWOOD

OSH

Operational Considerations

	Prefered	Tolerated	Avoid
Full Tree System	X		
CTL System	X		
Leaves Off	X		
Frozen Ground		X	
High Trail Footprint (>20% ratio)			X

Advanced regeneration in stratified mixture
(maybe too tall and likely sustain harvesting damage)

Getting Started

- Chose a harvesting system that will reduce the likelyhood of damage to regeneration and try to schedule harvest when there is snow to protect seedlings
- Design appropriate trail pattern to use (promote low trail foot prints)
- Decide the residual density of small trees of desired species to retain
- Prepare work instructions for machine operators with regards to target residual densities, trail pattern, pecking order and considerations to protect regeneration and release small trees (AGS)
- Determine quality standards to protect small trees, regeneration and soil
- Schedule the next re-entry

Regeneration established and ready for OSR

Saplings approx. 20 yrs. after OSR and ready for CT

Implementation Instructions

Residual Density in Selection Strip:	5 m^2/ha
Cut Priority:	Cut all merchantable trees >22cm and maintain/release AGS in pole size trees and saplings when present
Cutting Instructions:	saplings (<10cm) : protect AGS small (10-22cm): 1/2 medium (22-38cm): all large (38-48cm): all very large (>48cm): all

Additional Considerations

This treatment is about completely releasing regeneration that is already established by previous activities therefore, it is important to minimise damage to it. Treat when regeneration is less than 2m tall in order to avoid breakage when trees are felled. If possible, operate with snow cover and minimise trail footprint. Full-tree harvesting systems that utilise feller-buncher allow for controlled tree felling and positioning in trails to minimise damage.

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

Variant/Treatment:

UNIFORM 2-AGED/EXTENSIVE

UTA

System: **Two-aged/Extensive**

Sub-system: **Low Cover 2-Aged**

Stand Eligibility

- **FUNA:** all
- **Structure:** all
- Irregular stand structure
- Species that require some protection from exposure to regenerate successfully
- Mature to overmature development stage
- Poor quality stand
- Species of different lifespans
- Lack of pre-established regeneration
- Relatively even distribution of trees in stand
- Presence of quality pole-sized and small trees

System Objectives

The irregular high-forest system is characterized by a desire to regenerate the entire treated stand over a long period that is not continuous over time. It uses partial cuts of varying extents, allowing several vertical or horizontal stories of different age classes to be maintained: so forest cover is permanent but not necessarily dominated by mature trees throughout.

The main objective of this system is to generate stands with an irregular structure (two-story or uneven-aged structure including at least three age classes), preferably through natural seeding. This system is characterized therefore by the simultaneous presence of at least two cohorts of trees of different ages within the same stand. Because a wide spectrum of light conditions is created, this system allows species with different tolerances to shade and longevity to be grown together.

The re-entry after the first treatment is extended (30-35 years).

Description

This pattern is used when cover is uniform. Cover is opened progressively throughout the whole stand, targeting uniform distribution of residual stems and avoiding creating gaps that are too large.

The degree to which cover is opened up varies according to the tolerance of the species involved and the aggressiveness of the competition. Several harvests are conducted over an extended period (30-40 years) until two distinct cohorts of crop trees have been established. As in other types of irregular shelterwood variants, trees in all mature size classes receive treatment.

Regenerated sections may be harvested completely, open non-regenerated areas may have to be scarified and closed portions may undergo partial harvesting and any needed site preparation.

Partial removal usually involves harvesting a third of the stems according to simple rules (e.g.: for each group of three stems, harvest the largest, or the ugliest). The last cut corresponds to a final cut and occurs a few years later, when the sections that regenerated under cover are tall enough.

Desired Outcomes

Immediate	Mid-term	Long-term
• Acceptable amount of quality residual trees throughout the block • Creation of germination beds • Abundance of seeds for germination • Adequate Soil exposure • No site damage (i.e. ruts) • No residual trees at risk • Quality pole-sized trees released on 3 sides	• Recruitement of new cohort of desired species • Low competition by interfering plants • Good seedling survival of desired species • Moderate B.A. in vigourous residual trees • No residual trees at risk	• Full stocking of seedlings and saplings • Low competition • Two distinct cohorts of crop trees • No loss of merchantable volume

Key Success Factors

- Manage light in order to:
  - Control the establishment and growth of regeneration of desired species
  - Optimize increase in the diameter of the stems kept by providing optimal space for their crowns to spread
- Planned on good seed years
- Expose soil to create seed germination beds
- Maintain adequate cover to protect seedlings

IMPLEMENTATION
UNIFORM 2-AGED/EXTENSIVE

UTA

Operational Considerations

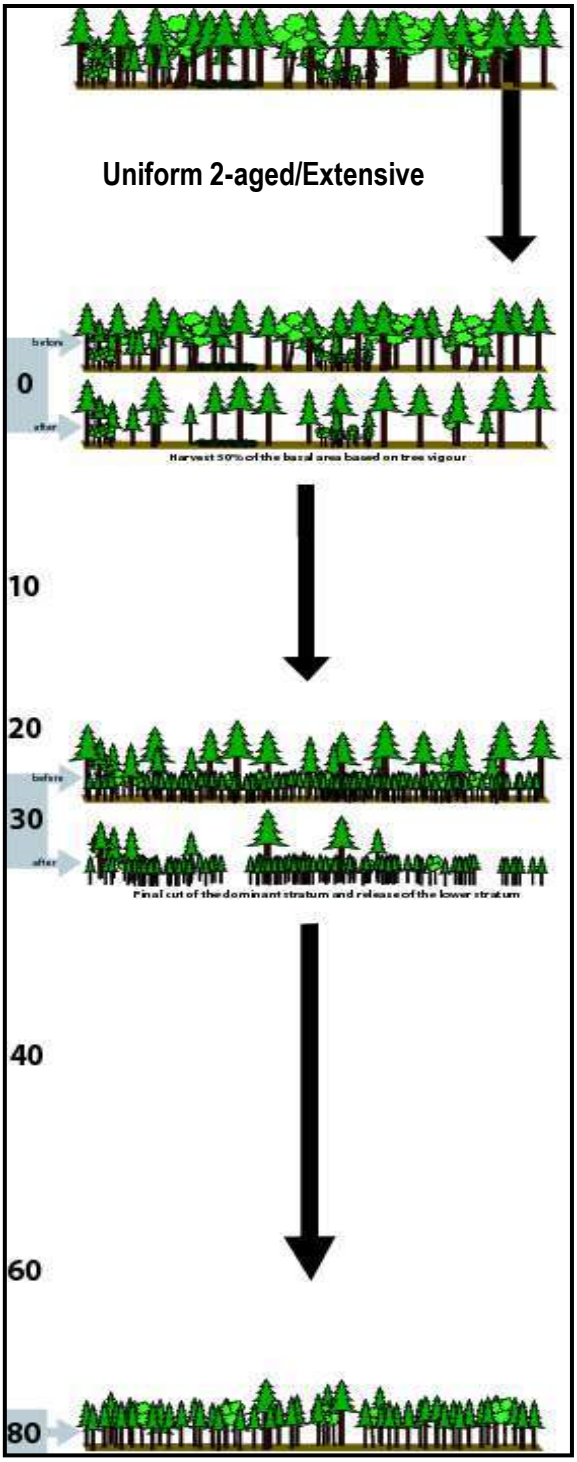
	Prefered	Tolerated	Avoid
Full Tree System	X		
CTL System		X	
Leaves Off	X	X	
Frozen Ground		X	
Outside Sap Season	X		

Getting Started

- Determine the ideal trail pattern to use (5m wide and 15m center to center or, 6m wide and 16m center to center)
- Decide on the overall target residual basal area or crown cover (between 8-12 m2/ha)
- Plan treatments in a good seed year and in the proper season
- Provide operators with simple instructions for harvest by tree size category as per below
- Provide visual guidelines for assessing residual density
- Prepare tree selection criteria (pecking order)
- Decide the timing of the next re-entry
- Prepare a checklist for implementation

Implementation Instructions

Residual Density in selection strip:	8-12 m2/ha
Cut Priority:	Cut most trees >48cm, trees with high grade products at risk and those from the UGS group
Cutting Instructions:	saplings (<10cm) : protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/2 large (38-48cm): 2/3 very large (>48cm): all openings <0.2 ha



Source: CERFO

Additional Considerations

- When releasing crop trees, leave some non-competing 'trainer trees to prevent the production of epicormic branches
- Large and very large trees in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques
Northern Hardwoods Research Institute

Variant/Treatment:

CONTINUOUS COVER TWO-AGED/EXTENSIVE

System: **Two-aged/Extensive**

Sub-system: **Moderate cover 2-aged**

CTA

Stand Eligibility

FUNA: all

Structure: all

- Irregular stand structure
- Species that require some protection from exposure to regenerate successfully
- Mature to overmature development stage
- Medium quality stand
- Species of different lifespans
- Lack of pre-established regeneration
- Relatively even distribution of trees in stand
- Presence of quality pole-size and small trees

Treatment Objectives

The irregular high-forest system is characterized by a desire to regenerate the entire treated stand over a long period that is not continuous over time. It uses partial cuts of varying extents, allowing several vertical or horizontal stories of different age classes to be maintained: so, forest cover is permanent but not necessarily dominated by mature trees throughout.

The main objective of this system is to generate stands with an irregular structure (two-story or uneven-aged structure including at least three age classes), preferably through natural seeding. This system is characterized therefore by the simultaneous presence of at least two cohorts of trees of different ages within the same stand. Because a wide spectrum of light conditions is created, this system allows species with different tolerances to shade and longevity to be grown together.

Description

This process creates favorable conditions for seedlings to establish and survive while allowing for tending residual stems and harvesting mature trees of poor quality. It is also a way to extend harvesting long-lived species within a mix of species with varying lifespans.

It produces larger diameter stems and spreads revenues over a longer period but it requires thorough knowledge of species ecology and optimized harvesting operations.

This sub-system differs from other 2-aged systems because it ***maintains a minimum 40% cover***. Harvesting pattern, frequency and intensity are guided by species autecology. The preferred way of creating gaps is by removal of dying or defective over mature trees. They can also be designed to release groups of saplings or pockets of pole-sized trees and regeneration. As well, young quality trees should be released.
This process may be perceived as an extensive selection cutting, if the emphasis is on a balanced form of structure to ensure that cover is permanently renewed.

Desired Outcomes

Immediate	Mid-term	Long-term
• Acceptable amount of quality residual trees throughout the block • Creation of germination beds • Abundance of seeds for germination • Adequate soil exposure • No site damage (i.e ruts) • No residual trees at risk • Relesed quality pole-sized trees	• Recruitement of new cohort of desired species • Low competition by interfering plants • Good seedling survival of desired species • Moderate B.A. in vigourous residual trees • No residual trees at risk	• Full stocking of seedlings and saplings • Low competition • Healthy mature strata • No loss of merchantable volume

Key Success Factors

Manage light in order to:

- Control the establishment and growth of regeneration of desired species;
- Optimize increase in the diameter of the stems kept by providing optimal space for their crowns to spread
- Planned on good seed years
- Expose soil to generate seed germination beds
- Maintain adequate cover to protect seedlings
- Released pole-sized trees
- Decision on wether trails will be re-used

IMPLEMENTATION

CTA

CONTINUOUS COVER 2-AGED/EXTENSIVE

Operational Considerations

	Prefered	Tolerated	Avoid
Full Tree System	X		
CTL System		X	
Leaves Off	X	X	
Frozen Ground		X	
Outside Sap Season	X		

Getting Started

- Determine the ideal trail pattern to use (5 m wide and 20m center to center or, 4 m wide and 18 m center to center)
- Decide on the overall target residual basal area or crown cover (14-16 m2/ha)
- Plan treatments in a good seed year and in the proper season
- Provide operators with simple instructions for harvest by tree size category as per below.
- Provide visual guidelines for assessing residual density
- Prepare tree selection criteria (pecking order)
- Decide the timing of the next re-entry
- Prepare a checklist for implementation

Implementation Instructions

Residual Density in Selection Strip:	14-16 m2/ha
Cut Priority:	Cut most trees >48cm, trees with high grade products at risk and those from the UGS group
Cutting Instructions:	saplings (<10cm) : protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/2 large (38-48cm): 1/2 very large (>48cm): all openings <0.2 ha

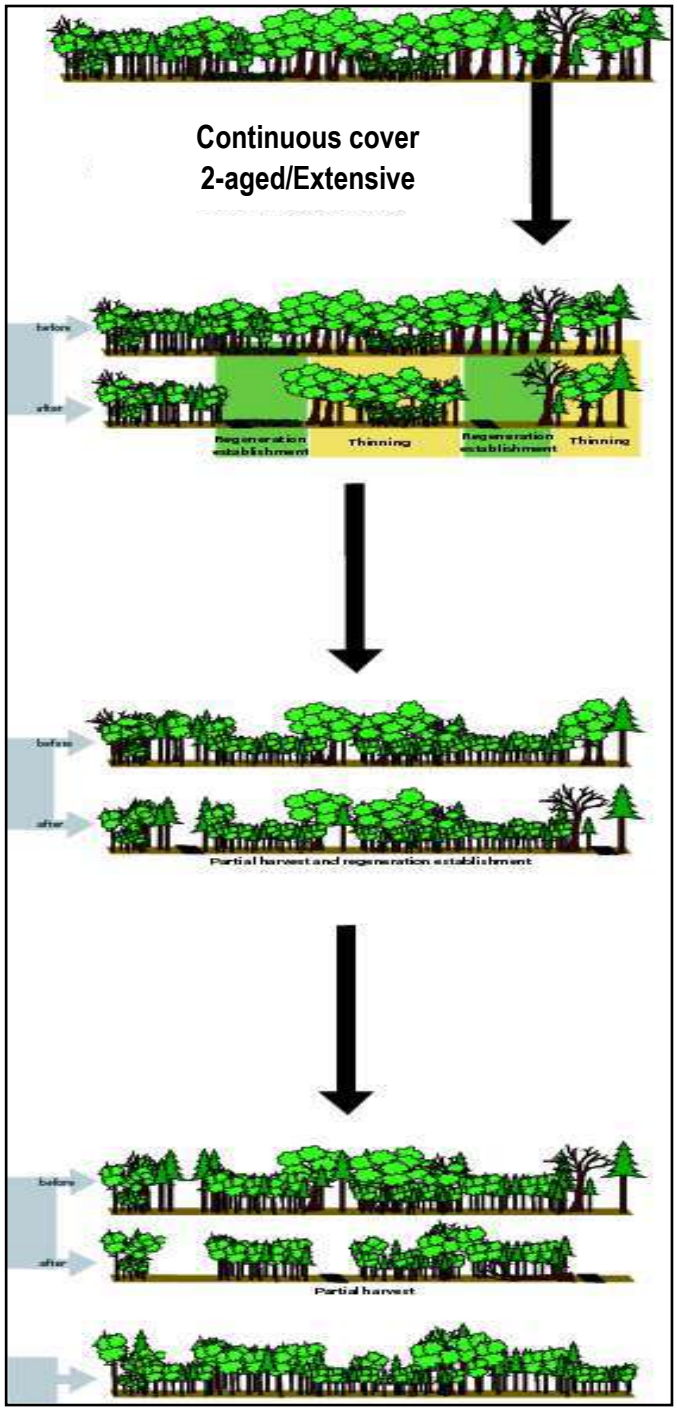


Image Source: CERFO

Additional Considerations

- When releasing crop trees, leave some non-competing 'trainer trees ' to prevent the production of epicormic branches
- Large and very large trees in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

Method/Treatment:

SINGLE-TREE WITH GROUP SELECTION

System: **UNEVEN-AGED**

Sub-system: **SELECTION**

SGS

Stand Eligibility

- **FUNA:** SMTH, YBTH, TOHW, THMX
- **Structure:** Balanced multi-cohort
- The proportion of beech must be less than 30% and not prominent in the understory
- Ideally, there should be at least 25m^2 /ha of basal area and >60% crown cover to allow harvesting enough volume
- More than half the trees need to be of quality (AGS)
- Should have a high proportion of sugar maple and yellow birch
- Acceptable regeneration should be present
- Site should have high productivity

Treatment Objectives

Production of high-quality sawlogs is a management goal. Under this method the highest-grade trees are selected and then "released" by removing lower grade trees which would otherwise compete with the selected tree for resources.

To continually create or maintain an uneven-aged stand by removing single trees or small groups of trees from various age and size classes. regeneration cut, tending operation and harvesting generally occur simultaneously, but may vary across the stand.

Specific objectives are:

- Create multiple cohort stand (at least 3 age classes)
- Perpetuate natural gap creation
- Regulate a balanced age-class distribution over the stand
- Promote conditions for good growth
- Control species composition and quality.
- Increase sawlog volume

Description

Individual trees are harvested using the Arbogast method also known as the ***BDq* method**. Under this method, a harvest is specified by defining a maximum diameter to retain (***D***), a residual basal area (***B***), and a q-ratio (***q***). The q-ratio is the ratio of the number of trees in a diameter class to the number of trees in the next larger class.

Regular re-entries (approx. every 20 yrs) remove merchantable timber, reduce competition to crop trees and promote regeneration of desirable species. Treatments are done in all 3 age classes.

Single mature trees or small groups of trees from a range of diameter classes are removed, uniformly across the cutover area.

Generally, the size of gap created in this method is equivalent to the crown spread of a single tree or clumps of mature trees.

Desired Outcomes

Immediate	Mid-term	Long-term
• BA>16m^2/ha • AGS>UGS • <5% crop trees damaged • Crop trees released on 2-3 sides • No site damage (i.e. ruts)	• Recruitment of new cohort • Healthy crowns • Diameter growth • Reduction of risk trees	• High Basal Area • AGS>75% • R1, R2 trees >75% • Sm, Yb >75% • Balanced age/DBH structure

Key Success Factors

- Small trail footprint with wide spacing and narrow trails
- Operate after sap season and with snow cover if possible
- Chose proper harvesting system
- Use trained operators dedicated to special harvesting
- Implement quality system
- Stratify stands correctly
- Develop BDQ methodology/targets

IMPLEMENTATION

SGS

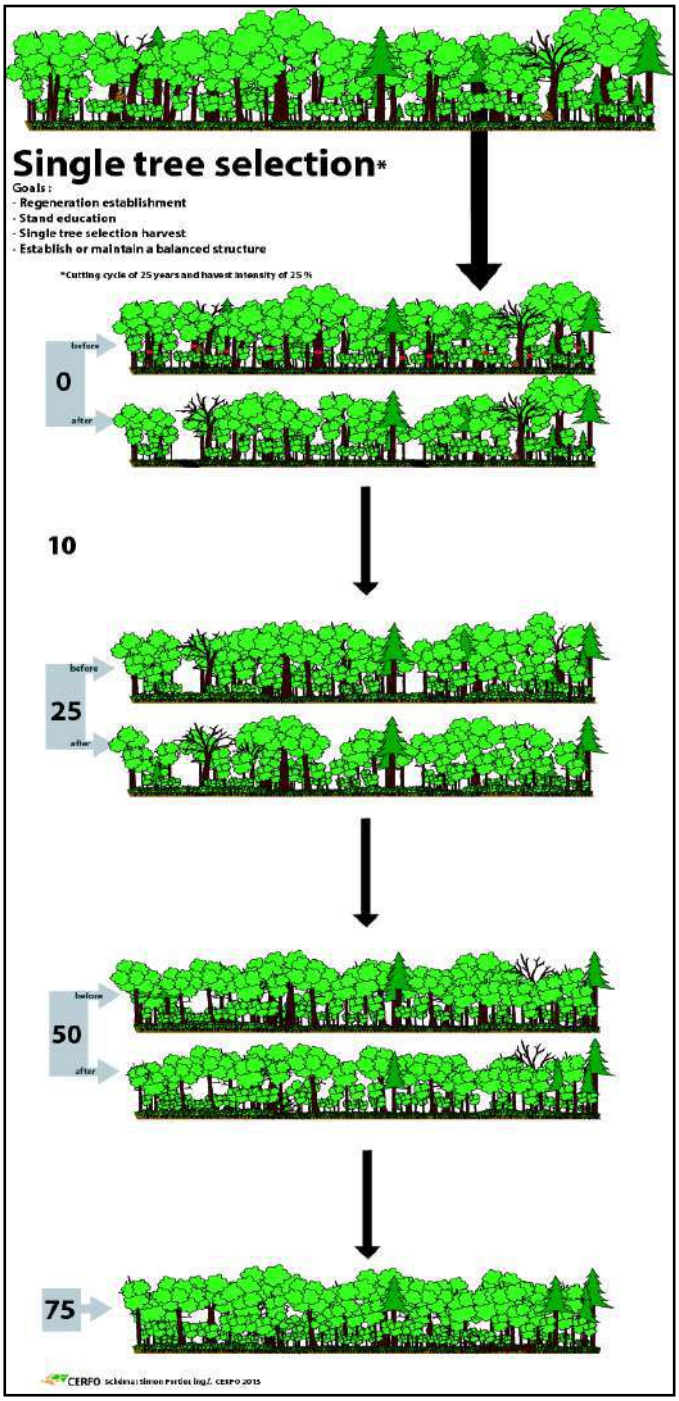
SINGLE-TREE WITH GROUP SELECTION

Operational Considerations

	Prefered	Tolerated	Avoid
Full Tree System	X		
CTL System	X		
Sap-free Season	X		
Frozen Ground	X		
Leaves Off	X		
High Trail Footprint			X

Getting Started

- Determine the ideal trail pattern to use (4 m wide and 20m center to center or, 5m wide and 25m center to center)
- Decide on the overall target residual basal area or crown cover (17-18 m2/ha)
- Plan treatments in a good seed year and in the proper season
- Provide operators with simple instructions for harvest by tree size category as per below
- Provide visual guidelines for assessing residual density
- Prepare tree selection criteria (pecking order)
- Decide the timing of the next re-entry
- Prepare a checklist for implementation



Implementation Instructions

Residual Density in Selection Strip:	17-18m2/ha
Cut Priority:	Cut most trees >48cm with high grade products at risk and those from the UGS group
Cutting Instructions:	saplings (<10cm): protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/4 large (38-48cm): 1/2 very large (>48cm): all openings <0.2 ha

Additional Considerations

- When releasing crop trees, leave some non-competing 'trainer trees to prevent the production of epicormic branches
- Large and very large trees in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings

NHRI SPS Prescription Tearsheet

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

COMMERCIAL THINNING

Intermediate Treatment

CT

Stand Eligibility

- **FUNA:** SMTH, YBTH, TOHW, OKHW,FPHW, THHW
- **Structure:** E1, E2,
- Regular stand or patch structure
- AGS>UGS
- Young to immature development stage
- High stocking
- Productive site
- Even distribution of trees in stand
- QMD<20cm
- BA > 20m²/ha

Treatment Objectives

Comercial thinning is a treatment common to many even-aged system where the goal is to release quality crop trees in even-aged stands so that they can transition into 2-aged and then uneven-aged stands.

The stands that were subjected to major disturbances generally develop as single cohort stand with one species or stratified mixture of more than two species (E1 and E2 stands). In this type of stands, trees grow without competition until the growing space is reoccupied. When the growing space is fully occupied, trees will compete for available light, moisture and nutrients. Thinning can redistribute the resources to the remaining trees and thus help produce larger diameter trees in a shorter period.

To fulfill this objective, trees that are (1) of undesirable species, (2) poor-quality (damaged or defective) and (3) good quality but in strong competition can be removed. Hence, this treatment is to improve stand composition, structure, growth, quality, and health.

Description

Commercial thinning is implemented to single cohort fully stocked tolerant-hardwood stands (BA>20 m2/ha), which have quadratic mean diameter less than 20 cm. Individual tree form and vigor are important considerations for CT. The objective of producing quality saw timber will only be met if the stand has larger proportion of trees with better form and vigor. Unlike in the case of softwoods, the **preferred method is a crown thinning (or thinning from above) where the emphasis is put on the release of quality Th trees that are often in the co-dominant layer.**

The stand is recommended for CT only if the proportion of AGS>UGS. Branch free bole length is another consideration that helps to determine thinning intensity.

The treatment is regulated by use of stocking guides and stand density management diagrams. If more than 50% of the trees have branch free bole greater than 4 m then the stand can be thinned to B-line. If not, then the stand need to be thinned to quality line for promoting natural pruning. This will help to maintain desired length of branch free bole.

A crop-tree variant can be considered where less emphasis is put on stand but more on elite trees and therefor results in a less uniform spacing.

Desired Outcomes

Immediate	Mid-term	Long-term
• Well stocked stand of crop trees after treatment • Crop trees released on 3 sides • Low damage on residual trees • Increased proportion of desired species and AGS • No site damage • Reduced proportion of trees at risk	• Increased growth on crop trees • Low competition by interfering plants • Good development of crowns on crop trees • Low tree mortality	• High proportion of sawtimber • Clear boles (5m) on elite trees • Stand ready for other intermediate treatment

Key Success Factors

- Fine determination of the target basal area by using stocking guides
- Very low trail ratio
- Use of specialized and smaller harvesters
- Focus on residual quality (low level of damage to crop trees, species selection, etc.)
- Implement in the dormant season (fall and winter) to minimize mechanical damage to trees.

IMPLEMENTATION
COMMERCIAL THINNING

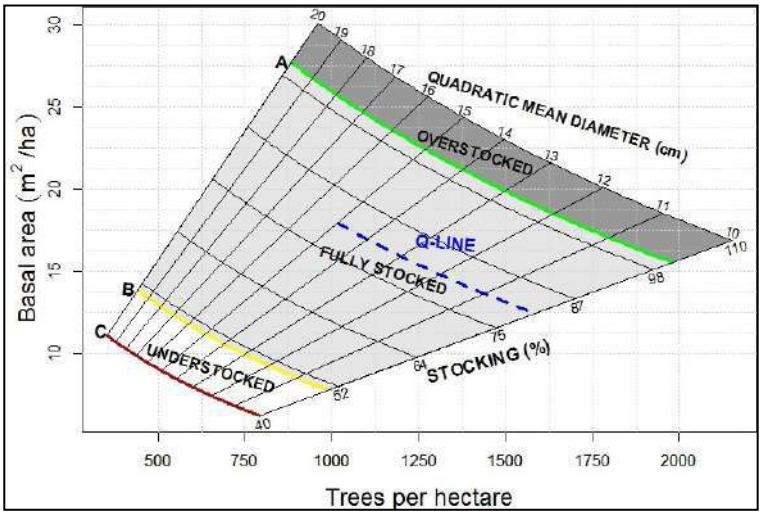
CT

Operational Considerations

	Prefered	Tolerated	Avoid
Full Tree System		X	
CTL System	X		
Leaves Off	X		
Frozen Ground	X		
Outside Sap Season	X		

Northern Hardwoods Stocking Guide (New Brunswick)

'A', 'B' and 'C lines are the stocking levels. The `A' line represents the normal condition of maximum stocking for undisturbed stands of average structure. The 'B' line is the lower limit of stocking needed for full occupancy of the site. Stands at 'C'-level stocking are expected to reach the 'B' level within 10 years.



Pre-planning

- Conduct a pre-treatment inventory to determine elligibility
- Decide on the thinning type based on managment objectives
- Use stocking guide to determine removal intensity and residual basal area.
- If BLC>4m, thin to B line
- Prepare quality standards and pecking order

Hardwoods Thinning Types

Crown Thinning (High Thinning, Thinning from Above):

The removal of trees from the dominant and co-dominant crown classes in order to favor the best trees of those same crown classes. As the trees removed are relatively large, it is often conducted as commercial operations. In this method, best dominant and co-dominant crop trees are ideally selected, favoured and carried through the entire rotation. The number of crop trees to leave is usually between 100 and 400 per hectare.

Free Thinning:

Trees are removed to control stand density and favor desired crop trees using a combination of low and crown thinning despite of the crown position. This type of thinning is used to develop and manage quality hardwood stands for the production of high value sawtimber and veneer logs.

Low Thinning (Thinning From Below):

The removal of trees from the lower crown classes to favor those in the upper crown classes. Least desirable competitors (high risk, low vigor, poor quality) are generally removed. The removal of some co-dominants may create canopy openings and releases the crowns of crop trees to stimulate their growth. This thinning type puts equal emphasis on the production of volume and quality.

Implementation Instructions

Residual Density in Selection Strip:	Thin to Q-line or B–line but leave a minimum of 14m2/ha
Cut Priority:	Cut mostly large trees of poor quality or undesired species then, those from the UGS group
Cutting Instructions:	Saplings (<10cm) : protect AGS Small (10-22cm): 1/4 Medium (22-38cm): 1/4 Large (38-48cm): all Very Large (>48cm): all Openings <0.2 ha

Additional Considerations

- When releasing crop trees, leave some non-competing 'trainer trees to prevent the production of epicormic branches.
- Large and very large trees in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings.

Appendix IV

SPS Implementation Tools

Work Instructions

NHRI SPS - Work Instructions

(PCC) Progressive Strip Clear Cut

SILVICULTURE SYSTEM	**EVEN-AGED**
SUB-SYSTEM	**CLEAR CUT**
OBJECTIVES	To regenerate a new stand within 20 years in situations *where the existing stand is not acceptable* in terms of species composition, stocking and quality and, does not contain quality pole size trees
VARIANTS	**(PCC)** Progressive Strip Clear Cut
GOALS	This regime will regenerate mostly yellow birch and mid-tolerant species through the use of 3 or 4 strips cut progressively within 20 years.

(PCC) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	MFT (prefered), CTL (adapted to increase scarification)
#2 - Harvest Season	Spring, Summer, Fall (*see* Note 2)
#3 - Trail Network	at the discretion of management
#4 - Green/Treatment Strip	Leave untreated
#5 - Cut Priority	Cut all merchantable trees
#6 - Cutting Instructions	Year1: establish first strip Year 10: cut 2nd strip Year 20: cut final strips width: 1.5 X tree height (20m to 30m average width depending on tree height)

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Germination Beds): Put emphasis on the creation of seed germination beds.
NOTE 2 (Key Success Factors): Conduct after sap season to minimize damage to crop trees.
NOTE 3 (Strip Patterns): Strip patterns can be altered but try to maintain 1-1.5 tree heights as width of strips.

NHRI SPS - Work Instructions

(RST) Retention Seed-Tree Cut

SILVICULTURE SYSTEM	**EVEN-AGED**
SUB-SYSTEM	**SEED-TREE CUT**
OBJECTIVES	To regenerate a new stand within 20 years in situations *where the existing stand is not acceptable* in terms of species composition, stocking and quality and, does not contain quality pole size trees
VARIANTS	**(RST)** Retention Seed-Tree Cut
GOALS	Regeneration of new cohort through the permanent retention of seed trees of desired species in clumps

(RST) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	MFT (prefered), CTL (adapted to increase scarification)
#2 - Harvest Season	Spring, Summer, Fall (*see* Note 1 & Note 2)
#3 - Trail Network	5 wide and 15m center to center or, 6m wide and 16m center to center (Trail ratio: 33%-38%)
#4 - Green/Treatment Strip	Residual Basal Area: 10-20 seed trees / ha
#5 - Cut Priority	
#6 - Cutting Instructions	Yr1: cut but retain seed trees

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Key Success Factors): Conduct in proper time to obtain scarification.
NOTE 2 (Key Success Factors): Avoid conducting under snow and plan on good seed years.

NHRI SPS - Work Instructions

(USH) Uniform Shelterwood

SILVICULTURE SYSTEM	**EVEN-AGED**
SUB-SYSTEM	**SHELTERWOOD**
OBJECTIVES	To regenerate a new stand within 20 years in situations *where the existing stand is not acceptable* in terms of species composition, stocking and quality and, does not contain quality pole size trees
VARIANTS	**(USH)** Uniform Shelterwood
GOALS	Within 20 years, completely start a new stand through 2 separate entries. First treatment is a seedling establishment cut applied uniformly throughout the stand.

(USH) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	MFT (prefered), CTL (adapted to increase scarification)
#2 - Harvest Season	Spring, Summer, Fall (*see* Note 2 & Note 3)
#3 - Trail Network	5m wide and 15m center to center or, 6m wide and 16m center to center (Trail ratio: 33%-38%)
#4 - Green/Treatment Strip	Residual Basal Area: 8-10m^2/ha
#5 - Cut Priority	Cut all trees >48cm, trees with high grade products at risk and those from the UGS group
#6 - Cutting Instructions	saplings (<10cm) : protect AGS small (10-22cm): 1/3 medium (22-38cm): 1/2 large (38-48cm): 1/2 very large (>48cm): all

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Creating Seed Beds): This treatment is about starting a new stand within 20 years so lower than usual emphasis is put on protecting crop trees. Rather put emphasis on creating seed beds. SCHEDULE THE FINAL TREATMENT (OSR) WHEN REGENERATION IS ESTABLISHED BUT < 2M HIGH.

NOTE 2 (Key Success Factors)**:** Conduct after sap season tom minimize damage to crop trees.

NOTE 3 (Key Success Factors): Conduct before snow cover in order to increase scarification.

NHRI SPS - Work Instructions

(**OSH**) One-Cut Shelterwood

SILVICULTURE SYSTEM	**EVEN-AGED**
SUB-SYSTEM	**SHELTERWOOD**
OBJECTIVES	To regenerate a new stand within 20 years in situations *where the existing stand is not acceptable* in terms of species composition, stocking and quality and, does not contain quality pole size trees
VARIANTS	(**OSH**) One-Cut Shelterwood (also known as Overstory removal)
GOALS	Complete or substancial removal of overstory in stands to **protect and release well established and desirable regeneration** but with unacceptable merchantable statum

(OSH) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	All
#2 - Harvest Season	Winter (under snow) (*see* Note 2)
#3 - Trail Network	5m wide and 25m center to center or, 4m wide and 20m center to center (Trail ratio: 20%)
#4 - Green/Treatment Strip	Residual Basal Area: <5m^2/ha
#5 - Cut Priority:	Cut all merchantable trees >22cm and maintain/release AGS in pole size trees and saplings when present
#6 - Cutting Instructions:	saplings (<10cm) : protect AGS small (10-22cm): 1/2 medium (22-38cm): all large (38-48cm): all very large (>48cm): all

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Regeneration): This treatment is about completely releasing regeneration that is already established by previous activities therefore, it is important to minimise damage to it. Treat when regeneration is less than 2m tall in order to avoid breakage when trees are felled. If possible, operate with snow cover and minimise trail footprint. Full-tree harvesting systems that utilise feller-buncher allow for controlled tree felling and positioning in trails to minimise damage.

NOTE 2 (Key Success Factors): Conduct after sap season to minimize damage to crop trees.

NHRI SPS - Work Instructions

(**UTA**) Uniform 2-Age

SILVICULTURE SYSTEM	**TWO-AGE, EXTENSIVE**
SUB-SYSTEM	**LOW COVER**
OBJECTIVES	To promote a two cohort stand by removing financially mature trees, tending small trees and establishing a new cohort. This regime is favoured when in the presence of a low quality mature statum but with the presence of a substantial amount of quality pole-sized trees
VARIANTS	(**UTA**) Uniform 2-Age
GOALS	Promote a 2-age class stand by putting emphasis on establishing regeneration. The entries are extended longer than in other regimes (25-35 years) and the resulting stand is homogenous

(UTA) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	MFT (prefered), CTL (adapted to increase scarification)
#2 - Harvest Season	Fall, early Summer when beech present (*see* Note 2)
#3 - Trail Network	5m wide and 15m center to center or, 6m wide and 16m center to center (Trail ratio: 33%-38%)
#4 - Green/Treatment Strip	Residual Basal Area: 8-12m^2/ha
#5 - Cut Priority	Cut most trees >48cm, trees with high grade products at risk and those from the UGS group
#6 - Cutting Instructions	saplings (<10cm) : protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/2 large (38-48cm): 2/3 very large (>48cm): all openings <0.2 ha

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Trainer Trees): When releasing crop trees, leave some non-competing 'trainer trees ' to prevent the production of epicormic branches. Large and very large trees of desired species but in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings.

NOTE 2 (Key Success Factors): Conduct after sap season to minimize damage to crop trees.

NOTE 3 (Key Success Factors): Release crop trees of all size on 3 sides when possible.

NHRI SPS - Work Instructions

(**CTA**) Continuous Cover 2-Age

SILVICULTURE SYSTEM	**TWO-AGE, EXTENSIVE**
SUB-SYSTEM	**MODERATE COVER**
OBJECTIVES	To promote a two cohort stand by removing financially mature trees, tending small trees and establishing a new cohort. This regime is favoured when in the presence of a low quality mature statum but with the presence of a substantial amount of quality pole-sized trees
VARIANTS	(**CTA**) Continuous Cover 2-Age
GOALS	Promote a 2-age class stand but maintain significant crown cover at all time. The entries are extended longer than in other regimes (25-35 years)

(CTA) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	MFT (prefered), CTL (adapted to increase scarification)
#2 - Harvest Season	Fall, Winter, early Summer when beech present (*see* Note 2)
#3 - Trail Network	5 wide and 20m center to center or, 4m wide and 18m center to center (Trail ratio: 22%-25%)
#4 - Green/Treatment Strip	Residual Basal Area: 14-16m^2/ha
#5 - Cut Priority	Cut most trees >48cm, trees with high grade products at risk and those from the UGS group
#6 - Cutting Instructions	saplings (<10cm) : protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/2 large (38-48cm): 1/2 very large (>48cm): all openings <0.2 ha

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Trainer Trees): When releasing crop trees, leave some non-competing 'trainer trees ' to prevent the production of epicormic branches. Large and very large trees of desired species but in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings.

NOTE 2 (Key Success Factors): Conduct after sap season to minimize damage to crop trees.

NOTE 3 (Key Success Factors): Release crop trees of all sizes on 3 sides when possible.

NHRI SPS - Work Instructions

(**SGS**) SingleTree with Group Selection

SILVICULTURE SYSTEM	**UNEVEN-AGED**
SUB-SYSTEM	**SELECTION**
OBJECTIVES	To maintain a multi-cohort stand with 3 or more age classes through periodic and regular harvest entries. Each entry accomplishes 3 main tasks: the harvest of financially mature trees, the tending of trees in the smaller sizes and the recruitment of a new cohort
VARIANTS	(**SGS**) Single Tree with Group Selection
GOALS	Regulate Basal Area, chose a maximum DBH to retain and the proportion of trees in each size class. The treatment is executed by focussing on individual trees but allowing the removal of groups of UGS trees.

(SGS) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	All
#2 - Harvest Season	Fall, Winter (*see* Note 2)
#3 - Trail Network	5 m wide and 25m center to center or, 4m wide and 20m center to center (Trail ratio: 20%)
#4 - Green/Treatment Strip	Residual Basal Area: 17-18 m^2/ha
#5 - Cut Priority	Cut most trees >48cm, trees with high grade products at risk and those from the UGS group
#6 - Cutting Instructions	saplings (<10cm) : protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/4 large (38-48cm): 1/2 very large (>48cm): all openings <0.2 ha

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Trainer Trees)**:** When releasing crop trees, leave some non-competing 'trainer trees ' to prevent the production of epicormic branches. Large and very large trees of desired species but in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings.

NOTE 2 (Key Success Factors): Conduct after sap season to minimize damage to crop trees.

NOTE 3 (Key Success Factors): Release crop trees of all sizes on 3 sides when possible.

NHRI SPS - Work Instructions

(**CT**) Commercial Thinning

SILVICULTURE SYSTEM	**N/A part of all even-aged sub-systems**
SUB-SYSTEM	**N/A part of all even-aged sub-systems**
OBJECTIVES	In young stands with an even-aged structure, regulate competition by releasing crop trees
VARIANTS	(**CT**) Thin to B-line or thin to Q-line
GOALS	Apply the concept of a stand density management diagram to reduce crop tree competition without creating conditions for branching

(CT) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	CTL
#2 - Harvest Season	Fall, Winter (see Note 2)
#3 - Trail Network	5m wide and 25m center to center or, 4m wide and 20m center to center (Trail ratio: 20%)
#4 - Green/Treatment Strip	Residual Basal Area: 14m^2/ha, thin to Q line or B line
#5 - Cut Priority	Cut mostly large trees of poor quality or undesired species then, those from the UGS group
#6 - Cutting Instructions	saplings (<10cm) : protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/4 large (38-48cm): all very large (>48cm): all openings <0.2 ha

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Trainer Trees): When releasing crop trees, leave some non-competing 'trainer trees ' to prevent the production of epicormic branches. Large and very large trees of desired species but in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings.

NOTE 2 (Key Success Factors): Conduct after sap season to minimize damage to crop trees.

NOTE 3 (Key Success Factors): Release crop trees of all sizes on 3 sides when possible.

NHRI SPS - Work Instructions

(**CT**) Commercial Thinning

SILVICULTURE SYSTEM	**N/A part of all even-aged sub-systems**
SUB-SYSTEM	**N/A part of all even-aged sub-systems**
OBJECTIVES	In young stands with an even-aged structure, regulate competition by releasing crop trees
VARIANTS	(**CT**) Thin to B-line or thin to Q-line
GOALS	Apply the concept of a stand density management diagram to reduce crop tree competition without creating conditions for branching

(CT) IMPLEMENTATION SEQUENCE

#1 - Harvesting System	CTL
#2 - Harvest Season	Fall, Winter (see Note 2)
#3 - Trail Network	5m wide and 25m center to center or, 4m wide and 20m center to center (Trail ratio: 20%)
#4 - Green/Treatment Strip	Residual Basal Area: 14m^2/ha, thin to Q line or B line
#5 - Cut Priority	Cut mostly large trees of poor quality or undesired species then, those from the UGS group
#6 - Cutting Instructions	saplings (<10cm) : protect AGS small (10-22cm): 1/4 medium (22-38cm): 1/4 large (38-48cm): all very large (>48cm): all openings <0.2 ha

ADDITIONAL CONSIDERATIONS

GENERAL NOTICE: The cutting instructions provided above are for the objectives of timber production only; other guidelines for wildlife habitat, conservation and diversity can override these recomendations.

IMPLEMENTATION SEQUENCE: First choose harvesting system (#1) and harvest season (#2). Select a trail network (#3), than target residual basal area in the green/treatment strip (#4). Finally follow the cut priorities (#5) and cutting instructions (#6) to meet the basal area target.

NOTE 1 (Trainer Trees): When releasing crop trees, leave some non-competing 'trainer trees ' to prevent the production of epicormic branches. Large and very large trees of desired species but in deteriorating health, and without high grade potential that do not compete with crop trees can be left for the production of seedlings.

NOTE 2 (Key Success Factors): Conduct after sap season to minimize damage to crop trees.

NOTE 3 (Key Success Factors): Release crop trees of all sizes on 3 sides when possible.

Appendix V

SPS Implementation Tools

Implementation Checklists

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

SPS Implementation Checklist

PROGRESSIVE STRIP CLEAR CUT — PCC

GENERAL INFORMATION

Block #: _____ NOTES: _____

Date: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with strip cuts: True: ☐ False: ☐

Strip cuts 20-30m wide (depending on tree height): True: ☐ False: ☐

Recommended harvest system (MFT preferred/CTL adapted to increase scarification): True: ☐ False: ☐

Recommended season (Spring, Summer, Fall): True: ☐ False: ☐

Notes: _____

_____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

Strips are oriented to maximize seed dispersion: True: ☐ False: ☐

Treatment completed un good seed year: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

_____

_____

Institut de recherche sur les feuillus nordiques Inc.
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SPS Implementation Checklist

RETENTION SEED-TREE CUT — RST

GENERAL INFORMATION

Block #: _____ NOTES: _____

Date: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with trail: True: ☐ False: ☐

Trail spacing (5m wide/15m center to center or, 6m wide/16m center to center): True: ☐ False: ☐

Recommended harvest system (MFT preferred/CTL adapted to increase scarification): True: ☐ False: ☐

Recommended season (Spring, Summer, Fall): True: ☐ False: ☐

Notes: _____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

No large trees with quality products were left (except for wildlife habitat purposes): True: ☐ False: ☐

Minimum Basal Area (10-20 seed trees/ha) was kept in the treated stand: True: ☐ False: ☐

Tree selection was conducted to increase AGS/UGS ratio: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

_____

_____

Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

SPS Implementation Checklist

UNIFORM SHELTERWOOD — USH

GENERAL INFORMATION

Block #: _____ NOTES: _____

Date: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with trails: True: ☐ False: ☐

Trail spacing: 5m wide/15m center to center or, 6m wide/16m center to center: True: ☐ False: ☐

Recommended harvest system (MFT preferred/CTL adapted to increase scarification): True: ☐ False: ☐

Recommended season (Spring, Summer, Fall): True: ☐ False: ☐

Notes: _____

_____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

No large trees with quality products are left (except for wildlife habitat purposes): True: ☐ False: ☐

Minimum basal area (8-10m^2/ha) was kept in the treated strip: True: ☐ False: ☐

Tree selection was conducted to increase AGS/UGS ratio: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

_____

_____

Institut de recherche sur les feuillus nordiques Inc.
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SPS Implementation Checklist

ONE-CUT SHELTERWOOD — OSH

GENERAL INFORMATION

Block #: _____ NOTES: _____

Date: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with trails: True: ☐ False: ☐

Trail spacing: 4m wide/20m center to center or, 5m wide/25m center to center: True: ☐ False: ☐

Recommended harvest system (All): True: ☐ False: ☐

Recommended season (Winter-under snow): True: ☐ False: ☐

Notes: _____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

All Trees > 22cm removed: True: ☐ False: ☐

Pole size trees and saplings are present: True: ☐ False: ☐

No large trees with quality products are left (except for wildlife habitat purposes): True: ☐ False: ☐

Minimum basal area ($5m^2$/ha) was kept in the treated strip: True: ☐ False: ☐

Tree selection was conducted to increase AGS/UGS ratio: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

_____

Institut de recherche sur les feuillus nordiques Inc.
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SPS Implementation Checklist

UNIFORM TWO-AGED/EXTENSIVE — UTA

GENERAL INFORMATION

Block #: _____ **NOTES:** _____

Date: _____ _____

By: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with trails: True: ☐ False: ☐

Trail spacing: 5m wide/15m center to center or, 6m wide/16m center to center: True: ☐ False: ☐

Recommended harvest system (MFT preferred/CTL with extra scarification): True: ☐ False: ☐

Recommended season (no snow): True: ☐ False: ☐

Notes: _____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Quality pole-sized trees are released on 3 sides: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

No large trees with quality products are left (except for wildlife habitat purposes): True: ☐ False: ☐

Minimum basal area (8-10m^2/ha) was kept in the treated strip: True: ☐ False: ☐

Tree selection was conducted to increase AGS/UGS ratio: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

_____

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SPS Implementation Checklist

CONTINUOUS COVER TWO-AGED/EXTENSIVE CTA

GENERAL INFORMATION

Block #: _____ NOTES: _____

Date: _____ _____

By: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with trails: True: ☐ False: ☐

Trail spacing: 4m wide/18m center to center or, 5 m wide/20m center to center: True: ☐ False: ☐

Recommended harvest system (MFT preferred/CTL adapted to increase scarification): True: ☐ False: ☐

Recommended season (Fall, Winter, early Summer - when beech present): True: ☐ False: ☐

Notes: _____

_____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Quality pole-sized trees are released on 3 sides: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

No large trees with quality products are left (except for wildlife habitat purposes): True: ☐ False: ☐

Minimum Basal Area (14-16m2/ha) was kept in the treated strip: True: ☐ False: ☐

Tree selection was conducted to increase AGS/UGS ratio: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

_____

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SPS Implementation Checklist

SINGLE-TREE WITH GROUP SELECTION — SGS

GENERAL INFORMATION

Block #: _____ NOTES: _____

Date: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with trails: True: ☐ False: ☐

Trail spacing: 4m wide/20m center to center or, 5 m wide/25m center to center: True: ☐ False: ☐

Recommended harvest system (All): True: ☐ False: ☐

Recommended season (Fall, Winter): True: ☐ False: ☐

Are openings < 0.2 ha: True: ☐ False: ☐

Notes: _____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Quality pole-sized trees are released on 3 sides: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

No large trees with quality products are left (except for wildlife habitat purposes): True: ☐ False: ☐

Minimum Basal Area (17-18m^2/ha) was kept in the treated strip: True: ☐ False: ☐

Tree selection was conducted to increase AGS/UGS ratio: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

_____

Institut de recherche sur les feuillus nordiques Inc.
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SPS Implementation Checklist

COMMERCIAL THINNING — CT

GENERAL INFORMATION

Block #: _____ NOTES: _____

Date: _____ _____

STAND ELIGIBILITY

Conditions within the block were suitable for the treatment: True: ☐ False: ☐

Block was not too variable where further stratification was needed: True: ☐ False: ☐

Notes: _____

_____

TRAIL PATTERN/PLANNING

Block is uniformly covered with trails: True: ☐ False: ☐

Trail spacing: 4m wide/20m center to center or, 5 m wide/25m center to center: True: ☐ False: ☐

Recommended harvest system (CTL): True: ☐ False: ☐

Recommended season (Fall, Winter): True: ☐ False: ☐

Are openings < 0.2 ha : True: ☐ False: ☐

Notes: _____

DESIRED SHORT-TERM OUTCOMES

The block is free of site and environmental damage: True: ☐ False: ☐

Quality pole-sized trees are released on 3 sides: True: ☐ False: ☐

Forest floor was lightly scarified to create germination substrate: True: ☐ False: ☐

Quality residual trees are free of damage from operation: True: ☐ False: ☐

No large trees with quality products are left (except for wildlife habitat purposes): True: ☐ False: ☐

Residual Basal Area (14m^2/ha), thin to Q line or B line: True: ☐ False: ☐

Tree selection was conducted to increase AGS/UGS ratio: True: ☐ False: ☐

ASSESSMENT

Treatment - **Pass** or **Fail**: _____

Preventive Measures/Improvements: _____

_____

Corrective Measures: _____

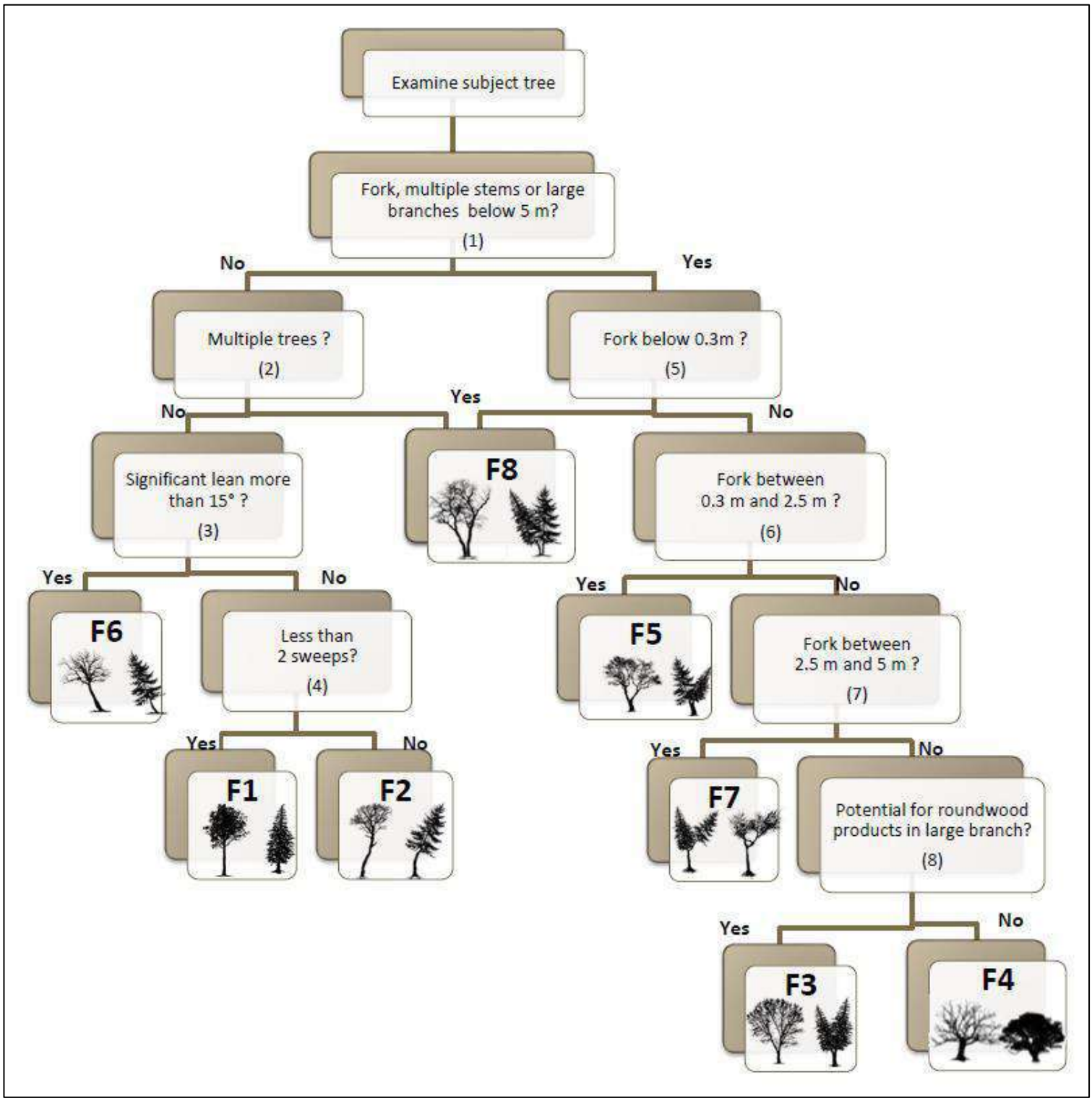
_____

Appendix VI

SPS Implementation Tools

Tree Classification System and AGS/UGS Matrix

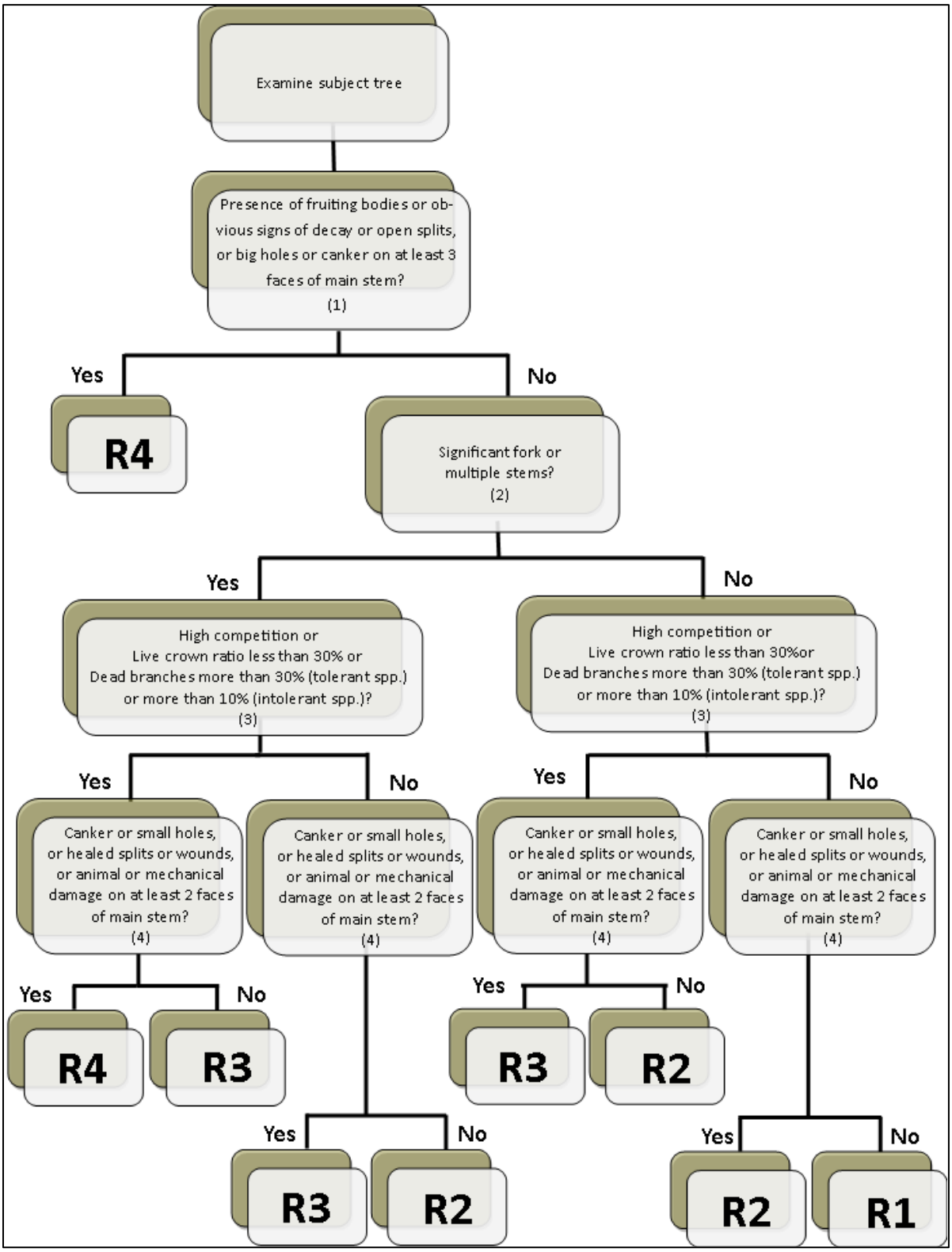
Tree Form Determination Key



Tree Form Summary

Code	Silhouettes	Stem count	Stem curve	Stem inclination angle (°)	Comment
F1		Single stem below 5 m	Sweep on max. 1 axis	Less than 15°	N/A
F2		Single stem below 5 m	Sweep on 2 axes or 1 significant curve	Less than 15°	N/A
F3		Single stem, large branches below 5 m	N/A	N/A	Presence of large branches Potentially carrying roundwood products
F4		Single stem, large branches below 5 m	N/A	N/A	Presence of large branches No roundwood products
F5		Multiple stem, Fork between 0.3 m and 2.5 m	N/A	N/A	N/A
F6		Single stem below 5 m	Sweep on max. 1 axis	Significant lean more than 15°	N/A
F7		Multiple stem, Fork between 2.5 m and 5 m	N/A	N/A	N/A
F8		Multiple trees or fork below 0.3 m	N/A	N/A	N/A

Tree Risk Determination Key



Tree Risk Summary

Rating	Probability of mortality	Value ($) projected in time	Probability of product downgrade
R1	Nil, > 25 years	Improve	Low
R2	Low, 15-25 years	Stable	Moderate
R3	Medium, 5-15 years	Deteriorate	High
R4	High < 5 years	Substantial loss	Very high

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Northern Hardwoods Research Institute Inc.

Conversion matrix to link the Tree Classification System for New Brunswick to the AGS/UGS System.

Version: Sept 2019

Species	Good form (F1, F2)				Acceptable Form (F5, F6, F7, F8)				Poor form (F3, F4)			
	R1	R2	R3	R4	R1	R2	R3	R4	R1	R2	R3	R4
Beech	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Poplar	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Red maple	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Red oak	AGS	AGS	UGS	UGS	AGS	UGS	UGS	UGS	AGS	UGS	UGS	UGS
Sugar maple	AGS	AGS	UGS	UGS	AGS	UGS	UGS	UGS	AGS	UGS	UGS	UGS
White ash	AGS	AGS	UGS	UGS	AGS	UGS	UGS	UGS	AGS	UGS	UGS	UGS
White birch	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Yellow birch	AGS	AGS	UGS	UGS	AGS	UGS	UGS	UGS	AGS	UGS	UGS	UGS
Black spruce	AGS	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Cedar	AGS	AGS	UGS	UGS	AGS	UGS	UGS	UGS	AGS	UGS	UGS	UGS
Fir	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Hemlock	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Jack pine	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Red pine	AGS	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Red spruce	AGS	AGS	UGS	UGS	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
Eastern white pine	AGS	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS
White spruce	AGS	AGS	UGS	UGS	AGS	UGS	UGS	UGS	UGS	UGS	UGS	UGS

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