Climate Change Resilience and Carbon Storage Silvicultural Prescriptions for the Acadian Forest Region

Appendix A - Definition of Terms v.1.0

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Definition of Terms

The following section offers definitions and explanations of some of the terminology used in the C&C Decision Tree and in this supporting document.

Stand

A stand is a distinct patch of forest. The stand is the basic management unit of silviculture. A stand is described and classified by its composition and structure; as well as the ecological character of the site the stand is growing on.

Silviculture

The science and technology of establishing and maintaining forest stands that have value to people. Silviculture includes both individual treatments and systems. Individual silvicultural treatments are actions intended to manipulate stand composition and/or structure towards a more desirable condition. A silvicultural system is a complete plan for the maintenance of stand composition and structure in the long term- into the next generation of trees.

Silvicultural Treatment

A specific action intended to manipulate stand composition, structure and dynamics. The majority of silvicultural treatments seek to manipulate the composition and structure of the vegetation, but some treatments attempt to alter the character of the site though site preparation.

Reserve

A "reserve" is a tree that is selected for retention following the final harvest and regeneration of a stand. Reserve trees are a defining characteristic of two-age silvicultural systems. Reserves can also be used in irregular silvicultural systems, which are known as "irregular systems with reserves". Reserve trees can be retained for many reasons including serving as "full-cycle" trees that are allowed to grow old and die in the stand, never to be harvested.

Full-Cycle Tree

A tree in a managed stand that is never harvested, that is allowed to grow old and die.

Development Stages

A stand that is dominated by a cohort of trees (i.e. "single-cohort-dominated stands", "single-cohort stands", "double-cohort stands") originates from a single event (i.e. major disturbance) that allows them to grow and develop. Single-cohort-dominated stands grow through a series of sequential development stages. This tool uses the following names for these development stages:

1. Stand initiation
2. Stem exclusion
3. Understory re-initiation
4. "Old growth"

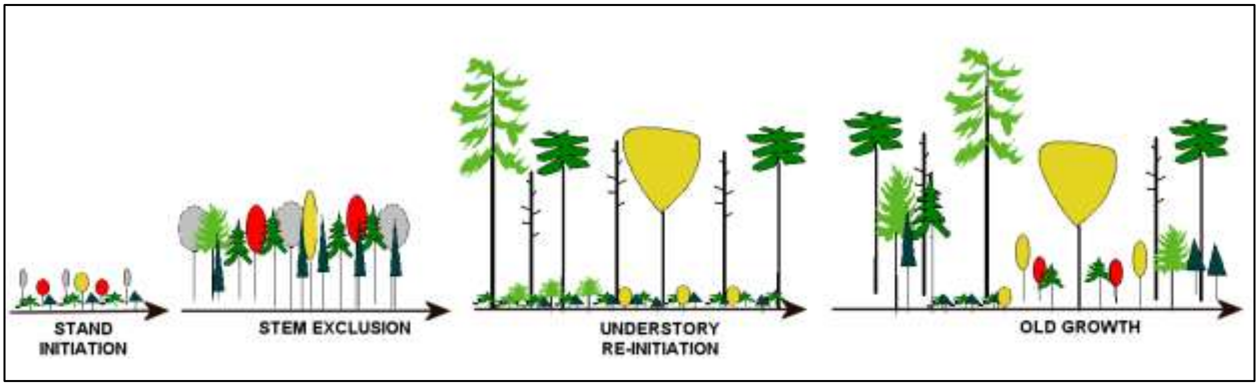

Figure 4. Stand development stages.

The Stand Initiation Stage

Following a major, stand-replacing disturbance where the majority of the canopy is removed/killed, the regeneration layer in a stand and the forest floor are fully exposed to light. This creates opportunity for both the release of already established regeneration as well as new regeneration in full sunlight. The total sum of all the tree regeneration that is released and/or established during this stage becomes a single cohort.

The Stem Exclusion Stage

Eventually a regenerating cohort forms a closed canopy and the trees effectively dominating the canopy prevent full sunlight from reaching the forest floor. A stand initiation stage that reaches a closed canopy state signifies the beginning of the "stem exclusion stage". During the stem exclusion stage trees compete for growing spaces and trees in each canopy layer become differentiated into different crown classes (i.e. dominant; co-dominant; intermediate; over-topped), and tree species with very different shade-tolerances and growth rates may produce multiple canopy layers. As the stem exclusion stage progresses, trees per unit area (i.e. trees/ha) gradually decline, density and volume increase, and the mean stand diameter (MSD) increases. New regeneration may establish during the stem exclusion stage, but it does not grow into the canopy as there is too little sunlight in the understory for trees to fully develop. Tree death during the stem exclusion stage does not result in effective canopy gaps. The space produced by tree death during the stem exclusion stage is quickly occupied by other developing trees in the canopy.

The Understory Re-Initiation Stage

As a stem exclusion reaches an advanced stage, the death of large old trees produces canopy gaps that cannot be filled by surrounding trees in the canopy. These canopy gaps allow sunlight into the understory, encouraging younger trees to grow up into the canopy. An understory re-initiation stage has a canopy that remains dominated by a single cohort, with scattered gaps of younger trees that are free to grow into the upper canopy.

The "Old Growth" Stage

Eventually the gradual understory re-initiation stage leads to a highly variable, irregular, multi-aged canopy, which is not dominated b y a single cohort. When the canopy-gap replacement in an old stand has advanced to the point that the original single cohort is no longer dominant, the stand has entered the "old growth" stage of development. This development stage is gap-driven, where individual trees reach their maximum ages and sizes and die. The stand becomes full of dead standing and fallen trees. The canopy is multi-aged and irregular in its structure. The understory is full of multi-aged trees and multiple canopy layers. There are many different names for this late development stage in forest stands, such as "the shifting-gap stage/phase", "the shifting mosaic", etc. The term "old growth stand" or "old growth forest" may refer to working definitions that are not specific to this stage of stand development.

Age Structure

The structural complexity of a stand is fundamentally determined by its age structure. The age structure of a stand is a function of its disturbance/treatment history.

Stands that have recently originated from a single stand-replacing event (i.e. "major disturbance") start out dominated by a single effective age of trees (i.e. "single cohort"). Stands that are dominated by a single cohort of trees go through a consistent and predictable sequence of development stages and stand dynamics. Stands that are dominated by a single cohort have relatively uniform canopies.

Stands that are dominated by a single cohort eventually reach old development stages where the death of old dominant trees creates canopy gaps. In the absence of a major disturbance, single-cohort-dominated stands eventually transition to multi-aged, gap-driven stands (i.e. "old growth development stage", "shifting-gap stage", etc.). Stands that are maintained by constant minor disturbances become an intimate mix of different effective ages (i.e. "multi-cohort stands" or "uneven-aged stands").

Even-aged Stand

A stand that is ***exclusively*** dominated by a single cohort of trees. The term single-cohort stand is synonymous with "even-aged stand" in silviculture. See "single-cohort stand" for more information.

Two-Aged Stand

A stand with a canopy that is dominated by single cohort, with scattered much older trees that came from the previous stand. The term double-cohort stand is synonymous with "two-aged stand" in silviculture. See "double-cohort stand" for more information.

Uneven-aged Stands

A stand that is an intimate mix of three or more distinctly different-aged trees (i.e. multiple cohorts). The term multi-cohort stand is synonymous with "uneven-aged stand" in silviculture. See "multi-cohort stand" for more information.

Effective Age

Effective age is the age of a cohort, not the actual biological age of the trees in a cohort. For example, when we say "this stand is 60-years old", we mean that this stand originated from a major disturbance that occurred 60-years ago. Natural advance regeneration can develop for decades, or even centuries, in the shade of a forest canopy, sitting and waiting for the light of a canopy removal. As a result, established advance regeneration can be a wide range of ages when it is eventually released and receives enough sunlight to grow into the canopy. For example, a shade-tolerant seedling could sit and wait for a century for enough light to fully develop. The effective age of this tree would be traced to the event that allowed it to freely grow, despite the fact that it has a central core of a century of ineffective growth.

Cohort

In silviculture, a cohort is a group of trees that originated from a single releasing disturbance. Trees that belong to a cohort can come from any source or mechanism. A cohort of trees has a single effective age, which is traced to the disturbance that established and/or released the regeneration. Silviculturalists manage cohorts; they manage the effective age of trees, not the actual biological/chronological age of trees. In silviculture, the term "age class" is synonymous with "cohort". However, the term "age class" can lead to misunderstanding and misinterpretation, as it can mean something very different when managing forests at the landscape level.

Single-Cohort Stand

A single-cohort stand is a stand that is ***exclusively*** dominated by a single age-group (i.e. cohort) of trees. A single-cohort stand originates from a major stand-replacing disturbance where no canopy trees survive.

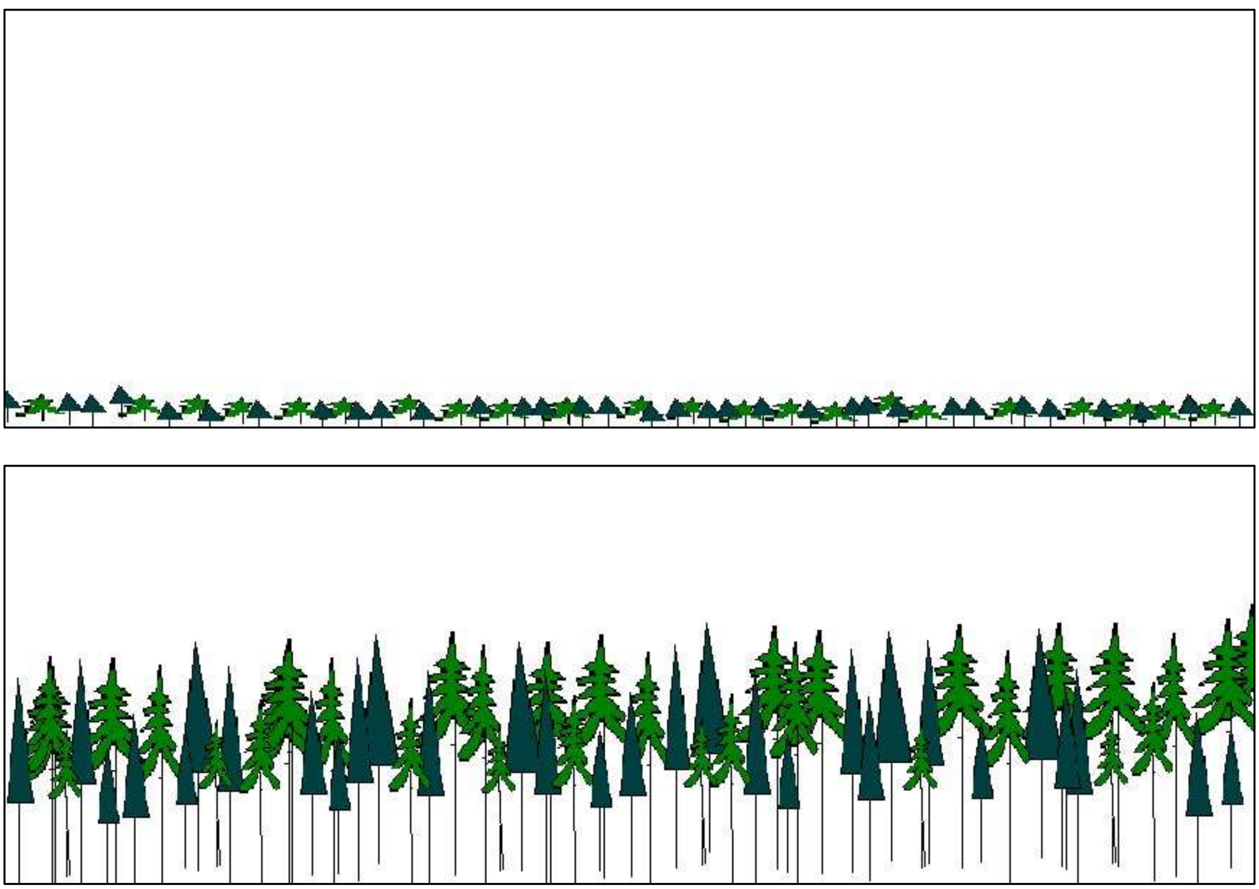

Figure 1. Single-cohort (even-aged) stands.

The term single-cohort stand is synonymous with "even-aged stand" in silviculture.

Double-Cohort Stand

A double-cohort stand has a canopy that is dominated by a single cohort of trees, with scattered much older trees. Like a single-cohort stand, double-cohort stands originate from a single, major, stand-replacing disturbance. Unlike, single-cohort stands, double-cohort stands occur when scattered canopy trees survive the major disturbance.

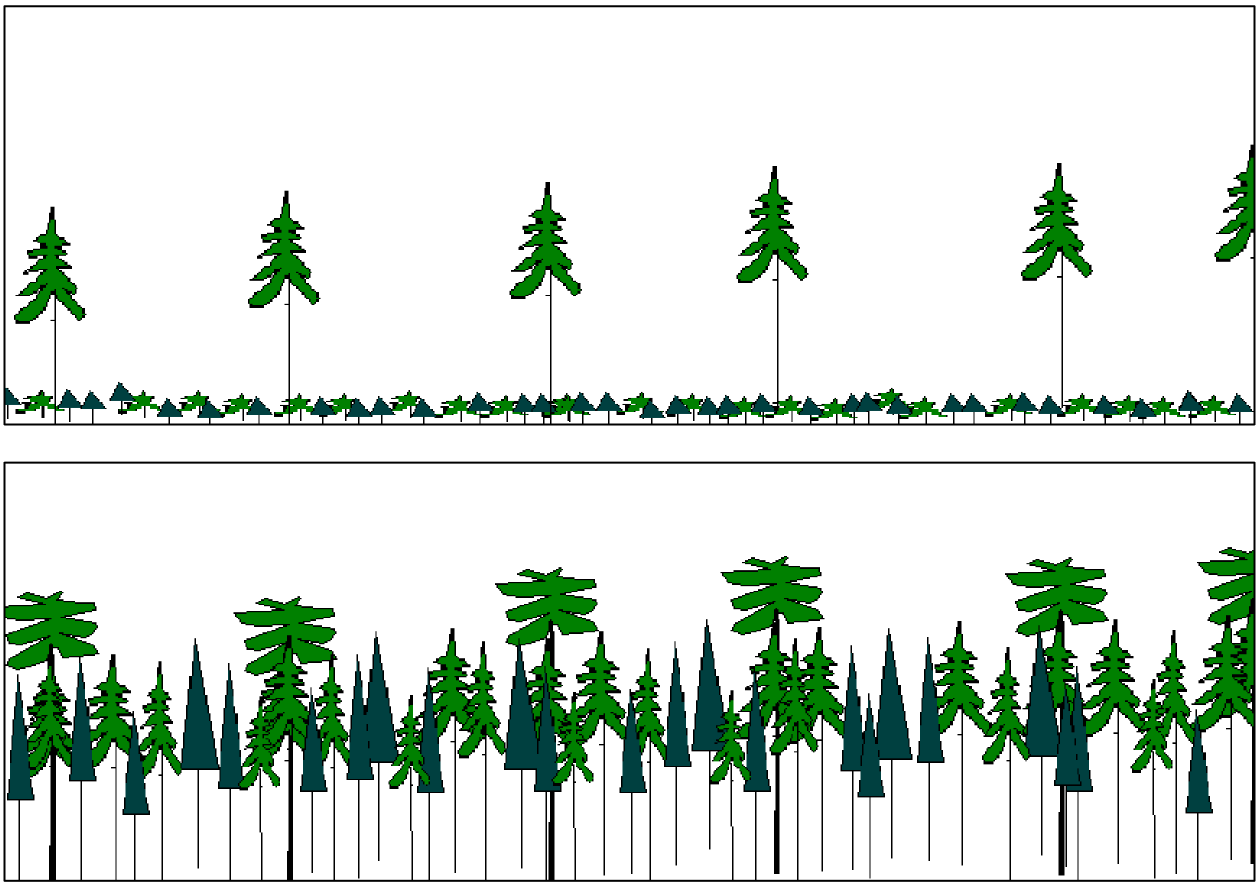

Figure 2. Double-cohort (two-aged stands).

The term double-cohort stand is synonymous with "two-aged stand" in silviculture.

Multi-Cohort Stand

A multi-cohort stand is a mix of multiple (i.e. three or more) distinct age-groups of trees (i.e. multiple cohorts). Multi-cohort stands are maintained by frequent, minor disturbances that produce canopy gaps allowing younger cohorts to grow up into the canopy.

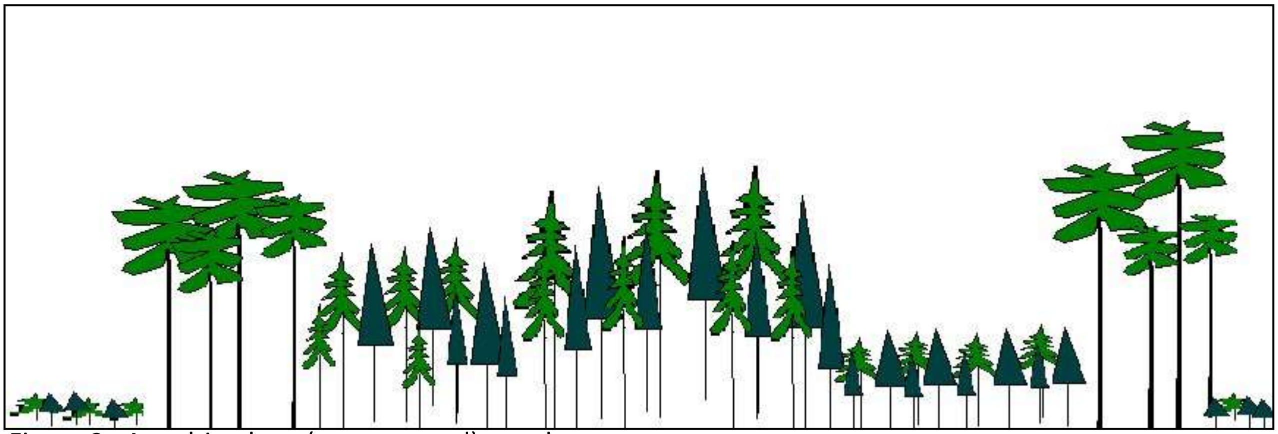
Figure 3. A multi-cohort (uneven-aged) stand.

The term multi-cohort stand is synonymous with “uneven-aged stand” in silviculture.

Silvicultural Systems

A silvicultural system is a complete plan for the maintenance of stand composition and structure in the long term – into the next generation of trees. In the Germanic tradition, silvicultural systems are primarily classified by the age structure they seek to maintain (i.e. even-age systems, two-age systems, uneven-age systems, etc.).

Even-age Silvicultural System

An even-age silvicultural system is a long-term plan for a stand that maintains the ***exclusive*** dominance of a single cohort of trees. In an even-age system the entire canopy is removed during final harvest, a new single cohort of trees is established and then grown to maturity, where it is harvested and regenerated into another cycle (i.e. rotation) of the system.

Two-Age Silvicultural System

A two-age silvicultural system is a long-term plan for a stand that maintains the dominance of a single cohort of trees but retains scattered canopy trees (i.e. “reserves”) when the stand is regenerated. In a two-age system the majority of the canopy is removed during final harvest, with scattered canopy trees retained. Following final harvest, a new single cohort of trees is established and then is grown to maturity, where it is harvested and regenerated into another cycle (i.e. rotation) of the system.

Uneven-age Silvicultural System

An uneven-age silvicultural system is a long-term plan for a stand that maintains an intimate mix of multiple cohorts of trees (i.e. three or more distinct cohorts in the canopy). Uneven-age systems are maintained through frequent partial cutting that harvests mature cohorts, producing canopy gaps- allowing younger cohorts to grow into the canopy. An uneven-age system is governed by continuous partial cutting- known as “selection cutting/harvesting”. The time interval in between “selection cuts” is called the “cutting cycle”. Uneven-age silvicultural systems are reliant on the continuous regeneration and ingrowth of desirable/acceptable growing stock. An uneven-aged stand is never “mature”, as it is a mix of different-aged cohorts. At each cutting cycle in an uneven-age system, mature trees are harvested, new regeneration is encouraged/established/released, young trees are encouraged to grow into the canopy, and immature trees can be tended. All phases of silviculture are constantly at work in an uneven-age silvicultural system. Uneven-age silvicultural systems are also called “selection systems” as they rely on the selection regeneration method.

Irregular Silvicultural Systems

Irregular silvicultural systems exist in a continuum between systems that maintain the dominance of a single cohort (i.e. even-age/two-age systems), and systems that maintain an intimate mix of three or more cohorts (i.e. uneven-age systems).

In an irregular silvicultural system, the canopy of a stand is very gradually regenerated (over decades), producing a very gradual establishment of regeneration. Eventually the canopy is removed, resulting in an "irregular stand" that is structurally complex because of the prolonged and gradual regeneration period. This highly variable regeneration can either occur naturally in old stands, or can be established through long, drawn out harvesting of the canopy. Once the final harvest of the canopy is complete, an irregular stand is treated like it is dominated by a single cohort and is grown for another cycle- eventually leading to another extended final harvest and regeneration period at the end of the cycle. During the final harvest and regeneration period of an irregular system, the treatments are very similar to the partial cutting associated with uneven-age systems, but unlike uneven-age systems, there is no attempt to maintain multiple cohorts in the stand through continuous harvest and regeneration.

Reserves can be retained at the end of the final harvest and regeneration period in an irregular system, which are known as an "irregular system with reserves". Due to all of the partial sunlight produced by the extended final harvest period, the shelterwood regeneration method is most commonly associated with irregular silvicultural systems, and are known as "irregular shelterwood systems" and "irregular shelterwood systems with reserves".

Selection Systems

Uneven-age silvicultural systems are classically referred to as "selection systems" because of their use of the "selection regeneration method" and "selection cutting" or "selection harvesting". There are two very different approaches to uneven-age systems:

1. Single tree selection systems
2. Group selection systems

Single Tree Selection Systems

Single tree selection systems (i.e. "individual tree selection systems") are a classical approach to uneven-aged stand management where the largest canopy gaps produced are the size of a large mature tree - hence the moniker "single tree" selection. Single tree selection systems have an artificial stand structure, where a stand is a uniform mix of all sizes and effective ages of trees. This stand structure requires continuous intensive intervention where the stand is artificially maintained at a low density (typically regulated by basal area) and desirable "crop trees" of all ages and sizes are maintained uniformly throughout the stand. True stem exclusion is artificially prevented in a single tree selection system, so that small, young desirable crop trees can gradually develop and grow into the canopy. At least partial shade is permanently maintained in a single tree selection system, which gives a competitive advantage to the most shade-tolerant species on a given site. Single tree selection systems, when successful, maintain a constant stable stand structure, but they require constant intervention/treatment, and therefore very frequent cutting cycles. A single tree selection cut/harvest as part of a single tree selection system seeks to: harvest scattered large mature trees, tend immature trees, maintain an artificial stand density, and encourage the regeneration of desirable trees. A single tree selection cut combines a final harvest, regeneration and tending treatment all in one.

Group Selection Systems

Group selection systems (i.e. "patch selection systems") are a classical approach to uneven-aged stand management where canopy gaps are produced by cutting "groups" or "patches" of trees. The size of the "group" or patch cut made can be modified in an almost infinite number of ways, to both harvest mature trees, as well as encourage, establish and release desirable regeneration. Age structure in a group selection system is maintained by means of area control and the length of the cutting cycle. For example, a group selection system might be maintained by regenerating 10% of the stand area, every 15 years. At a minimum, group selection systems require a continuous cycle of group selection cuts/harvests. Immature cohorts in a group selection system can be tended at any time. Unlike single tree selection systems, there is no requirement to regulate stand density and tend immature trees in a group selection system. The patch cuts in a group selection system can take any form or shape, including being cut in strips, sometimes referred to as a "strip selection system".

Partnerships

In 2018, with support from the New Brunswick Environmental Trust Fund, Community Forests International contracted Gareth Davies to develop climate-adaptive silviculture prescriptions for the Acadian Forest Region and build a decision tree tool for forest professionals. In 2019, with a first draft of this supporting document and the prescriptions decision key both complete, and with funding from Natural Resources Canada, Community Forests International partnered with the New Brunswick Federation of Woodlot Owners to continue refining these materials and to deliver capacity building activities to forestry professionals.

Suggested Citation

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Climate Change Resilience and

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Appendix B - Supporting Information v.1.0

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Contents

Introduction

This document provides context and background to the Climate Change Resilience and Carbon Storage Silvicultural Prescription Decision Tree (C&C Decision Tree). The purpose of this tool is to support the forestry practitioner in developing silvicultural systems to manage forest stands with the intended outcome of improving the stand's climate change resilience and carbon storage.

The C&C Decision Tree leads the practitioner towards individual recommended treatments. However, they also lead towards a management strategy, a silvicultural system to be used as a guide for the management of the stand in the long-term. This tool is designed to be used – to be tested and improved through use. This is a silvicultural tool, and as such is designed to be used for individual forest "stands" (i.e. distinct patches of forest at the operational level).

It is highly recommended that the user of this tool complete a thorough assessment and projection of the stand condition (i.e. composition and structure) and site quality (i.e. vegetation type, soil type, ecosite, site productivity, etc.) before using this tool. This tool is designed to work in a wide range of stand types/conditions and on a wide range of ecosites. This tool does not recommend a specific procedure for stand and site assessment.

This tool was developed specifically for the forests of the Maritime Provinces of Canada (a.k.a. the Maritimes). This forest, as well as the forests of the the Gaspé region of Quebec and those of the New England states, form a unique forest type known as the Acadian forest. The Maritimes, and indeed all of the Acadian Forest Region, has been historically located at the very northern limit of a temperate climate – a temperate-boreal (i.e. hemiboreal) transitional climate. Many of the temperate species found in the Maritimes are found at the northern limits of their historical ranges. Likewise, many of the boreal species found in the Maritimes are at the southern limits of their historical ranges. Unlike the more continental climates of hemiboreal forest regions/ecozones west of the Maritimes, the historical climate of the Maritimes has been relatively moderated by the North Atlantic, where precipitation has not been a limit to growth at the regional scale, and where summers have been cooler and winters milder, than more continental climates to the west. There is, however, considerable variability in local climates (i.e. ecoregions) within the Maritimes, due to proximity to the ocean and changes in elevation. For example, western New Brunswick has a significantly more continental climate than ecoregions closer to the coast, and the highest elevations in New Brunswick have historically had true boreal climates. Although this tool was developed for the specific geographical context of the Maritimes, this tool should work reasonably well for other cool, humid northern-temperate and hemiboreal forests.

Climate Change Context

Speaking very generally, climate scientists project that the climate of the Maritime provinces will continue to change and experience an overall increase in temperature and precipitation, with an increase in severe weather (storm) events. The increase in temperature is likely, however, to also increase evapotranspiration rates of plants across the landscape. This will, therefore, result in more intense and more prolonged droughts and consequently a net decrease of available water.

The present-day trends for climate change correspond to Representative Concentration Pathway (RCP) 8.5 - this RCP is one of four standard scenarios used by climate scientists to explore the depth and breadth of climate change by 2100. RCP 8.5 is considered the “worst-case” scenario and without significant decreases in humanity’s greenhouse gas emissions worldwide, we will collectively continue to align with this scenario. Here is a brief snapshot of the projected changes from now to 2100 in temperature and precipitation under RCP 8.5:

Temperature

The number of days per year reaching more than 25° Celsius across the Maritime provinces is currently a median of 6 days in cooler, coastal areas to 66 days in the warmest parts of the region (Figure 1). In contrast, by 2100, those cooler and coastal regions will see a median of 86 days over 25° Celsius, and inland areas could see as many as 119 hot days per year.

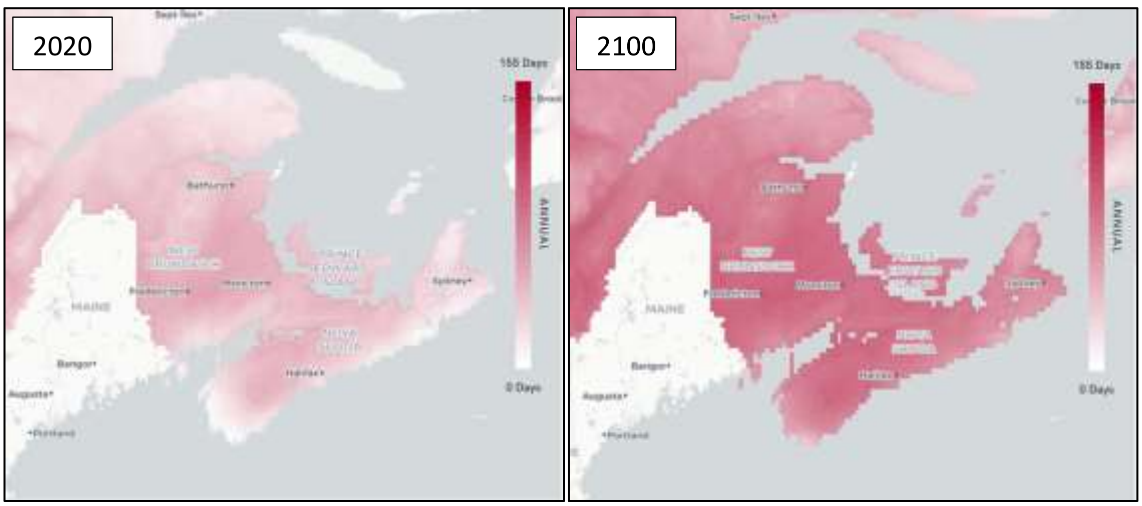

Figure 1. Number of days per year reaching 25° Celsius or above. (Images taken from the Government of Canada’s Climate Atlas at https://climatedata.ca/).

Currently, the Maritime provinces experience very few “tropical nights” – that is, nights where the temperature remains over 20° Celsius (Figure 2). By 2100, only the high elevation areas and coolest coastal areas will experience only a few tropical nights; most of the Maritimes provinces will experience as many as 40-50 nights per year over 20° Celsius.

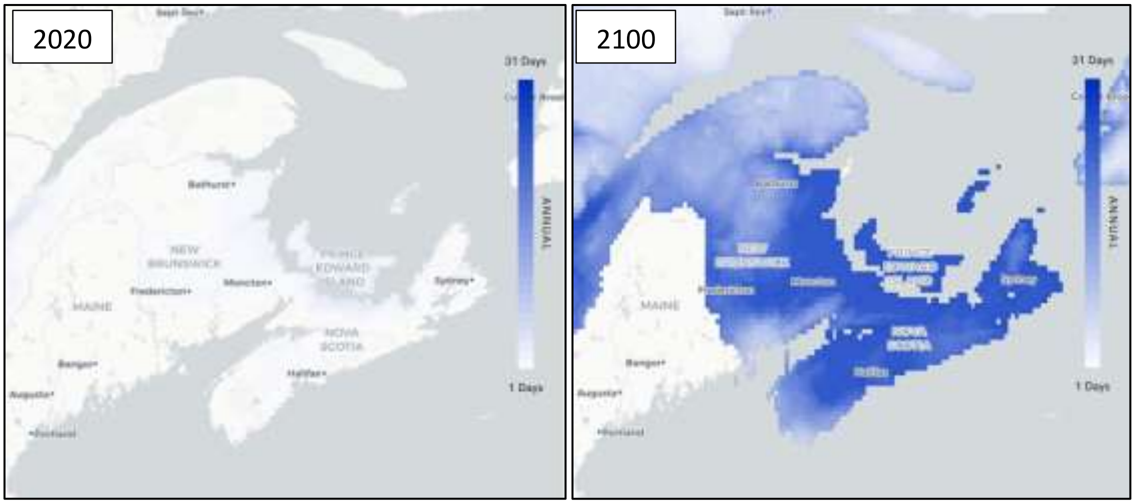

Figure 2. Number of days per year with “tropical nights” (i.e. nights that remain over 20° Celsius). (Images taken from the Government of Canada’s Climate Atlas at https://climatedata.ca/).

Precipitation

The total annual precipitation is projected to increase (Figure 3). In the dryer parts of the Maritimes, the total annual precipitation is projected to increase from a median of 1112 mm in 2020 to 1294 mm in 2100. And in the wetter areas, total annual precipitation is projected to increase by nearly 20 cm from 2020 (1466 mm) to 2100 (1653 mm).

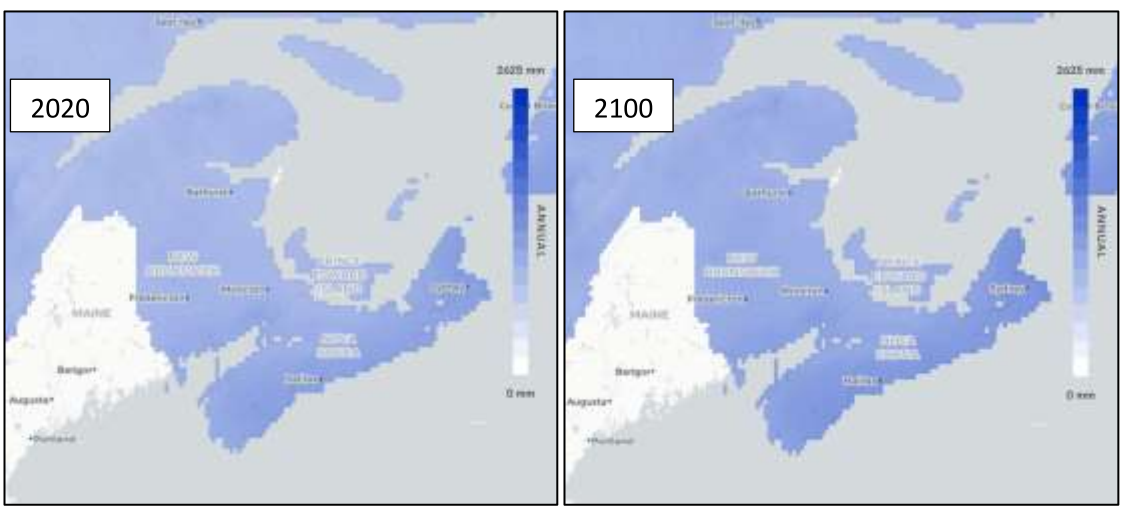

Figure 3. Total precipitation (in mm). (Images taken from the Government of Canada’s Climate Atlas at https://climatedata.ca/).

The intensity and severity of storms is predicted to increase as well, which is likely to have significant impacts on everyone and everything – infrastructure, homes and businesses, forests, habitats and wildlife, and directly on people themselves. In the wettest areas of the Maritime provinces, such as the east and south of Nova Scotia, the largest precipitation total on a single day is currently a median of 64 mm, and could increase to 85 mm by 2100 (Figure 4). In the dryer areas, such as in northern New Brunswick, the current median of 41 mm is projected to increase to 46 mm.

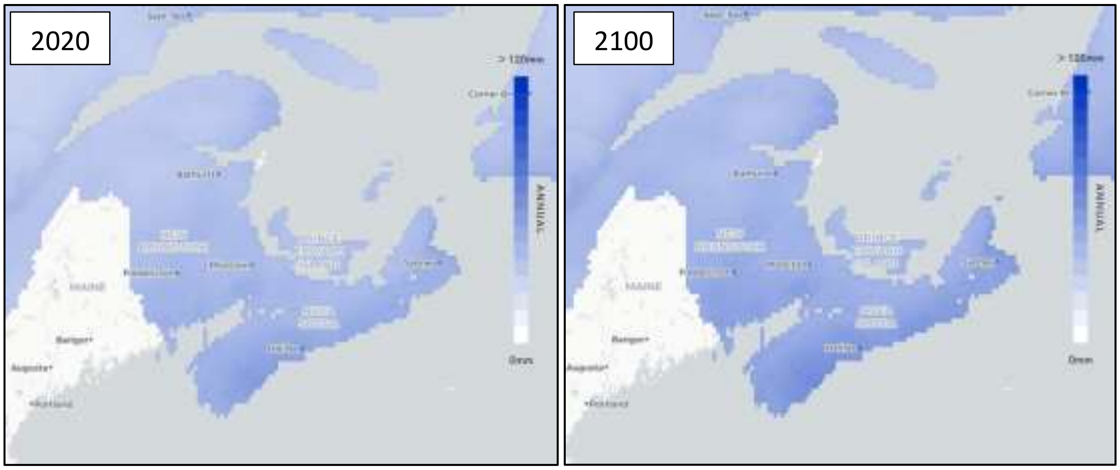

Figure 4. The largest precipitation total on a single day (in mm). (Images taken from the Government of Canada's Climate Atlas at https://climatedata.ca/).

Objectives and Intended Outcomes

This tool is designed to deliver on two silvicultural objectives:

1. Maintain or enhance the climate change resilience of a stand.
2. Maximize the carbon storage of a stand.

This tool does not treat these two objectives in isolation, thus there is a deliberate attempt for this tool not to marginalize one of these outcomes in order to achieve the other. The climate change resilience objective is most definitely of higher order priority to this tool. For example, the tool may recommend a treatment that may temporarily reduce the wood density of a stand with a resultant loss of carbon storage in order to steer the stand towards a more desirable condition of climate change resilience.

Silvicultural systems recommended by this tool exclude short rotation, even-age systems designed to maximize wood fiber production and minimize the risk of financial losses. A clear argument can be made that managing stands on very short rotations allows for the forest manager to more quickly respond to a changing climate (and a changing market). However, short rotation, even-aged silvicultural systems are incompatible with maximizing carbon storage, therefore they are not recommended by this tool.

Maintaining or Enhancing the Climate Change Resilience of a Stand: Tree Species Risk Assessment

One of the fundamental premises of this silvicultural tool is the notion of reducing the risks associated with climate change. The tree composition of a forest stand is a fundamental factor in the stand's capability to be resilient to climate change.

Facing climate change, some tree species in the Maritimes are projected to become more and more stressed (e.g. balsam fir, white spruce, white birch), while other tree species with more southern affinities are likely better adapted to the warming climate (e.g. eastern white pine, red oak, red maple). This tool classifies tree species that are projected to become more stressed by climate change as "high-risk." Tree species that are projected to be resilient in a warming climate are classified as "low-risk".

As an extension of this premise, stands that are dominated by tree species that are "high-risk" are inherently high-risk stands and not projected to be resilient in the face of a warming climate. Therefore, one of the fundamental premises of this tool is to silviculturally manipulate stands towards compositions that are dominated by "low-risk" tree species.

This tool makes no attempt to prescribe which tree species should be classified as "low-risk", versus "high-risk". Risk assessment and tree classification must be done within a specific ecological and potentially economic context. Tree species risk assessment is fundamentally dependent on ecological land classification. For example, balsam fir is clearly a high-risk species in the southern ecoregions of the Maritimes, but significantly less of a risk in northern NB and at high elevations. Similarly, red spruce is at relatively lower risk in very cool, perhumid ecoregions- such as the Fundy ecoregions, but at a much higher risk in ecoregions with a more continental climate. Ultimately, tree species risk assessment is a moving target that needs to be managed within a context that acknowledges and accounts for the specific dynamics of the local ecological context.

Stand-Level Carbon Storage: Density and Age Structure Management

From the perspective of tree management in a stand (i.e. silviculture), maximizing carbon storage amounts to maximizing the density of a stand, over the longest period of time possible.

Stand Density Management and Thinning

Stand density is defined here by the total amount of tree vegetation in a stand. Basal area per unit area (e.g. m^2/ha; ft^2/ac) has a direct correlation with total tree biomass and can be efficiently measured and managed in an operational context. Therefore, stands with higher basal areas are generally storing more carbon than stands with lower basal areas.

Silvicultural systems that are designed to maximize wood fiber production deliberately maintain stands at relatively low densities (i.e. low basal area) in order to maximize growth rate. The cornerstone of managing stand density for maximum stand-level growth rates is thinning. Intensive thinning regimes can maintain a stand density that is incompatible with the carbon storage objective.

This tool is intentionally very cautious with its recommendation to thin a stand. Intensively thinned stands are artificially maintained at low densities in order to maximize growth rates. High density stands store more carbon. Therefore, one needs to be very cautious with thinning regimes if an objective is to maximize carbon storage.

Age Structure Management

Conceptually, the ideal carbon-storage stand is one with a high density, and with a structurally balanced mix of many distinct ages of trees (i.e. the balanced uneven-aged stand). In a perfectly balanced uneven-aged stand, the density and structure of a stand is stable overtime. Therefore, by maintaining a balanced uneven-aged stand, one could theoretically store a defined amount of carbon in a stand indefinitely.

In practice, maintaining a balanced uneven-aged stand is easier said than done. Fundamentally, the maintenance of a balanced uneven-aged stand is dependent on continuous regeneration and ingrowth of desirable trees, and in this context, "desirable" would mean "low-risk" with respect to climate change resilience. There are few stands in the landscape where continuous recruitment of "low-risk" species is a reasonable expectation.

In practice, long-rotation irregular silvicultural systems are often more feasible than uneven-age systems. In general, to deliver on the carbon storage objective, this tool attempts to steer as many stands as possible towards either irregular or uneven-age silvicultural systems.

There are many climate-change-resilient tree species that are not tolerant of shade. Many of these trees are also ideal for storing carbon, especially if they are long-lived and grow to great sizes (e.g. eastern white pine). In certain contexts it may be desirable to grow a stand dominated by these species. Stands that are dominated by species that are not shade-tolerant can be difficult, if not impossible, to manage using irregular or uneven-age silvicultural systems. Growing stands dominated by these species may require growing the stand to maturity and then regenerating the entire stand over a relatively short period of time, with a resultant temporary loss in carbon storage. In these situations, it is recommended that long-lived species are favored and that the stand is grown for as long a rotation as possible (at least 100 years), thus maintaining carbon storage over as long a period as possible.

Reserves Trees and Forest Soil Carbon

Large dead trees play keystone roles in forest ecosystems at the stand level. They are critical structures with respect to wildlife habitat, and as deadwood is eventually incorporated into the soil ecosystem it provides key structure and function to soil, as well as being a source of carbon storage.

Conventional intensive silvicultural systems, which are designed to maximize wood fiber production, are carefully regulated so that the trees are harvested long before they grow old and die. The intensive thinning regimes associated with intensive silviculture also prevent stands from entering natural stem exclusion stages where trees die due to stress and competition for growing space.

To manage for carbon storage, it is recommended that all silvicultural systems incorporate permanent "reserves" that are intentionally retained and allowed to complete their lifecycles (i.e. "full-cycle trees"), which eventually decompose into the soil ecosystem. Even classical even-age silvicultural systems can be modified into two-age systems by simply selecting individual large trees at the end of the rotation to serve as permanent reserves (i.e. "full-cycle trees").

Old Stands with Unique Old Forest Conservation Value

In the Maritimes, there are stands that have unique old forest conservation value. The forests of the Maritimes have a history of more than 200 years of extensive, and increasingly intensive, timber harvesting. Over the past 40-50 years the predominant form of timber harvesting has produced stands that are dominated by a single age of trees. These young stands are typically grown to 40-80 years of age and then harvested and regenerated into another cycle of even-age growth. Increasingly (outside of protected natural areas), very few stands are allowed to continue growing into very old development stages. In some cases, these very old forest stands can only exist free of silvicultural treatment for long periods of time.

If a specific stand has unique old forest conservation value, which can only be maintained free of silvicultural treatment, it is recommended that the landowner consider managing the stand as a protected natural area and free of treatment.

Partnerships

In 2018, with support from the New Brunswick Environmental Trust Fund, Community Forests International contracted Gareth Davies to develop climate-adaptive silviculture prescriptions for the Acadian Forest Region and build a decision tree tool for forest professionals. In 2019, with a first draft of this supporting document and the prescriptions decision key both complete, Community Forests International partnered with the New Brunswick Federation of Woodlot Owners to continue refining these materials and to deliver capacity-building activities to forestry professionals. Additional support for this project was provided through Natural Resources Canada’s Building Regional Adaptation Capacity and Expertise (BRACE) Program in 2019-2021.

Suggested Citation

Community Forests International. 2019. Climate Change Resilience and Carbon Storage Silvicultural Prescriptions for the Acadian Forest Region v. 1.0.

Resource List

These publications informed the key concepts of the Climate Change Resilience and Carbon Storage Silvicultural Prescription Decision Tree and this Supporting Document:

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Response Framework Project. Newtown Square (PA): United States Department of Agriculture Forest Service.

Janowiak M. K., Iverson L. R., Fosgitt J., Handler S. D., Dallman M., Thomasma S., Hutnik B., & Swanston C. W. 2017. Assessing Stand-Level Climate Change Risk using Forest Inventory Data and Species Distribution Models. Journal of Forestry, 115 (3), 222–229.

Janowiak M. K., Swanston C. W., Nagel L. M., Brandt L. A., Butler P. R., Handler S. D., Shannon P. D., Iverson L. R., Matthews S. N., Prasad A., & Peters M. P. 2014. A Practical Approach for Translating Climate Change Adaptation Principles into Forest Management Actions. Journal of Forestry, 112 (5), 424-433.

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Swanston C. W., Janowiak M. K., Brandt L. A., Butler P. R., Handler S. D., Shannon P. D., Lewis A. D., Hall K., Fahey R. T., Scott L., et al. 2016. Forest Adaptation Resources: Climate Change Tools and Approaches for Land Managers. 2nd ed. Newtown Square (PA): United States Department of Agriculture Forest Service.

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