Ecosystem management in the boreal forest



MOTHER NATURE'S RECIPES



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This guide was created by

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PREFACE

THIS IS NOT A TEXTBOOK!

Forest ecosystem management... The expression is new. However, it has already been used in many instances and associated to a variety of forest practices that sometimes have nothing to do with real forest ecosystem management. There is a danger that the expression will have been worn out even before it truly sets foot in the forest.

That is why an expert committee was formed to conceive this guide. Its content is intended to be simple and concise. It is for all souls that are interested by what is occurring in Quebec's boreal forest. These souls could be engaged citizens, decision-makers and even foresters.

This guide will allow the reader to rapidly assimilate the main pieces of the concept of ecosystem management in boreal forests. Many enlightened readers will mean many citizens, many decision-makers and many foresters who together will allow a real ecosystem management approach to blossom in boreal forests.

To begin, forest management is all the practices that humans undertake in the forest. Man changes the forests that he manages. But with or without humans, ecosystems change. Mother Nature makes sure of it! Forest ecosystem management is an approach that guides humans to manage forests in order to reproduce artificially the way forests naturally change. Humans hence manage forests by being inspired by Mother Nature.

Happy reading!

photo Abitibi Bowater

photo N. Lecomte

Ecosystem management is already an expression used in many contexts. This simple guide aims to allow people to quickly grasp what ecosystem management really is in boreal forests.

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A GUIDE TO INSPIRE

Mother Nature, a natural source of inspiration

Over the last few decades, Quebec has done an enormous amount of investigative work on forest management, particularly in the boreal forest. Our knowledge has enormously progressed, which allows us today to reveal previously unknow forest management problems. One example of the work that has been done is the 2004 report of the Coulombe commission on forest management in Quebec's forests. One of the main recommendations of this commission was that ecosystem management be at the heart of the management of public forests in Quebec.

This recommendation identifies a major problem: our way of managing forests will in the long term produce important gaps between what our forests would look like if they were exclusively modeled by Mother Nature and what our forests would look like if they were managed by humans. The first culprit are our harvest levels that homogenize our forests over time, principally because we make our forest landscapes younger.

This homogenization can have significant impacts on the variety of life-forms that are found in the forest, in more scientific terms on the conservation of biodiversity. Indeed the variety of plants and animals that are present in boreal forests is linked to the variety of habitats or ecosystems. If the manner in which we proceed in forestry leaves behind very similar forests and particularly young ones, we necessarily lose a certain diversity of ecosystems that make up the landscape.

photo L. Farrell

We could compare our forest to a large population composed of men and women, of youths, of adults and of seniors, of students, of workers and of the unemployed, of cities and of villages, all evolving over time at the discretion of economic and social trends... What would a society be like if it was exclusively made-up of young men? Would such a society be sustainable? Ecosystem management is a sustainable development strategy for forests. To make it sustainable, development must be able to maintain the diversity of species. In the ecosystem management framework, forests are not only seen as a supplier of wood, but as a set of diverse habitats that provide multiple functions and that must be maintained in order to conserve the biodiversity that is found in these ecosystems.

Once we have identified an important problem -the homogenization of forests- and a solution -ecosystem management- what do we do? We must act! However if it is easy to use the expression during a public assembly or reunion, it is much more complex to understand this concept and even more so to know how to apply forest ecosystem management to our forestry practices. This is why this guide was written!

To fully understand ecosystem management one must first understand Mother Nature's recipes. One must know what ingredients she has in hand and what culinary techniques she uses to make forests change. The first step is to familiarise ourselves with the diverse natural disturbances that either make boreal forests younger or make them age, to also understand how boreal species have adapted to these disturbances and what type of landscapes are formed over time. With this in mind, it will be much easier to see the gaps between the methods of Mother Nature and the ones employed by humans. This exercise will especially allow us to imagine how ecosystem management can be done, which in other words means how we can apply management practices that will artificially recreate the effects of natural disturbances while always having in mind the need to maintain the heterogeneous character of forest landscapes.

We need to be clear that this guide deals exclusively with boreal forests. Since ecosystem management is inspired by natural forest dynamics, the boreal recipes cannot be exported to other types of forest ecosystems.

Currently, our forest practices are gradually creating important gaps between Mother Nature's forests and the forest managed by humans. These gaps may hinder the conservation of biodiversity in boreal forests.

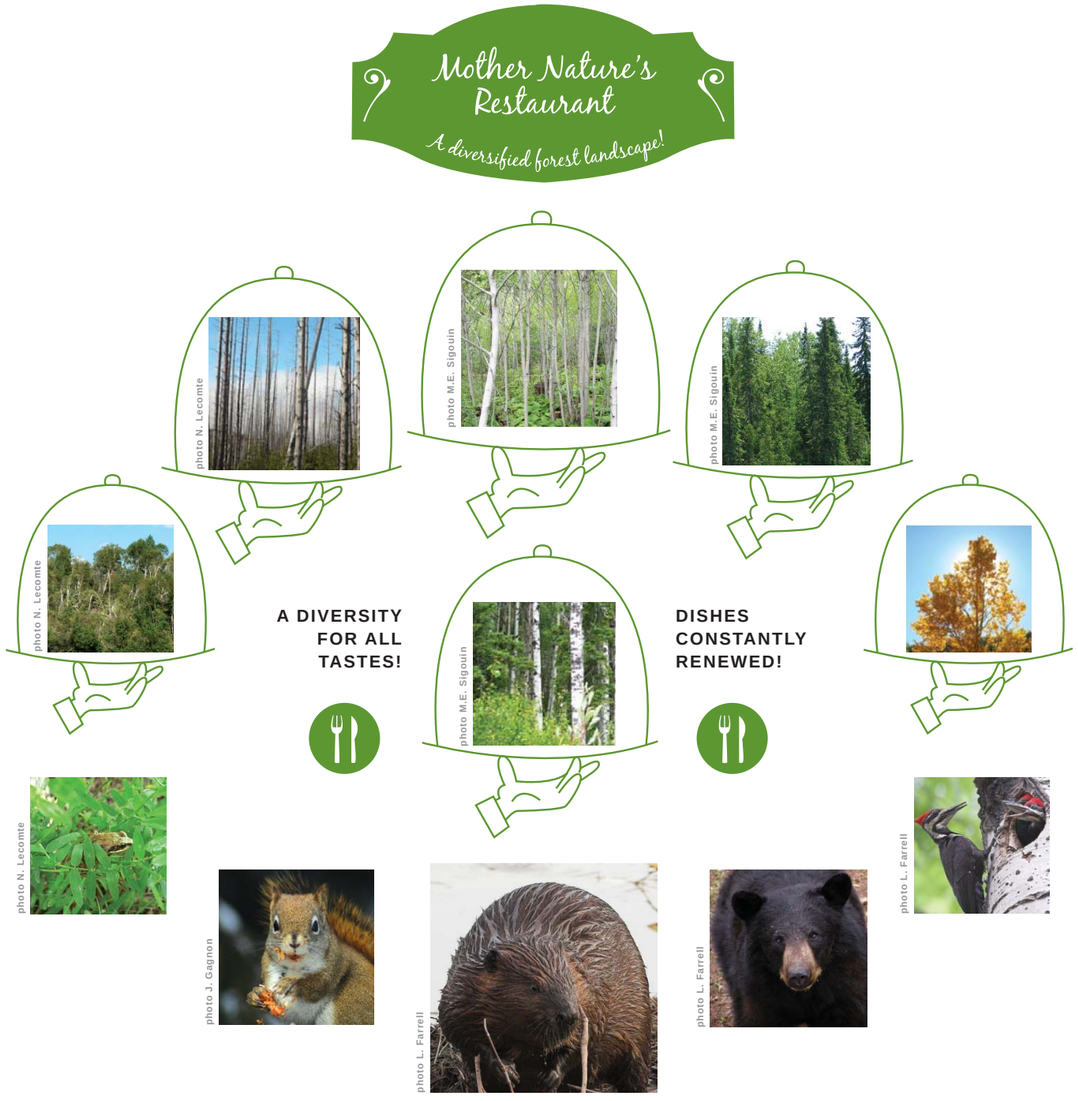
SECTION 1

MOTHER NATURE'S RECIPES

To be inspired by Mother Nature one must first understand what She does!

Let's imagine the forest landscape as if it was an immense buffet. It would be a diversified buffet with numerous different types of dishes. Each dish is a forest that has been cooked-up by Mother Nature. How has Mother Nature prepared these dishes, these forests? Without respite, She follows some recipes. These recipes are a bunch of ingredients to which She applies culinary techniques. Mother Nature has in hand very good ingredients: they are all the living species that compose the ecosystems of the boreal forest. A little bit like vanilla gives flavour to a dish and eggs that bind the dough of a cake, poplar and spruce are ingredients that each have their own characteristics. Mother Nature prepares these ingredients with the help of different culinary techniques. Sometimes she simmers, sometimes she roasts, sometimes she lets them rest. Her preparation techniques are the natural disturbances that occur in boreal forests. Natural disturbances are occasional events that modify ecosystems, which make forests change. With the same ingredients she constantly follows recipes to renew the dishes of the buffet. This causes forests to change constantly. With her chef's apron, Mother Nature produces through time a forest landscape that is typically boreal.

Natural disturbances are the culinary techniques used in Mother Nature's recipes to produce diversified forest landscapes. Forest ecosystem management is a combination of methods that artificially reproduce the effects of natural disturbances.



MOTHER NATURE'S CULINARY TECHNIQUES: THE NATURAL DISTURBANCE REGIME

To successfully follow a recipe, one must not only know the ingredients. One must especially know the mixing and cooking techniques. To be inspired by Mother Nature, it is necessary to understand how the diverse natural disturbances that occur on the landbase modify forest landscapes. In other words, one must understand and attempt to reproduce the disturbance regime that is typical of each region. The ecosystems that compose the forest landscape have been established according to the natural disturbance regime.

To create her buffet, Mother Nature applies two principle culinary techniques: (1) disturbances that create young forests; (2) and ones that create old forests. We classify these disturbances into two categories:

1. **MAJOR DISTURBANCES:**
   Fire that makes forests younger

2. **SECONDARY DISTURBANCES:**
   Insect outbreaks and wind throw (fallen trees following windstorms) that age forests.

The forest landscape is hence a diversified buffet where one finds forests of different compositions and structures that vary with respect to the age of the forest. The quantity and quality of forest biodiversity is linked to this diversified buffet.

Wind throws age forests

Insects, like this tent caterpillar, age forests

MAKING FORESTS YOUNGER

Fire is the main natural disturbance in boreal forests. It doesn't know in advance where it will pass: it burns old forests as often as young ones. Fire has the effect of putting the clock back to zero. After a fire, a new forest is formed. All the trees are the same age.

Fire is the main natural disturbance in boreal forest. It makes forests younger.

MAKING FORESTS OLDER

Getting old for a forest means change. Forest aging in the boreal is expressed by the gradual death of certain trees, which are slowly replaced by other trees. It is the secondary disturbances that are guilty of killing these trees. Insect outbreaks and windthrow cause the death of trees in small or large numbers. By replacing the dead trees the new trees can engender two main effects on the forest: a change in the tree species that make up the forest (composition), and a change in the structure of the forest. These two notions are explained a little further on.

photo N. Lecomte

Insect outbreaks and windthrow are natural disturbances that age forests by causing the death of a small or large numbers of trees.

To successfully do a recipe, one must not only know the ingredients. You especially need to know the mixing and cooking procedures. To imitate Mother Nature, you need to know the natural disturbance regime of the boreal forest, which means knowing how fire, insect outbreaks and wind throw work together naturally through time to produce a diversified landscape that is typical of boreal forests.

In forests, we characterize disturbance regimes with respect to the severity, the frequency and the size of the natural disturbances. A boreal forest has a disturbance regime with a specific severity, frequency and size of disturbances.

SEVERITY

On trees: Disturbance severity is evaluated by the number of trees that have burnt, or have been blown down by wind or have died following an insect outbreak. For example, by looking from above, one can evaluate the severity of an insect outbreak by estimating the number of dead trees with respect to the number of live ones.

On the ground : Disturbance severity can also be observed on the ground. For example, the severity of a fire can be estimated by measuring the depth at which the fire burnt the organic matter on the forest floor. The organic matter is composed of all the dead debris that is decomposing on the forest floor.

FREQUENCY

Disturbance frequency represents the percentage of a landbase that is affected on average per year by a type of disturbance. For example, fires are more frequent in dry continental regions of the boreal forest than they are in wet maritime regions. We calculate the frequency of fires as the percentage of the landbase that burns on average annually. Hence, a dry region will have on average about 1% of its land base burn every year while about 0,05% of a wet region's land base will burn annually.

SIZE

The size of a disturbance can greatly vary from one disturbance to another. Forest fires can burn large surface areas while wind gusts can only uproot or break a couple of trees.

FIRE: FOUNTAIN OF YOUTH

Fire is a THE manager of forest landscapes. Within the disturbance regime of the boreal forest, its actions are essential!

FIRE SEVERITY

All fires are not the same. A very severe fire gives off enough heat to burn all the trees from head to foot, all the understory vegetation but also most of the organic matter on the forest floor. A fire of low severity will burn much less of the organic matter on the forest floor and will spare many trees. Fires have physical effects on soils but also modify soil chemistry by freeing up nutrients through its combustion of the organic matter on the forest floor. The vegetation that colonizes burned forests benefit from this natural fertilizer.

photo S. Page

When a fire passes it leaves many live trees.

Fire is an inconsistent being! The shapes of burnt forests are irregular. A same fire can burn some zones intensely while barely touching others. Often, fires spare many islands of forests. These 'green' islands within a burned landscape are important shelters for animals and also for trees that will take advantage of being in these islands to disperse their seeds into the surrounding burned landscape.

FIRE SIZE

In boreal forests, large fires make the headlines of newspapers, however there are many more small fires than large ones. While there may be many small fires, it is the large fires that are responsible for burning the majority of the landscape and are hence more important. A large fire does in some sense erase the trace of the small fires that have occurred before its passage.

photo N. Lecomte

THE AGE OF FORESTS

One does not calculate the age of a forest by measuring the age of the trees. The proof is in the fact that an old forest has as many old trees than it has young ones. It is fire that determines the age of a forest. One therefore establishes the age of a forest by calculating the number of years that have passed since the last fire. If a fire has passed 100 years ago than the forest is 100 years old.

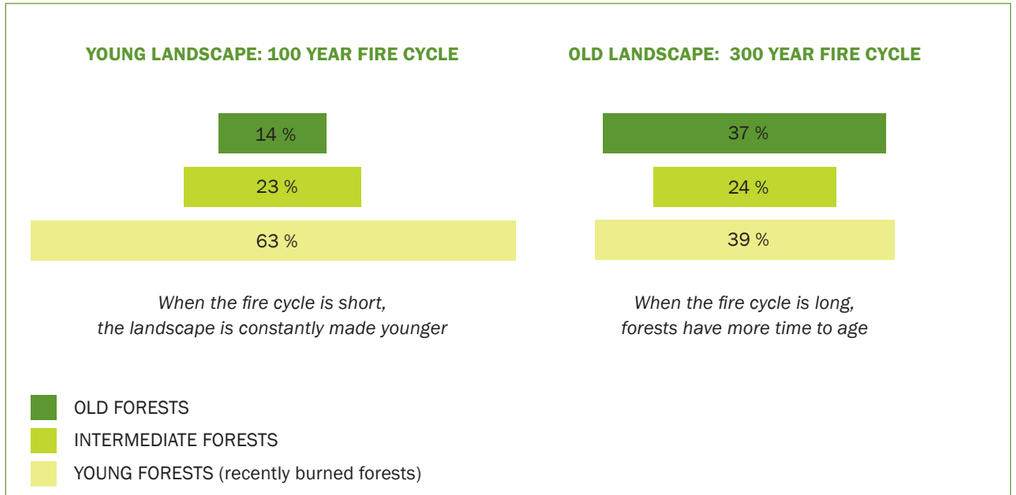
However, globally is a forest landscape dominated by young or old forests? It is the frequency of fires that determines this. When fires are frequent the landscape will be dominated by young forests (younger than 100 years) while when fires are relatively infrequent the landscape will be dominated by old forest (older than 100 years).

FIRE FREQUENCY AND FIRE CYCLES

Fire frequency determines the fire cycle. As the fire frequency becomes lower the fire cycle lengthens and vice versa. The fire cycle represents the number of years it takes for fires to burn the surface area of the forest landscape. For example for a landbase of 100 000 ha, if the fire cycle is a 100 years, this means that it will take 100 years for fires to burn 100 000 ha (i.e. 1% of the land base per year). If the fire frequency is half as frequent, the fire cycle will be 200 years, burning on average 0,05% of the landbase. This being said, some portions of the landscape may burn numerous times during the 100 years while others may escape fire during this 100 year period. For this reason, it is possible to find in all boreal landscapes, forests that have escaped fires during numerous centuries.

THE AGE OF OUR FORESTS

Doing a portrait of our forests with respect to their age is similar to the population pyramids demographers compile to describe populations. A high birth rate increases the number of young people at the base of the pyramids. In boreal forests, the birth rate is determined by fire. The shorter the fire cycle the more surface area is covered by young forests. The longer the fire cycle the more time there is for forests to age. The following diagram shows how the fire cycle influences the distribution of the age of forests in the landscape.

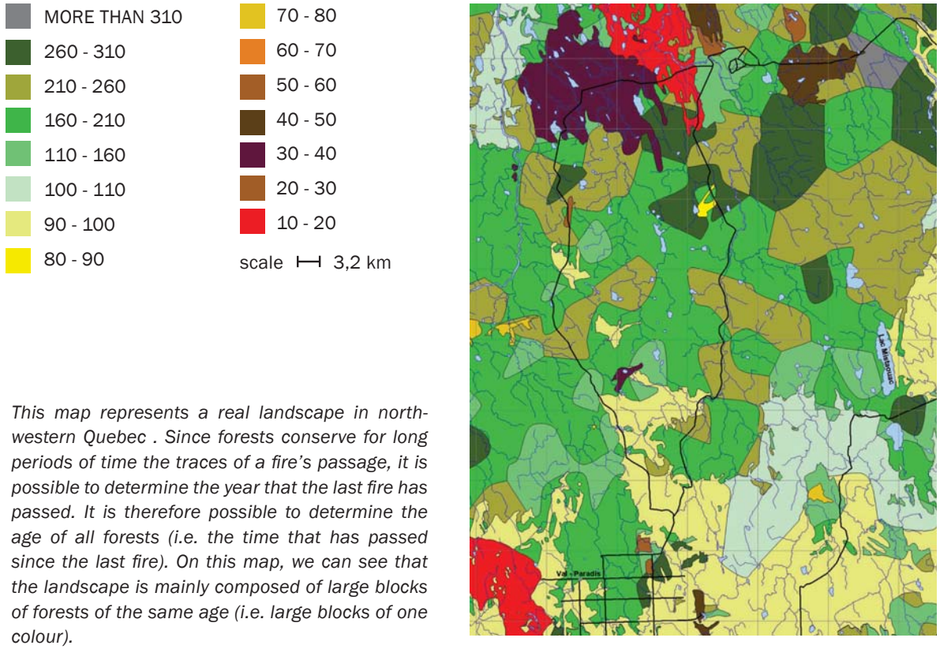


It is the presence of forests of all ages within a forest landscape that assures the conservation of biodiversity. There has to be young forests, intermediate forests and old forests.

THE AGE OF FORESTS IN A LANDSCAPE

Do the elderly prefer to be with the elderly and do youths congregate with youths? In forests, it appears so. Although there are old forests that were spared by fire surrounded by young forests, boreal landscapes are mainly characterised by large forest blocks of the same age. These blocks are composed of forest of the same age because they all originated from the same large fire. As we have seen, it is large fires that leave a significant impression on boreal landscapes.

THE AGE OF FORESTS IN NORTH-WESTERN QUEBEC



This map represents a real landscape in north-western Quebec . Since forests conserve for long periods of time the traces of a fire's passage, it is possible to determine the year that the last fire has passed. It is therefore possible to determine the age of all forests (i.e. the time that has passed since the last fire). On this map, we can see that the landscape is mainly composed of large blocks of forests of the same age (i.e. large blocks of one colour).

WHEN FIRE IS NOT AROUND

In the absence of fire, forests can age. Forests are then affected by secondary disturbances like insect outbreaks, windthrows, disease or simply old age. More often than not, these types of disturbances modify forest landscapes less than fires and usually do not disturb soils.

HUNGRY INSECTS

Insect outbreaks are relatively frequent in boreal forests. The main perpetrators are spruce budworm, tent caterpillar and hemlock looper. Spruce budworm prefers balsam fir needles but also chews on spruce foliage. Tent caterpillar has a preference for poplars and white birch.

These insects nourish themselves by eating the needles and leaves of trees. An important loss of foliage can provoke the death of trees that are severely affected. Insect outbreaks usually occur in a cyclical fashion. For example, spruce budworm outbreaks occur about every 30 years. Usually they are severe once every two outbreaks about every 60 years.

Tent caterpillar

Spruce budworm

VIOLENT WINDS

When strong winds blow in forests, trees fall. Trees knocked over, uprooted or broken by a wind are collectively called a windthrow. The older the tree or the taller the tree the more susceptible it becomes to wind. Winds have little effect on dense forests but when a forest opens up winds can do considerable damage. Large trees that are above the canopy are usually the trees that are most susceptible to being affected by winds.

photo M-E Sigouin

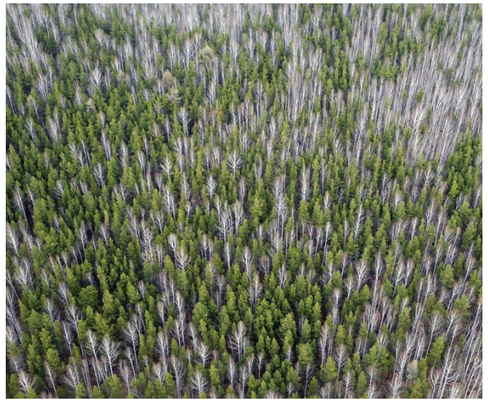
Small windthrow

photo N. Lecomte

Large windthrow

A SWISS CHEESE FOREST

Secondary disturbances like insect outbreaks and wind throws age forests. By provoking the death of trees, they augment the quantity of deadwood on the ground and they create openings in the canopy. These openings in the canopy, commonly called ‘gaps’, allow younger trees to grow up into the canopy and replace the older trees that have fallen. An insect outbreak can cause so many gaps in the canopy that this forest seen from above can look like Swiss cheese!



A forest after a severe insect outbreak: a mixture of living and dead trees.

THE IMPORTANCE OF OLD FORESTS

Old growth forests are of primary importance for the fauna and flora of boreal forests. Within these old forests we find green trees but also many dead trees. As a forest becomes older the more susceptible it becomes to secondary disturbances and the more likely we are to find snags and fallen dead trees. These snags often have holes that lodge many mammal and bird species while deadwood on the ground is a key habitat for many other species. Deadwood in the boreal forest is often more alive than we think!

The Great-horned owl nests in the abundant standing dead trees that are found in old forests.

A WELL ADAPTED FOREST TO NATURAL DISTURBANCES

When someone wins someone else loses! In boreal forests, tree species have developed strategies to face the natural disturbances that occur. Each species is a superhero that has its own special powers. These superheroes are divided into two main categories:

1. **Pioneer species that are adapted to fire**
2. **Shade tolerant species that can grow in the shade**

A. JACK PINE, TREMBLING ASPEN AND WHITE BIRCH ARE NOT AFRAID OF FIRE

Pioneer species are the first ones that colonise a burned forest because they have developed mechanisms to survive fire, with either super pinecones or with super roots! These trees grow quickly in conditions of full light like the ones found after fire, however they survive and grow poorly in shaded conditions found in the understory of dense forests. This is why these are tree species that we find frequently during the first stages of development of a forest.

photo N. Lecomte

jack pine

white birch

Trembling aspen

INGENIOUS PINECONES

Pinecones of jack pine are serotinous: they are covered with resin as if they had been dipped in wax. Jack pine needs the heat of a fire to burn this resin which allows its cones to open and disperse its seeds that have survived the fire.

ROOT AND STUMP SUCKERS

Trembling aspen can reproduce by seed like all plants but can also reproduce by root suckering, which means it can grow new stems from the roots of existing trees. In effect, when an aspen tree dies more sunlight reaches the ground, which heats up the soil which in turn stimulates the roots to produce suckers. Hence, when a fire passes and kills the mature aspen trees, the roots may survive underground and suckers can sprout by the thousands, all identical clones of the mother tree that was killed by the fire. Similarly, white birch can grow new stems after fire by producing suckers from a burnt stump. By adding this type of vegetative reproduction to their arsenal, white birch and trembling aspen greatly increase their chance of surviving on the landscape and of colonizing young forests after fire.

photo N. Lecomte

Serotinous jack pine cones

photo N. Lecomte

White birch stump suckers'

B. BALSAM FIR, WHITE SPRUCE AND EASTERN WHITE CEDAR PERSEVERE

These tree species are poorly adapted to the passage of fire, which decimates them. However, seedlings of these species can easily sprout and grow slowly under the shade of the pioneer species that have grown immediately following fire. Their strategy: time. Surviving and waiting in the shade until the pioneer species die out so that they can have their day in the sun. This is why we usually find an abundance of these species in the later stages of forest development. Balsam fir, white spruce and cedar are happy to see secondary disturbances come along, for by killing canopy trees they allow these species to take over the forest.

A/B THE AMBIVALENT BLACK SPRUCE

Black spruce is an ambivalent species that can very easily colonise forests after fire or during the prolonged absence of fire. It is a pioneer species that is also tolerant to shade. Black spruce cones are semi-serotinous, which means they are covered in a thinner coat of resin than the ones of jack pine. The heat of the sun can open black spruce cones. However the cones that are close to the trunk and hence in the shade of the branches remain sealed and are only opened by the heat of a fire. Furthermore, the lower branches of black spruce can grow roots in the soil and form new trees which are commonly called layers. With all these reproductive strategies it is not surprising that black spruce is the most common species in the boreal forest.

photo N. Lecomte

Balsam fir

White spruce

Cedar

photo N. Lecomte

Black spruce cones

THE MAIN ZONES IN THE BOREAL FOREST

As we have seen, boreal tree species are adapted to different types of natural disturbances but they also resist differently to climatic conditions. As a results we can divide the boreal forest of Quebec into 3 different zones, which are called bioclimatic zones and that differ with respect to which species dominates.

The Black spruce-lichen zone which is commonly known as the taiga, is a forest region composed mostly of small black spruce trees. The trees are well spaced and the forest floor is covered in lichens. Given the size of the trees, commercial forestry operations do not occur in this zone.

The Black spruce-feathermoss zone is mostly composed of black spruce with the occasional balsam fir and jack pine stand. The understory vegetation is dominated by mosses.

The Balsam-fir-white birch zone is dominated by balsam fir with the occasional occurrence of trembling aspen and white birch. The understory is often covered by herbs.

THE BOREAL FORESTS OF QUEBEC

BACK SPRUCE-LICHEN
BLACK SPRUCE-FEATHERMOSS
BALSAM FIR-WHITE BIRCH

GETTING OLD IN THE BOREAL

All forests age. As we have seen, all forests change in composition and in structure, which causes young forests to be become intermediate forests then old forests. Since each ecosystem is different, the characteristics of each stage of development varies from one bioclimatic zone to the next.

FOREST STRUCTURAL CHANGES

After a severe fire that has killed the majority of the trees, the new generation of trees are all about the same age and size. When a forest is mature we say that the structure of the forest is homogeneous or regular. When this mature forest continues to age, trees start dying here and there, which are replaced by smaller trees. Through time the structure of the forest becomes more heterogeneous as we find in the same forest large, medium and small trees as well as snags and dead trees on the ground. We at this point in time characterise the structure of the forest as irregular or heterogeneous.

CHANGES IN THE COMPOSITION OF FORESTS WITHIN THE BALSAM FIR-WHITE BIRCH ZONE

This bioclimatic zone possesses three main stages of development. Studies in this zone demonstrate that forests reach a new stage of development every 80 years. We call this the age of transition, in other words, the amount of years it takes a forest to reach a new stage of development. In this zone the first 80 years following fire are characterized by the dominance of deciduous trees, notably trembling aspen and white birch. Slowly but surely, the presence of deciduous trees diminishes while conifers start to take-up more room. Forests aged between 80 and 160 years are mostly mixed forests that contain both deciduous and conifer species. Finally, after 160 years, apart from a couple of white birch stems the forests are dominated by conifer trees mostly balsam fir with a bit of white spruce, cedar and black spruce.

THE 3 STAGES OF DEVELOPMENT IN THE BALSAM FIR-WHITE BIRCH ZONE

photo M-E Sigouin

Young forest (0-80 years)

photo O. Valeria

Intermediate forest (80-160 years)

photo N. Lecomte

Old forest (160 years and more)

HOMOGENEOUS STRUCTURE — HETEROGENEOUS STRUCTURE

CHANGES IN THE COMPOSITION OF FORESTS WITHIN THE BLACK SPRUCE-FEATHERMOSS ZONE

To the North of the Balsam fir-white birch zone, one finds the Black spruce-feathermoss bioclimatic zone. Because it is colder and the trees grow more slowly, the age of transition in this zone is about 100 years. At the first stage, hence between 0 and 100 years, we often already find a black spruce forest, however sometimes forests after fire can begin by being dominated by either trembling aspen or Jack pine. Nonetheless, regardless of which species dominates after fire, all forests, in the prolonged absence fire, will after a 100 years eventually be dominated by black spruce with at times some balsam fir.

THE 3 STAGES OF DEVELOPMENT IN THE BLACK SPRUCE-FEATHERMOSS ZONE

photo N. Lecomte

Young forest (0-80 years)

photo N. Lecomte

Intermediate forest (80-160 years)

photo V. Angers

Old forest (160 years and more)

HOMOGENEOUS STRUCTURE → **HETEROGENEOUS STRUCTURE**

SECTION SUMMARY : A BOREAL BUFFET

INGREDIENTS + **CULINARY METHODS** = **SUCCULENT LANDSCAPES**

photo L. Farrell

Mother Nature only uses high quality ingredients to create her forested landscape. The trees that make-up these forests each have their own characteristics. Each species has developed strategies to survive various natural disturbances.

In the boreal forest, Mother Nature uses natural disturbances to transform her forests. She uses fire to rejuvenate forest and insect outbreaks and wind gusts to age forests. For each natural disturbance, Mother Nature adjusts the size, the frequency and the severity. Under the influence of these natural disturbances the composition and the structure of forests changes.

With ingredients typical of the boreal forest and culinary techniques that are just as typical, Mother Nature produces a forest landscape that is typically boreal. This landscape is diversified as it is composed of young forests, intermediate forests and old forests. This diversity of forests created by Mother Nature conserves biodiversity.

A forest ecosystem management approach should be a collection of harvesting methods that artificially recreate Mother Nature's forest landscapes by being inspired by the effects of natural disturbances.

SECTION 2

THE SHORTCOMINGS OF THE CURRENT FOREST MANAGEMENT APPROACH

The current gaps between humans' recipes and Mother Nature's recipes

In urban planning, management plans divide the land base into residential zones, commercial zones, industrial zones, parks etc. They indicate where roads will be as well as other infrastructures. In forestry, the management plans show where forest interventions will take place through time. It indicates which and when forests will be harvested, which forests will be left untouched, which type of harvesting will take place, where roads will be built, etc.

Clear-cuts or CPRS are not necessarily bad... the problem is that this is virtually the only practice that is applied.

Currently and for numerous years, forest management plans in the boreal forest are virtually identical from one region to another. They do not take into account the differences that exist between ecosystems. Mainly, we plan and undertake clear-cuts where all the merchantable trees are harvested. Large clear-cuts than span thousands of hectares are not necessarily bad as they partially recreate the effects of a large fire, which is an important natural disturbance in the boreal forest. The problem is that this is often the only natural disturbance that we imitate. It's as if we did an urban management plan for a city that consisted of commercial zones without any parks or residential zones and that we then proceeded to apply this plan everywhere in the province!

As we saw in the first part of this guide, Mother Nature's management plan is much more complex. The effects of natural disturbances on the landscape are much more varied than the effects of our harvesting techniques that we currently undertake. We currently create a buffet with only one dish...

THE CPRS

La coupe avec protection de la régénération et des sols (CPRS, a cut that protects regeneration and soils) is the most utilized harvesting technique in Quebec. It is more or less a clear-cut. CPRS consists of cutting only mature trees, while preserving natural regeneration and minimizing the risk of soil erosion by limiting the movements of heavy machines, which are permitted only on specific, well-spaced skidding trails. Usually the amount of small trees left is sufficient for the forest to renew itself. If this is not the case trees are planted.

A COLLECTION OF CPRS BLOCKS

Individual CPRS cut blocks cannot by law exceed a certain size. However, CPRS blocks can be regrouped together as long as a narrow band (60m) of intact forest is left between each block. This forms a collection of CPRS blocks. Within these blocks there are also riparian buffers (20m), which are left standing.

MOTHER NATURE'S LEGACY AND HUMANS' LEGACY

photo Abitibi Bowater

Fire's legacy

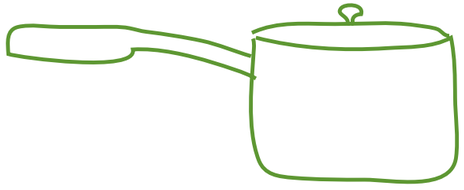
photo Abitibi Bowater

CPRS blocks' legacy

STRAIGHT EDGES

The size of a collection of clear-cut blocks can easily represent the size of a large fire. The main difference concerns the shape of these blocks. Since they are planned by humans, these blocks usually have very straight edges as opposed to fire edges that are irregular.

photo AFAT



A LANDBASE STRIPPED CLEAN

After a fire there are always some portions of the fire's area that have been left untouched and often trees are spared here and there. In Mother Nature's recipe, these fire-spared areas are essential. They represent a seed reservoir important for the regeneration of the burnt forest. Moreover, they are important shelters for numerous animals and plants. Finally, while the burnt forest will see a new forest emerge, these fire-spared forest will continue to age, which increases the diversity of forest types in the area.

As opposed to fire, current clear-cut blocks leave only small amounts of residual forests. They do leave cut-separators and riparian buffers that can be seen as imitation of the fire-spared forests that fires leave behind. However, just like the clear-cut edges, these cut-separators and buffers tend to be very linear. It can hence become difficult for the forest to regenerate after fire and some animals can't adapt to the narrow bands of forest and can have no where to eat or live.

photo L. Imbeau

A LACK OF DISTURBANCE ON THE GROUND

As we have seen, all fires do not disturb the ground in the same manner. Most, but not all, fires will burn the organic matter on the ground. The clear-cuts we undertake, also known as CPRS, poorly imitate the effects of fire on the ground. Along the skidding trails forestry machines compact the soil and organic matter instead of liberating the nutrients in the soil like fire. This sometimes renders the germination and growth of seedlings very difficult. Meanwhile, between the trails nothing is disturbed even when there is a thick layer of organic matter, which can also impede the growth of seedlings.

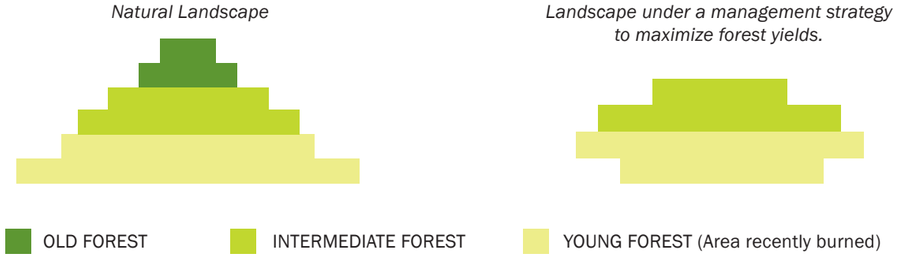
Uneven soil disturbance in a CPRS

LESS AND LESS ROOM FOR THE OLD

Our society is obsessed with youth and some people question what we should do with the elderly. Current forest management also tends to favour the young to the detriment of the old but some people wonder about the importance of old forests.

Today we harvest trees when they have reached maturity, This is the approach that is followed when one wishes to maximize forest yields as is the case in Quebec. The age of maturity varies from one species to the next but it is more or less around 90 years. If one harvests a forest when the trees have reached the age of 90, is one harvesting an old forest? We have seen that this is not the case. To reach the state of 'old forest', an ecosystem in the Balsam fir-white birch domain needs to be at least 160 years old while in the Black spruce-feathermoss domain it needs to be at least 200 years old.

THE AGE OF THE FORESTS



By always planning to harvest a forest when it has reached 90 years old, we do not allow forests to age and hence forests are not permitted to change their composition and structure. However, in a boreal landscape, there are always large blocks of old forests. Since CPRSs are our main harvesting tool, we constantly make forests younger. When we leave a harvested cutbock we give this forest a maximum of 90 years before we return. By doing this we are normalising the age of the forest on the landscape. Eventually, when we will have harvested most forests on the landscape, there will no longer be any forest blocks older than 90 years, which is a far cry from a natural landscape modeled by Mother Nature that is composed of young forest blocks, intermediate forest blocks and old forest blocks. This is worrisome because, as we have seen, old forests provide habitats that are different from the ones found in young forests.

ONLY YOUNG FOREST....THAT'S WORRISOME!

Currently, what worries our society is that the harvest of forests will make forests disappear. In theory, the way that forest management is conceived and put in place, total forest cover will be maintained in time. What is disappearing is the surface area that is covered by intermediate and old forests. Eventually the managed forest landbase will exclusively be covered by forests younger than 90 years old. Hence, it is not the loss of productive forest landbase, which should worry our society but more a loss of the diversity of forest types within our forest landscapes.

photo J. Gagnon

photo L. Farrell

IT'S CRUNCH TIME!

You smoke too much, you are obese and you don't do any exercise. In short, you are far from being healthy! Is it too late to change your way of living? Clearly not, as you are still alive. However, the more you wait the harder it will be and the higher the risk that you will cause permanent damage to yourself.

There is still time for us to change the manner in which we conceive and undertake forest management in the boreal forest. However, the longer we wait, the more the trend of making our forests younger across the landscape will have had an impact on the capacity of species to maintain themselves in an impoverished landscape dominated by young forests. We will then have to put more energy and time into re-establishing the integrity of our landscapes in order to artificially render human managed landscapes more similar to the ones managed by Mother Nature.

photo DMI

Ecosystem management inspired cut blocks

SECTION SUMMARY

Mother Nature's recipes

1. More of a 'regional' approach. She varies her recipes from one ecosystem to the next

2. She uses three main techniques: fire, insect outbreaks and windthrow

3. Mother Nature causes many small fires but it is the large fires that have a real impact on the forest landscape

4. Fire is a culinary forest technique that is highly variable. The edges of burned areas are irregular. Fire also leaves many standing snags which are key habitats for some species

5. In large burns, Mother Nature spares many trees and blocks of forests that are shelters for many plants and animals

6. Fires disturb the forest floor creating a natural fertilizer for the new generation of trees

7. With her 3 culinary techniques Mother Nature makes forests younger but also ages forests. She creates a landscape that is composed of young, intermediate and old forest blocks. This diversity of forest types maintains biodiversity on the landscape

Man's recipes

1. More of a 'fast food' type of approach. Humans do not adapt their approach. They apply the same recipe regardless of the type of ecosystem they are managing

2. Humans use basically one technique: CPRS

3. With respect to size, blocks of CPRSs can resemble large fires

4. Blocks of CPRSs are very linear with straight edges and all mature trees are harvested

5. Linear riparian reserves and separator-blocks between CPRSs are the only treed areas left after harvesting. This may be insufficient to act as shelters for plants and animals

6. The main soil disturbance within CPRS's blocks is the compaction of soils and the forest floor. The natural fertilizer found within the forest floor is not released and not readily available to the next generation of trees

7. With CPRS, humans only make forests younger and create a landscape dominated by blocks of young forests. In the long run these landscapes will only be composed of forests that are younger than 90 years. This endangers biodiversity.

SECTION 3

ECOSYSTEM MANAGEMENT IN BOREAL FORESTS

Humans and Mother Nature, the great reconciliation

DIVERSIFYING OUR CULINARY TECHNIQUES

In order for forest management to be considered ecosystem management, we must first be inspired by ALL the natural disturbances that occur in boreal forests. Hence, even in the landscapes managed by humans, the landscape needs to be diversified with respect to the composition and structure of the forests that make up the landscape.

Forest development occurs over long periods of time during which they are affected by numerous disturbances. For instance, a forest can establish itself following fire and then be affected by insect outbreaks and windthrow events and as a result be sprinkled by numerous forest gaps. To be inspired by Mother Nature is a complex problem. None-theless, what is really important is to diversify our recipe book. Currently, the dominance of CPRSs in boreal forests does not leave any room or time for humans to imitate the effects of secondary disturbances.To put in place an ecosystem management approach, clear-cuts can be maintained since they imitate the effects of fire that makes forests younger. However, we must make more room to undertake partial-cuts, which will that artificially reproduce the aging of boreal forests.

CLEAR-CUTS INSPIRED BY FIRE: ARTIFICIALLY REJUVENATING FORESTS

In order to truly be inspired by fire, the manner in which clear-cuts are undertaken must change with respect to many aspects. Firstly, these cuts must have edges and shapes that are less linear and more irregular. Moreover, forest managers must leave within these clear-cuts more green islands of different shapes and sizes and even live trees here and there.

FIRE'S LEGACY AND THE LEGACY LEFT BY ECOSYSTEM MANAGEMENT INSPIRED CLEAR-CUT

photo PMI

Fire

photo PMI

Ecosystem management inspired clear-cut

It could also be possible to recreate the fertilizing effects of fire by undertaking controlled burns. We could set fire to sites after harvesting has occurred. They are considered controlled burns because we make sure that the fire only burns the area that has been harvested and does not spread into the surrounding forest. This technique is risky and that is why currently it is rarely if ever used in Quebec. However, an intense ploughing that is called scarification can in some instances be effective in disturbing the forest floor.

Within an ecosystem management approach, large clear cuts will still have their place. However, humans will have to rethink the shape of these large cuts and put in place techniques to disturb the soil in order to take advantage of the potential fertilizer found within the forest floor by using either ploughing techniques or controlled burns.

PARTIAL-CUTS INSPIRED BY SECONDARY DISTURBANCES: ARTIFICIALLY AGING FORESTS

When we undertake partial-cuts, we only harvest some of the mature trees. By doing this, we recreate the effects of insect outbreaks and windthrows. Humans are artificially creating gaps in the forest canopy. These gaps allow small shade tolerant trees that are typically found in old forests to grow-up into the canopy. Hence, the structure and the composition of the forest can change following the effects of partial-cuts. The mature trees that are left behind combined with the young shade-tolerant trees in the understory that start to grow together form a forest with an irregular structure as the trees are of different sizes and ages. In the end, partial-cuts artificially age forests.

LEGACY OF AN INSECT OUTBREAK AND THE LEGACY LEFT BY AN ECOSYSTEM MANAGEMENT INSPIRED PARTIAL CUT

Insect outbreak

photo Abitibi Bowater

Ecosystem management inspired partial-cut

REGROUPING CUTS WITHIN THE FOREST LANDSCAPE

The natural disturbance regime in boreal forest primarily impacts the landscape with its large fires. The result is that within natural boreal landscapes, we find large blocks of forest that have the same age. When undertaking ecosystem management humans will have to think differently about how cut blocks are dispersed across the landscape. On one hand, we will have to plan to undertake partial cuts in large blocks in order to artificially age forest. On the other hand, we will also have to undertake clear-cuts in large blocks. The size and amount of these blocks will depend on the natural disturbance regime of the region.

HOW MANY OLD FORESTS? SETTING TARGETS.

How many old forests and how many young forests should be maintained in order to artificially recreate a natural boreal landscape? We saw in the first section of this guide that these proportions vary with respect to the length of the fire cycle. However these proportions also vary with respect to the age of transition, which is specific to each bioclimatic zone. For a same fire cycle, the shorter the age of transition the more old forests there will be. A forest manager who is planning an ecosystem management approach in a certain region must hence determine the age of transition and the fire cycle of the forest he is managing in order to determine the proportion of each stage of development that should be maintained on the landscape. To help forest managers, scientists, thanks to the results of years of research, have already determined these proportions. These proportions are presented in the following table.

PROPORTIONS OF FORESTS OF DIFFERENT AGES BASED ON THE AGE OF TRANSITION AND THE FIRE CYCLE

AGE OF TRANSITION	FIRE CYCLE											
	50 YEARS			100 YEARS			150 YEARS			200 YEARS		
60 years	70 %	21 %	9 %	45 %	25 %	30 %	33 %	22 %	45 %	26 %	19 %	55 %
80 years	80 %	16 %	4 %	55 %	25 %	20 %	41 %	24 %	34 %	33 %	22 %	45 %
100 years	86 %	12 %	2 %	63 %	23 %	14 %	49 %	25 %	26 %	39 %	24 %	37 %
120 years	91 %	8 %	1 %	70 %	21 %	9 %	55 %	25 %	20 %	45 %	25 %	30 %

Once we have determined our target with respect to the proportion of old forest on the landscape, we must still determine the amount of partial-cuts and clear-cuts we need to undertake. We will undertake clear-cuts to recreate young forests and partial cuts to artificially age stands and maintain older forest on the landscape.

CHOICES SOCIETY MUST MAKE

Humans like tables with precise numbers. But what do you know: Mother Nature does not actually fit well within a table describing the relationship between the fires cycle and the age of transition. Indeed, when we look back through time for a specific region, we notice that the fire cycle can vary from one period to the next. This hence means that through time the amount of young, intermediate and old forests has also varied. For example if a boreal forest region's fire cycle has varied between 100 and 200 years its proportion of old forests has varied between 25% and 45%. For humans who are attempting to apply an ecosystem management approach, which target proportion of old forests should we use? Determining the specific target within this range becomes a choice society as a whole needs to make.

photo J. Gagnon

Choosing between habitats for animals such as this owl and cutting wood is a choice society needs to make!

ADAPTING TO THE PARTICULARITIES OF EACH REGION

Management plans should not be the same from one boreal region to the next, for to be considered ecosystem management plans they need to be adapted to the history of human interventions, to the pattern of natural disturbances that will continue to occur and to the specific dynamics of each region.

A LITTLE CATCHING-UP

Once we have determined our target with respect to the proportion of the landscape that will be covered by old, intermediate and young forest, it is possible that forest managers may have some catching-up to do. Indeed, we have seen that the actions of humans during the past couple of decades have considerably rejuvenated forest landscapes. This hence means that we may have to diminish our use of clear-cut harvesting that make forests younger, and increase our use of partial-cuts that will artificially age forests.

ADAPTING TO NATURAL DISTURBANCES

Regardless of what we do, there will always be forests that burn, that fall down or that will be ravaged by insects. We will have to constantly adapt to the occurrence of natural disturbances by undertaking salvage operations in forests that have burned, fallen down or been ravaged by insects. We will have to annually adapt our management plan to the natural disturbances that occur on the landbase. For example, after a large fire, the forest manager should undertake salvage logging operations in this burn by replacing the clear-cuts that were planned in 'green' forests. Similarly, this forester will replace partial-cuts that were planned in mature forests by salvage harvesting operations in a wind throw. This being said, the manager will have to make sure that salvage operations are undertaken in the same manner as the ones occurring in 'green' forests. Hence salvage operations in a burn should also maintain the irregular shape of fires and maintain 'green' and burned blocks within the burn.

ADAPTING TO REGIONAL ECOSYSTEM DYNAMICS

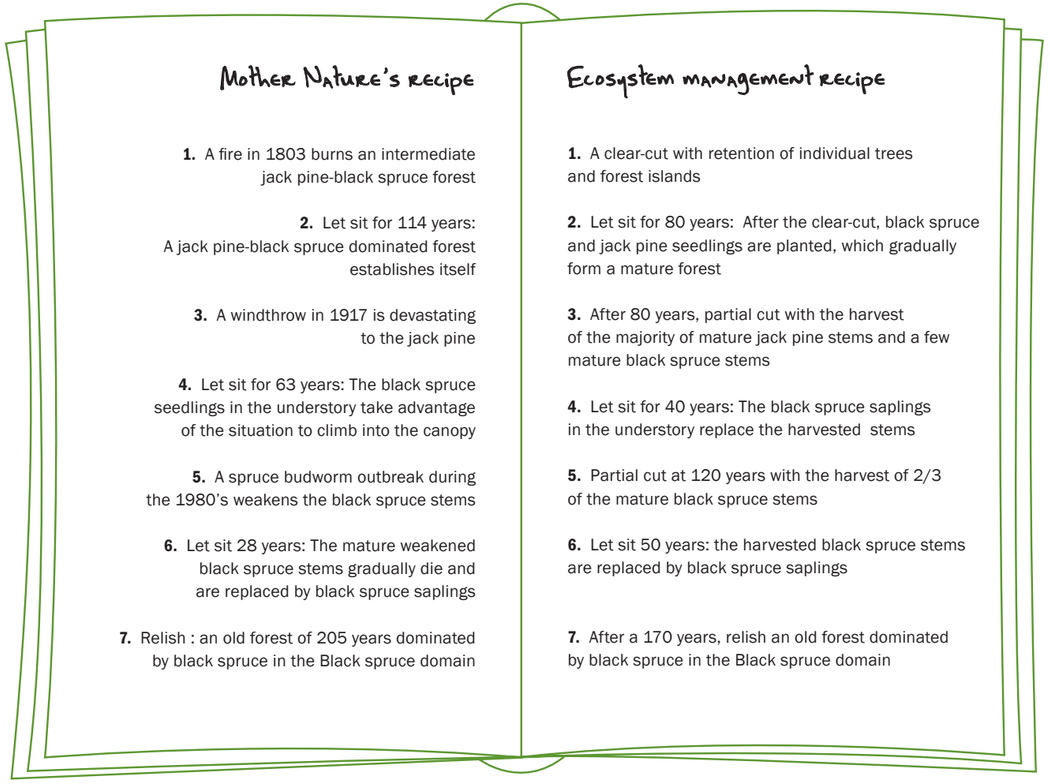
In the north-western part of Quebec, on cold humid clay sites, forest dynamics are characterized by an excessive accumulation of organic matter on the forest floor. Indeed, it is not rare in this region to find forest floor thicknesses that surpass 1m in old forests. When fires occur, they often burn this thick layer of organic matter contrarily to a CPRS which by protecting the forest floor are poorly adapted to this region. By leaving a thick forest floor, the new forest does not renew itself very well and grows poorly, which significantly diminished forest productivity. Large clear cuts followed by an intense ploughing of the forest floor may be better adapted to this region's ecosystem dynamics. We see then that it is not impossible to have very intensive forest management approaches incorporated into a regional ecosystem management plan. Ecosystem management does not necessarily go hand in hand with extensive management approaches. Intensive management approaches can be used in an ecosystem management plan as long as it is in agreement with the natural dynamics of the ecosystem.

Recipe for an old forest in the Balsam fir domain

Mother Nature's recipe	Ecosystem management recipe
1. A fire in 1820 burns an intermediate mixed forest	**1.** A clear-cut with retention of individual trees and forest islands
2. Let sit for 103 years: A poplar dominated forest establishes itself while seedlings of balsam fir and white spruce colonize the understory	**2.** Let sit for 80 years: By leaving mature conifer trees, a poplar dominated forest establishes itself with a sprinkling of conifer trees in the understory
3. A wind throw in 1923 is devastating to the poplars	**3.** Partial-cut with the harvest of 2/3 of the poplars
4. Let sit for 57 years: The conifers in the understory take advantage of the situation to climb into the canopy	**4.** Let sit for 40 years: The conifers in the understory take advantage of the situation and replace the harvested poplar stems
5. A spruce budworm outbreak during the 1980's ravages the conifers especially balsam fir	**5.** Partial cut at 120 years with the harvest of 2/3 of the mature trees (conifers and poplars)
6. Let sit 28 years: small balsam fir and cedar seedling replace the dead conifer trees	**6.** Let sit 30 years: small balsam fir and cedar seedlings replace the harvested stems
7. Relish : an old forest of 189 years dominated by conifers in the Balsam fir domain	**7.** After a 150 years, relish an old forest dominated by conifers in the Balsam fir domain

By following this recipe, humans can not only recreate an old forest in the Balsam fir domain but they can also do it quicker than Mother Nature!

Recipe for an old forest in the Black spruce domain



Mother Nature's recipe

1. A fire in 1803 burns an intermediate jack pine-black spruce forest

2. Let sit for 114 years: A jack pine-black spruce dominated forest establishes itself

3. A windthrow in 1917 is devastating to the jack pine

4. Let sit for 63 years: The black spruce seedlings in the understory take advantage of the situation to climb into the canopy

5. A spruce budworm outbreak during the 1980's weakens the black spruce stems

6. Let sit 28 years: The mature weakened black spruce stems gradually die and are replaced by black spruce saplings

7. Relish : an old forest of 205 years dominated by black spruce in the Black spruce domain

Ecosystem management recipe

1. A clear-cut with retention of individual trees and forest islands

2. Let sit for 80 years: After the clear-cut, black spruce and jack pine seedlings are planted, which gradually form a mature forest

3. After 80 years, partial cut with the harvest of the majority of mature jack pine stems and a few mature black spruce stems

4. Let sit for 40 years: The black spruce saplings in the understory replace the harvested stems

5. Partial cut at 120 years with the harvest of 2/3 of the mature black spruce stems

6. Let sit 50 years: the harvested black spruce stems are replaced by black spruce saplings

7. After a 170 years, relish an old forest dominated by black spruce in the Black spruce domain

By following this recipe, humans can not only recreate an old forest in the Black spruce domain but they can also do it quicker than Mother Nature!

SECTION SUMMARY
ECOSYSTEM MANAGEMENT IN THE BOREAL FOREST IN A FEW WORDS…

VARYING HARVESTING TECHNIQUES

Clear-cuts like fire make forests younger. To imitate Mother Nature, Humans must integrate partial-cuts to artificially age forests. The clear-cuts that we are currently undertaking must be modified: the edges must be more irregular, more intact forest blocks and standing individual trees must be left within cut blocks and sometimes manager should disturb the soil, as a fire would do.

REGROUPING CUTBLOCKS

Large fires determine the natural mosaic of forest landscapes and as a result the landscape is composed of large forest blocks of the same age. Humans must regroup smaller clear cuts and partial cuts into large blocks in order to maintain this pattern of large blocks of the same age.

SETTING TARGETS FOR THE AMOUNT OF FORESTS OF DIFFERENT AGES

To establish targets with respect to the amount of young, intermediate and old forest we should have on the landscape, humans must refer to Mother Nature's recipe for a given region. One determines these amounts by considering the fire cycle and the age of transition of the forest. Since fire cycles vary through time, these amounts also vary. Society as a whole must decide what amount of old, intermediate and young forest within the bounds of natural variability it wishes to maintain on the landscape.

ADAPTING TO PAST INTERVENTIONS AND TO FUTURE NATURAL DISTURBANCES

To be considered as an ecosystem management plan, management plans will differ from one region to the next because they must adapt to the history of human interventions and to the passage of natural disturbances that will continue to occur. Since the actions of humans during the past decade has mainly rejuvenated forests, it is possible that humans will have to diminish the amount of clear-cuts we undertake and increase the amount of partial cuts to artificially age forests. To attain his targets, humans will also have to adapt to the passage of natural disturbances by undertaking salvage harvesting operations in burned, blown down and insect ravaged forests.

INTENSIVE PRACTICES WITHIN AN ECOSYSTEM MANAGEMENT STRATEGY

It is not unthinkable to have some forests intensively managed within an ecosystem management plan. Ecosystem management does not go hand-in-hand with extensive management. Intensive management approaches applied to certain portions of a landscape can be envisioned as long as this type of management is in accordance with the natural dynamics of this forest.

SECTION 4

SUSTAINABLE FOREST MANAGEMENT: AN EQUATION WITH 3 VARIABLES

Other strategies on the landscape should go hand-in-hand with ecosystem management to genuinely speak of a sustainable approach to forest management.

Should we apply ecosystem management on every part of the landscape? No, for two reasons:

1. Although ecosystem management is an approach that aims to respect natural ecosystem processes, the landscape will still be altered by human hands. To respect the precautionary principle and also to allow humans to continue to study the effects of Mother Nature, protected areas should also be part of the equation that leads to sustainable forest management.

2. People that are very familiar with forest management quickly see that ecosystem management may imply a drop in harvest levels. What about human needs for wood? Aren't human needs also important and aren't they part of sustainable forest management? Indeed they are, and that is why to maintain and even increase harvest levels, agroforestry must also be part of the equation that leads to sustainable forest management.

Protected area

photo M-E Siguoin

Hybrid poplar plantation

PROTECTED AREAS : COMPLEMENTING THE NEEDS OF ECOSYSTEMS

Even if humans are looking to reproduce natural ecosystem processes, ecosystem management will always be an artificial version of Mother Nature's work. This is why it is important to establish protected areas in all the forested regions of Quebec as they will act as controls where Mother Nature will be allowed to act as She sees fit. These controls will guide our hands as we attempt to imitate Mother Nature. That being said the forests within these protected areas should be included in the strategies of an ecosystem management plan. For example, the old forests within the protected areas could be taken into account in the total amount of old forests that is to be maintained in a region under an ecosystem management plan.

photo Abitibi Bowater

Weeding a hybrid poplar plantation

AGROFORESTRY: INCLUDING HUMAN NEEDS

To keep our mills and the economy rolling, we will surely need more wood than will be provided by the areas under an ecosystem management plan. This is why the equation leading to sustainable forest management must include areas that are managed under an agroforestry system. Agroforestry is a system that grows trees to produce fibre. It aims to produce the maximum amount of volume for a given area, ideally on the most fertile sites that are close to communities. Under an agroforestry system, we use the quickest growing tree varieties and the best management techniques. On these agroforestry areas, the main goal is to produce trees to be harvested, exactly like a carrot farmer sows the best seeds in a fertilized soil in order to have as quickly as possible the highest yield of carrots that will be sold in supermarkets. We do not take into account Mother Nature unless She can help us in producing trees in the most efficient and quickest manner. To maintain wood flow to our mills we do not necessarily need the entire forest landbase. If we produce a lot more wood on a small surface area this will free up land that can be either designated as protected areas or managed in an ecosystem management manner.

THE HOLY TRILOGY

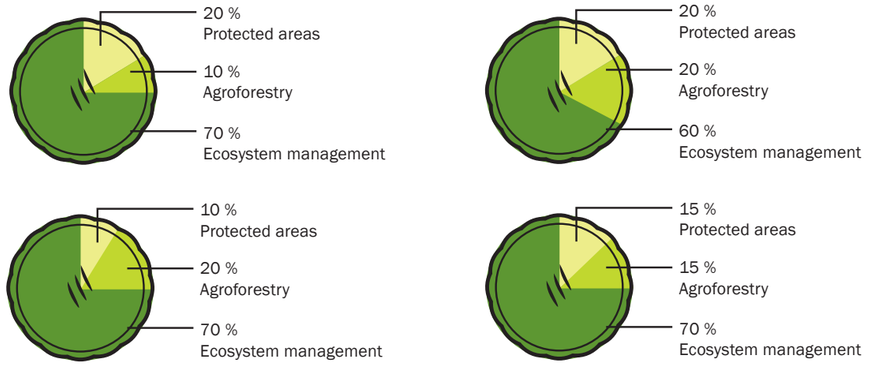
We find ourselves with a forest land base with areas that have three different vocations:

1. **Areas managed with an ecosystem management approach**
2. **Areas that are protected**
3. **Areas managed with an agroforestry approach**

From the areas managed with an agroforestry approach we will obtain a maximum amount of wood. Boreal life forms will be present, but the conservation of biodiversity will not guide the management of these areas. From the protected areas, no wood will be harvested. However, Mother Nature will be able to shape these landscapes with all her creativity that She possesses and will conserve all life forms of the boreal forest. Finally, from the areas managed with an ecosystem management approach, we will harvest some wood but less than from the agroforestry areas, and being inspired by Mother Nature we will be able to conserve biodiversity.

Mother Nature does not need protected areas, nor does She need agroforestry areas. Determining the proportions of the landbase that will be distributed between these different types of vocations, is a choice society needs to make. However, this choice is supported by our scientific knowledge, which informs us that these proportions should respect certain bounds of variability.

SOME EXAMPLES OF THE HOLY TRINITY: IT IS UP TO US TO CHOOSE WHICH PIE MEETS OUR NEEDS!



CONCLUSION

THE ALL OR NOTHING RECIPE

A problem that is well articulated is half solved.
- Shakespeare

Ecosystem management is an approach that aims to artificially reproduce the effects of Mother Nature. Although this approach is more complex than the one that is currently used, we can put the wheels in motion by setting simple targets. We cannot be far off the mark if we are inspired my Mother Nature's work. Let's make this u-turn by instituting a new management approach that will allow us to adapt as our scientific knowledge improves, as the results of our forest operations are know and as society's needs change.

Currently, we make our forests younger. Our clear-cuts partially imitate the effects of fire but we forget the disturbances that age forests. Also, we focus our attention on the age of trees. A tree that has reached maturity in our eyes is ready to be harvested. By seeing forests in this manner we forget to consider the age of forests that are found on the landscape. By applying this logic in the long term we will find ourselves with a managed landscape that is exclusively made-up of forests that are 90 years old or younger. Globally, we are slowly losing the diversified nature of our landscapes and we are making it harder for us to maintain biodiversity on these landscapes.

photo L. Farrell

photo L. Farrell

The **first objective** of an ecosystem management approach is to recreate a landscape where the proportions of young, intermediate and old forests will be similar to the ones found in landscapes naturally produced by Mother Nature.

The **second objective** addresses clear-cuts. This objective would be to render the shapes of clear-cuts more similar to the ones of fire and include significantly more residual trees and more 'green' islands within cutblocks.

The **third objective** will be to adjust our distribution of harvest blocks on the landscape. Mother Nature tends to cut up the landscape in big blocks: large expanses of young forest that have recently burned and large expanses of forest that are slowly aging. Therefore, we will have to regroup our cutblocks, be they partial or clear, into large expanses.

The **fourth objective** will be that forest managers annually adapt their management plans to the occurrence of natural disturbances. Regardless of what humans do, the boreal forest will always burn, will always be ravaged by insects and will always be taken down by fierce winds. In order to reach our targets with respect to the proportions of the different aged forests, humans will have to adapt to the passage of natural disturbances by undertaking salvage logging operations in forests that have burned, been ravaged by insects and have blown down. For example, the year following a large fire foresters will instead of harvesting green matures forests, will have to undertake salvage operations in this burn.

Finally, the **fifth objective** concerns reaching the goal of sustainable forest management. Since ecosystem management is inspired by Mother Nature, it is important to create protected areas a little bit everywhere that will act as controls and models of Her exploits. Furthermore, we must not forget our communities in our sustainable forest management objectives. We think that ecosystem management will lower harvest levels. However, if our communities wish to have more wood or maintain the wood volume they already get, we will have to create agroforestry areas, in other words fields of trees. These areas will exclusively aim to produce fibre. The speed at which ecosystem management will be implemented should with the Holy Trinity in mind , go hand in hand with the speed with which protected areas and agroforestry areas are implemented.

The editorial committee hopes that this document will have enlightened you with respect to what is truly ecosystem management. From one region to the next there will be differences in ecosystem management approaches. However globally to achieve sustainable forest management all the pieces should be present. If not we will not be able to speak of ecosystem management or sustainable forest management. This is **the all or nothing recipe!**

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Conférence régionale des élus de la Baie-James

Commission régionale sur les ressources naturelles et le territoire de la Baie-James

TO LEARN MORE

This guide has made you hungry? Please consult the book Ecosystem management in boreal forests written by numerous researchers and published by the Presses de l'Université Laval. This book explains in detail natural boreal forest dynamics and also presents a few pilot projects that have already implemented an ecosystem management approach.

Gauthier, S., Vaillancourt, M.-A., Leduc, A., De Grandpré, L., Kneeshaw, D., Morin, H., Drapeau, P. et Bergeron, Y. 2008. Ecosystem management in the boreal forest. Les Presses de l'Université du Québec, Québec. 600 p.

INTERNET VERSION

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If one had to answer all possible objections,
one would never do anything

-The Talmud