Ecosystem-based forest management

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Reference Manual for Ecosystem-Based Forest Management in Québec

Module 1

Foundations and Implementation Approach

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Québec

Reference Manual for

Module 1
Foundations and Implementation Approach

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Introduction

Forest stakeholders will be able to make their actions consistent with a coherent implementation of ecosystem-based forest management.

In 2005, the Ministère des Ressources naturelles et de la Faune (MRNF) made a commitment to promote the application of ecosystem-based management in Québec's public forests. This commitment requires that all forest stakeholders have a shared understanding of the concept of ecosystem-based forest management and its application, whether at the Québec-wide level or at the regional and local levels. This manual provides these individuals with information that will help them in the implementation of ecosystem-based forest management. It reviews the current knowledge on this topic and presents a practical approach to its application. It gives forest stakeholders, whatever their sphere of action, the references they need to make their actions consistent with a coherent implementation of ecosystem-based forest management. This manual is a complement to the other tools and approaches, whether existing or currently under development (e.g.: sustainable forest management manual, silvicultural guides, management by objectives and results, integrated land and resource management) for designing forest management plans under the ecosystem-based approach. However, while the manual's content is designed to meet the expectations of the MRNF, it is not a channel for passing on its strategic orientations and guidelines. Rather, this reference manual is intended for all individuals involved in the implementation of ecosystem-based forest management in Québec or interested in the subject.

The manual is made up of two modules:

- Module 1 is general in nature and summarizes all of the topics associated with the implementation of ecosystem-based forest management. This document constitutes Module 1 of the manual.

- Module 2 examines in greater detail the implementation approach associated with participative management and explains how the main ecological issues are assessed. It refers to other publications available on the topic and gives a few examples taken from pilot projects for ecosystem-based forest management in Québec.

This module-based structure allows the reader to have access to targeted information. Further information may eventually be added to the manual.

Photo: Jacques Duval, MRNF

1. Origin of ecosystem-based forest management

Ecosystem-based management is an ecological vision applied to sustainable forest management.

While ecosystem-based forest management is a relatively recent concept, the ecological issues related to forest management date back to the end of 19th century. In Europe, Gayer (1880) proposed a close-to-nature silviculture, which he defined as the search for harmonization with the "natural forces" of stand production. It was in the middle of the 20th century that the loss of forest habitats and its consequences on wildlife and plant life were highlighted by American naturalist Aldo Leopold, who had a major influence on the way people looked at the management of natural environments. The actual notion of ecosystem-based management appeared in the early 1970s and was initially applied to marine ecosystems. In the early 1990s, the concept was applied to forestry. The United States Forest Service, an agency of the United States Department of Agriculture (USDA Forest Service), made ecosystem-based management its philosophy for managing national forests in 1992. In Canada, the controversies that arose from the logging of British Columbia's major coastal forests led to the development of practices that were later adapted elsewhere in the country.

Integration of environmental concerns in forest management: from mitigation-oriented forestry to ecosystem-based forest management

Forestry practices in North America and Québec have evolved considerably over the last few decades. Initially, foresters attempted to mitigate the impact that wood harvesting could have on certain activities in the forest. At the time, the main concerns related to hunting and fishing activities. The multi-purpose management concept was then applied to actively promote the simultaneous use of several different forest resources. Later, integrated land and resource management was developed in way to simultaneously take into account various forest resources at the early stage of the planning process. By giving prior consideration to all resources and concerns, it is possible to optimize the socioeconomic spin-offs of the forest and reduce potential conflicts between forest users.


Photo: Conseil des Montagnais du Lac-Saint-Jean


Photo: Anonymous


Photo: Nathalie Michaud, Fédération québécoise des Clubs Quads


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The viability of **ecosystems** must be ensured…

to maintain all uses of the land.

More recently, it has become increasingly clear that the sustainable and simultaneous production of a few resources (for example: wood, hunting, fishing, water and landscape) cannot by itself guarantee ecosystem viability. It was therefore necessary to give more attention on biodiversity and on the ecological processes that support the long-term production of the goods and services provided by the forest. This change in perspective occurred as the result of the new scientific knowledge (landscape ecology and conservation biology, in particular), but also, and perhaps mainly, following changes in social values that influence public perception of the forest. Values associated with environmental ethics have taken a greater place and have contributed to the development of the ecosystem-based forest management concept.

Relationship between ecosystem-based forest management and sustainable forest management

Ecosystem-based forest management and sustainable forest management are two concepts that have evolved simultaneously in recent years. Both have arisen in response to the debates concerning the environmental management of forests. Sustainable forest management may be considered as a global concept that establishes the rules of a sustainable and fair use of resources and the forest environment. For this purpose, six criteria[1] have been defined by the Canadian Council of Forest Ministers (CCFM), to embrace all aspects of forest management. The environmental criteria (1, 2, 3 and 4) concern the viability of ecosystems, their productivity and the contribution of forests to global ecological cycles. The economic criterion (5) deals with the sustainability and the fairness of economic spin-offs, while the social criterion (6) takes into account the social factors related to the forest and the democratic character of decision-making. Within this context, ecosystem-based forest management is an adequate mean for respecting several aspects of these criteria and contributing to their local adaptation. Ecosystem-based forest management defines a management approach that guides forestry practices in such a way that sustainable forest management criteria are met. Ecosystem-based forest management is thus a vehicle for achieving sustainable forest management.

1. Criterion 1: Preservation of biological diversity; Criterion 2: Maintenance and improvement of the condition and productivity of forest ecosystems; Criterion 3: Conservation of soil and water resources; Criterion 4: Maintenance of the function of forest ecosystems as a component of global ecological cycles; Criterion 5: Maintenance of the multiple socioeconomic benefits society derives from forests; Criterion 6: Giving of proper consideration, in selecting forms of development, to the values and needs expressed by the communities concerned.

The natural character of forests is an important social value for Quebecers

2. Brief description of the concept

Ecosystem-based forest management aims to reconcile a rational use of forest resources with the need to preserve long-term ecosystem functionality.

Ecosystem-based forest management is a management approach based on knowledge of ecosystems and the way they function, to ensure that forestry practices contribute to biodiversity conservation. This approach doesn't necessarily mean to preserve virgin forests, since it includes the harvesting and production of wood. Ecosystem-based forest management aims to reconcile a rational use of forest resources with the need to preserve long-term ecosystem functionality (Gauthier *et al*., 2008). According to the ecosystem-based forest management concept, it is by maintaining the processes and functions of ecosystems that one can best sustain social and economic benefits.

Photo: Marc Leblanc, MRNF

This approach is particularly well adapted to forests having retained a certain degree of naturalness, as it is often the case in Canada and in Québec. In this context, management strategies and silvicultural treatments aim to shape managed forest and landscapes that present the diversity and irregularity of natural forests in order to maintain their ecological processes and attributes.


Photo: Philippe Meek, FPInnovations


Photo: Sébastien Méthot, MRNF


Photo: Marc Leblanc, MRNF

In summary, ecosystem-based forest management is an approach to forestry that aims to reduce the differences between managed forests and forests that are considered to be natural while meeting socioeconomic needs and respecting the social values related to the forest environment.

The participation and contribution of Aboriginal people in ecosystem-based forest management

The implementation of ecosystem-based forest management in Québec is being carried out in a context where Aboriginal people use the forests and have constitutional rights that must be taken into account in the forest management process of crown lands. As a result, it is thus required to implement ecosystem-based forest management in collaboration with Aboriginals and in respect with their rights and the agreements signed with some communities or nations. Owing to their culture and their particular occupation of the land, Aboriginal people have their own specific needs and values. Moreover, by their ancestral and current use of the land, they have developed traditional and local ecological knowledge, which may serve in the development of ecosystem-based forest management strategies. The participation of the Aboriginal people in the implementation of ecosystem-based forest management on the land they use is necessary to ensure that their needs, knowledge and values are taken into account while respecting their rights.

Photo: Hugo Jacqmain, MRNF

Photo: Jacques Robert, Natural Resources Canada


Photo: Consortium en foresterie Gaspésie-Les-Îles

3. Advocated implementation approach

The implementation of ecosystem-based forest management must begin with identifying the main ecological issues.

Afterwards, responses to these ecological issues must be considered as management objectives just like other economic and social objectives.

This section briefly presents the advocated approach for the implementation of ecosystem-based management in Québec's public forests. The main steps described below summarize the actions to be taken to apply this concept in a practical way.

The implementation of ecosystem-based forest management must begin with identifying the main ecological issues of a territory, based on the significant differences observed between the existing forest and what is considered to be a natural forest. In other words, it is necessary to determine what may constitute a threat to the viability of ecosystems and to the maintenance of their ecological functions. Afterwards, responses to these ecological issues must be considered as management objectives, just like other economic and social objectives.

Based on current knowledge, the best way of avoiding biodiversity losses is to reduce the differences between natural forest landscapes and the managed ones in order to keep habitat conditions within the natural range of variability. The closer the conditions in managed forests are to the ones of natural forests, the greater the chances that the majority of species will continue to find suitable forest habitats. The array of species present on a territory is adapted to the historical conditions of the forest and their fluctuations. The maintenance of the main attributes of the natural forest is an excellent *coarse filter* (see box) for meeting the needs of a majority of indigenous species. The preindustrial forest is used as the reference condition for identifying the main differences that should be avoided (see sidebar on page 13).

The conservation of ecosystems and species: the coarse filter and the fine filter approaches

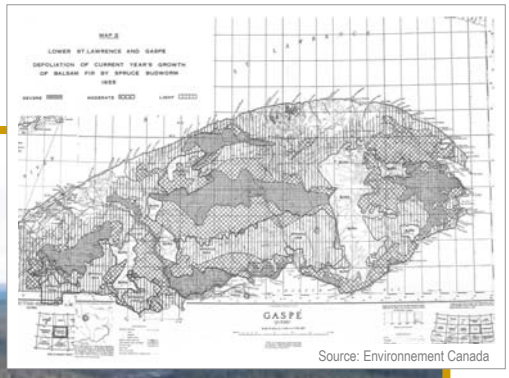
Addressing the question of biodiversity conservation by trying to consider each individual species is an unfeasible task. The number of species is too large, and all their needs are not yet known. Moreover, such an approach would be extremely costly and difficult to implement. Consequently, the use of a global approach, such as the coarse filter, is more appropriate. The coarse filter approach is based on the premise that the conservation of a spectrum of representative ecosystems in a given territory will be more effective for maintaining a majority of species (Hunter, 1990). With the application of a coarse filter approach, the list of species requiring specific monitoring can be reduced considerably.

First, the coarse filter allows the establishment and management of diversified conservation zones that are representative of the natural forest. These conservation zones are included in a landscape composed of managed forests. Second, within the managed territory, the coarse filter is based on the maintenance of certain ecological attributes (Hunter, 2005) likely to be particularly important for a majority of species. The coarse filter is generally based on the availability of these ecological attributes in a natural forest. The portrait of the preindustrial forest provides conditions of this natural reference. However, this sole reference is incomplete. A sound understanding of the needs and behaviors of the different animal and plant communities serves to validate the coarse filter. The latter is thus based on an understanding of the natural ecosystems dynamic and the needs of various species.

The fine filter approach complements the coarse filter approach. The fine filter approach is used to respond specifically to the needs of those species that do not find all necessary habitat requirements to survive in the environment provided by the coarse filter. Specific management concerns are then added to the coarse filter. The fine filter takes into consideration threatened or vulnerable species and ecosystems, but also those species and ecosystems, which although not yet threatened, could find themselves in a problematic situation if no specific conservation measure is adopted. To ensure the success of the coarse filter/fine filter approach, it is important to set up a monitoring system to validate the coarse filter and allow the early detection of species that would need additional conservation measures.

Using the preindustrial forest and the natural variability as reference conditions for describing the natural forest

The preindustrial forest corresponds to the forest before it underwent major transformations resulting from large-scale industrial logging. A portrait of this forest can be obtained from historical reconstitutions and our best understanding of local or regional ecosystem dynamics. The scale of analysis will vary according to the ecosystems and issues involved. With the help of this preindustrial forest portrait, differences generated by forest management can be identified. The portrait of the preindustrial forest serves as reference conditions. It represents one forest state among a range of possible natural states that could be generated by natural disturbances, the climate and the physical environment (for example, the fire cycle has tended to get longer since the Little Ice Age period). The extent of these possible states constitutes the natural variability of the landscape. **The goal is thus not to reproduce the preindustrial forest at a given time in its history, but rather to avoid differences that would drag the forest to a state never experienced before.**



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The differences are analyzed based on the attributes of the ecosystem that are most likely to play important biological roles (species composition, stand structure, spatial patterns, etc.) and according to the habitat needs of some species. The significant differences observed then constitute ecological issues which the management strategy must address. Acceptable alteration thresholds are determined for each of the issues based on an evaluation of the risks of the local loss of species. The precautionary principle (see sidebar) must be applied in those cases where the information related to thresholds is fragmentary or absent. The management objectives and the targets sought are based on these thresholds.

Photo: Jacques Duval, MRNF

Precautionary principle

"When there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing the adoption of effective measures to prevent environmental degradation" (Government of Québec, 2006, s. 6).

Ecosystem-based forest management is applied in territories where multiple users have various expectations regarding the forest. In this context, ecological issues must be addressed at the same time as economic and social issues. In this sense, the implementation of ecosystem-based forest management to ensure the viability of ecosystems necessarily unfolds in a spirit of cooperation and must be part of the integrated land and resource management process (see sidebar). "The objective of integrated land and resource management is to allow all stakeholders in a given territory to participate in the establishment of forest resource management orientations and to facilitate the concrete application of these orientations in integrated forest management plans" (Desrosiers *et al.*, 2010).

In such a process, all management issues are considered from the outset. The management strategy adopted aims to optimize the choices for maintaining the viability of ecosystems and managing resources in the search for the broadest possible consensus between the various stakeholders. By definition, ecosystem-based forest management makes room for the social and economic aspects of forest management. By taking into account the values and expectations of society related to forest management at an early stage, land use conflicts can be reduced and even resolved, thereby facilitating greater social acceptability.

Integrated land and resource management: a definition

"The integrated forest land and resource management is a cooperative and cooperation-oriented management approach. This on-going process aims to integrate, from the very outset of the planning, the visions of various stakeholders and managers, based on the conservation and development of all resources and functions of the environment. The result is an integrated and concerted approach to plan and implement forest land and resource management. Integrated land and resource management aims to increase the benefits and the spin-offs for the community and to optimize the use of land and resources" (Desrosiers *et al.*, 2010).

3.1 Participative approach based on issues and solutions

Since ecosystem-based forest management takes place in an integrated land and resource management context, it requires an approach that facilitates social concertation. This is why the advocated approach focuses on issues and solutions. This participative approach has great potential to lead to the emergence of new forestry practices that are more acceptable to all forest users (Desmarais, 2006). Such an approach makes it possible to simplify the discussion regarding problems that may be complex. The definition of issues opens the discussion to all partners in the territory and encourages their support. The debate on management issues makes it easier to reach a consensus on problems to be solved and management objectives to be determined. This approach also contributes to the success of participative management projects, in which all types of concerns can be considered as issues to be addressed simultaneously. Finally, this approach facilitates the implementation of management by objectives and results. The partners can thus agree on the objectives to be achieved with regard to the various issues, and specialists have the latitude they need to design innovative solutions, better adapted to local and regional realities.

Photo: Louis Deschamps, MRNF

3.2 Adaptive management

Attempting to maintain the diversity of the ecological attributes of natural landscapes in order to conserve biodiversity and ecological processes is a complex undertaking full of uncertainty. Moreover, the impacts of forest management on ecosystems are not yet fully understood. For this reason, the notion of adaptive management was defined by natural resource managers in the 1980s.

Adaptive management aims to achieve management objectives while learning from everyday management activities in order to make on-going adjustments to forest practices. For this learning to take place, the implementation of a management plan must be seen as the experimental application of a scientific method (in other words, as the testing of a hypothesis).

In order for this approach to be fully effective, the hypothesis to be tested and the protocol to be used must be defined on an *a priori* basis. Too often, monitoring is envisaged only at the end of the management process, which greatly reduces its effectiveness and increases its costs. This aspect will be further detailed in Chapter 7.

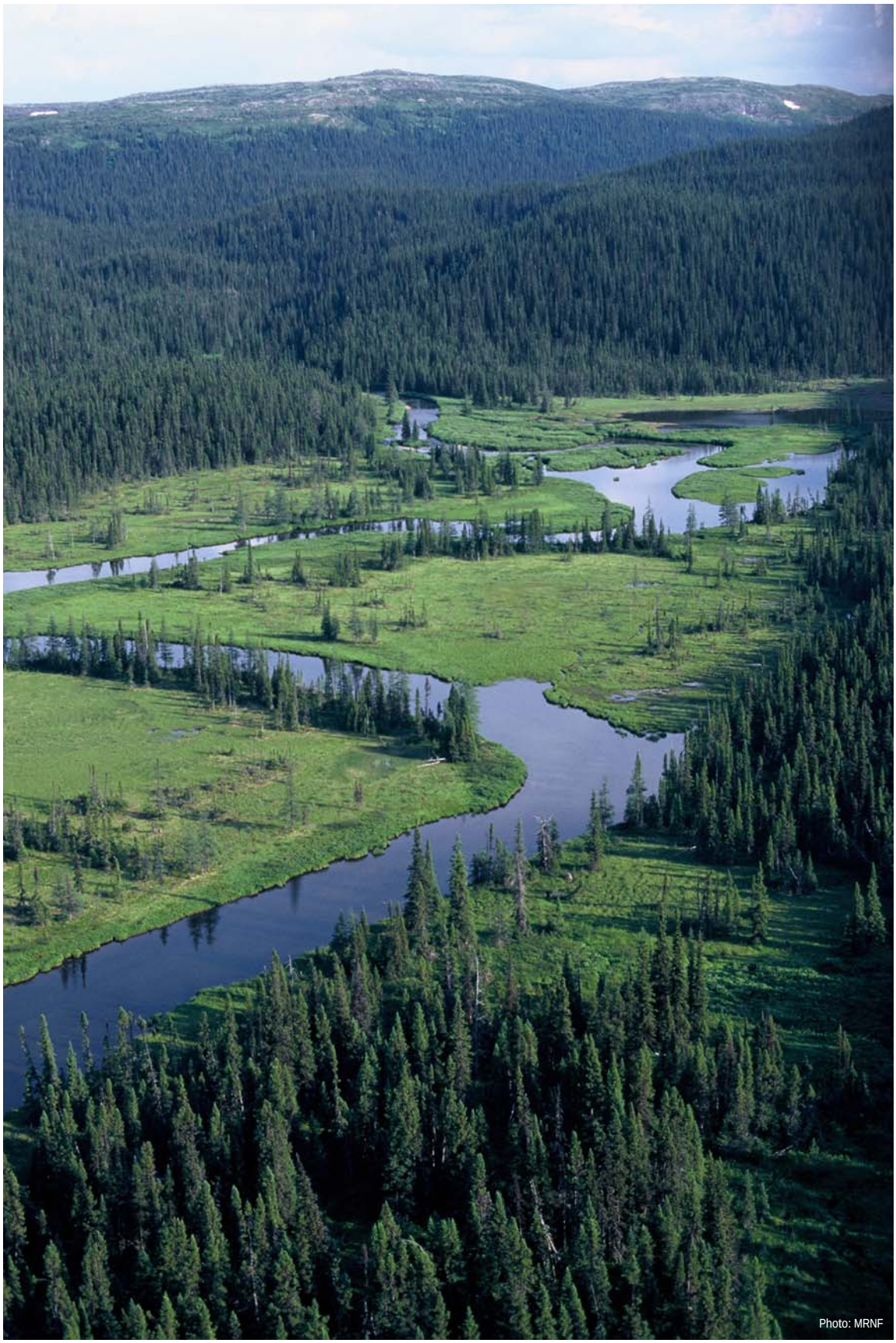


Photo: MRNF

4. Recognition of ecological issues in forest management strategies

With the implementation of ecosystem-based forest management, all forest stakeholders are faced with the new challenge of adequately taking into account ecological issues. These issues may be caused by forest management or other human activities.

With the implementation of ecosystem-based forest management, all forest stakeholders are faced with the new challenge of adequately taking into account ecological issues. These issues may be caused by forest management or other human activities.

An ecological issue may exist when a major difference in the diversity of ecosystems or the integrity of ecological processes is observed or feared between the conditions of the natural forest and those of the managed forest. Ecological issues can be grouped into three main categories: issues related to biodiversity, issues related to soil and water resources, and issues related to climate change.

Module 2 of the manual will include a description of each issue mentioned in this chapter as well as references to studies dealing with these, such as the report on biodiversity issues in the Réserve faunique des Laurentides pilot project (Comité scientifique sur les enjeux de biodiversité, 2007) as well as the guide to support the regional description of key ecological issues in regional plans for integrated land and natural resource development (Varady-Szabo *et al*., 2008).

4.1 Issues related to biodiversity conservation

In managed forests, the issues related to biodiversity are notably linked to the loss or simplification of important natural attributes. The research work carried out to date allows to identify the main biodiversity issues that take different forms accross Québec, depending on the ecosystem.

The main issues related to biodiversity are:

- the decrease of mature and old-growth forests (change in the age structure of forests);
- the decrease of certain forms of deadwood;
- the change in the spatial patterns of forests;
- the simplification of the internal structure of stands;
- the change in the species composition of forests;
- the species requiring special attention to ensure their survival;
- the integrity of riparian, wetland and aquatic environments.


Photo : Marc Leblanc, MRNF


Photo : Christian Bernier


Photo : Hugo Jacqmain, MRNF


Photo : Marc Leblanc, MRNF

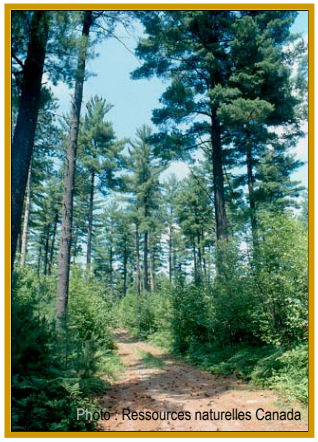


Photo : Ressources naturelles Canada


Photo : Pierre Petitclerc, MRNF


Photo : Marc Leblanc, MRNF

4.2 Issues related to soil and water resources

In the same way, recent research projects and monitoring initiatives have highlighted the main issues related to soil and water resources.

The issues generally related to soil resources are:

- the loss of productive area;
- rutting;
- paludification;
- the decline in ecosystem productivity.


Photo : Marc Leblanc, MRNF


Photo : Marc Leblanc, MRNF


Photo : Rock Paré, MRNF

The issues related to water resources are:

- the decrease of water quality due to surface erosion;
- the modification of peakflows (watershed management)

4.3 Issues related to climate change

The ecological issues related to climate change are not well known at this time. Current and future research may help us better define these issues (see sidebar).

Generally, these issues are two-fold:

- carbon sequestration in managed forests;
- the ecological impacts of climate change (such as species migration and changes in species composition or natural disturbance regimes).

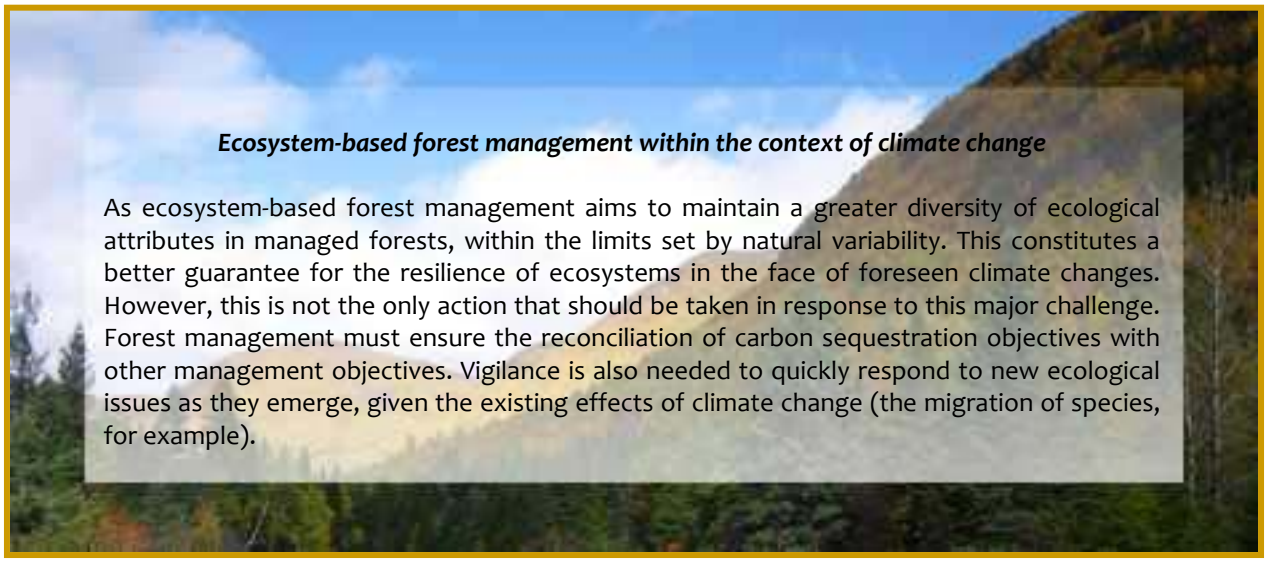


Photo: Sébastien Méthot, MRNF


Photo: Benoit Audet

5. Identification of objectives, indicators and targets in response to ecological issues

Once identified, ecological issues must be converted into management objectives to reduce the differences between the managed forest and the natural forest.

Once identified, ecological issues must be translated into management objectives to reduce the differences between the managed forest and the natural forest. Indicators and their quantitative targets will be set and will specify the anticipated results of the management strategy in relation to ecological issues. These targets are based on the level of alteration observed in a given territory, with the objective of driving the forest to a state where the risk of biodiversity loss is low. Because knowledge can evolve and climate conditions can lead to major changes in the natural dynamics of ecosystems, the targets will have to be reviewed and adjusted periodically.

In situations where the forest is still in a natural state (the virgin boreal forest, for example, is a preindustrial forest), the management strategy will involve planning operations to preserve the current attributes. The goal will be to maintain a state with an acceptable level of alteration, in other words close to the natural condition. In cases where the forest is highly disturbed, the strategy must include a restoration plan that will allow to bring the forest to the target state as soon as possible. This plan must also include significant and noticeable changes in the field. In all cases, a threshold must be established to avoid putting some species or ecological processes at risk. This threshold is known as the *alert threshold.* In the case of highly humanized landscapes, where the natural forest has been disturbed for many years, the restoration objectives must take into account the current use of the territory, and the ecological issues must be assessed accordingly.

5.1 Targets

Targets are set for each ecological issue in a given territory. A target corresponds to a level of alteration that falls within the limits of natural variation or that unlikely leads to a loss of biodiversity. They are determined on the basis of exhaustive reviews of the scientific literature, the needs of focal species (see box), the opinion of experts, and local and traditional ecological knowledge.

Photo: Hugo Jacqmain, MRNF

Focal species

Focal species are sensitive to changes in the ecosystem due to their specific resource or habitat needs (Comité scientifique sur les enjeux de biodiversité, 2007). For example, species that are sensitive to the availability of a closed-canopy forest or that have limited capacity for movement may be considered focal species. They serve as a reference for the analysis of certain key ecological attributes or the definition of quantifiable targets. Knowledge of the habitat needs of these species is an important complement to the ecosystem analysis carried out to develop a suitable coarse filter. For example, the American marten was used as a focal species within the framework of the ecosystem-based forest management pilot project in Réserve faunique des Laurentides to determine what proportion of stands taller than 7 meters in height should be maintained in the landscape.

Photos: Benoit Audet

Photo: Jérôme Rioux, GENIVAR

Photo: MRNF

5.2 Alert thresholds

Alert threshold corresponds to a level of alteration that significantly exceeds the limits of natural variation and beyond which science and experts anticipate serious changes to ecosystems. When the alert threshold is exceeded, the risks of losing species or changing ecological functions are high. The identification of alert thresholds is a key step, representing a basic safety net. When these thresholds can not be determined accurately, the precautionary principle must apply.

By dealing simultaneously with all management issues, it is easier to promote synergy and complementarity between the actions undertaken.

5.3 Synergy between actions through the association of ecological, economic and social issues

The management strategy must be drawn up in a inclusive manner. The answer to ecological issues must be considered at the same time as the answer to economic and social issues. A participative approach allows to associate issues and promote synergy and complementarity between the actions undertaken. Whenever possible, it is important to solve two or more problems with a unique action. This upstream integration of various issues is the most effective way to engage the planning process. It is also the best way to minimize the costs and optimize the benefits of a management strategy.


Photo: Pierre Beaupré

6. Main actions to achieve the objectives of ecosystem-based forest management: a toolbox that needs to be diversified

Management strategies must be based on a range of actions to shape managed landscapes in a way that maintains all the diversity and irregularity of natural landscapes.

In order to shape managed landscapes that maintain all the diversity and irregularity of natural landscapes, management strategies will have to promote a range of actions that will address ecological issues and, at the same time, meet society's economic and social objectives. These actions will take place at various scales, shaping the landscape itself or individual stands, and changing the spatial and temporal distribution of forest entries as well as the type of silvicultural treatment applied. To reproduce diversified forests, ecosystem-based forest management requires the use and adaptation of common practices as well as the implementation of new practices. The manager's toolbox therefore needs to be further diversified. Strictly speaking, there are no practices that are *ecosystemic* in nature, but several common practices are compatible with ecosystem-based forest management objectives. The question that needs to be answered is whether or not the practices make it possible to address the ecological issues. For example, the effect of large-scale uniform precommercial thinning may be to simplify stands and forest landscapes (Bujold *et al*., 2004). The same treatment, applied with a concern for the attributes of natural landscapes, is quite acceptable and may occasionally even address an ecological issue such as the invasion by early successional species (hardwood conversion) while improving the yield in desirable species.

6.1 Main categories of management tools

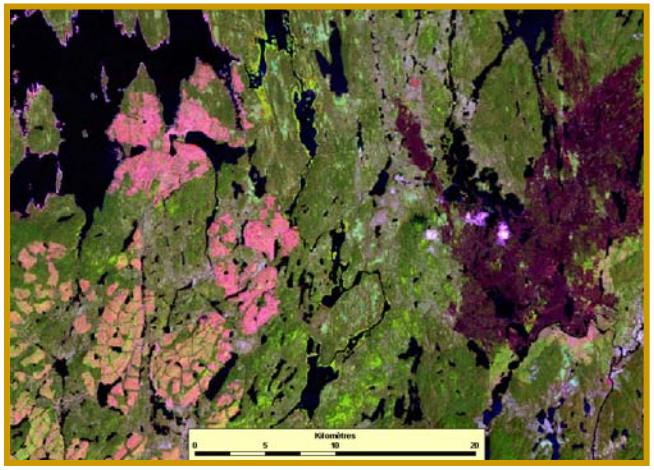
Basically, forest management consists of planning the spatial and temporal distribution of a variety of silvicultural treatments. Ecosystem-based forest management objective is to determine the types of cuts and the characteristics of the forests to maintain in order to reproduce, in particular, the ecological attributes of composition, age structure and spatial organization of ecosystems. The actions taken can be grouped into three categories: conservation actions, spatial patterns and temporal distribution of forest management activities, and silvicultural actions.

6.1.1 Conservation actions

Consideration for protected areas in the implementation of ecosystem-based forest management is essential, since they play an important role in maintaining biodiversity and the characteristics of natural forests at the landscape level. Protected areas help address some ecological issues across larger territories and serve as references for understanding the dynamics of natural ecosystems.


Photo: Sébastien Méthot, MRNF


Photo: Jean Pierre Jetté, MRNF



6.1.2 Spatial and temporal patterns of forest management activities

Spatial and temporal patterns refer to where, and when, silvicultural work will be carried out within a given territory. It also refers to the configuration of the harvest blocks and the size and shape of the residual forest within (for example: edge forest vs. interior forest). Spatial and temporal patterns of forest management activities must focus on various scales, depending on the ecosystem and the ecological issue. To simplify the approach, two scales are suggested: large landscape scale and management unit scale.

The large landscape scale corresponds to areas of land covering hundreds or thousands of square kilometers. These territories relate to the network of protected areas, the presence and the patterns of large forest ensembles (such as large forest tracts), connectivity, the construction and maintenance of the road network, and the situation of wide-range species (woodland caribou, wolf, etc.).

The harvest management scale corresponds to areas of land covering a few dozen, a few hundred or occasionally a few thousand square kilometers, depending on the bioclimatic domain. Issues tackled at that scale relate to:

- the proportion of each development stage of forest stands;
- the type, distribution and configuration of cuts;
- the quantity, distribution, composition and configuration of the residual forest as well as the period of their availability.

6.1.3 Silvicultural actions

Managers shape forest stands using silvicultural actions to deal with a range of ecological, economic and social issues at the same time. To tackle ecological issues, various silvicultural treatments aiming to mimic natural disturbances are used in varying proportions according to the ecological characteristics of the management area.

This section presents the main elements to take into account when developing silvicultural actions in a context of ecosystem-based forest management. The information presented here must be used in conjunction with the information found in the MRNF silvicultural guides currently in preparation.


Photo: Zoran Majcent, MRNF

Clearcutting

Areas affected by intense natural disturbances that lead to a complete renewal of the forest cover (known as “stand replacement disturbances”) are used as a guide for determining the amount of clearcuts. The area of land that may be clearcut is similar in size to the area affected by an intense natural disturbance. A large portion of clearcutting will be made up of what is called “variable retention clearcutting”[1]. Unlike traditional clearcutting, variable retention clearcutting promotes the establishment of forest stands with a greater variety of horizontal and vertical structures, leaving a variable quantity of commercial trees standing throughout the development of the upcoming mature stand. The form of retention also varies, from single trees to clumps, cohorts or blocks. Variable retention clearcutting criteria are set to retain biological legacies similar to those left following a major natural disturbance. These legacies (living trees, snags, woody debris on the ground, multiple vegetation layers, intact portions of undergrowth, etc.) play an important ecological role as a shelter for some species, which will be in a stronger position to re-colonize the site after the disturbance (known as “lifeboating”). The legacies can also serve to generate deadwood of various sizes in the years following the cutting.

1. The notion of variable retention clearcutting was recently defined in North America as part of the definition of the ecosystem management concept (Franklin et al., 1997; Galindo-Leal and Bunnell, 1995; Hunter, 1999).

Relative importance of the visual aspect

Because sight is one of the most important senses used by humans to perceive their environment, the visual impact of forestry practices affects their acceptability. Because clearcutting creates a major change in the forest cover, it is one of the practices with the greatest visual impact. On the other hand, variable retention clearcutting and partial cutting are more acceptable, because they maintain residual vegetation in cutting areas. Moreover, for the ecosystems where they apply, the dispersion of cuts and the reduction of their surface areas are also measures that contribute to improving the perception of logging. However, for ecosystems where natural disturbances such as large fires guide ecosystem-based forest management, caution is required, since large cuts are generally frowned upon and the public does not necessarily consider that clearcutting mimic the natural dynamics of a fire. It is crucial to take into consideration the use of the territory and the aesthetical expectations of users to ensure the acceptability of forestry practices in areas frequented by the public.

Photo: Barbara Pouliot, MRNF

Partial cutting

With regard to silvicultural actions, ecosystem-based forest management may, in many cases, require various types of partial cutting. All types of cutting that involve the retention of forest cover over the short or long term are grouped under the heading “partial cutting”. The main treatments envisaged here are commercial thinning, regular shelterwood cutting, irregular shelterwood cutting and selection cutting. These treatments allow to harvest volumes of wood while shaping stands in a way to tackle ecological issues. They also contribute to the tending of stands with the objective of achieving stand regeneration and conditioning objectives while ensuring the production of high quality wood.

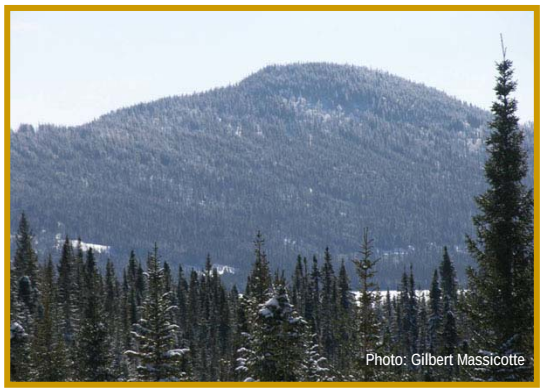


Photo: Gilbert Massicotte

These treatments are inspired from the characteristics of the natural disturbances in our forests. In Québec, major disturbances that lead to the renewal of the stand are often limited to a small proportion of the natural landscape. After a major disturbance, stands generally benefit from a long recovery period during which secondary disturbances occur (gap dynamic). Partial cutting seeks, among other things, to reproduce the effects of these dynamics.


Photo: Philippe Meek, FP Innovations

Specifically, these treatments help maintain, in the landscape, a sufficient proportion of forests with a closed, or rapidly closing, canopy. In some cases, the retention of the cover can be prolonged temporarily (commercial thinning or regular shelterwood cutting). In other cases, the retention of a permanent cover is possible (some variants of irregular shelterwood cutting and all selection cutting treatments). These cuts create stands having a complex and varied internal structure. Special measures may be applied in order to maintain various ecological attributes such as those associated with old-growth forests.


Photo: Marc Leblanc, MRNF

Site preparation

The mechanical disturbance of the soil by scarification or occasionally by controlled burning may be used to mimic certain natural processes such as forest fires or windfall. These means can be used to minimize problems such as soil paludification (peat formation) or limited humus mineralization and can help reproduce some attributes of the soil micro-topography (mounds and pits). In addition, they can facilitate the establishment of planted trees and the natural regeneration of certain species (such as yellow birch), and control competing vegetation.

Reforestation

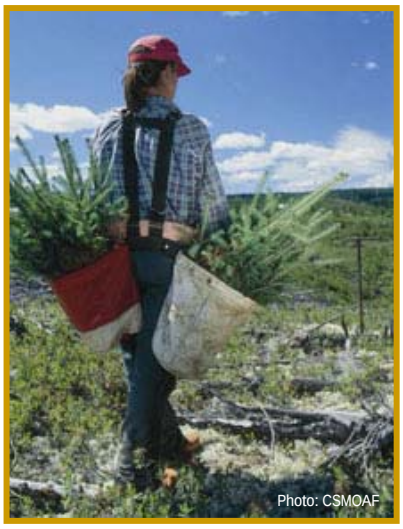


Photo: CSMOAF

Reforestation is carried out in cases where possible deficiencies in natural regeneration occur (failure of regeneration) or in cases where the conditions for establishment are absent (for example, for red pine). The treatment is applied using indigenous species associated with the site. An effort is made to reproduce a degree of irregularity in composition or structure, as found in natural stands. If these conditions are respected, the treatment can be combined with a wood production strategy that meets the objectives of ecosystem-based forest management. Reforestation is also carried out in the form of fill planting following a prescription for full afforestation if deficiencies in the natural regeneration are observed. Reforestation may sometimes be used to address species composition issues.

Precommercial treatments

Some treatments are carried out in young stands to control the species composition of the future stand (cleaning operations). Others are designed to manage stand composition and also to control the spacing between stems of the desired species (precommercial thinning). The extent of these treatments is, however, dependent on the proportion of regular stands found in a natural landscape, in order to avoid stand homogenization. Various methods can be used to help maintain a degree of plant diversity and a variety of vertical and horizontal structures in the treated stand. The treatments can be specifically adapted to obtain greater diversity in horizontal and vertical stand structure. They may be used to control certain shifts in composition (for example: hardwood conversion, species depletion, etc.). The negative impact of these treatments on small games species is well documented and should be taken into account, particularly in terms of the size of the treated area (Bujold *et al*., 2004).


Photo: CSMOAF


Photo : Lyna Breton, MRNF

6.2 Optimization of the management strategy: a decisive step

As part of the preparation of a management strategy, an optimization approach must be carried out. This is a decision-making assistance initiative that consists of an iterative process in which the ecological, economic and social impacts of the planned strategy are analyzed with a view to optimize the results. During the optimization, the strategy initially planned, as well as the management objectives and targets are reviewed to determine the extent of the impacts or the compromises required. This is a decisive step in which all of the management objectives and the associated strategies are considered side by side to ensure that they complement each other, and to promote synergies. The main elements taken into consideration, in addition to the responses made to ecological issues, are:


Photo: Anonymous

- The objectives and actions concerning wood production (including intensive silviculture).
- The development of a territory's potential for recreation and tourism.
- The consideration of social and cultural values, and the respect of measures and agreements.
- The use of varied forest products such as forest biomass and non-timber forest products. Forest biomass extraction plans must give due consideration to the ecological issues in the territory.
- The integrated pest and disease management. During the preparation of an ecosystem management strategy, the need to deal with the risks caused by insects and diseases must be taken into consideration. An integrated strategy to control insects and diseases must be devised simultaneously. Choices must thus be made to ensure the complementary of the objectives for reducing losses caused by insects and diseases, as well as the objectives related to ecological issues.
- The prevention of forest fires.
- Carbon sequestration. In response to climate change issues, it is important to develop a management strategy that aims to maximize carbon sequestration while pursuing other management objectives.


Photo: MAPAQ


Photo: Office of the Chief Forester

Photo: Jacques Duval, MRNF

7. Adaptive management and monitoring system

Adaptive management permits on-going learning based on everyday operations.

The implementation of ecosystem-based forest management is a complex task that requires consideration for a multitude of ecological attributes and processes in relation to a variety of economic and social objectives. Moreover, the impacts of forest management on ecosystems are not always well understood. As the learning process is never ending, it is not economically and socially desirable to suspend forestry activities or the evolution of practices due to a lack of knowledge. This is the context in which the concept of adaptive management was defined. Adaptive management permits on-going learning through everyday operations so that management strategies can improve as they are implemented. Adaptive management is more than a simple feedback loop. With adaptive management, the management activities are designed on an *a priori* basis to test a hypothesis in order to monitor the strategies implemented. This is equivalent to a scientific approach and requires the same degree of rigor. The hypotheses to be tested are directly related to the issues previously identified.

Monitoring constitutes the logical continuation of the reflection on issues, objectives and the forest management strategy. Given the context, protected areas are an important point of comparison for the monitoring system, since they serve as controls to the natural evolution of ecological processes and of animal and plant populations.

7.1 Types of monitoring

As part of an adaptive management approach, a monitoring program must be set up to evaluate the management strategy deployed. There are different ways of distinguishing the necessary degrees of monitoring. Work is underway in Québec to clarify this question, but it is already possible to identify at least three types of monitoring, namely application monitoring, effectiveness monitoring, and relevance monitoring.

7.1.1 Application monitoring (Have the actions been carried out as planned?)

Application monitoring refers to the methods used to verify compliance in the carrying out of the work according to the manager's instructions. The intensity of the monitoring may be adapted according to the level of complexity or novelty of the prescribed work, as well as the budget devoted to silvicultural treatments.

7.1.2 Effectiveness monitoring (Have the actions achieved desired results?)

Effectiveness monitoring is used to evaluate whether the prescribed treatments achieve the initial objectives. This monitoring requires clear and measurable objectives. The use of focal species in the monitoring system is a possible means of validating the effectiveness of the filter (coarse and fine) approach.

Photo: Sébastien Méthot, MRNF

7.1.3 Relevance monitoring (Are the objectives sought still relevant?)

Relevance monitoring makes it possible to check if the right objectives were targeted. This monitoring often involves activities close to basic research. It allows an understanding of the mechanisms that produced the observed effects of the management. This monitoring is an important link in the monitoring chain because it is used in the validation of the original hypotheses.

7.2 Feedback process

In order for the management approach to be really adaptive, the hypotheses must be validated or invalidated using a rigorous monitoring process. In light of this new knowledge, other hypotheses could be put forward to constantly improve management practices and policies.

Photo: Barbara Pouliot, MRNF

Photo: Claude Bélanger, ARBEC

8. Economic dimension

An accurate assessment of cost and benefit factors will promote the optimization of choices, innovation and the methodical improvement of forestry.

The previous chapters have shown how ecosystem-based forest management will lead to changes in the way the forests are managed. New issues will be addressed, and the forest management objectives will be formulated differently. As a result, forestry practices will evolve, and new methods will be put in place. Several scenarios may be proposed and compared. Since the economic is a key dimension of forest management, adequate analysis in this field will be a critical aspect of the implementation of ecosystem-based forest management.

Economic analysis must identify the key choices to be made to ensure that the new management approach is based on solid pillars and promotes sustainable economic spin-offs for society as a whole. This will allow to seize all business opportunities, take into account all possible benefits and promote synergy between the various management actions. At the same time, the analysis must take into account the effect of the parameters relating to costs and development constraints. The understanding of all these factors will promote the optimization of choices, innovation and the methodical improvement of forestry practices.

8.1 Allowable cut

The quantity and quality of the wood made available to mills is certainly one of the crucial elements of the economic analysis. Longer harvest rotations and the protection of certain intact ecosystems are factors that could, under certain circumstances, cause declines in the allowable cut. On the other hand, other factors related to new silviculture scenarios could lead to an adjustment of wood flows and hence result in positive impacts on the allowable cut, once again depending on the forestry context. The understanding of these factors will contribute to a better optimization of the management strategy.


Photo: Marc Leblanc, MRNF

8.2 Wood supply


Photo: Josée Pâquet, MRNF

The new silvicultural treatments provide a different perspective when it comes to the structure of wood supply costs. Harvesting, road construction and maintenance, and transportation costs must be evaluated under each of the proposed management scenarios. This analysis must also take into account the value of the wood products generate under the different silvicultural scenarios. To be complete, the analysis must measure costs for all steps in the silvicultural scenario (harvesting, reforestation, precommercial treatments, etc.). The availability of qualified manpower is another key factor to take into account.


Photo: Bruno Boulet

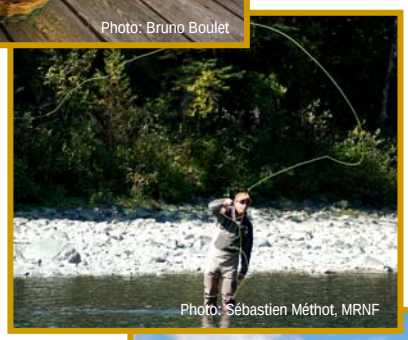


Photo: Sébastien Méthot, MRNF


Photo: Sébastien Méthot, MRNF

8.3 Multiple advantages and synergy between the various actions

Forest management activities allow the development of the forest environment and generate major economic spin-offs. While the economic spin-offs associated with wood have major economic weight, all of the forest's economic potential should ideally be developed at the same time. The use of all potential, such as vacationing, ecotourism, hunting, fishing and non-timber forest products, is often a guarantee of stability and greater wealth for communities that depend on the forest. To be effective, the economic lever of diversification must be applied in an integrated manner. The economic analysis must highlight this range of potential and assess the role that ecosystem-based forest management can play.

To meet a range of social demands, managers are called upon to carry out various actions in the forest. For example, some actions aim to ensure the integral protection of representative samples of the natural forest, whereas others target the protection of the visual quality or the conservation of Aboriginal values. The implementation of ecosystem-based forest management provides a good opportunity to promote the synergy between different, but interrelated, actions. It is important to avoid a compartmentalized analysis. To be effective, the search for synergy must take place in a formal manner, upstream from the preparation of the management strategy, by identifying the issues whose solutions may be related. That way, synergy can be actively promoted, and the undue imposition of constraints on wood production can be avoided. Under these conditions, ecosystem-based forest management becomes a tool that promotes the harmonization of values in an integrated land and resource management process.

8.4 Access to international markets

Environmental issues have become a key condition for gaining access to international forest product markets. The demand for products from forests which are managed in accordance with environmental values is increasingly present. The growing demand for certified forest products over the past decade clearly testifies to this fact. Within this context, the implementation of ecosystem-based forest management can provide a new leverage tool for the marketing of Québec products. In the face of climate changes, the promotion of wood products supplied in a context of ecosystem-based forest management could improve the competitiveness of our forestry industry in international markets. World competitors do not always possess the assets that we have, such as the advantages of targeting the management of a natural forest.

Photo: Marc Leblanc, MRNF

9. Social acceptability

Even if a forestry practice is scientifically based, technically sound and economically feasible, if it is not accepted by society, it will not be able to meet society's expectations and will be contested.

Social values are increasingly influencing choices in the forestry field. Even if a forestry practice is scientifically based, technically sound and economically feasible, if it is not accepted by society, it will not be able to meet society's expectations and will be contested. The social acceptability of a practice is a necessary condition for its success and its sustainability, because public perceptions influence policies and decision-making. This is an inescapable reality of modern forest management, and the social dimension must be deliberately included in its development and implementation. Political and commercial reality also dictates that the social acceptability of forest practices be considered at the local, national and international levels.

Ecosystem-based forest management was in large part born out of a reaction to clashing social values. This clash gave rise to several conflicts that shook the forestry world in North America since the 1990s. The controversy surrounding the protection of the spotted owl in the northwestern United States and concerning logging in the old-growth forests of around Clayoquot Sound in British Columbia are concrete examples. In this context, ecosystem-based forest management has appeared as a way of reconciling opposing views. In most cases, conflicts have been resolved by the negotiation of agreements designed to implement certain variants of the ecosystem approach. The most recent example of this type of agreement is that of the Great Bear Rainforest in British Columbia (Coast Forest Conservation Initiative, 2009).

If ecosystem-based forest management has arisen as a solution to social acceptability problems, its implementation must obey the same rules and meet society's expectations. This is why the managers responsible for applying the new concept have to integrate the multiple dimensions of social acceptability.

Informing the public, and giving stakeholders an opportunity to understand the theory of the proposed approach, are two essential conditions for a successful implementation. The duty to inform and to make information available in a format and a language that are accessible to a diversified public is a key task, particularly during an implementation phase associated with a new concept, as is the case with ecosystem-based forest management.

Photo: Luc Moore

The importance of informing the public is universally recognized, but this aspect alone cannot ensure social acceptability. Understanding the values of the various segments of the general public is even more important in order for these values to be taken into

account in forest management. Social values also create issues, which the forest management strategy must endeavor to address at the same time as it responds to ecological and economic issues. By learning more about social values, managers will be able to develop practices that respond to social issues, or to propose mitigation measures that control the impact on certain values (for example, by managing visual landscape quality). This exercise can only take place as part of an effective participative management process, and relies on the development of tools to understand social values (sociological studies, surveys, etc.). The implementation of ecosystem-based forest management following an approach based on issues and solutions appears to be an avenue that should be favored to respect this condition (see section 3.1).

Finally, social acceptability, in the same way as other management objectives, must be integrated into the adaptive management process. Hypotheses concerning the social acceptability of ecosystem-based management must be tested in order to allow the adjustment of practices as social values are better define and evolve. This dimension of the implementation of forest management, which is still not well known, must be validated regularly with the various stakeholders by means of different techniques, such as surveys, interviews, focus groups, and visual or map illustrations.


Photo: Josée Pâquet, MRNF


Photo: Marc Leblanc, MRNF

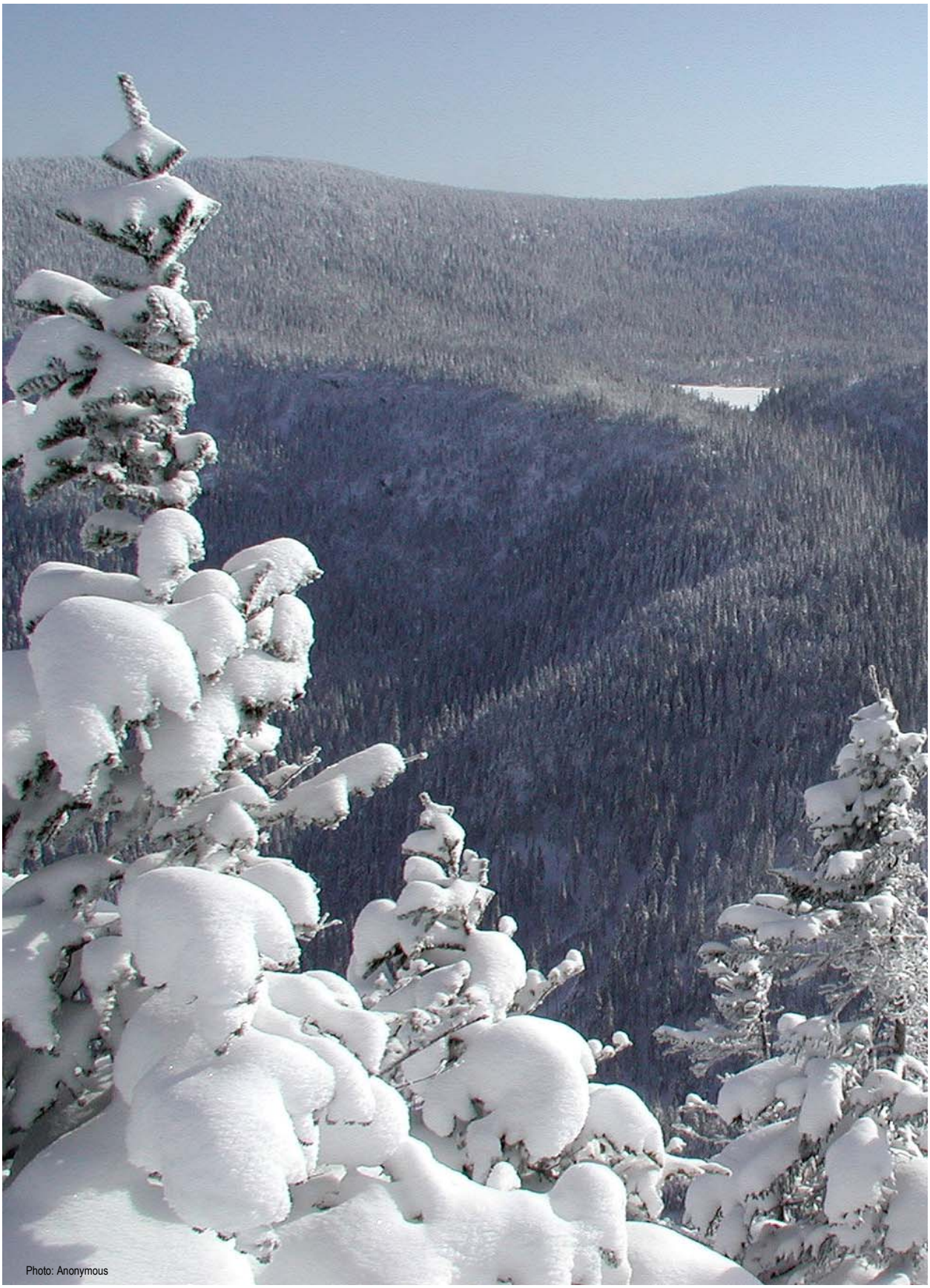


Photo: Anonymous

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