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# The forester's dilemma: paradoxes in the criteria and indicators for sustainable forestry

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**This article** focuses on criteria and indicators for sustainable forestry, with a discussion that should be of interest for the forestry research community as a whole. Based on local experience the problem of the limits of the content of criteria and indicators is addressed to their developers and users.



An orchid to be protected.  
*Une orchidée à protéger.*  
Photo B. Dupuy.

## RÉSUMÉ

### LE DILEMME DU FORESTIER : PARADOXES DANS LES CRITÈRES ET INDICATEURS DE L'AMÉNAGEMENT FORESTIER

L'aménagement forestier à long terme étant une entreprise complexe, il existe par nature des paradoxes dans les critères et indicateurs de certification. Différents moyens permettent de fixer un horizon de planification et des profils d'exploitation possibles qui, bien qu'assurant un rendement soutenu et la stabilité à long terme de la forêt, peuvent ne pas satisfaire à certains critères. L'amplitude de la variation dans le temps des données et des critères se heurte à des problèmes d'échelle temporelle et spatiale ainsi qu'à l'estimation de la perturbation anthropique acceptable lorsqu'on définit ce qui est naturel. La définition du caractère « local » dans le contexte biorégional est importante pour traiter les critères socio-économiques.

L'aptitude du forestier à traiter les contradictions internes dans les critères et indicateurs de la gestion durable s'améliorera avec l'expérience dans le processus de certification.

**Mots-clés :** aménagement, certification, critère, planification, communauté.

## ABSTRACT

### THE FORESTER'S DILEMMA: PARADOXES IN THE CRITERIA AND INDICATORS FOR SUSTAINABLE FORESTRY

Since sustainable forestry is a complex endeavor, paradoxes naturally exist in the certification criteria and indicators. There are different ways to establish the sustainability horizon and alternative harvest profiles that, although sustainable, may not meet specific criteria. The application of historic range of variation data and criteria must confront issues of time and spatial scales as well as how much human disturbance is natural. Defining "local" in the bioregional context is important for addressing socioeconomic criteria. The forester's ability to deal with the self-contradictions in the criteria and indicators of sustainable forestry will improve with experience in the certification process.

**Keywords:** management, certification, criteria, planning, community.

## RESUMEN

### EL DILEMA DEL FORESTAL: PARADOJAS EN LOS CRITERIOS E INDICADORES DE LA ORDENACIÓN FORESTAL

Al ser la ordenación forestal a largo plazo una tarea compleja existen, lógicamente, paradojas en los criterios e indicadores de certificación. Diferentes medios permiten fijar un horizonte de planificación y posibles perfiles de explotación que, aunque garantizan un rendimiento sostenido y la estabilidad a largo plazo del bosque, puede que no cumplan ciertos criterios. La aplicación de la evolución de la variación en el tiempo y de los criterios tropieza con problemas de escala temporal y espacial y con la estimación de la perturbación antrópica aceptable, cuando se define lo que es natural. La definición del carácter "local" en el contexto biorregional es importante para tratar los criterios socioeconómicos. La capacidad del forestal para gestionar las contradicciones internas en los criterios e indicadores del manejo sostenible mejorará con la experiencia en el proceso de certificación.

**Palabras clave:** ordenación, certificación, criterio, planificación, comunidad.



Douglas-fir stands of various ages in a sustainably managed forest, Washington, Pacific Northwest United States.

*Peuplements de sapins de Douglas (Pseudotsuga douglasii) d'âges différents dans une forêt aménagée de l'État de Washington, nord-ouest des États-Unis.*

Photo T. E. Howard.

## Introduction

Not only is sustainable forest management a complex endeavor, but there also are multiple perspectives on what sustainable forestry is. The spectrum of definitions ranges from extreme anthropocentric utilitarianism to extreme biocentrism (GALE, CORDRAY, 1994). Given the complexity of the task and the variety of viewpoints, it is not surprising that there are self-contradictions within the criteria and indicators that foresters must apply at the forest management unit level. These internal inconsistencies or paradoxes are both explicit and implicit in nature.

In an explicit paradox, we can juxtapose two criteria and immediately envision the potential for conflict. In an implicit paradox, the incongruities are less obvious, but they are perhaps more important because they hide value judgments and imperfect information within seemingly objective criteria.

This paper will discuss some of these explicit and implicit paradoxes to illustrate the difficulties foresters and certifiers confront when the criteria and indicators are applied at the forest management unit level. My purpose is to raise issues that are likely to be important as nations and regions develop criteria and indicators to fit the circumstances of their forests and societies. I will use examples from the Forest Stewardship Council (hereafter, FSC) and from one of its accredited certifying bodies, SmartWood, Inc. Their role as sources for this paper does not imply any special favor or criticism. They are simply the organizations with which I am most familiar. FSC is also one of the most important organizations providing third-party certification of forests in the North America. As of December 31, 2000, 2.86 million hectares of US forestland were FSC-certified (Forest Stewardship Council, 2000a). Approximately 38 percent of this amount is publicly owned forest.

In addition to FSC, there are other important sustainable forestry

programs in North America including the International Standards Organization's ISO 14001, the Canadian Standards Association's Canada's National Sustainable Forest Management System Standard (CAN/CSA Z809-96) and the Sustainable Forestry Initiative (SFI) of the American Forest and Paper Association. The Association is the major organization representing the US forest products industry. All members must observe the guidelines established in the SFI program. Currently, association members and SFI licensees manage 29 million hectares of forestland in North America. However, unlike FSC's third-party assessment approach, SFI began largely as a second-party certification process; i.e. the members adhere to the association's standards. SFI now includes third-party audits and has certified or is in the process of certifying nearly 20 million hectares of forest owned by twenty major forest products companies in North America.

It is not surprising to find self-contradictions in these North American systems or in certification systems around the world. It is the very nature of forest management that such paradoxes exist. DAVIS *et al.* (2000) describes two types of management problems, type A and type B. Type A problems have clearly defined goals, objectives, and constraints and employ objective criteria for selecting an optimum solution. Operations planning that use linear programming fit the type A situation. Type B problems, on the other hand, have multiple and, often, conflicting goals and objectives and there is no objective criterion for identifying the best solution. Subjective judgment must be employed to select the preferred course of action. Sustainable forest management is the classic type B problem. There are many views of what we should be sustaining and how we should do it. As a consequence, paradoxes naturally arise in the criteria and indicators that foresters apply at the management unit level.

*Faidherbia albida*. Niger.  
*Faidherbia albida*. Niger.  
Photo Barbier.



## Explicit Paradoxes

Within FSC's and SmartWood's criteria and indicators are several examples of potential self-contradictions. This paper will focus on two of these: the rate of harvest criterion and silvicultural prescriptions. Hereafter, the FSC proposed standards for North America are referenced as FSC x.x.x (Forest Stewardship Council, 2000b); SmartWood standards are referenced as SW x.x.x.

### Rate of harvest

One of the key certification criteria is the determination of the rate of harvest of forest products that can be permanently sustained (FSC 5.6). The managing forester must determine over what time period the harvesting rate should be measured and how to determine permanently sustainable levels. The time issue has two parts. The first is a minor consideration of annual versus periodic allowable cut. The second is determining the time horizon that ensures sustainability.

SmartWood's 5.6 calls for the determination of an annual allowable cut:

"5.6 Annual allowable cut (AAC), by area or volume, has been set or based on conservative and well-documented estimates of growth and

yield, and ensuring that the rate of harvest does not exceed sustainable levels" (SmartWood, 2000).

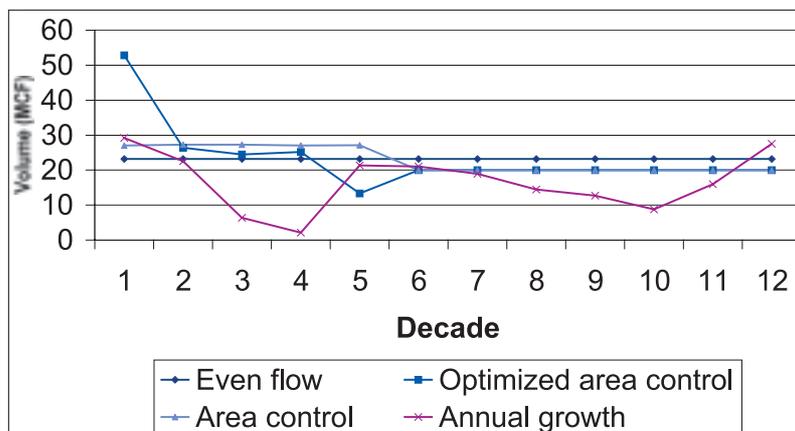
An annual allowable harvest is really only meaningful for larger ownerships that can actually support yearly operations. However, even on these forests, strategic planning is likely done on a larger increment of time such as a decade. A subsection of SW 5.6 softens the annual allowable cut criterion by providing for "other harvest calculations." However, the flexibility provided in the subsection appears to be an afterthought rather than a reflection of actual forest management practices.

The second and more important time issue is the length of the planning horizon that ensures permanence. How long is long enough to be sure the level is sustainable? In management planning, we typically set a planning horizon and use simulation or optimization models to generate different time profiles of harvest volumes and then implement the harvest schedule that best meets the organization's goals. In these models we set ending conditions that we hope will ensure sustainability. For example, the forester can employ an area control approach to regulating the forest and regulation will be achieved within one rotation. When the regulated forest is attained, we can be more certain of its future. Other, non-regulated, ending conditions are also possible, but the forester must specify when those

conditions will be attained. Is 120 years a sufficient horizon for sustainability or is a longer period needed to be sure that the harvest level is truly sustainable? FSC 5.6 sets a standard of "permanently sustainable", but operational harvest scheduling models require a finite planning horizon. That the criteria and indicators do not provide any clear guidance means that the managing forester must select and defend the planning horizon for sustainability for each management situation. The time horizon issue is also connected to how to determine permanently sustainable harvest levels.

Once the sustainability horizon has been selected, the forester must determine the level of harvest that can be perpetually sustained. The forester will use measures of growth and yield to help determine the permanently sustainable level. But growth and yield are only two factors for setting harvest levels. The initial age-class distribution of timber inventory and the structure of the target sustainable forest are important, too. At this critical juncture, some early criteria developed for the north-eastern US were inappropriately specific:

An allowable cut has been derived based on well-documented estimates of growth and yield to provide non-declining sustained yield of forest products and this target is being followed in harvest planning (emphasis added) (SmartWood, 1997).



**Figure 1.** Sustainable harvest patterns for even-flow, simulated area control, optimized area control, and annual growth harvest methods of harvest scheduling for a 12 decade planning horizon.

*Programme de coupes pour un rendement soutenu, témoin de surfaces simulé, témoin de surfaces optimisé, et méthodes de détermination de l'accroissement annuel de la coupe pour un programme de coupes à un horizon de douze fois dix ans.*

The paradox in this criterion is that the requirement for non-declining yield may impede other goals of sustainable forest management. If we have over-mature unmanaged stands, their removal may result in near-term harvest levels that cannot be sustained in the long-run when those tracts are replaced with new, managed stands. Thus, the criterion may exclude transitions to age-class structures that may actually be preferred on ecological, as well as social and economic grounds.

Furthermore, in the transition period between today's existing forest and the future's target forest, it may be necessary to remove timber at a rate greater than the pre-determined level of sustainable harvest. If the forester applies area control methods to an unregulated forest, the harvest flows during the transition period prior to regulation may be very erratic. If the initial distribution of the age-class inventory is skewed towards more mature classes, the near-term harvest flows will be above the long-term sustained yield established for the regulated forest. For, example, in forests managed to a sustainability horizon of 120 years, both the optimization and non-optimization approaches to area control have higher levels of near-term harvests than the level specified by the non-declining even-flow alternative (Figure 1). The area control alternatives, once regulated, are sustainable to the sustainability horizon, but at a somewhat lower level than that of the non-declining even-flow method. Thus, we have three alternatives that are sustainable, but with very different harvest schedules.

The smooth flows of timber that are eventually accomplished with a regulated forest are not necessary conditions for sustainability. Foresters managing large and small forests can also adopt management strategies that harvest stand growth without regard to smoothing the harvest flows from the entire forest over the planning period. A forest management plan that is based on the aggre-

gation of optimum stand management decisions without regard to forest-level smoothing can be perfectly sustainable, although the time profile of harvest flows may be very irregular (Figure 1).

A non-declining sustained yield criterion is not really useful to owners of smaller forests who are not concerned with the continuity of volumes, income, or other outcomes of management. The non-declining language employed in early SmartWood standards was probably linked to US national forest policies that dictate non-declining even-flow harvests. Originally adopted to prevent rapid liquidation of publicly-owned old growth timber in the western US, a non-declining harvest level does not fit most conditions of 21<sup>st</sup> century forestry and could impede sustainable forestry.

### Silvicultural prescriptions

A second example of an explicit paradox can be found in the section on sustaining forest production and resource quality in the Northeast SmartWood Guidelines for the Assessment of Natural Forest Management (SmartWood, 1997):

- Management strategies prevent over harvesting of individual tree species (section 4.3);
- Management strategies emphasize improving long-term stand quality (section 4.4);
- Management addresses the restoration of degraded or low quality forest stands (section 4.5).

In many forest situations, we know that, due to past management practices and natural forces, the forester may be confronted with an overabundance of less desirable species. In the northeastern United States, red maple (*Acer rubrum* L.), a species of relatively low market value, is claiming an increasing share of the forest inventory. If the goal is to improve and restore forest stands, silvicultural prescriptions would empha-



Managed stand of eastern white pine, New Hampshire, Northeastern United States. This species is sensitive to air pollution.  
*Peuplement aménagé de pins Weymouth (Pinus strobus) dans le New Hampshire, nord-est des États-Unis. Cette essence est sensible à la pollution atmosphérique.*  
Photo T. E. Howard.

size over-harvesting red maple and other less wanted species in favor of more commercially desirable species such as sugar maple (*Acer saccharinum* L.) or yellow birch (*Betula alleghaniensis* Britton). Therefore, to meet criteria 4.4 and 4.5, the forester may need to compromise on criterion 4.3. Similar dilemmas may confront foresters in managed forests anywhere in the world.

Furthermore, to the extent that the criteria and indicators create expectations for continuous forest canopies, single tree or small group selection appear to be the preferred silvicultural systems. This preference may discriminate against light-demanding tree species, which, in addition to being commercially valuable, are important for sustaining wildlife populations.

## Implicit Paradoxes

Implicit paradoxes are subtle and foresters may not be as aware of the implications of these potential self-contradictions. To illustrate the importance of implicit paradoxes, the following sections address the concepts of “natural” forest management and “local processing”.

### Natural forest management

FSC certification criteria and indicators promote natural forest management. To implement natural forest management requires an assessment of what is natural. One of the important indicators of whether current and future management is natural is to compare the current and expected conditions to those of the past. The historic range of variation (HRV) serves as a benchmark to which comparisons can be made.

Proposed FSC North American standards (FSC 6.3.a) prefer management decisions that produce outcomes and conditions within the historic range of variation to outcomes that are not within that range (Forest Stewardship Council, 2000b). To establish the HRV for a given situation,

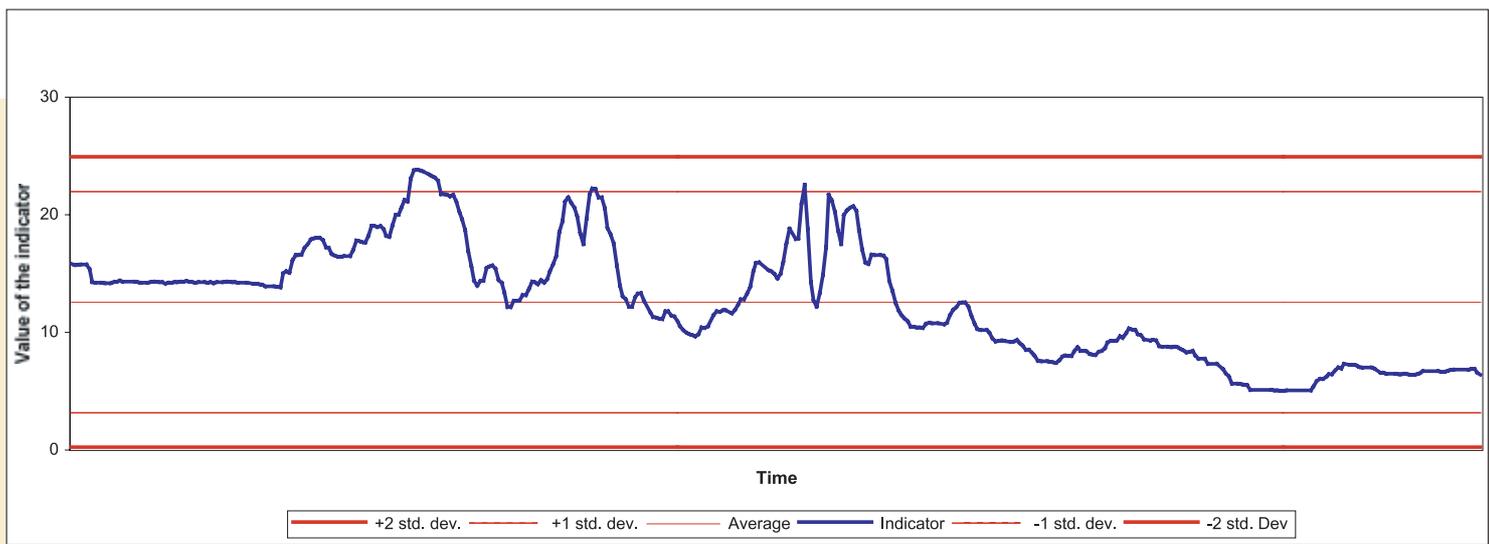
foresters must have a reliable time-series of observations from which to construct the historical record as well as a reliable prediction about the outcome of future management that will be compared to that historical record.

The HRV can be represented as a graph of the relevant data with the indicator variable for the criterion on the vertical axis and an appropriate time scale on the horizontal axis (Figure 2). The observations are plotted on a grid that shows the mean value of the observations and one or two standard deviations above and below the mean. To use the graph, foresters must evaluate the pattern and trends as well as the average conditions and upper and lower bounds. In Figure 2, the indicator has rarely ventured outside of either the upper or lower bounds of one or two standard deviations from the average. However, the trend in the indicator is clear and most recent observations are decidedly below the long-run average.

HRV raises issues of spatial and time scales, and of the appropriateness of human disturbance. The spatial scale paradox is that the historic data are often collected across a large spatial scale so that, on average, the range of variation is more limited than it is on the local scale (Figure 3).

On the local scale, ecological parameters such as the percent of old growth forest can range from zero to 100 percent while on the regional scale, the percentage of old growth forest may only vary between 25 and 75 percent. Thus, applying regional (large scale) information to more site-specific (small scale) management may produce “unnatural” results.

The time scale over which the historic range of variation is measured introduces additional implicit paradoxes. Some definitions of the historic range of natural variation in North America put a premier value on conditions that existed prior to European settlement. For convenience, I will refer to such perspectives as *holistic*. The holistic critique of disturbances that began with European settlement in North America is that those disturbances were born of a world-view that held humanity separate from nature, so-called dualism. The critique argues that the dualist approach should be abandoned in favor of a holistic approach that recognizes humanity as part of nature. However, by defining natural conditions in terms of a pre-European metric, holists must, paradoxically, adopt the dualist philosophy that actions of the Europeans in North America were and are, in fact, separate from nature.



**Figure 2.** Historic range of variation: example pattern showing value of indicator, average and  $\pm$  one or two standard deviations.  
*Amplitude de la variation dans le temps : exemple montrant la valeur de l'indicateur, la moyenne et  $\pm$  un ou deux écarts-types.*

Few would argue that a return to pre-European conditions in North America is either feasible or desirable. However, there is a tendency to define natural as being free from Western industrial disturbances. The disturbances caused by native populations are seen as natural because there is the widely held view that the indigenous people lived in harmony with nature and that their interactions with nature were benign. The paradox in that view is that native populations also lived at the mercy of nature. If drought was extensive, death and population reduction were the natural consequences. Furthermore, their activities were not always benign. Native Americans were, in fact, knowledgeable land managers and made particularly heavy use of fire (WILLIAMS, 1989). Although not a North American example, the Maori of New Zealand's South Island were also once prolific users of fire for wildlife management purposes. Excessive burning over a long time period led to the destruction of large areas of native beech forest that were replaced by tussock grass communities that today cover thousands of hectares.

There is another time dimension to the criteria and indicators that seek to maintain natural forest conditions: the future. The paradox is that we are using the paleoecological record (the past), to judge existing management activities and to formu-

late plans (the present) that we hope will replicate the past in the future. Yet, how can we be sure that macro conditions that we cannot control and that influence the success or failure of our management will be as expected? Can we re-create the past if anthropogenic atmospheric pollution warms the global climate outside of the range historic variation? Will the forest that we have re-created in the image of the historical forest be more vulnerable to environmental disaster if the worst-case predictions of global warming are realized? Would we be better off simply maintaining the kinds of forests we have now? I do not know the answer, but surely we should be thinking about this rather than merely accepting that the forests we have today are automatically inferior to those of the distant past.

For that matter, can we really re-create the past? Global trade, for example, is accelerating the pace of dispersion of unwanted plant and animal pests. In this century, we have lost the once dominant American chestnut (*Castanea dentata*) from the entire eastern United States due to an imported disease. Dutch elm disease has largely eliminated American elm (*Ulmus americana* L.) and the hemlock woolly adelgid threatens eastern hemlock (*Tsuga canadensis* L. Carr.) from New York City to the Canadian border. Gypsy moth, another introduced pest, has had profound influences on the structure of eastern US

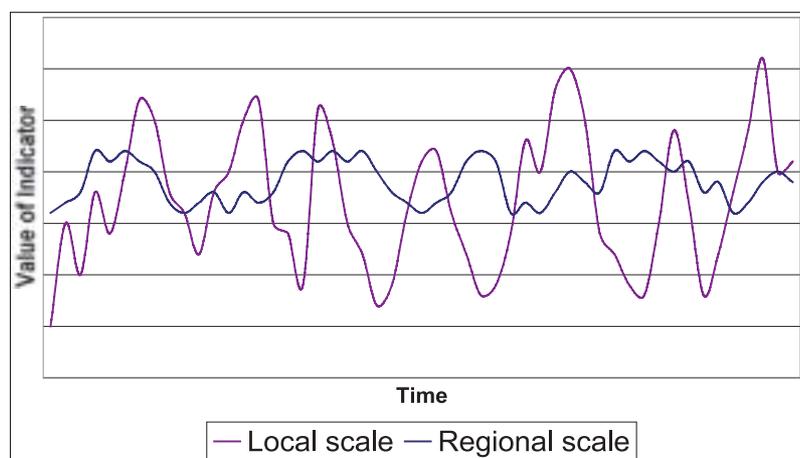
forests. In the face of these and other future attacks, does "natural" become an elusive goal?

Even if we assume that these issues can be resolved to our satisfaction, we are still faced with the fundamental question of whether or not prescriptions that take the forest management unit beyond the bounds of the HRV by one, two, or more standard deviations, are acceptable. Should we reject a prescription that perturbs the system beyond "acceptable" deviation but from which it can rapidly recover to within the bounds of natural variability? Again, time scale becomes an issue. Is the extraordinary variation acceptable if recovery occurs in a decade? a rotation? or a millenium? The answer is clearly a value judgment, not a matter of science.

### Local Processing

The FSC principles and criteria for sustainable forest management encompass a broad range of social and cultural issues. Many of the criteria expect the managing forester to consider the impact of management on local communities. For example, FSC Principle 4 urges "(f)orest management operations (to) maintain or enhance the long-term social and economic well-being of forest workers and local communities" (Forest Stewardship Council, 2000b). The subsections of this principle reinforce the emphasis on local communities. The goals associated with these criteria are to provide higher levels of economic and social benefits to natural resource dependent communities and to prevent exploitation of those communities. FSC criterion 5.2 also clearly favors local processing of harvested timber:

"Forest management and marketing operations should encourage the optimal use and local processing of the forest's diversity of products" (Forest Stewardship Council, 2000b).



**Figure 3.** Local versus regional scale patterns of historic range of variation. *Comparaison d'amplitudes de variation dans le temps aux échelles locale et régionale.*

The local processing preferences were developed partly to avoid situations in which an exporting nation received little or no benefits. Wood colonies were to be avoided, and the local processing criteria seem particularly directed toward some developing nations, where deforestation and forest exploitation are at least partially attributable to the log export market.



Long leaf pine managed as habitat for red cockaded woodpecker, a rare and endangered species, Florida, Southeastern United States. *Forêt de Longleaf Pines (Pinus palustris) aménagée comme habitat pour le pic à cocarde (Picoides borealis), espèce rare et en danger d'extinction. Floride, sud-est des États-Unis.*  
Photo T. E. Howard.



Loading logs for local processing, New Hampshire, Northeastern United States. *Chargement de grumes destinées à la transformation locale. New Hampshire, nord-est des États-Unis.*  
Photo R. Weyrick.



Local processing of small diameter logs. Maine,, Northeastern United States. *Transformation locale de grumes de faible diamètre. Maine, nord-est des États-Unis.*  
Photo R. Weyrick.

Given the local processing criterion as a basis for argument, some advocacy groups have opposed certification of specific forest owners in the northeastern United States because those owners exported unprocessed logs. This creates an interesting paradox. If the manager embraces a strict definition of local processing that excludes log exports to foreign markets, there may be problems with economic viability criteria. The log export markets in the northeastern US typically offer higher prices for logs than do domestic markets. These higher revenues may be the critical marginal revenue increments necessary to maintain long-term forest management and even to protect the forest from conversion to non-forest uses with higher economic rents.

But the export-local market issue can be even more complicated. The northeastern US forest is the wood source for dozens of wood products manufacturing facilities in southern Quebec, Canada. Approximately 14 percent of the annual harvest from the four border states of Maine, New Hampshire, Vermont, and New York is exported to Canada, mostly to Quebec (IRLAND, 1999). The mills that import these unprocessed logs are highly dependent upon this flow and several mills have longstanding relationships with log suppliers and landowners in the US. Many of these mills are located within 100 kilometers of the international boundary between the US and Canada and are often closer to the source forest than competing mills in the United States. In this context, is the nearby Canadian mill "local" or not? Some of the region's environmental groups have suggested that these exports are not acceptable and have proposed changes to public policies that would limit these export flows (Northeast Natural Resource Center, 1995).

FSC 4.1.a calls for using local foresters, loggers, and contractors and to "hire "qualified local workers" (Forest Stewardship Council, 2000b).

Yet, in some cases, Canadian logging companies use Canadian labor to harvest American timber. Many of these Canadian workers live much closer to the forest management unit than do Americans. Would these Canadians be considered local workers?

The border regions of southern Quebec and the northern fringe of the northeast US share a common ecosystem and interact economically and socially. In assessing the criteria related to local processing, how would we judge a US forest enterprise that exports 60 percent or more of its harvest from its forests located adjacent to southern Quebec, to buyers in southern Quebec? Does this constitute local processing? Some opponents of forest management argue that it is not local processing, but, paradoxically, these are often the same people who favor environmental protection across political boundaries on the basis that the ecosystem is the appropriate jurisdiction. They seem to acknowledge political boundaries when it is convenient to their argument. It would be better if FSC and others employed a bioregional approach in judging the degree of local processing.

In a bioregional approach, the ecosystem is the preferred unit of analysis and it explicitly integrates human communities as part of those ecosystems. The sustainability of a bioregion must encompass not only the sustainability of the resource base, but must combine community sustainability beyond its economic dimensions to include social and cultural sustainability of resource-dependent communities (HOWARD, STRAUSS-FOGEL, 1999). Thus, in a bioregional framework, log exports are not automatically grounds for non-certification. Instead, we recognize that ecosystems, economies, and cultures, may transcend international boundaries. In the present example, if the managing forester adopts a bioregional view, then the foreign mills in Quebec are, indeed, paradoxically, local.

## Conclusion

None of the above paradoxes, whether they are explicit or implicit, can be resolved easily. Perhaps they cannot be resolved at all. The developers of criteria and indicators of sustainable forestry in North America and around the world need to consider potential self-contradictions in the criteria to avoid undue tension between the theoretical ideal and the realities of real forestry. Furthermore, it is important that managing foresters, in conducting their responsibilities, be mindful of the conflicts and tensions embedded in certification criteria and indicators. They will need to clearly communicate to owners, accrediting bodies, and stakeholder communities how they have balanced these tensions. The owners, accrediting bodies, and stakeholders, each with their own interpretations of "sustainable forestry", will judge how well the balance has been achieved.

Just as the forest itself is dynamic, so, too, is the certification process. The process will evolve as forest science advances and as foresters gain experience in applying the criteria and indicators in practical situations. Practicing foresters, researchers, and organizations concerned with the development of appropriate certification criteria must continue to share information and ideas if certification is ultimately to be successful.

This is scientific contribution number 2 079 from the New Hampshire Agricultural Experiment Station.

Hevea plantation in China.  
*Plantation d'hévéas en Chine.*  
 Photo B. Dupuy.



Red oak stump, Maine, Northeastern United States.  
*Souche de chêne rouge (Quercus rubra). État du Maine, nord-est des États-Unis.*  
 Photo T. E. Howard.

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## Synopsis

### LE DILEMME DU FORESTIER : PARADOXES DANS LES CRITÈRES ET INDICATEURS DE L'AMÉNAGEMENT FORESTIER

Theodore E. HOWARD

**Du fait** que les définitions de la gestion durable vont d'un utilitarisme anthropocentrique extrême (le « rendement soutenu ») à un biocentrisme extrême, les critères et indicateurs de l'aménagement forestier renferment des contradictions explicites et implicites. Les critères et indicateurs du Forest Stewardship Council (FSC) fournissent d'excellents exemples des paradoxes auxquels se heurtent les forestiers au niveau de l'unité d'aménagement.

#### Le rythme de récolte

Un critère de certification essentiel est la détermination du rythme de récolte des produits forestiers qui peut être maintenu de façon durable. Le gestionnaire forestier doit déterminer sur quelle durée ce rythme de récolte doit être mesuré, et comment il pourra fixer des niveaux de production soutenue. Dans les modèles d'aménagement, on choisit un horizon de planification, et par des méthodes de simulation ou d'optimisation on détermine différents profils de volumes de récolte dans le temps. On applique alors le calendrier de récolte qui répond le mieux aux objectifs du propriétaire forestier. Cependant, les critères et indicateurs ne spécifient pas quel doit être l'horizon de planification. Les niveaux de récolte pouvant être maintenus de façon durable dépendent non seulement d'estimations de croissance mais également de la distribution initiale des classes d'âge et de la structure de la forêt aménagée à atteindre. Des critères qui privilégient des profils temporels de récolte (tels que le flux régulier non décroissant) peuvent exclure des transitions vers des structures de classes d'âge qui pourraient en fait être préférées pour des motifs tant écologiques que sociaux et économiques. En réalité, il y a toute une gamme de profils de récolte, dont certains présentant une succession très irrégulière, qui assurent cependant la stabilité à long terme.

#### Les prescriptions sylvicoles

Les critères et indicateurs concernant les prescriptions sylvicoles doivent être souples, de manière à donner au forestier les moyens d'améliorer les conditions des peuplements et d'aménager la forêt pour toutes les essences indigènes. Les critères anciens ont souvent empêché l'abandon d'essences de faible valeur commerciale, et privilégié des régimes sylvicoles qui favorisaient les essences d'ombre.

Les critères de certification du FSC encouragent l'aménagement des forêts naturelles. L'évolution dans le temps de la variation naturelle est un indicateur utile pour comparer les conditions actuelles et prévues avec celles du passé. Le forestier doit être attentif à harmoniser l'échelle des données du passé avec celle de l'unité d'aménagement pour éviter de créer des conditions non naturelles. Du fait que l'homme a influé sur les paysages forestiers, l'échelle de temps de la variation du passé doit répondre à la question : quelles sortes de perturbations humaines sont acceptables lorsqu'on définit ce qui est naturel ? En outre, on fait appel au passé pour juger les actions et les plans d'aménagement du présent, afin de reproduire le passé dans l'avenir. Cependant, les futures conditions climatiques mondiales et le transport accru de parasites peuvent créer des conditions telles qu'une forêt recréée à l'image du passé pourrait être plus vulnérable à une catastrophe écologique. Les principes et critères du FSC pour l'aménagement forestier rationnel englobent un large éventail de questions sociales et culturelles, entre autres une nette préférence pour la transformation locale des produits. Un système néocolonial, dans lequel l'exportation de grumes peut conduire au déboisement et à la surexploitation des forêts, doit être proscrit. Cependant, les marchés d'exportation de grumes offrent généralement des prix plus élevés pour les grumes que les marchés intérieurs. Ce surcroît de revenus peut correspondre à l'accroissement marginal critique de revenus nécessaire pour maintenir l'aménagement forestier à long terme et même pour protéger la forêt d'utilisations non forestières plus rémunératrices. Les marchés intégrés de produits forestiers du nord-est des États-Unis et de la province canadienne de Québec illustrent

la difficulté de définir le terme « local » pour les besoins de la certification. Les bois bruts et les produits finis traversent la frontière, de même que la main-d'œuvre du bois. Certains soutiennent que les flux qui traversent la frontière ne sont pas locaux, mais cet argument omet de reconnaître que les régions frontalières partagent un écosystème commun et sont économiquement et socialement interdépendantes. Si les forestiers américains adoptent un point de vue biorégional, alors les usines étrangères du Québec sont locales. Dans une approche biorégionale, l'écosystème est l'unité d'analyse privilégiée, et les communautés humaines sont implicitement intégrées en tant qu'élément de cet écosystème. La gestion durable au niveau de la région englobe la gestion des ressources en même temps que la stabilité économique, sociale et culturelle à long terme. Ainsi, dans un cadre biorégional, les exportations de grumes ne sont pas automatiquement des motifs de non-certification. Au contraire, nous considérons que les écosystèmes, les économies et les cultures peuvent transcender les frontières internationales.

#### Un travail collectif pour la certification

Ceux qui conçoivent des critères et indicateurs de la gestion forestière durable doivent considérer les contradictions internes potentielles dans les critères afin d'éviter des conflits insolubles entre forêt idéale et forêt réelle. Les forestiers doivent se préoccuper de ces pressions et faire savoir aux propriétaires forestiers, organismes d'accréditation et communautés intéressées comment ils ont neutralisé les tensions. Les propriétaires, les organismes d'accréditation et les parties prenantes, chacun avec sa propre interprétation de la « gestion forestière durable », jugeront dans quelle mesure un équilibre a été réalisé.

Le processus de certification évoluera au fur et à mesure des progrès de la science et à mesure que les forestiers acquerront de l'expérience dans l'application pratique de critères et indicateurs en situation réelle. Les forestiers, les chercheurs et les organisations concernées doivent continuer à partager l'information et échanger leurs idées pour que la certification s'impose avec succès.