The “emulation of natural disturbance” (END) management approach in Canadian forestry: A critical evaluation

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ABSTRACT

The “emulation of natural disturbance” (END) is an ambiguous forest management approach that embodies an environmental ethic of “following nature” and the values associated with the nature/culture dichotomy. Given climate change projections, the emulation of natural disturbance or any approach that commits itself to reproducing a snapshot of the past history and evolution of forests may not be appropriate over large areas of the forested landscape. The adoption of a naturalistic forest management approach may appear to make sense for biodiversity conservation, but such an approach may not be adaptive in a rapidly changing climate. Rather than aiming to “follow nature,” Canadian forestry should strive to be innovative in its efforts to manage its forests.

Key words: emulation of natural disturbance, TRIAD, environmental ethics, naturalistic forest management, climate change, adaptation

RÉSUMÉ

L'approche écosystémique visant à reproduire des paysages naturels à une signification équivoque et elle promouvoit une éthique et des valeurs environnementales particulières. Les projections climatiques sont telles qu'une approche d'aménagement forestier qui vise à maintenir le paysage à l'intérieur des limites de variabilité naturelle semble beaucoup trop conservatrice et son application semblerait inappropriée à la grandeur du paysage. Plutôt, une nouvelle approche à la fois flexible et innovatrice serait mieux pour augmenter la capacité adaptative des forêts, des communautés et des compagnies forestières situées au Canada.

Mots clés : perturbation naturelle, triade, éthique environnementale, aménagement naturaliste, changement climatique, adaptation

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“coarse filter” approach to forest biodiversity conservation (Hunter 1993) which links the maintenance of biodiversity to silvicultural practices that emulate the size-frequency distribution of non-anthropogenic disturbances. According to Hunter (1993: 115), the core idea of the “coarse filter” approach is:

“That for any given type of disturbance, small-scale disturbance events usually outnumber larger events, and

that imitating this pattern would maintain spatially diverse forest landscapes that would provide suitable habitat for a wide range of organisms with varying spatial requirements.”

In other words, it is presumed that by maintaining stand and landscape compositions and structures similar to those resulting from natural disturbances, we can reduce the negative

Introduction: What is the END forest management approach in Canada?

Over the last decade, a naturalistic approach to forest management—the “emulation of natural disturbance”—has gained ascendancy in North American forestry and has been written into a number of provincial forest policies in Canada (Boyd 2003). The “emulation of natural disturbance” (END) is a

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impacts of timber harvest on biodiversity and maintain essential ecological functions (Attiwill 1994, Bunnell 1995, Bergeron and Harvey 1997, Angelstam 1998, Seymour *et al.* 2002).

The END is typically justified by reference to the following evolutionary reasoning: (1) that periodic disturbances are inherent to dynamic forest ecosystems (Pickett and White 1985); (2) that natural disturbances are strong determinants of species composition as well as ecosystems structure and function (White and Walker 1997), and (3) that forest ecosystems and their species composition have evolved in and adapted to particular disturbance regimes (Bunnell 1995). In practice, a common objective of the END is to design forest management practices that fit within a historical range of variability of “natural” disturbance regimes (Landres *et al.* 1999). Although the underlying logic of the END appears to be straightforward, there is a wide range of interpretations as to how to apply it on the landscape (see Landres *et al.* 1999 for a review).

In their article “What is the “END” (Emulation of Natural Disturbance) in forest ecosystem management? An open question” (Klenk *et al.* 2008), the authors attempted to decipher the meaning of the END for academic forest scientists. They conducted interviews with forest scientists across Canada and used textual network analyses to construct mental models of the meaning of the END. Results from their analyses indicated that there is a wide range of variability among mental models of the END. Qualitative analyses of interviews also illustrated contrasting or contradictory interpretations of the scientific, social, moral, and philosophical dimensions of the END.

The apparent lack of consensus should come as little surprise given that many of the scientific constructs used as building blocks for the END, such as “ecosystem,” “biodiversity,” and “disturbance” are themselves contested and ambiguous (Rykiel 1985, Botkin 1990, Takacs 1996, Fitzsimmons 1999). Sustainable forest management itself, as Sample *et al.* (1993: 41) suggested, “is appealing, but complex and it is not widely understood by the public, by forest policy and management professionals, or even by researchers.” The vagueness of the END and its accompanying conceptual foundations suggests that using the END to guide Canadian forest policy requires reconsideration.

In what follows we begin by articulating some of the problems with the END. We then discuss how the END has infiltrated an alternative forest management approach which, at first sight, seems inimical to the purposes of the END. In the last section we briefly sketch an alternative approach to landscape zoning that does not incorporate the END and that we believe might be more suitable in the face of current challenges.

The Ethics and Values Underlying the END: A Critical Commentary

The END may be interpreted as the embodiment of an ethic or value orientation of “following nature” (Klenk 2008a). The idea of following nature is neither new nor restricted to North American silviculture and forest management. Close-to-nature silviculture has a long history in Europe and is thought to have been spearheaded by Karl Gayer, professor of silviculture at the forestry faculty of Munich in 1880 (Schutz 1999). The idea that nature is a good model to follow has informed

some of the most important and enduring silvicultural systems in forestry, namely the uneven-aged forest management system known as the selection system (Schutz 1999).

Why is nature a good model to follow in forestry? The answer to this question is doubtless complex since the norm of “naturalness” has a long history (Lovejoy and Boas, 1935). “Naturalness” has even been heralded by some conservationists as an “imperative for biological conservation” (Angermeier 2000). What is “natural” is often tied to the ideas of the “order of nature” or the “natural law,” which are taken to be normative for human behaviour. That is, humans should conduct themselves in a way that is fitting, that is natural according to the “order of nature” or “natural law.” It is not uncommon that those who look for and believe in an “order of nature” have derived ethical obligations to fit within this “natural” order (Glacken 1967, Rolston III 1979), which have in turn affected the manner in which they perceive, study and manage nature.

The END, like all scientific constructs, can potentially be viewed as embodying some bias, value perspective, worldview or religious belief (Longino 1990, Putnam 2002). Often, particular beliefs and values are projected as being *de facto* legitimate because they are couched or transmitted by scientific constructs (Fischer 1990, Jasanoff 1990, Latour 2004). Indeed, the literature is replete with attempts to articulate, delimit, quantify, and objectify the END, as though the choice of a historical range of variation is simply a matter of getting the science right (see *Ecological Applications* volume 9, 1999; *Forest Ecology and Management* volume 155, 2002; and *Silva Fennica*, volume 36, 2002).

If the END does indeed embody an ethic of “following nature,” its explicit inclusion into Canadian provincial forest policy (Boyd 2003) can be challenged insofar as the embodied and particular ethical and value commitments are obscured by its scientific characterization. This hinders an important debate and negotiation about what values and whose ethics will guide forest management.

There are, however, some exceptions to the strictly scientifically articulated characterizations of the END (Kimmins 2004, Perera and Buse 2004). Take for instance, Kimmins’ (2004: 13) characterisation of the END:

“Management over ecologically significant temporal and spatial scales that attempts to emulate the ecosystem effects of physical (allogenic) or biotic (biogenic) disturbance events, the frequency and/or severity of which have been changed by human action but which have historically determined the potential pathways, patterns, and rates of autogenic successional development in the ecosystem in question. Such emulation aims to maintain the historical range of variation, or a socially acceptable subset thereof, in desired ecosystem conditions and functions over defined spatial and temporal scales.”

Although Kimmins mentions “a socially acceptable subset” of the historical range of variation, he does not discuss the implications of this social dimension of the END. In fact, his characterization of the END begs the question: what are the norms guiding a “socially acceptable” END?

Most interpretations of the END suggest a particular value commitment: the strict separation of culture from nature.

Indeed, the appropriate range of “natural variability” is often implicitly held to be before European colonization of the North American continent (Fulé *et al.* 1997, Moore *et al.* 1999, Betts and Loo 2002, Oliver *et al.* 2002). In other words, the END reflects the perspective that the “natural order” is distinct from culture—at least European culture.

There are 2 problems with trying to uphold the nature/culture dichotomy in forestry. First, forest management decision-making involves adjudicating among a complex mix of competing cultural, economic, social and environmental values as articulated by different stakeholders. Trying to uphold the nature/culture dichotomy in such a context risks polarizing the debate, or silencing the voice of stakeholders and representatives such as forest communities, First Nations and recreationists who hold potentially different understandings, knowledge and values of nature and culture.

A second problem is the challenge of planning the long-term sustainability of forest practices given climate change. If we accept that climate change is caused by humans, this implies that what were deemed “natural” landscapes are now more humanized. But anthropogenic climate change does not give us a license to “do anything” on the landscape. “Humanized” landscapes should not be viewed as *de facto* normative templates for deciding how to manage forests—neither they nor “non-humanized” landscapes are *a priori* normative, historical benchmarks. How we should manage forests is not up to environmental history to decide. This is a value judgment that may require a solid factual, historical basis, but should not be reduced to a statement of fact.

This is not to say that, by looking to the historical evolution of forests, we cannot gain an understanding of how humans and non-humans have interacted and transformed each other in the process. It would seem wise not to ignore the consequence of past human agency in the planet’s ecosystems—we might learn to shape and take shape within nature in less destructive ways.

This leads us to our concern with applying the END in forest policy. It would seem important from a democratic point of view that the values and ethics that shape forest management policy be determined by societal dialogue and debate, rather than on the particular views of forest scientists (Klenk 2008b). We are not questioning the importance of factual, scientific forest knowledge in policy decision-making, but we are questioning the implicit advocacy of particular value commitments and ethics embedded in “scientific” forest management approaches such as the END.

As the epithet “scientific” in “scientific forestry” attests, science is often venerated as a source of authority in decision-making in natural resource management. In forestry especially, both science and nature form the basis of forest management. A few quotes from classic texts should be sufficient to illustrate the point:

“The central task of applied professional forestry is to take a parcel of forestland, decide how to treat it to grow trees and other forest outputs, implement the treatment, and predict when and how much wood and other products will result. Doing this well is the test. If we cannot decide what to do or if we cannot predict what will happen when we implement a treatment, our claim to professional status is more hype than substance.” (Davis and Johnson 1987: 25)

“Adaptive management [of forest ecosystems] is the only logical approach under the circumstances of uncertainty and the continued accumulation of knowledge. Management must be designed to enhance the learning process and provide systematic feedback from monitoring and research to practice.” (Kohm and Franklin 1997: 5)

“The majority of the best [silvicultural] choices are imitations of those natural communities that have grown well in nature.” (Smith 1986: 10)

We should remind ourselves, however, that the rise of scientific forestry was tied to centralized state-building initiatives in which the disorderly array of human and non-human nature was contained, separated, and ordered to facilitate state administration of natural resources (Peluso 1992, Scott 1998, Guha 2000, Whited 2000). Such top-down command and control of natural resource management, the attempt to “control ecosystems and socioeconomic institutions that respond to erratic or surprising ecosystem behaviour with more control,” has been likened to a pathology (Holling and Meffe 1996).

A more democratic approach to policy-making would be to engage in a dialogue about the meaning and values underlying the END, or any other forest management proposal, rather than rely on the implicit value judgments underlying so-called “scientific” forest management approaches. Indeed, any proposed forest management approach embodies particular values and ethical commitments (whether with regards to, for instance, biodiversity conservation, adaptation to climate change, or environmental justice issues) and it is not sufficient to justify a forest management approach on the basis of science—in fact doing so is misleading. What is needed is to engage in applied ethical reasoning (Klenk and Brown 2007). For those who believe that ethical judgments are merely statements of opinions or feelings, this position would obviously be problematic. But this is not a reasonable belief! Sound ethical judgments are the result of careful deliberation, i.e., a process of rational adjudication among potential lines of actions and reasons for these actions (Dewey 1939). From this perspective, forest scientists would be expected to articulate explicitly their value judgments rather than simply rely on a scientific interpretation of nature, i.e., the historical range of variability of forested landscapes, to suggest how best to manage forests. Thus, instead of appealing to nature and relying on the *a priori* legitimacy of scientific constructs to shore up their ethical commitments, forest scientists would be expected to defend their value judgments with reasons and engage in a societal dialogue as to what values and whose ethics will guide forest management.

In sum, the lack of a clear articulation of the ethics and values underlying the END suggests grounds for concern over using the END in Canadian forest policy—policy-makers may be relying on a “scientific definition” of the END in forest policy and thereby covering up the actual state of disagreement over its underlying values and stifling what could be a productive debate as to its merits and limitations. In the next section, we discuss how the END has infiltrated *non extensive* (Baskent and Yolasigmaz 1999) approaches to forest management such as zoning (e.g., TRIAD) which do not solely prioritize biodiversity protection.

Zoning in the END Forest Management Approach

Forest land-use specialization, such as landscape zoning, seeks to divide landscapes according to dominant uses such as timber production, watershed protection, recreation and so on, in an effort to support multiple values separately rather than across entire ecosystems (Vincent and Binkley 1993, Baskent and Yolasigimaz 1999, Zhang, 2005). It is thought that zoning may help resolve potential conflicts through the separation of dominant uses of forests into special use areas, while allowing for the integration of biodiversity conservation with the maintenance of timber yields at the landscape level (Binkley 1997). Zoning as an approach to landscape management has been supported and contested by a number of authors (Gladstone and Ledig 1990, Vincent and Binkley 1993, Bull 1996, Hunter and Calhoun 1996, Binkley 1997, Sedjo and Botkin 1997, Messier and Kneeshaw 1999). It has been applied in numerous countries around the world including New Zealand, Australia, Malaysia, Russia, China, Guyana, and Canada. A North American variant of this approach which has been applied in Canada (Alberta and New Brunswick) is called the TRIAD.

Seymour and Hunter (1992) promoted the TRIAD to justify the creation of large, high-quality protected areas. In their approach, intensive forest management can make up for the loss of timber production resulting from the creation of protected areas. Their TRIAD divides the landscape into 3 zones, each with its own fundamentally different management objectives: (1) intensive forest management, (2) ecological reserves, and (3) multiple-use extensive management (Hunter and Seymour 1992, Nitschke and Innes 2005, Zhang 2005). The extensive forest management zone is a matrix buffering ecological reserves from the intensive forest management areas. In terms of biodiversity conservation, the matrix is of critical importance in that it serves as habitat in its own right, increases the effectiveness of reserves, and extends landscape connectivity (Franklin 1993, Norton 1999, Lindenmayer and Franklin 2002).

For the matrix to promote ecosystem integrity and conserve biodiversity, it has been asserted that it should be managed according to ecosystem management tenets that require emulating natural disturbances (Bunnell 1995, Lindenmayer and Franklin 2002). There are 5 general principles to guide forest biodiversity conservation: (1) the maintenance of connectivity; (2) the maintenance of landscape heterogeneity; (3) the maintenance of stand structural complexity; (4) the maintenance of aquatic ecosystem integrity; and (5) the use of natural disturbance regimes to guide human disturbance regimes (Lindenmayer *et al.* 2006). The critical role of the END is further reinforced by these authors in their definition of "ecologically sustainable forestry":

"Perpetuating ecosystem integrity while continuing to provide wood and non-wood values; where ecosystem integrity means the maintenance of forest structure, species composition, and the rate of ecological processes and functions *within the bounds of normal disturbance regimes*." (Lindenmayer *et al.* 2006:434, emphasis added)

Thus, while the TRIAD obviously differs from the END by its inclusion of intensive forest management in the landscape, the 2 approaches are clearly connected. The matrix in the TRIAD, as some of its advocates have characterized it, is

meant to be managed according to the END approach. There is cause for concern, however, in suggesting that we deploy the END over a large proportion of the landscape, as in the matrix. The concern, other than the implications discussed above of the values and ethics underlying the END, is that, to the extent that the END resists changes in species composition and strives to maintain "natural conditions," it is a highly conservative management principle. To be conservative, or resistant to change, may be called for in terms of biodiversity preservation in a relatively stable climate, but in a rapidly changing climate such a position may not be adaptive.

Envisioning an Alternative Zoning Approach

Forest management attempts to maintain forested landscapes within "natural historical variation" are difficult to reconcile with proactive strategies of assisted migration to produce historically novel ecological communities (MacLachlan *et al.* 2006, Fox 2007, Hunter 2007). Neither are naturalistic forest management approaches open to risk-spreading strategies that create novel spatial and temporal variation in a range of conditions at multiple spatial scales in an effort to compensate for our lack of knowledge about the habitat requirements of migrating species (Lindenmayer *et al.* 2006). In other words, innovative forest management approaches that would combine the values and interests of "nature" and "culture" in creating novel ecological-social communities are severely constrained by the criteria of maintaining "natural historical variation."

For forest landscape management to become more adaptable to a changing climate, perhaps a more flexible and risk-spreading strategy would be to adopt a zoning framework like the TRIAD, but it could embody adaptive flexibility over the majority of the landscape instead of embodying a conservative standpoint over a majority of the landscape (reserves and matrix zones as currently conceived). Although we can only briefly sketch here a new vision for the TRIAD, an *innovative* TRIAD (iTRIAD), its formulation is meant to embody the values of flexibility and adaptability. These values are meant to balance what we perceive to be an over-emphasis on biological conservation in current forest management approaches (END and TRIAD), which does not adequately address the challenges of climate change and the importance of recognizing the socio-ecological hybrid dimensions of forestry.

If we take landscape zoning as a reasonable approach to forest management⁴, the iTRIAD would see ecological reserves and intensive management zones complemented by a zone of innovation rather than a zone dominated by the END forest management approach. The matrix in this alternative framework would not necessarily deploy the END but rather provide an opportunity to test hybrid forest management practices. The matrix would be a zone where forest management practices would be socially negotiated and debated; where communities could be involved in setting innovative goals for their economic and ecological futures (Higgins 1999); where species migration could be facilitated (Hannah *et al.* 2002a, b); and where government and the for-

⁴Needless to say, this approach to forest management should also be justified on the basis of sound normative reasoning. But it is beyond the scope of this paper to justify the use of landscape zoning in forest management *per se*.

est-products industry could engage in partnerships with other stakeholders to undertake innovative and sustainable development projects. The iTRIAD matrix does not preclude biodiversity protection; however, we would not prescribe this value *a priori*. Rather, our vision of the matrix seeks to give a greater voice to stakeholders whose interests do not correspond to the dominant (yet restrictive) interests that embody the nature/culture dichotomy in forestry.

To conclude, it is our view that the emulation of natural disturbance or any approach that commits itself to reproducing a snapshot of the past history and evolution of forests may not be appropriate for large areas of the forested landscape. Indeed, future climate conditions are likely to reshape and reassemble the social-ecological communities that are currently present in unexpected ways. That Canadian forests are changing due to climate change may be unfortunate, but that should not detract us from striving to be flexible and innovative in our efforts to adapt to climate change. In this light, we should reconsider the relevance and appropriateness of an ethic of "following nature" and the nature/culture dichotomy in Canadian forestry.

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