REGIONAL ENVIRONMENTAL ASSESSMENT OF FOREST MANAGEMENT: EXPERIENCE IN ONTARIO AND MINNESOTA

by

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ABSTRACT

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Environmental assessment (EA) was originally conceived as a process applying to discrete projects such as power dams and timber harvest plans, but increasingly it is being applied to programs and policies for large areas. Such is the case for forest management, where EA is finding application to regional management strategies. The aim in this study was to investigate and analyze the quality of two regional EAs of forest management: (a) the Ontario Class EA for Timber Management on Crown Lands in Ontario; and (b) the Minnesota Generic Environmental Impact Statement (GEIS) on Timber Harvesting and Associated Forest Management Activities. The Ontario EA was a difficult hearing-dominated venture where experts brought testimony before a quasi-judicial tribunal. The Minnesota EA centred upon quantitative impact analyses undertaken by inter-disciplinary study teams and documented in concise reports. Both these EAs looked at forest management issues across huge areas, and both were completed in 1994.

A broad cross-section of criteria derived from EA literature was used to judge the quality of the EAs, including factors pertaining to elements of process, technical and scientific requirements, and outcomes. I applied the criteria in describing and evaluating the two EAs and found them generally to contrast strongly with each other. The paper summarizes the strengths and weaknesses of the two EAs so that similar endeavours in the future can be designed to avoid some of the pitfalls encountered in the preparation of the Minnesota and Ontario regional environmental assessments.

Key Words: environmental assessment, forest management, timber management, class environmental assessment, generic environmental impact statement.

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CHAPTER 1 - INTRODUCTION

There has been much call from environmental assessment (EA) practitioners for a general movement of the focus of EA from the local project level up to the regional program level (Duinker, pers. comm., 1993). This is seen as a way to ensure that cumulative impacts of many small projects or actions are addressed through the EA process. Cumulative impacts are especially important in forest management, where actions consist of numerous local (stand level) harvest and silviculture treatments spread across forests and regions through decades of time. Each local treatment may itself have little environmental impact but, taken together, may have dramatic effects across broad landscapes.

1.1 THE OPPORTUNITY

Two neighbouring sub-national jurisdictions in North America have recently completed comprehensive EAs of forest management within their respective boundaries (Figures 1 and 2). In Ontario, the Ministry of Natural Resources submitted its "Class EA for Timber Management on Crown Lands in Ontario" in June 1987 (OMNR,1987b), and a public hearing by the Ontario EA Board began in May 1988. The hearing concluded in November 1992, and the EA Board released its decision in April 1994

Figure 1. Province of Ontario and State of Minnesota highlighted on a map of North America.

Figure 2. Area of the undertaking in the Province of Ontario.

(Koven and Martel, 1994). Meanwhile in late 1989, the Minnesota Environmental Quality Board (EQB) ordered the preparation of a statewide generic environmental impact statement (GEIS) on the environmental and economic impacts of logging in Minnesota forests. The Draft Summary GEIS was released in June 1993 (Poyry, 1993a,), followed by a public review and final re-release in April 1994 (Poyry, 1994).

Considering the importance the EA community has attached to EA of regional resource-management programs, it is timely to make a critical comparison of the two regional forest-management EAs. Such assessments are the first of their kind, and ought to be useful in informing the broader community of practitioners of EA and forest management of the strengths and weaknesses of these novel experiences. Similar regional program assessments in other areas might thus avoid pitfalls.

1.2 STUDY OBJECTIVES

The objectives of the study are:

1. To compare and contrast, across a wide range of descriptive and evaluative criteria, the comprehensive forest-management EAs undertaken in Ontario and Minnesota.

2. To determine the quality (strengths and weaknesses) of the exercises in regional program EA.

3. To formulate recommendations for improving the approaches used for broad-based forest-management EA.

1.3 PROJECT RATIONALE

It is hypothesized that contemporary EAs of broad-scale forest management would be undertaken incorporating "state of the art" methods, while avoiding the pitfalls documented in the EA literature. The hypothesis will be tested by determining whether two EAs for broad-scaled forest management are consistent with quality EA as defined by a suite of technical, process, and substance criteria. Although there have been several critical studies of EA, this study will be the first to compare and contrast two unique EAs of forest management in neighbouring jurisdictions. This study will highlight the strengths and weaknesses of both EAs so that future EAs of broad-scale programs or activities can be designed, prepared and implemented efficiently.

Most of Ontario's EA programs, policies, and legislation were designed for small-scale, local, discrete projects. Application of the process to broad-based regional plans and policies is controversial (Dunster and Gibson, 1989). This study ought to provide useful

insight into some of the difficulties that arise when current EA practice is applied to the difficult case of regional forest management. The results of this study should help the OMNR in its future EAs. Furthermore, this study's findings and recommendations are expected to be applicable to some degree in other provinces in Canada.

1.4 APPROACH AND METHODS

The study was undertaken in 4 phases:

(a) a literature review to help the reader understand the background and evolution of EA and North America and to highlight characteristics of quality EAs of regional resource management plans;

(b) criteria development for use in making a comparative evaluation of the two forest management EAs;

(c) description and evaluation where the two EAs are compared and discussed against the established criteria to determine strengths and weaknesses of each, relative to each other and to the ideal characteristics of quality EA; and

(d) development of recommendations and conclusions where the key deficiencies discovered in the comparative evaluation are highlighted and discussed so that future regional program EAs can avoid pitfalls.

1.4.1 Phase 1: Literature Review

The EA processes of today have the documented trial-and-error tribulations of some two decades of practice and development behind them. It was therefore necessary to undertake a literature review to trace, the evolution of EA practice in North America, the application of EA to forest management, and particular concerns that have been raised in evaluations of EA method, documentation and practice.

1.4.2 Phase 2: Criteria Development

The EA literature identifies several key components that together define a quality EA. Using this literature as a base, I developed criteria that are fundamental to quality EA, and that would help me undertake a critical comparative evaluation of the two EAs. I categorized the criteria as follows. The first category of criteria was organized around the process, context and environment that shaped the EAs (e.g., legal and administrative framework, public participation, conflict resolution). The second set was categorized as technical elements of quality EA (e.g., scoping, alternatives, forecasting, mitigation, monitoring). The third category of criteria were grouped under substance issues analyzed in the two EAs (e.g., causes and effects). The fourth category focused on how well the EAs were documented (e.g., amount of information, and format of the EAs). A complete list of criteria used in evaluating the two EAs can be found in Figure 3.

PROCESS CONTEXT AND ENVIRONMENT
Legal and Administrative Frameworks of Regional Forest Management EAs
History of Forest Management EAs
Key Players and their Roles
Public Participation
Conflict Resolution
Financial Cost, Timeliness and Efficiency
TECHNICAL ELEMENTS OF THE ASSESSMENT
Overall Approach - Goals and Objectives, Cumulative Impacts and Integration
Alternatives
Impact Scoping
Description of Environment, Baseline Studies
Impact Forecasts, Quantitative Forecasts
Mitigation and Alternatives
Design and Commitment to Monitoring
Adaptive Management Science
SUBSTANCE ADDRESSED IN THE ASSESSMENT
Causes
Access
Harvest
Regeneration
Maintenance and Protection
Effects
Maintaining Forest Productivity
Forest Health
Biodiversity
Water Quality and Fisheries
Soil Quality
Wildlife Habitat
Recreation, Tourism, and Aesthetics
Forest Heritage Values
Global Warming and Climate Change
DOCUMENTATION
Amount and format
Readability, comprehensibility and presentation

Figure 3. Criteria for comparing and contrasting the Ontario Class EA and the Minnesota GEIS.

1.4.3 Phase 3: The Comparison and Contrast

A consistent format was used in evaluating the EAs against each criterion. First, each criterion was defined as to the issues it addressed, why it is important for EA of forest management, and what is expected in the EAs. Second, each EA was examined to determine if it addressed the topic in a thorough, effective and efficient manner. Were the material and discussion organized effectively and presented thoroughly? What focus was taken, and what conclusions were reached? The third section discusses whether reality in the EAs met my expectations.

1.4.4 Phase 4: Recommendations and Conclusions

The key weaknesses and strengths of each EA were highlighted and discussed so that future EAs of forest management can avoid making the same mistakes.

CHAPTER 2 - OVERVIEW OF ENVIRONMENTAL ASSESSMENT

2.1 THE BIG PICTURE

2.1.1 EA: United States and the World

The roots of EA can be traced back to the National Environmental Policy Act (NEPA) of 1969 which was signed by United States President Richard Nixon on January 1, 1970. At the time few members of Congress, and industrial development community, or the environmentalists foresaw how this new law would change the way the world community looked at environmental issues and development projects (Burdge, 1991). Under NEPA, proponents of development projects that involved U.S. federal land, federal tax dollars, or federal jurisdiction were legislatively required to file an environmental impact statement (EIS) detailing the impacts of the proposed project and project alternatives on the physical, cultural and human environments (O'Riordan and Hey, 1976). The NEPA legislation also required proponents to identify monitoring programs to determine whether prescribed mitigation measures were actually working (NEPA, 1970).

Early proponent attempts at preparing EISs were largely unsuccessful (Burdge, 1991). One of the EISs that set precedent was prepared for the Trans-Alaskan pipeline permit

(Beanlands and Duinker, 1983). In February 1970, an eight-page EIS was submitted to accompany an application for the Trans-Alaskan pipeline permit. This EIS document was judged to be inadequate, and subsequently redrafted several times over the next three years (Burdge, 1991). During that time the EIS had grown from eight pages to eight feet thick, but, more importantly, most potential environmental problems had been addressed to the satisfaction of the courts (Burdge, 1991). This EIS resulted in impact assessment administrations that were established with the expectation of receiving such voluminous documentation. It had become clear that the federal courts would hold agencies to a strict accounting for performance of the part of NEPA that was justiciable, namely, the environmental impact statement and its legislative requirements (Caldwell, 1988).

The passage of NEPA established the legal requirement for federal agencies to incorporate environmental considerations into their decision-making (Burdge, 1991). The Council on Environmental Quality (CEQ) was established to oversee the implementation of NEPA requirements. The CEQ first published guidance to federal agencies in April 1973 (Heffernan et al., 1975). Since this guidance was not binding, federal compliance was rather unsuccessful. As a result in 1978 the CEQ published Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act (Caldwell, 1988). In consultation with CEQ, other federal agencies, and the interested public, each federal agency prepared specific procedural guidance for carrying out its NEPA requirements. The level of detail varies considerably but the guidance

generally helps the proponent determine if an EIS is necessary and how it should co-ordinate and prepare the EIS (Grima et al., 1989).

Two levels of assessment came into play through NEPA. The first level was to apply an EA to the project and its alternatives and to determine what its impacts might be. If the responsible agency determines that there will be no significant impacts, it files a Finding of No Significant Impacts (FONSI). If significant impacts are found, the federal agency must prepare a detailed EIS (Renwick, 1988, Dunster, 1992).

The soundness of the U.S. EA process is attested to by its adoption, with various modifications, in at least 30 other countries, notably Canada, Australia, and the European Community (Caldwell, 1988). In 1981 the International Association for Impact Assessment (IAIA) was founded and provided an international forum for persons interested in research and practice of Environmental Impact Assessment (EIA), Social Impact Assessment (SIA), and technology assessment. In 1985, the European Economic Community began to recommend EISs for its members and by 1989 this recommendation became a requirement (Burdge, 1991). An equally important event happened in 1986 when the World Bank made a public commitment to include EIA in its project appraisal process. Taking the cue from the World Bank, regional donor and lending organizations followed suit (Burdge, 1991).

Worldwide interest in sustainable development and EA gained further momentum with publication of the World Commission on Environment and Development report entitled "Our Common Future" in 1987, commonly known as the Brundtland Report (Burdge, 1991). The Commission defined sustainable development, accepted now as the guiding principle of environmentalism in the 1990s, as "meeting the needs of the present without compromising the ability of future generations to meet their own needs" (Ramphal, 1992). As well, the Commission explicitly identified EA as an invaluable tool for aiding environmental decision-making (FEARO, 1988).

2.1.2 EA in Canada

Canada followed NEPA's lead and introduced a federal EA process in late 1973 (Duinker, 1994). Canada's government realized the difficulty of protecting the environment with after-the-fact remedial measures, and wished to avoid the negative public image that was generated when environmental problems developed later (Gibson and Savan, 1986; Bowden and Curtis, 1988). As well, the public was feeling increasingly left out of land-use decisions, and EA was envisioned as a procedure that would include it (Ministry of Environment, 1973).

The new federal process was called the Environmental Assessment and Review Process (EARP). EARP was viewed as a two-stage process. The first stage involved a self-

assessment by a development initiator, to determine if the proposal would or might have significant impact. If so, the initiator would proceed to stage two, an EIA with public review. An initiator was any federal department, agency, or project proponent requiring federal property or federal funding. After initial screening for impacts, the project could be determined to have (a) no effects and therefore proceed, (b) minimal impacts that could easily be mitigated and proceed, or (c) significant impacts that necessitate a formal review (stage 2). The Minister of Environment would then appoint an Environmental Assessment Panel (EAP) of four to eight members to prepare EIS guidelines, which were generally released for public review before being finalized. When completed, the EIS is submitted to the EAP and scrutinized by the public and other reviewers for deficiencies. After a public review of the project in hearings, the EAP would report its findings to the Minister of Environment and Minister of Initiating Department who together would decide whether to allow the project to proceed (Bowden and Curtis, 1988). A few of the initial major projects that the new federal process applied to were; the Nuclear Power Station at Point Lepreau, New Brunswick; the Alaska Highway Gas Pipeline Project, Yukon Territory; and the Hydro Electric Power Project, Cape Breton Island (Federal Environmental Assessment Review Office, 1982). Justice T.R. Berger (1977) used the federal process to order a 10 year moratorium on development of the MacKenzie Valley pipeline so that social impacts of the pipelines development on the Yukon's native people could be addressed.

The federal government's role with regard to EA legislation has undergone considerable change since its beginnings in 1973 (Duinker, 1994). From its inception, EARP has been the subject of criticism from environmental groups who levied three major complaints: the self-assessment approach, the non-legal nature, and the limited role of public participation (Jeffery, 1990). In June 1984, the Minister of Environment announced changes to EARP in an attempt to correct several of its shortcomings and broaden its scope. The reforms, however, did not include any changes to the processes non-legal nature (Bowden and Curtis, 1988). More recently, deeper discontent with EARP, particularly evident in EAs for the Rafferty-Alameda and Oldman River dams, prompted the federal government to reform and legislate the EA process. In June 1990 the federal Minister of the Environment announced a reform package that included new EA legislation in Bill C-78 (Gibson, 1990). In June 1992, after nation-wide consultations and a comprehensive Parliamentary review, Bill C-13, the Canadian Environmental Assessment Act (CEAA), received Royal Assent. The Act, once proclaimed, will apply to projects for which the federal government has a decision-making authority, whether as a proponent, land manager, source of funding, or regulator (Canadian Environmental Assessment Agency, 1993). Meanwhile EARP, which is a law of general applicability, still applies.

2.1.3 EA in Ontario

Ontario became the first province to pass a comprehensive piece of EIA legislation with its EA Act in 1975. This detailed Act set an international standard and included useful features that were unprecedented at that time (Dunster and Gibson, 1989).

The purpose of Ontario's EA Act is "the betterment of the people of the whole or any part of Ontario by providing for the protection, conservation, and wise management of the environment" (EA Act, R.S.O 1990, c.E.18.s.2.). The EA Act provides a broad definition of environment that includes not only the natural environment, but the social, cultural and economic components of the environment. It automatically applies to projects of Ontario government ministries and to municipal and conservation authority projects. Projects carried out by the private sector generally are not subject to the Act. However, private sector projects can be made subject to the Act if the potential environmental impacts are considered sufficient to warrant such action. A public project is included unless exempted, while a private project is excluded unless and until designated (Gibson and Savan, 1986).

There are two levels of EA in Ontario: the project EA and the Class EA. The project EA is modelled after the U.S. project-specific experience, but the Class EA is unique to Ontario (Dunster, 1988). A Class EA was described (Ministry of Environment and Energy, 1993) as a streamlined EA planning and approval process for projects that have

predictable environmental effects, and are not of a size, scale or strategic significance to warrant an individual EA. A Ministry of Environment (Ministry of Environment, 1981) document stated that projects examined under the Class EA process are likely to cause minor effects in most cases. Examples were electric transformer stations and substations, highway widenings, moderate-sized extensions, sewage treatment plants, and communications towers. The Class EA is submitted and processed like any other EA; this includes the possibility of a hearing before the EA Board (Ministry of Environment, 1981).

The Class EA process involves a self-assessment process where the proponent examines the planning process for relatively small and frequent projects to ensure environmental consequences of such projects are taken into account. self-assesses the project in accordance with the approved planning process. Once approved, the Class EA commits the proponent to follow a specified set of procedures every time a project within the approved class is undertaken. This amounts to a streamlined version of the full assessment process. In the event that "significant" environmental problems arise in implementing the Ontario Class EA, provision is made for the case to be bumped up to the more detailed requirements of a full project EA (Dunster, 1988).

2.2 EA: TWO DECADES OF REFLECTION - THE UNITED STATES AND THE WORLD

Caldwell (1988) believed that under the stimulus of NEPA and other environmental statutes in the United States, the state of environmental science has advanced markedly in the past two decades. Renwick (1988), however, argued that NEPA has been superseded by other environmental laws and its role and relevance in the decision-making process today is much diminished today compared to its earlier environmental decision significance.

2.2.1 Problems Identified

A recent paper by Armour (1990) advocated that progress of EA has been excruciatingly slow and that the problems associated with the process are the same today as they were in the mid-seventies. EA continues to have a strong project-only focus even though it is well recognized that the policies and plans which provide the context for projects are by far the more significant determinants of environmental quality (Armour, 1990). Moreover, environmental professionals continue to be assigned relatively marginal roles in deference to engineers and lawyers who clearly dominate the process and are serving their best interests by being more concerned with EAs procedural requirements that its substantive goals (Armour, 1990).

Tywoniuk (1989) addressed the importance of incorporating an environmental perspective into all facets of decision-making, including the planning and impact assessment phase. Management of the environment is in the hands of many people and proper management involves integrating an environmental dimension into the normal planning and management processes of all these people (McDonald and Brown, 1989). Dunster (1992) and Lee (1983) further supported this contention by arguing that impact assessment processes are typically independent of routine planning efforts, but many of the principles of EIA should form an integral part of all resource planning and management processes.

Progress in adopting EIA as an environmental tool has been extremely slow in developing countries, with only 9 of 121 countries having established a framework for its implementation (Ebisemiju, 1993). Ebisemiju attributes this poor performance to serious flaws in their legislative, administrative, institutional and procedural frameworks.

In a review of EIA processes throughout the world, Hollick (1986) stated that on the whole EIA procedures have been poorly integrated with other environmental management legislation, land-use planning and development control systems. He also highlighted the general failure of EAs to give adequate consideration to alternative courses of action and their consequences. As well, Hollick (1986) found that court enforcement tends to encourage encyclopedic rather than analytical EISs, reduce

cooperative action between agencies, and absorb substantial resources. In the long run, political commitment to EIA is more important than court enforcement.

2.2.2 Solutions Identified

Caldwell (1988) made several suggestions for improvements to the whole arena of EA. The scope of EA should broaden and must be integrated with analysis of socioeconomic impacts. Integrated multidisciplinary processes ought to become the expected conventional approach to planning and decision-making. He stated:

> " We see our problems as economic, political, behavioral, demographic, and even environmental, but we seldom see the interconnections among them" (Caldwell, 1988).

Wood and Dejeddour (1991) argued that the extension of EIA from projects to strategic EA (SEA i.e., EA of policies, plans and programs) would make decision-makers consider significant impacts which were previously neglected, early in the planning process. Project EIAs often occur too late in the planning process to ensure that all relevant alternatives and impacts are adequately considered. Cumulative impacts, synergistic impacts, regional impacts, and non-project impacts all may be better assessed initially at policy, plan or program levels rather than at the project level. Burdge (1991) recognized

the difficulty with implementing policy-level EA. He stated that, generally, biophysical and social impacts are most observable at the project or community level. He believed it is difficult to assess biophysical and social impacts at a regional level because research has not yet delivered reliable knowledge at these levels. Burdge (1991) felt that impact assessment community must put more emphasis on monitoring, post-impact evaluation of impacts, mitigation procedures, and cumulative effects.

Rees (1988) argued that if one's goal is to achieve sustainable development, then current EA is inadequate. He argued that the present EA system is largely reactive, has low political status, ignores the cumulative effects of incremental development, and is expected to have only a marginal effect on project design and implementation. At present, the economy and the proposal are considered to be independent of the driving variables, and the environment and EA the dependant ones. By contrast, sustainable development requires a proactive planning approach in which ecological integrity is the governing factor and the permissible level of economic activity is the dependant variable (Rees, 1988).

Ebisemiju (1993) proposed the following improvements to EA: legislative demands rather than administrative suggestion; mandatory involvement of local people in scoping, reviewing, monitoring and auditing impacts; and conducting the EIA as a fully internalized element of the planning process rather than as a separate exercise divorced from the technical and economic aspects of project planning and design.

Burton et al. (1983), in a review of EIA on national and international fronts, distinguished between those approaches which are formal and explicit, and those that are informal and implicit, and discussed the progress and limitations made with respect to each process reviewed. They acknowledged an increasing trend to extend the EIA system to environmental problems that are international and sometimes global in scope. Large-scale examples include carbon-dioxide-induced atmospheric warming, acid rain, stratospheric ozone depletion, integrated pest management, and the control of toxic substances. On a smaller scale, there are jurisdictional problems if a nuclear power station is to be located on a river between two countries. Burton et al. (1983) concluded that more research and cooperation is needed between countries in order to develop efficient EIA methods that will transcend international borders and ameliorate friction.

2.3 EA IN CANADA: REFLECTIONS

Canada is recognized as a country that has made major contributions toward understanding environmental systems, improvement of assessment procedures for environmental decision-making (at project, program, and policy levels), and establishment of strategies to achieve a sound balance between economic and environmental development objectives (Rosario-Partidario, 1993). This is not to say that there are no problems with EA in Canada or specifically in Ontario.

2.3.1 Weaknesses

A major review of the scientific quality of impact assessment in Canada was conducted by Beanlands and Duinker (1983). Their study revealed many faults with EIA as it was practiced in the 1970s. Environmental impact statements tended to be descriptive rather than predictive, lacked a rigorous approach to analysis and interpretation of data, and provided results of questionable value for decision-making or subsequent retesting and replication. Proposed mitigation measures were based largely on generalised principles, and monitoring, either to test predictions or to facilitate impact management, appeared to be the exception rather than the rule.

A review by Needham and Swerdfager (1989) identified common and recurring concerns that have emerged from reviews of EIA in Canada. These included: post-development auditing, process implementation costs, process maintenance costs, scoping procedures, methods for considering cumulative impacts, soundness of science in EIA, provision of intervenor funding, legal status of EIA, accessibility of information, timeliness of EIA, and social impact assessment. These concerns can be difficult to resolve. There have been few improvements to date, and Canadian EIA has traditionally been characterized by a marked absence of innovation and dynamism (Needham and Swerdfager, 1989).

Other reviewers have found that the main limitations of EIA in Canada can be grouped into two broad categories - context limitations and analytical limitations (Spaling et al.,

1993). Context limitations refer to constraints in the socio-political arena, particularly the institutional setting and statutory basis of EIA. Analytical limitations refer to shortcomings which influence the scientific integrity of EIA. Under context limitations, the issues raised are: the non-legal status of EIA; the various roles of institutional actors and the whole concept of self-assessment; integration into decision-making; and the local project focus. Some of the analytical limitations that have emerged from EIA literature were: weak experimental approach; inadequate boundary settings in terms of time and space; insensitivity to cumulative impacts; inability to handle variability; and uncertainty. Evaluations of EIA over the past twenty years have helped practitioners to recognize the limitations of various methods (Spaling et al., 1993). The lessons derived from these evaluations include challenges and opportunities for the institutional and scientific components of EIA. Any meaningful shift of EIA in the future will require continued scholarly research, increased participation of economic and social stakeholders, and heightened commitment from political institutions (Spaling et al., 1993).

Smith (1989) examined Canadian EA provisions using ten comparative criteria, and found that the best known and most frequently cited examples of assessment provisions in Canada are those of EARP and Ontario. This, however, does not mean that the well known or oft-cited are synonymous with the best, most representative, or most effective. Smith (1989) suggested that Canadians look to Saskatchewan or to Newfoundland for better models of EA provisions. Two years later, Smith (1991) acknowledged that since

his earlier study most provinces and the federal government have acknowledged their process weaknesses and have undertaken EA reforms.

There have been several criticisms of Canada's EA Review Process (EARP) (Ross and Saunders, 1993). EARP has been narrow focused, discretionary, advisory in nature, enticing little public participation, and lacking a decent monitoring program. Such criticisms of EARP have prompted the federal government to examine its regulatory and approval regimes. The Canadian Environmental Assessment Act (CEAA), drafted in 1990, led to a number of key advances world wide, including specific requirements for the environmental assessment of policies and programs, and consideration of cumulative effects. It remains to be seen if the CEAA will improve on previous weaknesses with the Canadian system (Ross and Saunders, 1993).

2.4 EA IN ONTARIO: REFLECTIONS

In 1988 a report on the state of EA in Ontario was released by the Canadian Environmental Law Association (Gibson and Savan, 1986). The authors found that the key elements of Ontario's process were sound. However, the study identified significant weaknesses in the current application of the Ontario EA Act. Some of the major findings included: unduly long government review periods; heavy reliance on exemptions; and inconsistent application of Class EA process (Gibson and Savan, 1986). In response

the Environment Minister, Jim Bradley, launched a project called the Environmental Assessment Program Improvement Project (EAPIP) in April 1988, to look at ways of improving the EA program through changes in legislation, regulations, policies, guidelines and administrative practices (Environment Ontario, 1988).

After extensive consultation, the EAPIP task force published its discussion paper in December 1990 (Ministry of Environment, 1990). This report was reviewed during a series of public meetings held by the Environmental Assessment Advisory Committee (EAAC), and in July 1993, EAAC published the final report (EAAC, 1993). The report suggested ways in which the Ministry of Environment should:

(a) streamline the EA review process;

(b) clarify principles of direction in the EA so that proponents are aware of their role;

(c) integrate the Canadian EA Act with Ontario's EA Act;

(d) improve public consultation;

(e) clarify and promote class EA;

(f) enhance environmental accountability; and

(g) achieve more timely and effective hearings (EAAC, 1993).

2.5 CUMULATIVE EFFECTS ASSESSMENT

As the complexity, pace, and scale of developments have increased, it has become clear that environmental impacts are cumulative (Environmental Protection Agency, 1992). Cumulative effects assessment (CEA) is but one of the "new twists" on EA to come along recently (Duinker, 1994). Cumulative impacts, however, have been of concern to environmental regulators for some time (Environmental Protection Agency, 1992). In the U.S. the Council on Environmental Quality (CEQ) clarified in 1978 that impacts of cumulative change must be considered under NEPA, where these impacts defined as:

> "the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time" (U.S. Environmental Protection Agency, 1992).

The following analogy illustrates this concept. If a single rivet pops out of a jet's wing no serious threat exists, because no one rivet contributes significantly to the plane's airworthiness. But if enough rivets are lost, the integrity of the structure gradually weakens until a failure occurs (U.S. Environmental Protection Agency, 1992). In this analogy, the cumulative effects of the individually minor impacts would be catastrophic.

Examples of cumulative environmental effects include the incremental loss of prairie wetlands caused by agricultural practices, the degradation of Great Lakes water quality by persistent addition of toxic chemicals, and global warming caused by the build up of greenhouse gases in the upper atmosphere (United States Environmental Protection Agency, 1992).

Cocklin et al. (1992) identified a process approach to understanding cumulative impacts with three main dimensions: sources of change, pathways of accumulation, and impact accumulation. The environmental changes can come from single large developments or multiple small developments. There are numerous pathways for the effects of projects to accumulate in the natural environment. Cumulative change is recognizable in several dimensions. Environmental change that is the product of diverse multiple sources has generally fallen entirely outside the scope of EIA as it is practised in most countries (Cocklin et al., 1992).

In 1985, the Canadian Environmental Assessment Research Council (CEARC) and the U.S. National Research Council (NRC) jointly sponsored a conference on cumulative environmental effects (CEARC and U.S. NRC, 1986). Cocklin et al. (1992) described this as a watershed event with three outcomes of particular importance. First, the conference demonstrated that many eminent scientists had been thinking about cumulative change in the environment. Second, current institutional arrangements are inadequate to deal with cumulative effects. Third, the conference set the tone for future

research on cumulative effects. After the workshop CEARC continued research on cumulative environmental effects (Peterson et al., 1987; Sonntag et al., 1987; CEARC, 1988a). Research has continued in the U.S. but without a great deal of co-ordination overall (Cocklin et al., 1992).

2.5.1 Accounting for Cumulative impacts

With the processes and mechanisms for managing cumulative impacts not well established, Bardecki (1990) argued that cumulative impacts should be addressed not through EA but through processes and procedures of planning and environmental regulation. Others have argued that an Adaptive Environmental Assessment and Management approach (AEAM) (Holling, 1978) would inherently incorporate cumulative effects (Sonntag et al., 1987; Wathern, 1988). The United States Environmental Protection Agency Wetlands Research Program (Environmental Protection Agency, 1992) has developed a synoptic approach to cumulative impact assessment by adapting various existing methods. This synoptic approach is touted as an inexpensive, rapid assessment method that can assist managers and regulators in evaluating cumulative impacts within the regulatory constraints of tight schedules and budgets (Environmental Protection Agency, 1992).

In Ontario there is no specific requirement in the EA Act or regulations for the consideration of cumulative impacts. A number of provincial Acts (e.g., Beach Protection Act, Conservation Authorities Act, Game and Fish Act) exercise control over concerns of an environmental nature (Bardecki, 1990). These Acts are presumed to deal with potential cumulative environmental effects administratively by regulating undertakings with various guidelines and planning procedures (Bardecki, 1990). However, Gosselink and Lee (1987) stated:

> " One of the biggest hazards is the expectation that traditional, deterministic procedures can be transferred from current practices to fulfil the requirements of cumulative impact assessment".

The regulation of cumulative impacts is a matter of fitting the process of regulation of individual undertakings into a larger spatial and temporal context. EA is not readily structured to do so (Bardecki, 1990).

Rees (1988) suggested that cumulative effects can best be accounted for and managed on a regional basis. For this purpose it will be necessary to divide and restructure existing political units into functional planning units based on ecological criteria such as climatic and soil vegetation patterns, or watershed boundaries.

2.5.2 Cumulative Impacts and Forests

Forests worldwide are coming under increasing scrutiny as countries and international organizations seek to understand the concept of sustainable development at an applied level (Duinker, 1994). Several forest-oriented EAs have been undertaken at various geographic scales (e.g., OMNR, 1987a; Nilsson et al., 1992; Shugart et al., 1992; Poyry, 1993a).

In Canada, CEARC initiated a study to review current practices for identifying and assessing cumulative effects (Sonntag et al., 1987). The research effort examined three case studies where cumulative effects had been identified and attempts were made to address these effects. A New Brunswick forest case study focused on the cumulative effect, over a 70-year period, of a large number of small-scale harvests on the long-term sustainability of forest production. This case study is generally applicable to forestry in other provinces. Stands were harvested in spatially inconsistent patterns and in volumes exceeding recruitment because no thought was given to the magnitude of impacts on either temporal or spatial scales (Ratie et al., 1987). At the point where the need for management intervention became essential to sustain economic development, it was quickly realized that local impacts had cumulated incrementally in time and space to create noticeable resource degradation at the regional level. No longer could decisions be made at local or stand levels without deciding what the larger, regional forest should look like. There was an apparent need to assess stands individually to reflect unique

characteristics and then to combine them to create a cumulative assessment of the forest structure as a whole (Rattie et al., 1987). Sonntag et al. (1987) concluded that there is a specific need to create an extensive communication network to obtain maximum understanding and acceptance by all players of the need and long-term benefits of cumulative effects management.

2.6 EVALUATING QUALITY IN EA

After twenty years of widespread use of EA, an extensive track record exists upon which to evaluate its effectiveness (Spaling et al., 1993). Determining the general quality of EA studies, however, is difficult because there is incomplete agreement on the criteria that should be used to evaluate quality (Lee, 1983). Several researchers have focused their efforts on specific aspects of EA. After reviewing current EA methods, Lee (1983) and Shopley and Fuggle (1984) proposed that the quality of EA could be improved by careful use, selection and combination of existing methods, more emphasis on initial scoping, preparing guidelines to help spread relevant information, and more research on EA and its methods. Lemmons and Porter (1993) contended that all existing methods for EA have some limitations which can be compensated for by using multiple methods balancing qualitative with quantitative ones. Whitney and Maclaren (1985) reviewed EA methods and found that none of them are entirely suitable for a particular problem. The best approach may be to adapt existing approaches to suit the relevant problem.

Thinking along similar lines, Gardner (1989) examined nine approaches to decision-making for EA to determine how they support the principles of sustainable development. She found that while none of the methods were singularly ideal, each had strengths and weaknesses, and could best serve the principles of sustainable development as part of a co-ordinated approach.

In the United States the Environmental Protection Agency (EPA) is responsible for examining all EIS's to determine their adequacy in fulfilling NEPA's requirements. Dickerson (1987) scrutinized the adequacy of 244 EIS's in the United States and found thirty percent to be inadequate. The criteria used by EPA to judge adequacy generally fall into four categories: impact predictions, mitigation measures, alternatives, and consistency with other programs. Dickerson (1987) concluded that EIS adequacy is a problem, one that needs attention at all levels of involvement in the NEPA process.

2.6.1 Quality of EA in Canada: Particular Concerns

Three roles to be addressed by an EA Panel in determining adequacy of the EIS are: focus, scientific and technical soundness, and clarity of presentation (Ross, 1987). Is the EIS suitably focused on the key questions which need to be answered to make a decision about the proposed action? Does it address all the important environmental issues? Does it adequately address predicted impacts, mitigation measures, treatment of

alternatives, monitoring and management programs? What methods were used to guide the overall EIS preparation and what was the rationale for this approach? Ross (1987) stated that positive indication of the quality of science in an EIS would be signs that it was prepared using an interdisciplinary approach.

The key criteria in evaluating EA process quality are effectiveness, efficiency, and fairness (CEARC, 1988b). Did the information in the EA contribute to decision-making? Do the proposed mitigation and compensatory measures achieve the approved management objectives? Were the EA decisions timely and relevant to economic and other factors? Was the process open to all interested parties? CEARC (1988b) believed that a guide should be developed to assist government agencies and developers to integrate evaluation methods into their EA and management practices. As a result in 1991 and 1993, CEARC and the Federal Environmental Assessment Review Office (FEARO) established initiatives for an annotated bibliography and a draft manual for integrating EA with CEA.

Whitney and Maclaren (1985) proposed an 'ideal' framework against which to judge EA process quality and method. They defined method as an overall sequence of steps in carrying out an EA, mainly scoping, prediction, assessment of the significance of the predictions, and evaluation and monitoring. Their major concerns with current EA methods were that, with few notable exceptions, most did not distinguish between the predictive and evaluative aspects of the methods reviewed, and even when they were

distinguished, the studies usually unduly overemphasized one phase. By applying a checklist of questions to the scoping, prediction, significance assessment, evaluation, monitoring, and mitigation sections of the EA process, the evaluator will be better able to judge the strengths and weaknesses of the EA (Whitney and Maclaren, 1985).

2.6.2 General Concerns

Several different approaches to EA evaluations have evolved over the past twenty years (Spaling et al., 1993). Most EA evaluations tended to comment on EA process, methods, goal achievement and conceptual underpinnings, all of which share equal importance for effective EA (Spaling et al., 1993). Those reviewers that focused on process evaluation shared the common misconception that effective EA is related solely to legislative, policy or institutional design (CEARC, 1988a). Some EA evaluations focus on the methods and techniques used to identify information required for EA. An underlying assumption here is that the effectiveness of EA is improved by scientifically generated information with evaluation criteria being derived from principles of research design and scientific analysis. Two groups emerge - those who use ecological theory and methodology to assess the scientific basis of EIS reports (e.g. Beanlands and Duinker, 1983), and those who use accepted standards of scientific investigation to evaluate specific techniques of impact analysis. These techniques include checklists, matrices, overlay mapping, systems diagrams and simulation modelling. Examples of the latter

include Nichols and Hyman (1982), Shopley and Fuggle (1984), and Whitney and MacLaren (1985). Spaling et al. (1993) concluded that:

> " an EA process with clearly stated goals, well defined implementation procedures, rigorous methodology and a firm theoretical framework is yet to be developed. EA is subject to political forces, societal values, institutional idiosyncrasies and limited scientific capability, all of which influence actual EA performance."

2.7 APPLICATION OF EA TO THE FOREST SECTOR

2.7.1 United States

The passage of NEPA forced the United States Department of Agriculture Forest Service (USDA Forest Service) to update its planning strategies for the National Forests. In 1974 the Forest and Rangelands Renewable Resources Planning Act (RPA) was passed. It outlined the planning requirement for the National Forests. The Act would require the USDA Forest Service to prepare a national plan every 10 years, in which all activities would be detailed including the output for timber, recreation, and other resources (Dunster, 1992). Conflict over this legislation arose, and as a means of ameliorating concerns, new legislation was introduced (after much debate) and Congress

passed the National Forest Management Act of 1976 (NFMA) (Robinson, 1988). The 1974 RPA, as amended by the 1976 NFMA, required the preparation of a forest plan for each national forest. An EIS is also required for each forest plan. In brief, forest management planning at the federal level is: legally specified; multi-layered, complex, and time-consuming; and driven by detailed economic and demand analyses (Poyry, 1993a).

According to Robinson (1988), the NFMA enabled environmentalists to challenge in the courts the practices of clearcutting and even-aged management in national forests, that is, in his view, cutting far beyond sustained-yield capacity while managing the forests on short rotations.

The USDA Forest Service system for natural resources decision-making is extremely diverse and complex (Poyry, 1993a). The system is based on a myriad of federal legislation, regulations and guidelines as well as the USDA Forest Services's own voluminous standards, regulations and guidelines. The Forest Service is thus faced with a difficult task in natural resource decision-making (Poyry, 1993a). The complexity of the land resource plans creates some difficulty for public and agency understanding of how results and alternatives have been derived.

Despite the plethora of plans, appeals, revisions, and new plans, the application of EIA in the United States to forest planning and management has had many benefits. These

benefits stem mainly from court mandates which made it necessary for the USDA Forest Service to undertake research to examine the effects of timber management on forest ecosystems (Dunster, 1992).

State and federal forest landowners operate programs directed toward the major biological components and uses of the forest environment, such as timber, water, fisheries, wildlife, and recreation. These programs are most administratively distinct in the state forest system and least administratively distinct on the national forests. The emphasis placed on each program varies by ownership. Counties are oriented towards programs of timber production and on-the-ground management, while federal land is directed towards programs involving planning and non-commodity uses of resources. The net effect is that the state forest management programs initiated by the USDA Forest Service have elements of both commodity and non-commodity orientations (Poyry, 1993a).

2.7.2 Canada

The application of federal and provincial EA processes to Canada's forests is atypical, and forestry is clearly a responsibility allocated mostly to the provinces. Ross and Saunders (1993) recognized a distinction between EA for the construction and operation of industrial plants for the processing and treatment of timber, and EA for practices

involved with timber management (i.e. harvesting, protection, and renewal and the plans under which such activities are carried out). The EA process is commonly applied to specific local projects, but it is seldom applied to decisions involving the allocation and management of public forests. The OMNR has attempted to examine forest management for Ontario using an unconventional application of the class assessment approach that centres on timber management plans (Dunster and Gibson, 1989). Rather than adopting the U.S. system of subjecting each management-unit plan to an EIA, the Ontario approach has been to try and integrate EIA principles into routine planning methods (Dunster, 1992).

Newfoundland's highly touted 1980 Environmental Assessment Act provides the legislative basis for EA for that province. It is administered by the EA Division of the Department of the Environment of that (Smith, 1989). A separate assessment committee is formed for each undertaking or class of undertaking (e.g., hydro-electric developments, or forest management plans). Where an assessment board is appointed, its membership is drawn from both inside and outside the public service and includes at least one representative from the affected locality. Guidelines issued by the Department of Environment and Lands of Newfoundland and Labrador require that an EIS be prepared for proposed timber harvesting projects (e.g. Corner Brook Pulp and Paper, 1989). To date, though, the application of Newfoundland's EA process to forest-mangement plans has run into many obstacles; no forestry EAs have moved smoothly and fully through the process (Duinker, 1994, pers. comm.).

CHAPTER 3 - EVALUATING THE ONTARIO AND MINNESOTA EAs

3.1 PROCESS CONTEXT AND ENVIRONMENT

3.1.1 Legal/Administrative Basis and Framework of Regional Assessment

The legal standing of EA differs between jurisdictions. The outcomes of some processes are legally binding, while others are purely advisory with no legal force. A process that is tied up with legal wrangling can be inefficient. On the other hand, a process that is not legally based risks being labelled incredulous and ineffective (Needham and Swerdfager, 1989). According to Gibson (1990a), all central components of an EA process must be enshrined in law, and compliance with requirements and products of the process must be legally enforceable.

What legal and administrative frameworks exist in Ontario and Minnesota that would influence the EAs?

The Ontario EA

Ontario's EA Act, which was passed in 1975 and came into force in 1976, was pioneering legislation. According to Dunster (1988), the Act has four central strengths:

(a) it has a legislative base providing for public involvement and enforceable decisions;

(b) it requires proponents to defend the purpose and rationale for their undertakings and to show they have considered alternative ways of achieving the identified purposes;

(c) it defines the environment broadly, requiring assessment of social, economic and cultural as well as biophysical impacts; and

(d) it applies automatically to all public-sector undertakings unless they are specifically exempted from the beginning of their planning work.

In essence, the Act requires every "proponent" of an "undertaking", subject to the legislation, to prepare an EA document showing that the proposal is the product of environmentally sensitive planning. It must set out the purpose and rationale of the proposed activity, and describe the undertaking and alternatives to it as well as the potential effects and the means of mitigating negative effects.

There are two levels of EA in the Ontario process: the aforementioned project EA, and the Class EA. The Class EA was initially established for smaller, frequently recurring undertakings where a common set of procedures for construction and implementation could be identified. However, there is nothing in the EA Act and regulations that restricts Class EAs to projects with minor impacts. Once regulations are approved by Cabinet, the Class EA commits the proponent to follow a specified set of procedures every time a project within the approved class is undertaken, thereby accounting for negative environmental effects (Dunster, 1988).

The Ontario Ministry of Natural Resources (OMNR) chose to use the Class EA approach which is enshrined in law, to meet its responsibilities for assessment of forest management activities.

The Minnesota GEIS

The Minnesota Environmental Quality Board (EQB) was established by the Minnesota Legislature in 1973 to serve as an interdepartmental forum for addressing and resolving environmental issues (Poyry, 1993j). A Generic Environmental Impact Statement (GEIS) is a specific form of environmental review that can be used to study certain types of projects not adequately reviewed on a case-by-case basis. Only the EQB is authorized to order a GEIS; however, any person or government body can request the EQB to

consider the preparation of a GEIS (Poyry, 1993j). A GEIS differs from specific environmental impact statements (EIS) in four important ways:

(a) a GEIS is focused on discovering cumulative impacts, and providing a context in which a project-specific EIS could be assessed;

(b) GEIS implementation is discretionary in nature which means that a Minnesota EQB decision to prepare a GEIS is voluntary with respect to proponents and is considered a long-range planning document that can provide useful information regarding geographically broad and long-term consequences that are unlikely to be identified in project-specific environmental reviews;

(c) it focuses on making recommendations; and

(d) its costs are usually covered by special legislative appropriations (Poyry, 1993j).

Discussion

The established administrative and legal framework of Ontario and Minnesota influenced the respective EAs. The Ontario EA Act prescribed a quasi-legal "cookbook-like" approach, and used an EA Board hearing to determine where developments can take place and under what circumstances. Court-like behaviour dominated the hearing, where lawyers grilled witnesses about their evidence, and there were winners and losers. In this context, the application of EA to forest management was naturally approached by

interested parties as a vehicle for public deliberations and decision-making on the larger area of public policy.

Once the Minnesota EQB decided to prepare a GEIS, it had a specific legislative protocol to follow. The focus in a GEIS is on making recommendations that, when implemented will reduce negative environmental impacts. The EQB, unlike the EA Board in Ontario, is not a decision-making tribunal; therefore its recommendations are merely that and do not necessarily have to be implemented.

3.1.2 History of Forest Management and EA

EA has had its highest-profile applications during a two-decade history to resource-development projects such as dams, pipelines, power plants, oil fields, electric transmission lines, highways, mines, and other large engineering works. Except perhaps for USDA Forest Service decisions, applications to forest management have been fewer, lower in profile and subject to considerable controversy and confusion (Duinker, 1994, pers. comm.).

What developments occurred in Ontario and Minnesota to bring forest management at such broad scales to high-profile EAs?

The Ontario EA

Since 1976, when the provisions of the EA Act came into force, the OMNR, as the agency responsible for administration of Crown forest land in the province, has been considering how to apply EA to forest management (Dunster, 1992). The provincial Cabinet, recognizing the difficulties certain agencies and ministries would have in complying with the EA Act, had the authority to grant temporary exemption orders to allow the proponents time to prepare and comply. The first of nine exemptions to the OMNR regarding timber management was issued in June of 1977. As time passed the exemption orders were increasingly turned into regulatory instruments requiring OMNR to follow specific procedures for public notification during the preparation of forest management plans and for developing primary access road plans and pesticide spraying programs. Two drafts of a forest management EA were prepared, considered and rejected in 1977 and 1980. The first public version, entitled Class EA for Forest Management on Crown Lands in Ontario, was released for comment in 1983. The fifth and final version was submitted in June of 1987 and was the subject of the EA hearing discussed in this report. The hearing ran from May 1988 to November 1992, and was staggering in terms of scope, cost, and length (Dunster, 1992).

The Minnesota GEIS

In July 1989, a citizen petition was brought before the Minnesota EQB asking for the preparation of a GEIS on timber harvesting and forest management in Minnesota. The major concern was the lack of a formal environmental review process to provide an analysis of the cumulative impacts that expanded timber harvesting might have on Minnesota's environment. After lengthy deliberation, the EQB unanimously passed a resolution to authorize the preparation of the GEIS in December 1989. The GEIS study was based on three overarching objectives:

(a) to develop a basic understanding of the status of timber harvesting and related forest management activities in Minnesota, and how this level of statewide activity relates to long-term sustainable levels of timber removals;

(b) to identify and assess impacts associated with current and potential elevated levels of statewide timber harvesting and forest management activity; and

(c) to develop strategies to mitigate existing or potential significant adverse impacts.

Discussion

Integrating forest management with EA has been a controversial struggle in Ontario. The Class EA approach was developed to meet requirements not clearly anticipated by

those who drafted the legislation. The OMNR responded by using an unconventional application of the Class EA approach that centres on timber management plans and thus has opened the larger subject of forest management policy to public examination and debate (Dunster, 1988, 1992). In Minnesota, forest management and EA, through the GEIS process, seem to have been integrated with much less conflict and controversy.

3.1.3 Key Players and Their Roles

The key players involved in EA have a large role in determining its content and outcome. Who were the key players in the development of the Ontario and Minnesota EAs, and what roles did they each play?

The Ontario EA

The EA Act (EA Act, R.S.O., 1980 c. 140) combined information gathering rules with decision-making exercised by an EA Board. The Board functions as a quasi-judicial administrative tribunal empowered to make decisions about undertakings which are subject to the EA Act. Only the Cabinet is empowered to vary or rescind any decision made by the Board. The EA Board for the Class EA, consisted for most of the hearing

of two persons, and they presided over the hearings and rendered a decision in April 1994 (Koven and Martel, 1994).

Under the provisions of the EA Act, a proponent to which the Act applies must prepare and submit an EA to the Minister of Environment for review. In the Class EA the proponent was the OMNR. The OMNR's mission was "to contribute to the environmental, social and economic well being of Ontario through the sustainable development of natural resources" (Direction 90's, (OMNR, 1991)).

The Ministry of Environment (MOE), another key player, coordinates the review of all EAs and ensures that the proponent follows the approved planning process. Prior to the hearing the MOE played this role for the Class EA. During the hearing, MOE played the role of intervenor.

Many other parties gave evidence at the hearing as intervenors. They represented special interest groups, citizens groups, and professional organizations. The main other intervenors in alphabetical order included:

(a) Canadian Association of Single Industry Towns;

(b) Forests for Tomorrow;

(c) Grand Council Treaty #3;

(d) Nishnawbe-Aski Nation;

(e) Ontario Federation of Anglers and Hunters and Northern Ontario Tourist Outfitters Association;

(f) Ontario Forest Industries Association;

(g) Ontario Metis and Aboriginal Association; and

(h) Ontario Professional Foresters Association.

The Minnesota GEIS

The Minnesota EQB is responsible for addressing and resolving environmental disputes. Legislated responsibilities of the EQB are to:

(a) initiate interdepartmental investigations into the state's environmental problems;

(b) review and coordinate the environmental programs of state agencies to ensure compliance with state environmental policy;

(c) review the rules and criteria of state agencies for granting and denying permits; and

(d) coordinate the development of legislative proposals submitted by state agencies (Poyry, 1993j).

The EQB created a ten-person advisory committee representing diverse backgrounds to provide direction and oversight to the GEIS study process. Some of the major

responsibilities of the Advisory Committee were to:

(a) advise the EQB on the scope of the GEIS, including the issues to be examined, the type and level of detail of studies;
(b) advise the EQB on the selection of a consultant to assist in preparation of the GEIS;
(c) review and provide comments on draft reports; and
(d) make recommendations on the alternatives presented for the mitigation of impacts where analysis indicated the potential for significant impacts (Poyry, 1993j).

The contractor hired by the EQB to prepare the GEIS was Jaakko Poyry Consulting Inc. of Tarrytown, New York. The study team of Jaakko Poyry (JP) was organized into a core group, six specialist study groups, the preparers of five background papers, and other specialist staff. In total more than 60 individuals helped prepare the GEIS.

The core group was comprised of JP consultants and the local study group coordinator. It was responsible for:

(a) overall analysis, writing and preparing the study documents;

(b) presentations to the EQB Advisory Committee and the public, and ongoing liaison with the state; and

(c) contract administration matters (Poyry, 1993a).

The specialist group was subdivided into six study teams to provide in-depth analysis of the ten issues specified in the Final Scoping Document (FSD). Several other groups also contributed to the study process. The Minnesota Planning Office was the state's agent for administering the GEIS study and was actively involved in all aspects of planning and preparing the GEIS. As well, selected technical experts reviewed the final draft technical papers before they were submitted for approval by the EQB.

Discussion

The proponent in the Ontario Class EA, i.e. the OMNR, had a goal to provide "a continuous and optimum supply of timber to Ontario's wood products industry (OMNR,1987b)". The nature of this goal and the diverse intervenor groups represented at the hearing invited confrontation, disagreement and inefficiency. The main proponent in Minnesota (i.e., the EQB) had a much broader goal, and, in a positive way, had no vested interest in the outcome of the EA.

The OMNR made the assertion in the hearing that the proposed system for forest management would work well. Intervenor groups at the Class EA hearing constantly questioned this presumption (Koven and Martel, 1994). This approach to EA is cumbersome when compared to the Minnesota approach where interest groups and specialists became actively involved early in the process to assist the EQB and the consultant create the GEIS.

3.1.4 Public Participation

Effective public participation has been characteristic of exemplary EA since most EA processes were established (Hollick, 1986; Lee, 1983; Ross, 1987; Whitney and Maclaren, 1985). With few exceptions, public review provisions are part of all EA processes (Hollick, 1986). For public participation to play a meaningful role in EA-related decisions, it must be:

(a) started early in the process, and continued throughout;

(b) inclusive and fair, so that all affected and interested citizens have reasonable opportunities to participate;

(c) effective, so that citizens have a chance to be heard and to influence decisions; and

(d) efficient, so as not to drain EA resources unduly and delay decisions (Environmental Assessment Advisory Committee, 1992).

Given that both EAs being examined here were begun in the late 1980s, well over ten years after the Ontario and Minnesota EA processes were established, one would expect that meaningful public participation exercises would have been implemented.

The Ontario EA

According to Smith (1989), public participation in Ontario's EA process is only just acceptable. Much of the opportunity for public input remains the discretion of proponents, who are encouraged but not required to engage the public during preparation of EA documents. With the public hearing format prescribed by the EA Act, public input occurs late in the process and in a restrictive format.

No public input occurred in the Class EA until the hearing began in May 1988. Most of the input gained from intervenors during the hearing process occurred in the formal setting of evidence gathering by the EA Board. Negotiations among the parties took place outside the hearing on two occasions, the latter of which was successful in making parties reach consensus on many terms and conditions.

Given the significance and extent of the undertaking, the EA Board created additional opportunities for citizens to participate in the hearing process in a less-formal way by holding sessions across Northern Ontario. Thus, while the main hearing was dominated by major interest groups represented by legal counsel, the satellite sessions focused on interested citizens representing themselves before the Board.

A key feature of the hearing process is that it fosters controversy and confrontation by virtue of the court-like protocols of giving evidence. It is safe to say that the hearing process run by the Ontario EA Board, which constitutes the main forum for public participation in the EA process, is a legal arbitration process with winners and losers, and not a conciliatory exercise where participants work together to develop solutions to the EA problems at hand.

Minnesota

While the EQB had authority for the GEIS and retained a consultant to undertake the required studies and prepare documents, the Minnesota public was given several opportunities to participate. First, an Advisory Committee was struck to provide frequent input to the study team on behalf of Minnesotans. Second, a public scoping exercise was undertaken early to provide an appropriate focus to the GEIS. Finally, public comment was invited on the draft GEIS, both in writing and in verbal form at a

series of public meetings held across the state. The final GEIS (Poyry, 1994) contains a record of all public input on the draft GEIS (Poyry, 1993a) and a summary of how each comment was responded to.

Discussion

The Minnesota GEIS comes much closer to what the literature advises would be a reasonable public participation program for EA than does the Ontario Class EA. While we cannot judge the effectiveness of GEIS public participation activities, it seems to have been efficient and fair. Public participation in the Class EA was late in the process, and highly inefficient (the hearing comprised over 400 hearing days spread over some 4.5 yr). The responsible parties deserve credit for arranging informal satellite hearing sessions across Northern Ontario, which raised the program's effectiveness and fairness.

3.1.5 Conflict Resolution

The opportunities for conflict among people involved in the use and management of natural resources and environment have never been greater than at present (Wondolleck, 1988; Johnson and Duinker, 1993). This is due to a variety of factors:

(a) we use the forest and environment in an increasingly wide variety of ways;

(b) citizens are demanding more participation in natural resource decision-making;

(c) the amount of available land and environment we can use and enjoy is either fixed or decreasing;

(d) people's attitudes towards more responsible management of natural resources and environment have evolved rapidly over the past decade; and

(e) people are incredibly mistrustful of each other, organizations and institutions.

Johnson and Duinker (1993) proposed "consensus-based decision-making" as a mechanism for resolving natural resource and environment disputes. Such a decision-making process does not mean that all parties are completely satisfied with the final outcome, but rather that a fair negotiation-based process was used to reach agreement.

Is there evidence of attempts at consensus-based conflict resolution in Ontario's and Minnesota's EA processes?

The Ontario EA

In Ontario, the EA Board exists as the most powerful environmental decision-making tribunal in North America (Johnson and Duinker, 1993). It uses quasi-judicial procedures to decide whether development can take place, and under what

circumstances. This is a court-like approach that thwarts cooperation. Fortunately, attempts by competing interest groups to resolve their environmental differences through negotiation are increasing. An example occurred in the Class EA. In May 1991, H. Illing was retained to assist the parties reach agreement on terms and conditions related to timber management on Crown lands in Ontario. The parties clearly indicated that they wished to resolve issues and felt pressure to come to accommodation (Illing, 1991). Reaching unanimous agreement on all terms and conditions was highly improbable, so the facilitator's role was to resolve as many issues among as many parties as possible. Illing (1991) saw this process as a positive step, especially in light of a new spirit of co-operation which evolved through these negotiations.

The Minnesota GEIS

The Minnesota GEIS, due to its nature and goals (See Sec. 1.1) engendered little confrontation. After the Draft GEIS was completed, the EQB established a 90-day written comment period, as well as six public meetings so that people could voice their concerns. Minnesota law requires that all public comments be considered prior to finalization of the GEIS study. All comments received were noted in the final version of the GEIS (Poyry, 1994). Those comments that raised significant issues were answered in writing, and the final GEIS was altered to reflect information and perspectives raised during the public comment period. Although this cannot be viewed as a form of

negotiation-based conflict resolution, the key here was that in the GEIS process there was insufficient conflict to necessitate it.

Discussion

The attempt at conflict resolution late in the Ontario hearing to assist the EA Board in coming up with a decision was laudable and partially successful. Perhaps a similar process undertaken early in the hearing or prior to the hearing could have been useful.

The Minnesota GEIS evolved with minimal publicized conflict due in large part to the discretionary nature of a GEIS. The GEIS was built on a spirit of co-operation among many diverse groups to ensure that the adverse effects of forest management and timber harvesting would be recognized and accounted for.

3.1.6 Financial Cost, Timeliness and Efficiency

To be efficient, an EA process should try to achieve its purpose with as little effort and resources as possible. The EA process should therefore be:

(a) operated and organized so that benefits are maximized, and costs are minimized (Gibson and Savan, 1986; Kennett, 1993); and

(b) operated so that delays are minimized, and completed in a reasonable length of time, to ensure the developmental, economic, social, and technological climates for the project have not changed so much during the assessment that when finished, it is outdated and irrelevant (Gibson and Savan, 1986; Needham and Swerdfager, 1989).

According to these criteria, were the EA's carried out in Minnesota and Ontario efficient?

The Ontario EA

OMNR's Class EA document took over 10 yr to complete and more than 4 yr to debate in a hearing. Eli Martel, one of the two EA Board members was quoted (Cox, 1993) as follows:

> "Nothing is worth this. The hearing was absolutely necessary but in my humble opinion, it shouldn't take this long to present a planning process".

No one envisioned in 1976, when the provisions of the EA Act came into effect, that the OMNR would spend over 18 years, and acquire nine exemption orders, while trying to meet the requirements of the Act. Section 1.2 (History of Forest Management and EA) briefly outlines how the EA evolved since 1976.

The estimated cost of the Class EA hearing has been estimated at somewhere over 20 million dollars (Cox, 1993). This does not include the costs of preparing the Class EA, nor the money spent by intervenors on lawyers. The Ontario Federation of Anglers and Hunters (OFAH) spent an estimated $1,000,000, the Northern Ontario Tourist Outfitters Association (NOTO) spent $100,000, and, the Ontario Forest Industries Association (OFIA) spent millions upon millions to prepare for and be represented at the hearings (Cox, 1993). The quasi-judicial nature of the Class EA hearing meant that millions of dollars were spent on legal consulting and representative fees! This surely runs contrary to the principle of maximum environmental benefit for minimal cost!

The Minnesota GEIS

The Final Scoping Decision associated with the GEIS specified a schedule for study preparation. The Draft GEIS was to be started in June 1991, completed in January 1992, and released for public comment in March 1992. The final document was to be ready for June 1992. This schedule constrained the study methodology and the study

time-frame was extended to June 1993; the Final GEIS was released in April 1994. The GEIS study team strongly suggested (Poyry, 1994) that processes to implement suggested recommendations in the report begin immediately.

Funding for the GEIS, which totalled $ 875,000 U.S. (Poyry, 1993a) came from public and private sources. The GEIS made mitigation recommendations to the State which would cost money to implement and administer. Calculating those costs was beyond the scope of the GEIS. It has been speculated (Kilgour, 1993, pers. comm.) that many researchers became involved in the GEIS process, not for huge consulting fees, but because they were interested in the process and felt personally motivated to contribute to it.

Discussion

Ontario's Class EA for timber management was arguably inefficient. It was not designed to operate in a way that avoided costs and confusion. Ontario spent two orders of magnitude more than Minnesota. It would be interesting to find out how much money was actually spent in preparing the EA outside of legal fees and associated costs. Despite these costs, most participants were confident that the hearings will help Ontario form an improved planning process, one which brings together the often radically different demands on the provincial forests (Cox, 1993).

Preparation of the Class EA and completion of the hearing took far too long. In hindsight, the decade leading up to submission of the Class EA document in June 1987 (OMNR, 1987b) was probably one of uncertainty during which no-one was really confident about how to bring timber management into Ontario's EA process. Part of the reason the hearing was so protracted was that OMNR brought all its evidence forward in the hearing rather than in the EA document (Duinker, 1994, pers. comm.). Another factor was the continuing debate among the lawyers representing intervenors and the EA Board's first Chair (a lawyer himself and expert in tribunal law and environmental regulation (Jeffery, 1990)) over matters of hearing procedure (Duinker, 1994, pers. comm.). In sum, the EA document (OMNR, 1987b) on which the hearing was based was, to say the least, rather uninformative, and the world moved quickly past the document in the seven years between its submission the EA Board's decision (Koven and Martel, 1994).

In Minnesota the consultant followed the scheduling timelines as strictly as possible but felt constrained by the 3-yr time-frame. More time was required for data collection and synthesis, including interaction among participants (Poyry, 1993a). The Minnesota GEIS was designed efficiently, had a fixed budget, and evolved within the constraints of that budget.

3.2 TECHNICAL ELEMENTS OF THE ASSESSMENT

The following technical elements must be adequately addressed if an EA is to be effective. Over the past 25 years, EA practitioners have stressed that these elements form the backbone of EA, and if some are missing or are inadequate the EA will be less than ideal.

3.2.1 Overall Approach - Goals and Objectives, Cumulative Impacts and Integration

Consistent themes in the literature are that EA should:

(a) inform decision-makers through an integrated planning process and take environmental considerations into account from the earliest stages of consideration and planning of an undertaking (Beanlands and Duinker, 1983; Hollick, 1986; Sadler, 1986; MOE, 1990);

(b) ensure that proposed projects are developed and evaluated publicly in the light of clearly stated purposes, adequate consideration of alternatives and cumulative impacts, careful evaluation of potential impacts on the social, economic, cultural, and biophysical environment, and to propose means of ameliorating those impacts (Beanlands and Duinker, 1983; Gibson and Savan, 1986).

Conventional EA has been generally limited to consideration of individual project-level perturbations, and attention is rarely given to cumulative impacts (CEARC, 1988a; Gibson, 1990; Duinker, 1992; ; Kennett, 1993). To be effective, EA must be guided by a systematic interdisciplinary approach (Ross, 1987) that is integrated with cumulative impact assessment (Duinker, 1994).

Did the Minnesota and Ontario regional EAs on forest management use a broad spatial and temporal scope for analysis, take a comprehensive and interdisciplinary approach, and incorporate analysis of cumulative impacts into the existing assessment framework?

The Ontario EA

The goal of the proponent was to prepare an EA for timber management that met, surpassed, or satisfied the requirements of the EA Act. The goal for EA is to ensure environmental consequences of projects and plans are evaluated fully and factored into the decision-making process. The OMNR applied the Class EA approach (see Section 1.1) in seeking its approval. In Ontario there is no specific requirement in the legislation or regulations for the consideration of cumulative impacts, although they are recognized in Ontario's EA guidelines (Bardecki, 1990). The EA consisted essentially of cases made before the EA Board, on the basis of existing knowledge - no new impact analyses were undertaken (Duinker, 1994). The Ontario EA focused on planning matters at the

management-unit level, missing the opportunity to address the cumulative effects of timber management actions at the regional or provincial levels.

The Minnesota GEIS

The main goal of the GEIS was to address the cumulative impacts that expanded timber harvesting might have on Minnesota's environment (Poyry, 1993a). Concrete goals/objectives for the Minnesota GEIS were stated earlier (Section 3.1.2).

To prepare the GEIS, Jaakko Poyry created a multidisciplinary team led by senior consultants from the USA, Australia, Canada, and the United Kingdom. As well, Jaakko Poyry subcontracted a select group of scientists drawn largely from the University of Minnesota. In total more than 60 individuals from a cross-section of backgrounds were utilized to help prepare the integrated GEIS. Many workshops and team meetings were held to integrate the findings of the various researchers (Poyry, 1993a).

Discussion

General goals/objectives for EA of forest operations were not satisfied in the Ontario Class EA. The decision-makers were not informed or involved early in the planning

process, and consideration of alternatives was inadequate. The OMNR chose to ignore cumulative impacts in its EA despite several research initiatives (Beanlands et al., 1985; Peterson et al., 1987; Sonntag et al., 1987; CEARC, 1988a) that document the importance and practicality of addressing them.

It is argued (Dunster and Gibson, 1989) that the OMNR narrowed the scope of inquiry of the Class EA to cover only the issue of timber management instead of the broader forest management. However, the Class EA hearing has forced the OMNR to re-evaluate its land-use practices and as a result, many of its recent policy initiatives are moving towards integrated resource management (Koven and Martel, 1994).

Using an interdisciplinary approach the Minnesota GEIS effectively examined cumulative impacts. It looked at timber management across the state, not just in individual operating blocks or administratively defined forests, and it examined impacts not only of timber management activity but of a broad range of associated activities (Duinker, 1994).

In the Minnesota GEIS the consultant and research and advisory groups recognized the importance of an integrated approach but felt constrained by the time structure of the study. As a result many of the tasks were undertaken independently and combined later to create the GEIS document. The study can none-the-less be deemed integrated and interdisciplinary - the VECs were scoped early in the process, and background information was prepared, discussed, amalgamated and used by researchers to prepare

simulation models. Model outputs were then used by study groups to make impact forecasts and develop mitigation strategies.

3.2.2 Alternatives

If EA processes are to be truly useful in informing decision-makers of the potential consequences of proposed developments (Beanlands and Duinker, 1983), the processes must assess more than one future scenario. Indeed, environmental impacts are defined, and thus can only be forecast, as differences between two potential futures (Duinker, 1986; 1989b). This means that, in addition to the proposed undertaking, an EA needs at least one other future for comparison purposes. This is often the do-nothing alternative. More meaningful, though, is preparation of several plausible alternatives to the proponent's preferred undertaking (Hollick, 1986).

Given that alternative forest-management strategies are indeed possible, and can affect the environmental in different ways, it is vital that EAs of forest management seriously consider meaningful alternative courses of action (Gibson and Savan, 1986; Dunster, 1988). Hollick (1986) observed that while most EAs describe a wide range of options, all but the proponent's preferred one are usually dismissed in a few pages. Such treatment makes mockery of the concept of viable alternatives to the undertaking.

The Ontario EA

Section 5(3) of the EA Act requires that an EA submitted to the Minister shall contain alternatives to the undertaking (i.e., alternative ways of meeting the proponent's goals) as well as alternative ways of carrying out the undertaking. Regarding the former, OMNR presented four alternatives in the Class EA:

(a) timber management including access, harvest, regeneration and maintenance of the timber resource;
(b) cessation of timber management on Crown land; industry would meet its wood requirements from purchases and harvests on its own lands;
(c) timber harvest with no regeneration or maintenance activities; and
(d) recycling of all physically capturable, discarded wood-based products.

The Class EA was quick to dismiss the latter three alternatives as infeasible and unacceptable. The Class EA document and the hearing devoted much attention to alternative ways of carrying out basic activities of access, harvest, regeneration and maintenance.

The Minnesota GEIS

In the GEIS, three statewide timber-harvest scenarios were defined as alternatives in terms of volume harvested per year:

(a) 4 million cords (14.5 million m^3), which was the 1990 level;

(b) 4.9 million cords (17.8 million m^3), which was the estimated harvest level required to meet the needs of all current mills and foreseeable new and expanded mills up to 1995; and

(c) 7 million cords (25.4 million m^3), calculated as the theoretical maximum long-term sustainable harvest level.

All impacts in the GEIS were assessed using these three scenarios as alternatives. Regarding alternative ways of undertaking forest management in Minnesota, these were brought into the assessments as ways to mitigate adverse and unwanted environmental impacts of traditional approaches to forest management. Thus, impacts were forecast for traditional means of forest management at three different levels of intensity, and alternative means were investigated as mitigation measures.

Discussion

Some have argued that OMNR worked in several ways toward a narrowing of the scope of the Class EA (e.g., Dunster and Gibson, 1989). One example is the definition of the undertaking as timber management and not forest management. Another seems to be the lack of a meaningful treatment of alternatives to the undertaking. It is relatively easy to define such alternatives in a way that makes them immediately dismissable, and this was done in the Class EA.

In defence of the Class EA, as mentioned above, the proponent and intervenors at the hearing spent large amounts of time discussing alternative ways of provide access, taking timber harvests, and implementing forest regeneration and maintenance. As well, they covered exhaustively (if not exhaustingly) the options available for both the technical and the public-involvement elements of the timber-management planning process.

On the other hand, the Minnesota GEIS presented a suite of credible forest-management scenarios, and assessed all impacts against them. The rationale was that environmental impacts would vary significantly in degree, if not as well as in kind, to different overall harvest levels across the state. In public responses to the draft GEIS, some people noted that the alternatives should have included scenarios where the statewide timber-harvest level would be significantly lower than the 1990 level, and perhaps even a no-harvest scenario to demonstrate a severe case of impacts.

In summary, the Minnesota GEIS seemed to deal well with alternatives both to and of the undertaking, while the Ontario Class EA dealt well only with alternative means of implementing one undertaking.

3.2.5 Impact Scoping, Time and Space Bounds

Impact scoping has been defined by many authors. Kennedy and Ross (1992) saw it as the process of identifying important issues of a proposal and focusing the EA on the high-priority issues. Beanlands and Duinker (1983) proposed that it is the process of early identification of an initial set of VECs to provide a focus for subsequent activities. Scoping is an initial attempt to reduce the scope of EA to the most important potential effects (Beanlands, 1988).

EIAs should be required to show clear temporal and spatial contexts for the study and analysis of expected changes in VECs (Beanlands and Duinker, 1983). Often impacts can only be delineated and accounted for properly using ecological boundaries, but administrative and jurisdictional issues prevent their full application. The establishment of time and space boundaries is a critical first step in impact scoping and assessment.

A functional impact scoping process for EA should have the following stepwise components:

(a) an initial impact identification phase for consideration of the wide realm of social and scientific issues related to the EA;

(b) an assessment phase to eliminate insignificant impacts and concentrate on the important impacts; and

(c) an impact management planning phase in which a plan for the monitoring and mitigation of those key impacts is elucidated and communicated to decision-makers and the public (Kennedy and Ross, 1992).

(d) clearly defined time and space bounds that go beyond examining immediate impacts on individual local-level sites.

Did the EAs undertaken in Ontario and Minnesota employ scoping techniques that were consistent with exemplary EA?

The Ontario EA

No public impact scoping to help identify VECs took place in drafting the Class EA before its release in 1987 (Dunster and Gibson, 1989). The EA Act requires public notice and opportunity for comment and participation when EA documents and

government reviews are completed and when the hearings are held, but the Act does not require public involvement in the early stages. By foregoing early multi-stakeholder scoping, the OMNR created a Class EA that included both significant and insignificant issues throughout the hearing process (Koven and Martel, 1994).

In Ontario, Crown lands are divided up into forest management units, the spatial unit of timber mangement. The timber management undertaking, and the projects that comprised it should have been evaluated at the timber-management-unit level. Instead, the EA focused on the undertaking and its physical actions and impacts at the stand level. The management-unit level is where managers set and establish performance goals and targets. The focus in the EA was inappropriately on impacts from stand-level actions on indictors of concern, and not where it should have been - on the cumulative impacts over space and time of all the actions of timber management at the management unit level (Duinker, 1994).

The Minnesota GEIS

The first step in conducting the GEIS was to identify and define the issues to be addressed in the study. This was accomplished through a scoping process (Poyry, 1993a). The main purpose of scoping was to focus the study by clearly defining the critical issues in need of examination. In addition, the scoping process established other important

GEIS study parameters such as study objectives, assumptions and alternatives to be analyzed.

The GEIS focused on the examination of cumulative impacts of timber harvesting and forest management activities occurring on all timberland in Minnesota over a 50-year planning horizon. The study considered all forest lands and resources within the state's boundaries including commercial forest lands (timberland) as well as reserved and unproductive forests. To achieve the stated objectives, the study had to be conducted at a scale of resolution that provided this broad perspective while still including sufficient detail to substantiate the analysis and enable appropriate strategies to avoid identified impacts. To achieve this purpose, the state was divided into ecoregions. Ecoregions are geographic regions with similar physical and biophysical characteristics.

Discussion

Despite recommendations in the literature, the OMNR did not undertake a scoping exercise that was consistent with exemplary EA during preparation of its Class EA. It seems that collection of voluminous information on a wide variety of topics dominated the assessment process. On the other hand, the Minnesota GEIS employed an interdisciplinary scoping process early, and thus focused subsequent efforts on determining, analyzing and mitigating specific impacts.

In the Minnesota GEIS, impacts were projected on an ecosystem or ecoregion basis over a 50-year planning horizon. This approach is consistent with what is recommended in the literature. Ontario, on the other hand, defined impacts only at the site level with little regard for natural or jurisdictional boundaries and integration between different ownerships.

3.2.6 Description of Environment: Baseline Studies

Beanlands (1988) noted that baseline studies are perhaps the most commonly recognized, yet least understood, element of EIA. The term usually refers to the collection of background information on the environmental and socioeconomic setting for a proposed development project and is normally one of the first projects undertaken in an EIA after scoping. Beanlands and Duinker (1983) used the term baseline to mean a description of conditions existing before development, against which subsequent changes can be detected through monitoring.

If baseline and process studies are going to be useful for EA they must be: (1) recorded and discussed so that future scientists can judge their adequacy, and learn from their mistakes; (2) designed with adequate controls for baseline studies and experimentation; and (3) constantly looking for natural real-world experimental opportunities to test impact hypotheses (Hilborn and Walters, 1981).

What baseline studies were undertaken in the Ontario Class EA and Minnesota GEIS, and according to the literature did they contribute to quality EA?

The Ontario EA

The OMNR collected and submitted a wealth of background information on the environmental and socioeconomic setting for the proposed undertaking. It would be difficult, however, to argue that the OMNR sufficiently described existing baseline conditions against which subsequent changes could be measured through monitoring. The lack of quantitative descriptive analysis in the proposed forest planning method will make modelling and monitoring impacts difficult.

The Minnesota GEIS

The GEIS study required the collection of baseline data describing the existing forest condition and future industry demands. This information was used to generate scenarios that depict how, when, and where harvesting would have to take place. The separate study groups developed a clear understanding of the existing resource base and then used these data to model and predict quantitatively the changes on various ecosystem components expected to result from specified levels of timber harvest (Poyry, 1993a).

Discussion

The Minnesota GEIS was an attempt at incorporating baseline data into development of quantitative impact forecasts. Only time, as ever, will tell if these predictions stand true. Follow-up research from the GEIS is necessary and should be directed towards developing adequate controls and monitoring programs for the forecasts.

Ontario's Class EA focused on generalized and quantitative descriptions of existing conditions and impacts. In this scenario implementing monitoring programs, learning from experience, designing adequate controls and determining scientific conclusions is next to impossible.

3.2.7 Impact Forecasts

Learning in resource and environmental management becomes possible only when expectations (forecasts, predictions) for the future can be unambiguously compared with reality (measurements) (Baskerville, 1985; 1993; Duinker and Baskerville, 1986). Error recognition is impossible without quantitative forecasts, measurement of outcomes, and a rigorous comparison of the two (Duinker, 1986). While there are some advocates of a prediction-free approach to EA, or at least an approach that leaves predictions qualitatively stated and open to much interpretation, most of the impact forecasting

literature urges analysts to make forecasts quantitative and specific (e.g., Holling, 1978; Duinker, 1986; Duinker and Baskerville, 1986; Walters, 1986).

Given the state of knowledge as to what makes for defensible and useful forecasting in EA (Beanlands and Duinker, 1983; Duinker and Baskerville, 1986), one would expect to find the following in the Class EA and the GEIS, and supporting documents:

(a) quantitative statements of future impact types and levels, complete with time and space bounds and resolution; and
(b) assumptions underlying the forecasts and structure and details of the models used to help make the forecasts.

The Ontario EA

Aside from some background work in estimating overall sustainable timber-harvest levels from provincial Crown land, and recognition of area-based simulation as a means of calculating forest-level sustainable timber-harvest levels, the Class EA contains no quantified forecasts of any environmental impacts of continued timber management in the area of the undertaking. One could argue that, because the Class EA was dedicated to ensuring that a sound environmental planning process would be part of timber management on Crown lands, such forecasts were not required. On the other hand, a

great deal of documentation and testimony were given to the EA Board about the potential impacts of timber access, harvest, renewal and maintenance. Whether at the local, forest, regional or provincial levels, none of these impacts were forecast quantitatively in the Class EA. The EA Board was forced to make judgements about the acceptability of a wide range of timber-management activities based entirely on qualitative expert testimony.

The Minnesota GEIS

The GEIS was based almost entirely on quantitative simulations of the responses of environmental variables to three 50-yr, statewide timber-management scenarios. The ability to model the distribution of harvesting activities needed to meet the three levels of wood demand was of fundamental importance to the impact assessment process. Results from this initial modelling formed the basis for the impact analysis and mitigative strategy formation undertaken by the various study groups. In addition, comparison of the output from the unconstrained model runs with the output from the second model runs indicated the likely changes in forest conditions resulting from adoption of the potential mitigation strategies. This useful sensitivity analysis allowed the decision-makers to examine the marginal costs and benefits of the mitigative actions.

Some of the models used and their outputs were:

(a) the Stand and Tree Evaluation Modelling System (STEMS) (Belcher et al., 1982) was used to help describe the existing forest condition;

(b) the forest management scheduling model DTRAN (Hoganson and Kapple, 1991) was used to predict the changes to the forest under three alternative timber-harvest levels over a planning horizon of 50 yr; and

(c) the study group examining economic and management issues used the USDA Forest Service Model IMPLAN (Impact Analysis for Planning) (Palmer et al., 1985).

Discussion

Using the standards set by Duinker and Baskerville (1986) for forecasting impacts in EAs, one would judge the Ontario Class EA as deficient in this regard, and the Minnesota GEIS as a strong exercise in dynamic system modelling in support of decision-making. In the Minnesota case, one would hope that decision-makers make good use of the forecasts in setting directions for future forest management in the state. In the Ontario case, one would hope, since EA for forest management will be dealt with largely in local forest-management planning, that future forest planning processes will move from the traditional qualitative approach toward integrated forest management, or even

adaptive ecosystem management (Ontario Forest Policy Panel, 1993). In this way all important forest values that are amenable to quantification will be examined simultaneously in a comprehensive quantitative forecasting framework.

3.2.8 Mitigation and Alternatives

An important result of an EA is the design and implementation of measures to mitigate adverse environmental effects (Munro, 1985). Beanlands and Duinker (1983) found that mitigation measures proposed to eliminate or offset negative impacts of an undertaking are often based largely on generalized principles and not grounded in specific findings. Most mitigation practices in Canada usually involve no more than the application of sound construction techniques (Sadler, 1986). Gibson and Savan (1986) noted that most EA's seek to dismiss concerns about obvious impacts with the assertion that mitigation measures will be taken so that no significant environmental effects occur. Ross (1987) insisted that mitigation measures proposed in an EIS should be described fully and their rationale provided. Ideally, a broad range of possible mitigation alternatives should be suggested and considered before an ideal alternative is chosen and implemented. It is reasonable to expect that Ontario's Class EA and Minnesota's GEIS would examine mitigation strategies and avoid the associated problems that have been highlighted in the literature.

The Ontario EA

The proponent acknowledged that timber management operations may cause a variety of environmental effects. However, most negative environmental effects can be prevented or minimized through proper planning and implementation of timber management operations or mitigated through application of remedial measures (OMNR,1987b). It seems OMNR seeks to mitigate negative effects through the use of the "guidelines approach" and a variety of "how to" implementation manuals. Compliance with the provisions of existing individual provincial guidelines and construction/operational and resource/environmental manuals is supposed to mitigate the adverse effects of timber operations (Koven and Martel, 1994). Some examples of various guidelines and manuals are: A Silvicultural Guide to the Jack Pine Working Group in Ontario (OMNR, 1986b); Timber Management Guidelines for the Protection of Tourism Values (OMNR, 1986a); Aerial Spraying for Forest Management (OMNR, 1981); Environmental Guidelines for Access Roads and Water Crossings (OMNR, 1988a); and Golden Eagle Habitat Management Guidelines, (OMNR,1987b).

During the hearing, the implementation-manual mitigation approach was criticized as being focused on "constraints" to the production of timber instead of identifying "quantifiable objectives" for other forest values. The OMNR argued that the current state of information and knowledge would not allow adoption of this approach (Koven and Martel, 1994). In the EA Board Decision (Koven and Martel, 1994), keeping these

manuals and guidelines current with up-to-date scientific knowledge was given high priority.

The Minnesota GEIS

One of the main objectives of the GEIS was to develop strategies to mitigate the existing or potential significant adverse impacts that might result from the three alternative levels of timber harvesting proposed. The study plan identified several important areas which would require detailed studies of possible environmental effects and suggested mitigation alternatives. Some of the areas were: maintaining productivity and the forest resource base; forest soils and health; biodiversity; forest wildlife and fish; forest recreation; and aesthetics and unique historic and cultural resources.

In the Minnesota GEIS, the mitigation measures proposed to ameliorate negative environmental effects were examined fully and their rationale was provided. The GEIS listed several alternative mitigation strategies for major impacts. Based on an analysis of identified mitigation alternatives, preferred mitigation strategies were selected by considering:

(a) the effectiveness in mitigating the identified significant impacts;

(b) the beneficial and adverse effects on other resource values;

(c) the physical, biological, administrative, and financial feasibility; and

(d) the probability and duration of success.

The mitigation strategies recommended to address significant impacts are categorized into three groups which reflected their main focus:

(a) those that required further forest-based research (e.g. undertake an inventory of the state's biodiversity features);

(b) those that required landscape-level responses (e.g. examine measures to reduce the area of forests converted to other land uses); and

(c) those that required site-level responses (e.g. modifications to harvesting practices and equipment).

Discussion

The Minnesota GEIS approach to identifying impacts and recommending mitigation measures was the result of a skilful blend of art and science (e.g. simulation modelling). Ontario's attempt on the other hand was vague, unclear and subjective (e.g. qualitative analysis and guidelines). Many impacts were identified but mitigation strategies were not discussed. The proponent relied on adherence to provincial guidelines, construction/operational and resource/environmental manuals to eliminate or minimize

environmental impacts. This "cookbook like" approach may work, but it does little to enhance the forest manager's ability to undertake forest-level analysis and subsequent "reflection before action" (Baskerville, 1990).

3.2.9 Design and Commitment to Monitoring

EAs should be required to demonstrate and detail a commitment to a well-defined program for monitoring project effects (Beanlands and Duinker, 1983). Effects monitoring, where the actual and predicted impacts are compared with each other, is an integral component of the assessment process (Duinker, 1989a). As such, guidelines or terms of reference should place emphasis on monitoring effects in the design of impact studies. Beanlands and Duinker (1983) emphasized that a program for effects monitoring must be well defined and focused to prevent the concept from becoming an excessive drain on time, money and resources.

Compliance or surveillance monitoring (sometimes called post-development audit) consists of ascertaining whether or not prescribed operations are being carried out according to plan (Whitney and Maclaren, 1985). Effects and compliance monitoring together enable accurate assessment of environmental impacts and provide the basis for audit of predictions and mitigation (Munro et al., 1986).

How did Ontario and Minnesota approach effects and compliance monitoring in their respective EA's?

The Ontario EA

Effects and compliance monitoring programs are not well designed in the Class EA and as a result, the document has come under fire for lack of adequate monitoring mechanisms to determine success or failure of implementation (Dunster and Gibson, 1989). Compliance monitoring programs that determine compliance with guidelines and standards are described in the Class EA, and should be simple to administer. The difficulty, however, will lie in finding the staff and funds required to assess compliance or to ensure that findings which demonstrate a failure to meet the established goals or standards are released (Dunster, 1988).

Effects monitoring will be difficult because the OMNR made no progress towards defining what will constitute an acceptable effect. If these have not been defined initially, effectiveness and scientifically sound audit of the results cannot be measured later because nobody will be able to know for sure what was actually predicted in the first place (Dunster, 1988; Duinker, 1989b).

The provisions of the EA Act require the proponent actively to monitor the effectiveness of management efforts and their environmental effects. The EA Board approval provided explicit monitoring conditions going beyond OMNR's traditional role of ensuring compliance with plan requirements and operational rules and restrictions. These conditions refined the existing compliance monitoring system and order the development of new ways of ensuring effectiveness monitoring (Koven and Martel, 1994)

The Minnesota GEIS

The GEIS was a focused exercise that collected a tremendous amount of baseline data on Minnesota's forest resource condition and made judgements about how timber harvesting affects these conditions. The GEIS proposed an administrative framework as well as strategic program recommendations and supporting program development plans that would enable implementation of the suggested recommendations. The consultant who prepared the GEIS argued that it was beyond the scope of a GEIS to design and undertake effects monitoring for response programs and mitigation methods that are not in place yet. This observation contradicted studies which state that EAs should always design monitoring programs (e.g. Beanlands and Duinker, 1983). The GEIS did, however, emphasize the importance of monitoring and flagged the areas where monitoring programs are needed, e.g. in assessing the impacts of timber harvesting on water quality and fisheries (Poyry, 1993n).

Discussion

The importance of effects and compliance monitoring programs is acknowledged in both the Ontario and Minnesota EA's. The proponent in the GEIS by-passed the opportunity to design and implement monitoring programs and merely suggested areas where monitoring programs are needed. The Class EA, which focused on a timber management planning process, should have examined and adopted adequate effects and compliance programs to ensure impacts associated with the process are monitored, and used to adjust future management. The EA Board subscribed to this philosophy and included several terms and conditions which will ensure that proper monitoring programs are established (Koven and Martel, 1994). On the basis of establishing commitments to monitoring the Ontario Class EA was clearly superior to the Minnesota GEIS.

3.2.10 Adaptive Management Science

Adaptive management of resource and environmental systems was defined by an interdisciplinary team of biologists and systems analysts working in the mid-1970s at the International Institute of Applied Systems Analysis (IIASA) (Holling, 1978). The Adaptive Environmental Assessment and Management (AEAM) approach is a collection of concepts, techniques, and procedures intended for the design of creative resource management and policy alternatives (Sonntag, 1983). Holling (1978) recognized that

instability is a common characteristic of ecosystem behaviour and as such it is only prudent to expect and prepare to benefit from the unexpected.

AEAM is management with a built-in learning process (Baskerville, 1985). The design of management goals, actions and the measurements of progress are carried out in a manner that allows the manager to learn about the system from management of it. As managers learn about the system, they are able to re-design it. The AEAM approach typically uses a workshop procedure to bridge knowledge and people gaps. Usually a simulation model is used as a focus to develop links between people and to synthesize existing information (Duinker, 1985).

According to Lee (1993), adaptive policies and management define experiments to probe the behaviour of a natural system. Experiments often bring surprises, but if resource management is recognized to be inherently uncertain, the surprises become opportunities to learn rather than failures to predict. Adaptive management offers the hope that by learning from experience, we can reach and maintain a managed equilibrium with a resilience able to withstand surprises (Lee, 1993).

Were the principles of the adaptive management used in the Ontario and Minnesota EAs?

The Ontario EA

The preparation of the Ontario EA did not incorporate any of the underlying principles of adaptive management. Baskerville (1990) spent many hearing hours advocating the advantages of such an approach, but his advice went unheralded in the EA Decision (Koven and Martel, 1994).

The Minnesota GEIS

The GEIS study was not designed with the principles of adaptive management in mind. However, the GEIS study approach did incorporate the following elements of adaptive management.

(a) The Final Scoping Decision (FSD) called for a study that would enable the EQB to assess the cumulative impacts of timber harvesting and related forest management at a statewide level over time, for each of the specified harvesting scenarios. It was decided that a scale of resolution that subdivided the state into seven ecoregions would best meet those requirements.

(b) The study teams used simulation models to project impacts well into the future. This approach is essential if managers are to learn from management of the system.

(c) The GEIS was prepared by small interdisciplinary teams working together in a workshop environment (Poyry, 1993a).

Discussion

The Ontario Class EA and the Minnesota GEIS were not designed with to adhere to the principles of adaptive management. However, the GEIS approach did share some characteristics of an adaptive management philosophy. It was prepared by interdisciplinary workshop teams, was ecosystemic rather than jurisdictional, and the employed simulation modelling. The EA Board heard testimony at the hearings that advocated the adaptive management approach, but it received little mention in the EA Decision (Koven and Martel, 1994). Perhaps the EA Board felt that as the OMNR moves towards an integrated approach to forest management, some of the principles of adaptive management would inherently be incorporated.

3.3 SUBSTANCE ADDRESSED IN THE ASSESSMENT

The Ontario and Minnesota EAs used different approaches to organize the subject matter of the EAs. One would expect each EA to deal with a variety of things that cause environmental impacts, as well as a range of endpoints (Barnthouse and

VanWinkle, 1980) or Valued Ecosystem Components (VECs) (Beanlands and Duinker, 1983) that may be affected by the causes. The OMNR chose to organize the EA according to causes. Thus, the major impact-oriented discussions, both in the documents and the hearing, were organized around the topics of forest access, timber harvest, renewal and maintenance/protection. On the other hand, Jaakko Poyry organized the Minnesota EA mainly around VECs. Thus, background documents and major chapters in the GEIS were titled according to VECs such as forest health, biodiversity, recreation, soils, etc.

Since both causes and effects must be addressed in a complete and competent EA, one would expect to find a thorough examination of a wide range of effects under each causal agent in the Ontario EA, and a thorough examination of all relevant causal agents under each VEC in the Minnesota EA. The analysis now turns to the main causal agents and VECs, each in turn, to discover the adequacy of the attention each received in the two EAs.

3.3.1 Causes

3.3.1.1 Access

For forest operations to occur, timber stands must be accessible. Forest road construction, maintenance and use for the provision of access to forest stands has the potential to cause some of the most severe environmental impacts associated with forest management activities (OMNR, 1987b). Road building can cause severe soil disturbances, destroy specific wildlife and aquatic habitat, and alter the way people use a previously remote but subsequently accessible land base (Burroughs and King, 1989). Many people consider access roads a blessing while others would prefer that the forest wilderness remain remote (Case and Rowe, 1978).

Given the importance and necessity of the provision of access to forest stands, it is reasonable to assume that both Minnesota and Ontario would have examined and attempted to mitigate associated impacts in their respective EAs.

The Ontario EA

The OMNR acknowledged that the provision of access to forest stands for timber extraction has the potential for significant impacts on the environment, but argued that

these impacts will be reduced in the future because most of the province is now partially accessed and therefore there will be less road-building in the future (OMNR, 1987b).

The OMNR proposed that negative effects associated with the construction and maintenance of forest access roads could be mitigated, prevented or minimized by:

(a) sound road location and construction;

(b) using appropriate implementation manuals and guidelines, particularly the Environmental Guidelines for Access Roads and Water Crossings (OMNR, 1988a) and the Code of Practice for Timber Management in Riparian Areas (OMNR, 1991a); and

(c) involving local citizens committees in the planning process (Koven and Martel, 1994).

The EA document and hearing focused primarily on debating how access roads are planned and accounted for in the TMP and who can use these roads once they are constructed. Most intervenors were unsatisfied with the OMNR's effort in presenting the negative effects of road access in the EA (Koven and Martel, 1994).

The Minnesota GEIS

In Minnesota virtually all wood is transported by road. The Minnesota GEIS evaluated how the provision of access for timber harvesting effects the Minnesota environment by examining its influence on forest soils, recreation opportunities, water quality and fisheries, forest health, biodiversity etc. The negative effects of building access roads are minimized and mitigated by following comprehensive Best Management Practices (e.g. Best Management Practices for Water Quality, (Poyry, 1993j)).

Discussion

The Minnesota GEIS examined the effects of providing road access on the site, forest, and regional environment, while the Ontario EA limited its qualitative description of effects to the site and forest level. The Ontario EA described how access roads are planned and accounted for at the management-unit level, with no effort on impact prediction and analysis at any level.

3.3.1.2 Timber Harvest

Timber harvest renews or rejuvenates the forest overstory and makes wood available for use by society. Harvest operations and methods, silvicultural prescriptions and utilization standards, and methods have the potential to influence most parts of the forest ecosystem including microclimate, nutrient availability, microbiology of the site, insect and disease activity, hydrology, and aesthetic quality (Barger, 1979; Freedman, 1989; Mahendrappa et al., 1990). Most of the effects of timber management occur at the site level; however, the accumulation over space and time of many small-scale local-level harvests have the potential to accumulate into significant cumulative effects on a regional basis.

EAs of timber management influence what choices are available to forest managers. The EAs recently completed in Ontario and Minnesota ought to have thoroughly examined the potential and cumulative impacts of alternative timber harvest methods to determine how to keep negative impacts at acceptable levels.

<u>The Ontario EA</u>

Through the Class EA process, the means by which the OMNR regulates logging, the planning process that determines how and where timber is harvested, and the public's

influence on timber harvest decision-making, were brought to light and thoroughly debated.

The Class EA document qualitatively addressed the potential aquatic, terrestrial, social, economic and cultural effects of each alternative harvest method. During the hearing the OMNR proposed that the application of a common planning process (timber management planning) would address and mitigate the environmental effects of harvest activities and account for the interests of other users of Crown land forests. However, a TMP addresses impacts at the site-specific and perhaps the management-unit scale, with little co-ordination between units at the broad provincial scale. This approach makes it difficult to control and comprehend the way the whole forest develops temporally and spatially, and makes cumulative impact detection difficult.

The Minnesota GEIS

The Minnesota GEIS thoroughly examined the broad-scale impacts of three timber harvest levels and related activities on wildlife, forest productivity, water quality and fisheries, economic and management issues, biodiversity, forest health, wildlife, and others. A background paper was prepared on the harvesting systems currently used, and the systems potentially available for use in Minnesota (Poyry, 1993h). The GEIS Harvesting Systems Background Paper (Poyry, 1993h) recommended numerous factors be

considered when choosing a harvesting system such as stand location, sensitivity class, land use designation, species of tree being cut, volume per acre, logging area size, and many others. Impacts from timber harvesting are to be mitigated by training workers to use harvesting methods and equipment that are environmentally sensible in the light of economic objectives (Poyry, 1993h).

Planning logging operations carefully, using equipment properly, and following Best Management Practices ((BMPs) comprise of a set of guidelines for reducing the impact of timber harvest activities on water quality and aquatic ecosystems), and training workers will minimize the negative environmental impacts of harvesting operations while sustaining economic objectives.

Discussion

Quantity notwithstanding, the quality of information and level of detail provided in the Class EA regarding impacts of alternative timber harvest levels and methods was inadequate. The focus of the Class EA process was directed at defending the status quo, instead of building forecasting models and designing mitigation and monitoring programs for alternative harvest levels. Countless hearing hours were spent by intervenors arguing about the merits and effects of one harvest method over another, with no clear answers emerging from the evidence heard.

The GEIS, on the other hand, focused on detection and mitigation of the stand-level and broad-scale negative effects of three harvest levels on numerous VECs. This simulation approach will help forest managers make enlightened decisions and develop strategic responses at the regional and state levels.

3.3.1.3 Regeneration

Regeneration, the process of forest renewal, occurs naturally or is assisted by artificial means. The methods associated with regeneration have the potential to alter the environment significantly. Site preparation may expose mineral soils and contribute to erosion (OMNR, 1987b). Herbicides are often used for chemical site preparation, which may have adverse effects on wildlife, water quality, and overall forest health (Poyry, 1993d). Care must be taken when planning operations to ensure that site productivity is maintained while reducing environmental impacts (Tippin, 1978).

Given the potential for local and broad-scale environmental impacts of forest renewal, I expected both the Minnesota and Ontario EAs to examine the environmental implications of alternative regeneration methods.

The Ontario EA

In Ontario, renewal of the timber resource may occur in one of three ways following harvest:

(a) the area may be left to regenerate itself;
(b) the area may receive a site preparation treatment to facilitate regeneration of certain species naturally; or
(c) the area may be regenerated by seeding or planting with or without prior site preparation.

The effects of typical renewal methods on the aquatic, terrestrial, social, economic, and cultural environment were qualitatively described in the Class EA document (OMNR, 1987b). The proponent, during the Class EA process and hearing, however, was not focused on the effects associated with timber renewal. Instead, the OMNR presented typical regeneration procedures and argued that associated environmental impacts would be accounted for through various guidelines, while intervenors scrutinized the success/failure rate of these methods and recommended alternative proposals.

Forests for Tomorrow argued that natural regeneration would be the best suitable alternative for Ontario, but failed to convince the EA Board that it could work successfully to replace some or most of the artificial regeneration treatments used today

(Koven and Martel, 1994). The OMNR argued that it is inappropriate to dictate artificial or natural regeneration methods and that these decisions must be made by the forester for each individual site (Koven and Martel, 1994).

The Minnesota GEIS

The Minnesota GEIS focused on examining and describing the effects of timber management activities including renewal. Sophisticated planning models were used to develop schedules of forest management activities including harvesting, regeneration, and thinning for the three harvesting scenarios. In this way, analysts were able to examine the potential effects of different regeneration levels on various ecosystem components at a broad scale. The RXWRITE model, a set of programs used to develop options for the prescriptions for harvesting and other management activities for each area of forest, was used to model regeneration (Poyry, 1993i).

Discussion

The Class EA process focused on debating the validity of current typical regeneration methods and mitigation procedures on the site and forest level. In the proponent's defense, perhaps issues such as these should have been addressed by an EA of policies

and programs, not the specific undertaking for which approval was sought (Spaling et al., 1993). The Minnesota GEIS used predictive models to determine the effects that alternative regeneration levels would have on the site, forest, and state of Minnesota.

3.3.1.4 Maintenance and Protection

Forest maintenance operations include tending and protecting the forest from insects and disease pests. These operations are carried out to ensure the survival and development of the desired tree crop. Tending generally refers to removal of the undesired species in a stand. This can be accomplished by applying herbicides or by using brush axes or brush saws. The intent of protection operations in timber management is to control forest insect and disease pests when they are out-competing desired tree species or are in a high or epidemic population.

The controversy surrounding the use of chemicals for forestry purposes is ironic. The quantity of pesticide used in forestry is much smaller than that used in agriculture. In spite of this fact, pesticide use in forestry has attracted a disproportionate amount of high-profile attention (Freedman, 1989).

Although knowledge gaps exist, scientific literature on the environmental impacts of various chemicals is widely available (Malik and Vanden Born, 1987; Campbell, 1990;

Lautenschlager, 1993). There is a demonstrated need for the wise and judicious use of herbicides and pesticides for forest protection practices in Canada (Holmes and Kreutzweiser, 1991). In some cases they may even be the most economical and environmentally friendly alternative (Freedman, 1989; Kimmins, 1992).

Given the controversy and uncertainty surrounding the use of chemicals in the forest, I expected that an EA of timber and forest management would extensively examine impacts and alternatives of forest maintenance and protection tools before drawing conclusions and making recommendations.

The Ontario EA

The OMNR position on protection and maintenance operations was that they were safe and effective. Intervenors and individuals appearing at community visits and the hearing indicated concerns with respect to the use of pesticides (both herbicides and insecticides) in timber management in Ontario. These concerns related primarily to the potential risks to human health, non-target terrestrial and aquatic biota, and soil. The proponent and the Ontario Forest Industries Association (OFIA) generally responded by arguing that the pesticides used in timber management have been evaluated and registered for use for that specific purpose by both the federal and provincial governments, and

Canadian regulatory requirements are considered among the strictest in the world (Koven and Martel, 1994).

Intervenor groups proposed alternative methods so that herbicides and insecticides would not be used, but the OMNR argued that its integrated pest management program, which is described as the integration of six types of control techniques, is the most suitable alternative.

The Minnesota GEIS

The Minnesota GEIS examined the methods used to protect various tree species and the current usage of herbicides. The negative effects associated with their application on overall forest health were modelled and quantified.

The methods used for timber stand improvements in Minnesota are generally aerial chemical, ground chemical, mechanical release, residual stem felling and non-commercial felling (Poyry, 1993d). Herbicide and insecticide use is uncommon on Minnesota forested lands. Although some local agencies have an active spraying program, the total use of pesticides in any ecoregion is limited.

Herbicides currently constitute the primary pesticide usage, the majority of which is limited to site preparation, release and roadside weed control in cutover northern conifer forests. Aerial spraying is on the decline due to perceived environmental hazards, and as a result, mechanical ground spraying has become the dominant mode of application in Minnesota. In the event that nuisance outbreaks (e.g. gypsy moths) require large-scale spraying, impacts of forest insecticides could be significant. There is no evidence to suggest that such impacts will occur, nor that increases in nuisance outbreaks would be correlated with harvest scenarios (Poyry, 1993d).

Discussion

Both Ontario and Minnesota examined the options and impacts associated with the use of chemicals in the forest. The evidence in the Ontario Class EA was based on qualitative expert testimony. The Minnesota GEIS, however, quantitatively projected impacts of various timber management scenarios on overall forest health.

3.3.2 Effects

3.3.2.1 Maintaining Forest Productivity

Forests and the biotic resources extracted from them are renewable, so in theory can be managed to meet the needs of society indefinitely. In the past decade, professional foresters have been under tremendous pressure to implement changes to ensure that long-term health and productivity of all forests are maintained. An ecological approach is called for, one that manages the forest as a complex system functioning as a whole, not as a collection of parts (Maser, 1988, 1994; SAF Task Force, 1991; Aplet et al., 1993; Ontario Forest Policy Panel, 1993).

To what extent do the EA's of Minnesota and Ontario examine this issue and ensure that the long-term health and productivity of the forest is maintained?

<u>The Ontario EA</u>

The objective of OMNR's Forest Resource Program on Crown Lands in Ontario is stated as: to provide for an optimum continuous contribution to the economy by forest-

based industries and to provide for other uses of the forest, through environmentally sound timber management practices (OMNR, 1987b). The OMNR argued consistently throughout the hearing that its TMP process would ensure that the long-term health and productivity of the resource is maintained (Koven and Martel, 1994). Three policies have been formulated to provide direction for the achievement of OMNR's provincial Forest Resources Program objective. These policies are: (a) sustained yield management; (b) forest production policy; and (c) integrated resource management policy. These policies and the TMP process were scrutinized by intervenors throughout the hearing as to how they could maintain the long-term health and productivity of Ontario's forest (Koven and Martel, 1994).

The Minnesota GEIS

The underlying premise of the GEIS was to determine how increased timber harvesting would affect the long-term health and productivity of Minnesota's forest. The GEIS specifically addressed the sustainability of various harvest levels over a 50-year planning horizon with special emphasis on forest productivity and timber supply. Planning and simulation models were used to develop hypothetical schedules of forest management activities. These schedules formed the basis for detailed impact analyses on timber and non-timber resources.

Discussion

The proponent in the Ontario Class EA hearing assured the EA Board that under its proposed planning process forest productivity would be maintained. This assumption is based largely on qualitative expert testimony and speculation. In contrast, the Minnesota GEIS balanced advanced modelling techniques with expert quantitative/qualitative analysis to forecast how different timber harvests would affect the overall productivity of the forest. However a 50-yr impact prediction horizon is likely too short for confident conclusions to be made about long-term forest productivity.

The Class EA hearing may have played a role in prompting the evolution of several policy changes in Ontario since 1988. These changes will affect the way forest productivity is maintained and managed in Ontario. Some of the initiatives currently underway or complete are:

(a) A Draft Natural Heritage Strategy for Ontario (OMNR, 1992);

(b) A Report on the status of Forest Regeneration (Ontario Independent Forest Audit Committee, 1992);

(c) Diversity, a report from the Ontario Forest Policy Panel (Ontario Forest Policy Panel, 1993);

(d) Looking Ahead, A Wildlife Strategy for Ontario (OMNR, 1993);

(e) A Report on the Conservation of Old-Growth Red and White Pine (Old Growth Advisory Committee, 1993);

(f) A Timber Production Policy;

(g) A Policy Framework for Sustainable Forests (OMNR, 1994); and

(h) A Land-Use Planning Review Project (OMNR, 1994).

3.3.2.2 Forest Health

Forests have a major life-support role in sustaining planetary health and quality of human life (Society of American Foresters, 1993). How to sustain and define health of forest ecosystems has emerged as a key challenge for the forestry profession (Maser, 1988; Kolb et al., 1994). The management of forests should be undertaken so as to ensure that they are sustained in a healthy condition over long periods of time (Poyry, 1993d). In the past a forest was presumed to be healthy when biotic or abiotic influences did not threaten the attainment of either current or future management objectives (Poyry, 1993d). Today some people are taking a more holistic approach to defining forest health in which a forest is believed to be healty when all natural forces affecting a forest are allowed to act (e.g. Maser, 1988; Gordon, 1994).

To what extent do the EA's of timber and forest management in Ontario and Minnesota deal with the issue of forest health?

The Ontario EA

Maintaining forest health was not specifically addressed in the Class EA. However, the timber management planning process addresses maintenance of the timber resource which involves protection of the timber resource from insects and disease.

Timber management operations in Ontario are recognized to cause a variety of environmental effects on the overall health of the forest, but the scale and extent of this effect is not known (OMNR, 1987b).

The Minnesota GEIS

The GEIS specifically examined the impacts of three alternative timber harvesting and forest management scenarios on forest health as affected by infestations of insects and diseases. Mitigation alternatives focused on developing strategies to prevent pest build-ups, to monitor and plan responses, and to apply stand-level mitigation (Poyry, 1993d). Strategies discussed included:

(a) monitoring and, if required, manipulation of age-class distribution of forest types to manage changes in susceptibility and vulnerability associated with changes in stand age;

(b) promoting better training of operators and introducing equipment that will reduce the level of damage to trees retained after thinning or selection cutting in forests;

(c) developing integrated pest management strategies for the major pests; and

(d) increasing basic and applied research on most serious pest problems.

Discussion

The proponent in the Ontario Class EA did not examine the effects of timber management activities on broad-scale provincial forest health; instead, it delivered a qualitative description of site-level causal agents and related effects. The Class EA planning process is supposed to account for forest health by ensuring that none of its approved parts contribute significantly to forest health degradation. The Minnesota GEIS, specifically examined the implications of alternative timber harvesting levels and related activities on the State's broad-scale forest health.

Both the Class EA and GEIS neglected to interpret forest health in the new "ecosystemic" way. Instead they documented impacts based on a "pest on trees" definition of forest health. A more useful definition of forest health from an ecosystem perspective should include specific types and rates of ecological processes, and numbers and arrangements of structural elements that characterize diverse, productive, forest ecosytems in major biogeographic regions (Kolb et al., 1994).

3.3.2.3 Biodiversity

Biological diversity or biodiversity refers to the variety and abundance of species, their genetic composition, and the communities, and landscapes in which they occur (Poyry, 1993b). It also refers to the ecological structures, functions, and processes at all these levels (Society of American Foresters, 1991). Biological diversity occurs at spatial scales that range from local through regional to global. The three main components of biodiversity are compositional diversity (the number of species present in an area and the genetic variation within individual species), structural diversity (the spatial arrangement and mixture of species within a stand and over the landscape) and functional diversity (the variety of natural processes occurring in a region) (Boyle, 1991; Harris, 1991).

Managing for biodiversity is of critical importance because it is essential to the ecological wellbeing of the planet, and human welfare is ultimately dependant on this (Hunter 1990). Deliberate forest management that moves from a local level to the regional context must play a key role in conserving biodiversity (Society of American Foresters, 1991).

Forest management activities have the potential to affect biodiversity both positively and negatively (Society of American Foresters, 1991). To what extent were biodiversity effects examined and accounted for in the EA's carried out in Minnesota and Ontario?

The Ontario EA

The OMNR, in its Class EA, did not provide any specific approach to manage forests specifically for biodiversity. Instead the proponent proposed to use featured species management as its primary mechanism to address wildlife concerns (Koven and Martel, 1994). Featured species management would in effect manage for between 70 to 80% of vertebrate species, leaving the remaining 20 to 30% subject to some yet-to-be-defined approach.

The OFAH-NOTO coalition advocated that the OMNR should immediately make use of the best available knowledge and resources regarding biodiversity. The key measure is that current timber management activities should be designed now to incorporate biodiversity concerns, not in 10-15 years when the ultimate biodiversity management approach is designed. The coalition further argued that the proponent's featured species management approach (based on a single featured species for each forest region) and the application of discretionary habitat guidelines (based on implicit professional judgements) must be rejected, on the grounds that they fail to satisfy fundamental environmental planning principles and contradict good resource management (i.e. adaptive management) principles (Koven and Martel, 1994). As a result, the OMNR stated it would move from a management approach which focused primarily on

individual species to one which strives more explicitly to conserve biodiversity (Koven and Martel, 1994).

The Minnesota GEIS

Biodiversity is specifically addressed in the GEIS. A technical paper (Poyry, 1993b) examined the following issues of concern identified in the scoping process: biological diversity in forests at genetic, species, and ecosystem levels; forest-dependant species of special concern; threatened or endangered species or habitats; and old-growth forests. Impacts were evaluated for the base, medium, and high harvest scenarios.

The technical paper (Poyry, 1993b) highlighted six values of biodiversity that are important to Minnesota:

(a) conservation of local populations with natural resistance to disease;

(b) conservation of genetic strains of forest trees and other plants which are adapted to local climate and site conditions;

(c) conservation of species which may produce new, economically valuable products;

(d) conservation of rare species that may play critical but currently unknown roles in ecosystem function;

(e) conservation of aesthetic and recreational values; and

(f) knowledge of ecological processes that is useful for management.

The biodiversity study (Poyry, 1993b) recommended that a comprehensive inventory of biological features in Minnesota's forest lands be undertaken, followed by development of timber harvest methods consistent with maintaining rare species and communities identified in the inventory. Second, corridors of extended-rotation forests should be distributed across the landscape in such a way as to connect major parks, wilderness areas, and old-growth areas. Third, an effort should be made to re-establish red and white pine and upland white cedar cover types and maintain or increase the conifer component of mixed-species aspen and birch stands.

Discussion

The Minnesota GEIS working group on biodiversity (Poyry, 1993b) recognized the paramount importance of protecting the State's compositional, structural and functional biodiversity. It identified several negative effects of timber harvest on biodiversity and suggested alternatives to mitigate them.

Much of the testimony during the Class EA hearing that dealt with biodiversity focused on its definition, its importance, and how OMNR's current featured species approach

was inadequate. As a result the OMNR is working on moving towards an approach that strives explicitly to conserve biodiversity but maintains that it will be difficult because the scientific knowledge on biodiversity is still in its infancy (Koven and Martel, 1994).

3.3.2.4 Water Quality and Fisheries

The removal or alteration of forest cover and associated forest management activities in a watershed has wide-ranging effects on water resources and fish. Forest management choices affect the amount, timing, and quality of water yield (USDA Forest Service, 1979b). Disturbance to the soil surface increases erosion and sediment inputs to waterbodies. Changes to the riparian canopy alter inputs to the aquatic community and affect the amount of light reaching the water surface. Light in turn affects primary producers (Anderson and Potts, 1987).

It is highly uncertain how a given change in the vegetation of landscape will affect a specific water body; however, it is more than obvious that timber harvesting can significantly alter the water quality of a watershed (USDA Forest Service, 1979b; Brown, 1970; Anderson and Potts, 1987). Thus, it is reasonable to assume that both the Minnesota and Ontario EA's would examine the implications of timber harvesting for water quality and fish habitat.

The Ontario EA

The OMNR in its Class EA examined several effects of timber harvest on water quality and fisheries. Mitigation measures are ensured through the use of implementation manuals and guidelines. The pertinent guidelines are:

(a) Timber Management Guidelines for the Protection of Fish Habitat (OMNR, 1985a);

(b) Aerial Spraying for Forest Management - an Operational Manual (OMNR, 1981);

(c) Resource Access Roads and Implementation Strategies and Guidelines (OMNR, 1985b);

(d) Environmental Guidelines for Access Roads and Water Crossings (OMNR, 1988a); and

(e) Code of Practice for Timber Management Operations in Riparian Areas (OMNR, 1991a).

These manuals include standards and provide direction on how to prevent or mitigate potential adverse effects of timber management operations at the site level.

The Minnesota GEIS

The analysis of impacts on fisheries and water quality caused by the three alternative timber harvest scenarios was developed from literature reviews and professional experience. The analysis focused on first through third-order streams and 10 to 50 acre (4 to 20 ha) lakes. The issues analyzed were:

(a) sedimentation, nutrient loading and run-off;
(b) fertilizers, compost, sludge and pesticides;
(c) aquatic ecosystems, wetlands and peatlands; and
(d) forest-dependant fish and their habitat.

The impact analysis focused on site-level as well as broad-scale statewide impacts. The analysis of effects of increased timber harvest was developed from literature reviews and professional experience.

Discussion

Both the Minnesota and Ontario EAs recognized the potential impacts timber management activities could have on water quality. During the Class EA many intervenors raised doubt as to whether Ontario's guideline approach to protecting water

quality was adequate or accounted for cumulative watershed effects (Koven and Martel, 1994). No original research was conducted for the Class EA; instead the proponent relied solely on qualitative expert testimony to support its current practices. The Minnesota GEIS work was well organized, well presented and had observations based on quality technical research (Poyry, 1993n). Both approaches made recommendations to mitigate and minimize adverse effects. The OMNR advocated the use of implementation manuals and guidelines which direct overall management regimes to mitigate and reduce effects. In Minnesota, Best Management Practices (BMPs) are used for the same purpose. BMPs are a suite of guidelines developed to help reduce the impact that timber harvesting and forest management activities have on water quality and aquatic ecosystems. As well, based on the GEIS results, several mitigation measures that improve watershed management and increase the effectiveness of BMPs were suggested (Poyry, 1993n)

3.3.2.5 Soil Quality

Soil plays an integral role in forest growth and management. It provides nutrients and moisture for tree growth, serves as a medium for root growth, and physically supports the equipment used in harvesting, yarding, and other operations (Poyry, 1993e). Forest management activities can have a diverse impact on soil properties, and these in turn affect forest productivity (Armson, 1977). Nutrient depletion reduces soil fertility,

directly affecting tree growth (Johnson, 1983). Soil compaction can reduce and disrupt soil porosity, thereby restricting water and air movement into and through the soil (Poyry, 1993e). This results in soils with poor aeration, which negatively affects plant growth. Surface soil, which is easily disturbed, is particularly important to forest growth because it contains a disproportionate amount of soil nutrients (Rosenberg, 1964).

Given the role that soil quality plays in forest growth and management, I presumed that the Minnesota and Ontario EA's would closely examine the potential effects of current practices and ensure that mitigation efforts are in place.

The Ontario EA :

The Class EA qualitatively documents the potential negative effects that timber management can have on forest soils. Some of the areas that received special recognition during the EA because of their association with soil quality were: road construction, compaction and proximity to watercourses; stream crossings; mechanical site preparation and prescribed burning. Mitigation of negative effects is accomplished by adherence to various OMNR guidelines and by careful planning when laying out the silvicultural ground rules in the TMP process (Koven and Martel, 1994).

The Minnesota GEIS

The Minnesota GEIS quantitatively examined the impacts of three alternative forest management scenarios and related activities on soil. The study group (Poyry, 1993e) examining this issue described the existing environment in terms of nutrient cycling, soil compaction, and soil erosion. It then described a method for assessment of impacts, predicted some impacts and assessed their significance, and identified potential and preferred mitigation measures to address significant impacts.

Discussion

The Minnesota GEIS included a well-researched analytical quantitative technical paper outlining the significant soil impacts, and the potential mitigation measures to address them. The Ontario Class EA (OMNR, 1987b) listed the items that had the potential to cause significant impacts and referenced the various guidelines that would mitigate these effects. No specific studies were commissioned to predict or quantify the negative effects that timber harvest would have on soil quality.

3.3.2.6 Wildlife Habitat

Wildlife is an integral part of forest ecosystems. Forest management affects wildlife habitat and populations both adversely and positively (Martell, 1983; Snyder and Bissonette, 1987; Crete, 1988; Parker, 1989; Smith and Williams, 1989). While most forested areas are managed primarily for timber interests, there has been increasing public pressure for timber management to integrate wildlife and timber management (Bonar, 1989). As a result, several professional conferences and seminars in Canada have dealt specifically with theory, practicality and methodology of integrating forest management and wildlife (e.g. Forestry and Wildlife Management in Canada, (Dauphine, 1984); Wildlife Forestry Symposium Prince George, (Chambers, 1990)).

The EA's carried out in Minnesota and Ontario ought to have examined the effects of forest management and related activities on wildlife.

<u>The Ontario EA</u>

The Class EA categorized the effects of timber management on wildlife into the four phases of timber management: access, harvest, renewal and maintenance. OMNR wildlife managers practise a featured-species approach which aims to provide habitat for chosen species, including threatened or endangered species, as well as common species

such as moose or deer. Various guidelines require OMNR to avoid construction in wetlands, avoid breeding areas and times, minimize road width, and regenerate right-of-way beside roads (e.g., Timber Management Guidelines for the Provision of Moose Habitat, (OMNR, 1988b); Habitat Guidelines for Cavity Nesting Birds (OMNR, 1984)). As well, wildlife habitat can be identified on the values map and protected through the Area of Concern planning process (OMNR, 1987b).

Much of the EA hearing time was consumed debating whether the proponent's evidence presented about the effects of timber management on wildlife was credible, applicable, and valid (Koven or Martel, 1994). It was clear from the hearing that wildlife population trend monitoring efforts in Ontario were weak, and the influence of provincial guidelines uncertain (OFAH, 1990).

The OMNR addresses wildlife habitat planning through timber management planning. Intervenors argued that OMNR collects information about fisheries and wildlife but it is not used properly in timber management planning (Koven and Martel, 1994). As a result of the hearing the EA Board ordered Condition 16 to ensure that adequate inventory information is available for each forest management unit for use as background information in TMP (Koven and Martel, 1994). As well, intervenor evidence persuaded the EA Board to order, in Condition 94, the addition of the pine marten and pileated woodpecker as featured species in Ontario (Koven and Martel, 1994). The OFAH/NOTO Coalition was unsuccessful in persuading the EA Board to order any

Conditions requiring the OMNR to incorporate its proposals on integrating habitat-supply analysis and biodiversity into OMNR's wildlife management program (Koven and Martel, 1994)

The Minnesota GEIS

In the GEIS a detailed technical paper on wildlife (Poyry, 1993f) assessed the potential impacts of base, medium, and high levels of timber harvest on Minnesota's forest wildlife over a 50-year planning period. Selected species of interest that depend on forested habitat for survival were analyzed. These included 22 small to medium-sized mammals, 5 large mammals, 138 birds, and 12 herptofauna. The study group described Minnesota's wildlife, projected significant impacts, and described possible and preferred mitigation methods.

Two issues of concern were addressed: what are the forest-dependant species of wildlife, their specific habitat requirements, and their current status and distribution; and to what extent does timber harvesting and forest management affect populations and habitats of each of the ten different groups of wildlife? The strategy employed by the study group to assess impacts was to link abundance of each species to specific Forest Inventory Analysis (FIA) forest cover-types and age or size classes in the existing forests of Minnesota. For each species of bird and mammal, an index of relative abundance was

constructed. The indices weight area of each combination of forest type/size class by its value as habitat for the species. The direction and magnitude of habitat carrying capacity change in the future can then be estimated by examining projected areas of forest types and size classes under each of the three harvesting scenarios. Based upon these predicted effects, alternative mitigation strategies were suggested.

Discussion

The Minnesota EA presented the effects of timber harvest and forest management on wildlife in a thorough, effective and efficient manner. Although the Ontario EA did not follow a similar approach, it highlighted the deficiencies with the current system for managing timber and wildlife concerns.

3.3.2.7 Recreation, Tourism and Aesthetics

Forests are being called upon to satisfy a diverse range of often incompatible values. To some, the forest has aesthetic, spiritual, recreational, environmental or heritage value, while to others it has economic value and potential (Elsner and Smardon, 1979; Godbey, 1988; Peterson, 1974; Peterson and Driver, 1988). Society and science have developed both pursuits of the forest with increasing vigour and as a result conflicts over land use

are inevitable (Godbey, 1988). The forest manager is a key player called upon to help resolve such conflicts. Foresters must find new ways of incorporating non-timber values and uses of the forest with the timber values so that opportunities exist for both (Ashton 1985; Duinker, 1991).

To what extent did Ontario's and Minnesota's EAs account for forest-management effects on recreation, tourism and aesthetics?

The Ontario EA

The Class EA document examined the effects on tourism, aesthetic and recreation resources according to the four components of timber management that cause them: access, harvest, renewal and maintenance. The OMNR proposed that these effects would be adequately mitigated by adherence to various guidelines (e.g., Timber Management Guidelines for the Protection of Tourism Values, (OMNR, 1986a); Timber Management Guidelines for the Provision of Cultural Heritage Resources, (OMNR, 1991b)) and by preparing the TMP according to its proposed procedure (OMNR, 1987b).

Testimony during the EA hearing led the Board to conclude that Timber Management Plans can have a broad range of positive or negative effects on tourism, recreation and aesthetic resources depending on how operations are designed and carried out. The

planning and public consultation processes ordered in the Conditions of Approval are designed to prevent, reduce or mitigate the negative effects as much as possible (Koven and Martel, 1994). It was evident from the hearing that OMNR's approach to visual reserves to protect aesthetic concerns of the tourism and recreation groups was unsatisfactory (Koven and Martel, 1994). As a result the Board ordered Condition 24 which ensures that visual resource management will be incorporated into every TMP (Koven and Martel, 1994). The witnesses representing FFT and the OFAH/NOTO Coalition argued unsuccessfully that the OMNR be required to adopt sophisticated tools of socio-economic cost-benefit analysis as part of decision-making process in preparing TMPs (Koven and Martel, 1994).

The Minnesota GEIS

The Minnesota GEIS study group analyzed and described the existing environment, the impacts expected from timber harvesting and forest management activities, the significant impacts, and the preferred mitigation strategies for the impacts. The specific question the study group (Poyry, 1993o) addressed was: to what extent does timber harvesting at the base, medium and high scenarios affect the recreation and aesthetic opportunities in Minnesota's forests?

Impacts on National and State forests were not thought to be significant because visual management guidelines that effectively address impacts are already in place. Timberlands not in federal or state ownership have no visual management guidelines in place. For the base, medium, and high scenarios respectively, 38, 44, and 48 percent of non-federal and non-state timberlands by area, were projected to be significantly affected.

Mitigation strategies discussed include:

(a) co-ordinated road and trail plan;

(b) a prohibition of harvesting in the most recreationally sensitive timberland plots, and a range of strategies for the remaining timberland plots including:

- allowable size of harvest area;
- allowable harvest system;
- allowable shape of harvest area;
- edge treatment;
- harvest area pattern requirement;
- residue management;
- planting specifications;
- restrictions on season of harvest; and
- information and interpretive programming.

Discussion

Recreation, tourism, and aesthetics were contentious issues that received considerable attention during the Class EA hearing, and getting the representative parties to come to agreement on relative terms and conditions was difficult (Illing, 1991). The Board then had the onerous task of sifting through the testimony to determine a suitable compromise. The Board's decision basically defends the status quo, where non-timber values will continue to be incorporated as constraints to timber production. The EA Board missed an opportunity here to require the OMNR to build upon several of its own recent policy initiatives that suggest a more integrated approach where tourism, aesthetics and recreational opportunities have fair seats at the decision-making table (e.g. Direction '90s (OMNR,1991c); Diversity, (Ontario Forest Policy Panel, 1993)).

The Minnesota GEIS centred on qualitative and quantitative analysis to determine and document how timber harvesting will affect tourism, recreation and aesthetics in Minnesota. By taking this approach the impacts are clearly illustrated and are much more likely to convince land-use decision-makers of their worthiness for consideration, conservation.

3.3.2.8 Forest Heritage Values

Heritage values are a range of historic property types which reflect historic and cultural diversity (Poyry, 1993m). The significance of these sites lies in the connection which they make with the past (Duinker, 1991). For example, five-thousand-year-old campsites on abandoned shorelines could hold valuable clues to scientists studying adaptation to climate change (Poyry, 1993m). Some heritage sites will undoubtedly be located in forested areas.

How were heritage values incorporated into Minnesota's and Ontario's EAs?

The Ontario EA

The effects of timber management on heritage resources in Ontario were scarcely documented and accounted for in the timber management Class EA (OMNR, 1987b). Ministry guidelines for the protection of cultural heritage resources were not in place until 1991 (OMNR, 1991b). According to the OMNR, valuable heritage sites can be protected from the negative impacts associated with timber management by giving them special designation such as Areas of Natural and Scientific Interest (ANSI). These sites would then be managed as Areas of Concern (AOCs). Guidelines and implementation

manuals are used to ensure that impacts are mitigated, and all decisions about AOCs are reported in the TMP.

The topic of old-growth forests received considerable attention during the course of the EA hearing. The OMNR probably did not expect that it would be such a hot issue, and as a result was unprepared to refute much of the testimony on this subject (Koven and Martel, 1994). In January 1992, the OMNR established an advisory committee to develop a strategy to conserve old-growth forests. The hearing testimony convinced the EA Board to order, in Condition 103, that the OMNR develop a conservation strategy, management directions and definitions for old-growth white and red pine by May 1995 (Koven and Martel, 1994).

The Minnesota GEIS

In Minnesota, forests often are the setting for important cultural and historic resources. The GEIS study team (Poyry, 1993m) addressed the question: to what extent could harvesting at the three specified levels affect the heritage resources of Minnesota? Analysis of the effects of timber harvesting and forest mangement activities on heritage resources was developed form literature reviews and from the professional experience of the authors and other experts who made their records available (Poyry, 1993m). The

work was presented in an ecoregion framework, and the impacts were quantified as fully as possible, given the study and time constraints (Poyry, 1993m).

Predictive and locational models were used as a method for estimating the likelihood of the occurrence of particular types of cultural heritage sites on particular types of landscapes. Using the outputs from these models the study group then assessed the impacts that timber harvesting could have on these sites. They found that under the base, medium, and high harvesting scenarios, 105,000, 121,000, and 142,000 sites respectively had the potential to be affected (Poyry, 1993m). Several alternative mitigation strategies were suggested, ranging from those that required statewide coordination and leadership to those that simply require modifications to harvesting and site preparation equipment and techniques (Poyry, 1993m).

Discussion

Cultural and heritage resources are highly regarded and respected in Minnesota, and as such must be incorporated into EA. As a result the study team addressing these resources designed a systematic and efficient approach to impact assessment. It used modelling techniques to enlighten the process, impacts were identified and where possible quantified, and alternative mitigation strategies were presented (Poyry, 1993m). The proponent in Ontario, realized during the hearing that cultural and heritage

resources were important to the people of Ontario, and as a result has agreed to accelerate its program to identify and protect areas of natural or scientific interests (ANSIs).

3.3.2.9 Global Warming

In recent years, evidence has shown that the earth's atmosphere has changed and is continuing to change as a result of past and present human activities (Duinker, 1990). These global changes mean that forest managers may have to implement special management strategies to maintain forest health and productivity. No one fully understands how these changes will affect spatial relationships among forest landscapes, communities and species, making decision-making difficult (Harrington et al., 1991). As a result several conferences and symposiums have been held to address this developing concern (e.g. Forests in a Changing Climate (Qureshi, 1992); Symposium on Regional Response to Global Climate Change: New England and Eastern Canada 1993 (Hautman, 1993)).

Given the potential impacts that global change may have on the forests of North America, it is reasonable to assume that Minnesota and Ontario forest EAs would examine these potential impacts.

The Ontario EA

The OMNR's proposals and evidence in the Ontario Class EA had no reference to the potential effects that global change may have on the forests of Ontario. At the provincial policy level, no processes currently exist to deal with global change and forests.

The Minnesota GEIS

The purpose of the background paper on global atmospheric change (Poyry, 1993g) was to document the extent to which research has been conducted on the relationship or interaction between global atmospheric change and Minnesota forests. The Minnesota GEIS used information from the latest available modelling techniques (General Circulation Models) to investigate how global change can potentially affect Minnesota's forests and recommended mitigation plans to deal with these possible changes (Poyry, 1993g). They did not design the models themselves but rather borrowed the results of other investigators (e.g. Mitchell and Lupton, 1984; Washington and Meehl, 1989), and applied them to Minnesota.

Discussion

The Minnesota GEIS addressed the global change issue to a degree, but Ontario's EA did not examine global change in any way.

3.4 DOCUMENTATION

3.4.1 Amount and Format

According to Ross (1987), if an EIS is to be useful to decision-makers and form an adequate basis for public review, it must be focused on the matters which will make a difference to the outcome of the review, and should not attempt to be encyclopedic. It must be logical, well written, and easy to follow so that it can be understood by experts and interested non-experts alike.

The Ontario EA

The volume of information presented to the EA Board proved to be too much to possibly absorb (Illing, 1991; Koven and Martel, 1994). The parties submitted over 60 witness statements ranging in size from 200 to 1500 pages. The record of the EA

hearing grew to over 70,000 pages of daily transcripts in 411 volumes, and 2,300 exhibits with tens of thousands of pages of supporting material.

The Minnesota GEIS

The study components of the GEIS for timber management and related activities in Minnesota comprised nine stand-alone study documents addressing the technical issues of concern and five support studies addressing identified areas of interest as well as several short summary leaflets for wide public distribution. A Draft GEIS document (Poyry, 1993a) (an initial report targeted to fully synthesize and integrate the materials from the nine technical papers and five background papers, clearly summarize all relevant impacts and describe recommendations to address the identified impacts) was prepared, and following public and peer review, a Final GEIS document was released (Poyry, 1994).

Discussion

According to the criteria Ross (1987) set above, the amount and format of information in Ontario's Class EA was much less than ideal for decision-making purposes. The Minnesota GEIS comes much closer to meeting ideals for amount and format of

information contained in an EA. The GEIS was well written, not encyclopedic, easy to follow, well organized, and focused on the key issues.

3.4.2 Information Dissemination

All EA involves the analysis and synthesis of information relating to the proposed project, its alternatives, and its potential environmental implications. Such information originates from many different sources and is sometimes difficult to obtain. This can hinder the development of the entire EA profession and makes for inefficient decision-making. Sadler (1986) recommended that mechanisms should be developed for information dissemination in order to improve the entire decision-making process.

How well was information gathered for and generated from the Class EA and GEIS, and disseminated and made available to interested groups or persons?

The Ontario EA

Much of the Class EA document was prepared by OMNR behind closed doors (Dunster and Gibson, 1989). As well, the evidence OMNR would use to defend the Class EA's

position was unknown until presented during the hearing. This process made intervenors scramble to prepare scientifically sound rebuttals in short order.

The Minnesota GEIS

The Minnesota GEIS was not prepared behind closed doors. The EQB Board and its appointed Advisory Committee was made up of citizens and professionals representing a cross-section of the people of Minnesota. Public involvement in the GEIS process was encouraged, and numerous opportunities existed for formal public input. Information generated from the various study groups was shared amongst other study groups (Poyry, 1993a).

Discussion

The Class EA and the evidence to defend it was prepared by OMNR staff behind closed doors. This type of process raised suspicion among intervenor groups and fostered inefficient decision-making. The GEIS process was open to public scrutiny from the start, and as such, the interaction among study participants evolved efficiently.

3.4.3 Readability, Comprehensibility and Presentation

If an EA is to serve as the basis for a public review, it must be well written, understandable, and well presented. It is all too easy to obscure critical issues with poor organization and writing (Curtis, 1982; Ross, 1987). Were the EAs in Ontario and Minnesota easy to read, easy to understand, and well presented?

The Ontario EA

The EA for timber management in Ontario was a two-part process: a Class EA document prepared by the proponent, and a hearing process before a quasi-judicial Board to debate with interested parties the validity of the Class EA. The Class EA document was easy to read and comprehend, but hearing transcripts and testimony, however, was not. No summary of the hearing was put together to synthesize information generated, until the 560-page "Decision of the Board" was released in April 1994 (Koven and Martel, 1994). This decision document does not include all the information generated during the hearing, and therefore stacks of testimony and exhibits will remain un-summarized and reader-unfriendly.

The Minnesota GEIS

The GEIS was well-written and easy to read and well-indexed. The GEIS study components consisted of a draft summary GEIS document, nine stand-alone studies, five support studies, and a final GEIS.

Discussion

The Class EA document and process is a difficult package from which to extract information. The Decision of the Board is well written, and could be considered a summary document, but a vast amount of hearing testimony will remain in an awkward form. In sharp contrast, the GEIS contained a wealth of new information that was organized, focused and presented in a way that made reading it enjoyable, and as such should provide decision-makers with much-needed credible and useful information.

CHAPTER 4 - DISCUSSION AND CONCLUSIONS

The call for the general movement of the focus of EA from the local discrete project level up to the regional program level has been responded to in the Ontario and Minnesota EAs of forest management planning. These two regional program EAs are the first of their kind, and the broader community of practitioners of EA ought to be informed of the strengths and weaknesses of these novel experiences. Although the two jurisdictions are neighbouring, the social, political and administrative frameworks for forest planning contrast sharply, making comparison difficult at times. Notwithstanding these differences, the value from this critical comparison/contrast is that it should enable future regional program assessments to avoid pitfalls and to be focused, efficient and ultimately more effective. The strengths and weaknesses of the two EAs are highlighted in Figure 4.

	MINNESOTA GEIS	ONTARIO EA
STRENGTHS	1. Sound scientific approach. 2. Active public input and participation early in process. 3. Good documentation, easy to follow and interpret. 4. A co-operative effort between stakeholders. 5. Efficient and effective	1. Process had a legally binding outcome. 2. Process lent support to other major policy and scientific work. 3. Provided a context for a thorough airing of many complex and sensitive issues. 4. Process led to realizable improvements to the TMPP.
WEAKNESSES	1. Process generated recommendations only. 2. Process had no implementation measures.	1. Weak scientific approach. 2. Protracted hearing meant world moved beyond EA position. 3. The voluminous documentation and lengthy hearing. 4. Adversarial hearing.

Figure 4. Relative strengths and weaknesses of the Ontario Class EA and the Minnesota GEIS.

4.1 STRENGTHS OF THE MINNESOTA GEIS

4.1.1 Sound Scientific Approach

The Minnesota GEIS was organized and prepared by adhering to a rigorous scientific approach, one that is recommended in the EA literature (e.g. Beanlands and Duinker, 1983). Public participation was fostered early and encouraged throughout the process. To achieve its goals and determine impacts of timber harvesting on a host of VECs, the GEIS employed sound scoping and forecasting, and developed a suite of mitigative techniques.

4.1.2 Documentation

The GEIS was well written, easy to follow, and well organized. From a research standpoint, the design and documentation of GEIS should enable future researchers to effectively access specific information on key issues.

4.1.3 Efficient

The GEIS was a relatively inexpensive process - costing less than 1 million dollars over 3 years (Section 3.1.6) - especially when compared to Ontario's Class EA.

4.1.4 Co-operation of Stakeholders

The GEIS process initiated by the Minnesota EQB was designed to include a broad cross-section of stakeholders who were interested in and connected to the forest and timber lands. Public input was encouraged and solicited throughout the GEIS development. As well, any written comments or concerns with the GEIS development were responded to in writing by the preparers. More than 60 individuals, comprised mostly of research scientists, university professionals, and the consultant's specialist staff, worked together with the EQB to prepare the GEIS. The GEIS was a co-operative effort from start to finish, and as such evolved quickly and efficiently.

4.2 STRENGTHS OF THE ONTARIO CLASS EA

4.2.1 Legally Binding Outcome

The outcome of the Class EA hearing is legally enforceable. Therefore on May 18, 1994 the Class EA became a legally binding code of forest practices for Ontario. The terms and conditions and their implementation is therefore expected to receive high political priority and financial commitment.

4.2.2 Process Lent Support to Other Major Policy and Scientific Work

The critical public scrutiny that the OMNR received during the Class EA undoubtedly hastened some long overdue policy commitments and reforms within the OMNR itself. Section 3.3.2.1 documents some of the policy changes that have occurred.

4.2.3 Provided a Context for a Thorough Airing of Complex Controversial Issues

The EA hearing provided a platform for airing several of the key controversial forest management issues that have developed over the past two decades. The EA Board heard evidence about the potential environmental effects of silviculture, with the clearcut

issue dominating many hearing days. Whether or not the OMNR was practising sustainable forestry was constantly scrutinized during the hearing. Regeneration methods and success were thoroughly debated throughout the Class EA, as well as the possible positive and negative environmental effects of pesticide use. The EA hearing successfully provided an opportunity for any interested group or individual to be heard.

4.2.4 Led to an Improved Timber Management Planning Process

The Class EA and hearing led to many substantial improvements to the OMNR's timber management planning process. Examples include; the creation of local citizen's advisory commitees; enhanced public notice and comment opportunities; an improved relationship with Ontario Aboriginal peoples; and, updating of research and background information needed to prepare the plan (Koven and Martel, 1994; Lindgren, 1994).

4.3 WEAKNESSES OF THE MINNESOTA GEIS

4.3.1 GEIS Generated Recommendations Only - No Implementation Measures

The focus of the GEIS was on developing recommendations. It was supposed to provide the context in which future forest project EISs can be assessed. This means that

Minnesota spent $1 million making recommendations that could plausibly be shelved because of lack of political momentum and commitment. It has been reported recently in a Minnesota newspaper (Myers, 1994) that the 26-member group charged with developing goals and guidelines for state legislature is bogged down. This is frustrating the timber industry because it wants the controversial issues addressed so it can know what to expect from the regulations. Without built-in implementation measures, the state of Minnesota and the people charged with implementation will have a difficult battle getting consensus on key issues and presenting these issues to the state.

4.4 WEAKNESSES OF THE ONTARIO CLASS EA

4.4.1 Weak Scientific Approach

The proponent in the Class EA did not prepare the EA according to recommendations in the EA literature (e.g. Beanlands and Duinker, 1983). The scoping process was inadequate and public input was all but absent in drafting the Class EA document. Few quantitative, testable impact forecasting or prediction methods were employed in documenting impacts. Mitigation and subsequent monitoring programs were suggestive at best. Cumulative impacts (i.e. aggregation of site-specific impacts at a regional level) were largely ignored. The EA Board was faced with the arduous task of discerning clear

pathways from the contrasting opinions presented. Perhaps much of the lengthy controversy in the hearing could have been avoided if the OMNR had brought a scientifically defensible EA before the Board at the beginning of the hearing.

The focus of regional program EAs must be on using state-of-the-art scientific knowledge to determine the potential environmental impacts of the plans and policies being evaluated. This is crucial to the entire EA. An EA that is not based on sound scientific impact analysis cannot be evaluated effectively.

4.4.2 The Voluminous Documentation and Lengthy Hearing

The EA Board was subjected to far too much information, both in length of time of the hearings and volume of evidence heard (Section 3.4.1). This made it difficult for the Board to assess when a subject had been adequately covered or if the evidence was relevant (Koven and Martel, 1994). The parties at the hearing did not submit summaries of their evidence until ordered to do so by the Board. The enormous case presented by the OMNR put other parties with less resources at a disadvantage. The EA Board has recommended in its Decision that the EA Act be amended to allow the Board to set time limits for all phases of a hearing (Koven and Martel, 1994).

4.4.3 Adversarial Hearing

The adversarial and quasi-judicial nature of the hearing allowed it to be dominated by lawyers, whose tactics and skirmishes cost significant amounts of time and money, but added little to the evidence the Board had to consider (Koven and Martel, 1994). It had been estimated that three quarters of the time during OMNR's case was taken up by cross-examination, even though hundreds of questions were asked and answered in advance in interrogatories (Koven and Martel, 1994). The Board has been convinced that EA hearings can not be efficiently conducted based solely on an adversarial model using court-like rules.

4.4.4 Protracted Hearing

Because the EA hearing and decision process lasted roughly six years from start to finish, much of the information presented to the Board had become outdated. However, the Board was obliged, having to adhere strictly to Ontario EA protocol, to consider none other than the evidence presented to it. For example, in 1988 when the hearing began, the proponent argued that timber management planning could adequately address all environmental concerns. Since 1988, however, the OMNR itself has journeyed beyond timber management planning to an integrated forest management planning process, and

a transition to ecosystem management will soon follow (e.g. OMNR, 1994). The EA did not incorporate this shift in philosophy.

4.5 "COMPASS AND GYROSCOPE: INTEGRATING SCIENCE AND POLITICS FOR THE ENVIRONMENT"

The title above is also that of a recent book by Kai Lee (1993). Lee explained that combining the principles of science and politics is vital for sustainable management of natural resources. Rigorous science is the compass, developing more useful knowledge, and practical politics is the gyroscope, keeping decision-making balanced among competing interest groups. Lee (1993) proposed an adaptive management approach (Holling, 1978; Walters, 1986) as the rigorous scientific compass and bounded conflict as the practical political gyroscope. Lee (1993) explained:

> Adaptive management embodies a simple imperative: policies are experiments; learn from them. In order to live we use the natural resources of the world, but we do not understand nature well enough to know how to live harmoniously within environmental limits. Adaptive management takes the uncertainty seriously, treating human interventions as experimental probes. Its practitioners take special care with information. First they are explicit about what they expect, so they can design methods and apparatus to make measurements. Second they

collect and analyze information so that expectations can be compared with actuality. Finally they transform comparison into learning - they correct errors, improve their imperfect understanding, and change action and plans.

4.5.1 Measuring Up: A Template for Effective Regional EAs

Lee (1993) stressed that effectiveness in natural resource management will improve if science and politics are integrated for the environment. Regional impact assessments are undoubtedly a complex mix of politics and science. Learning how to integrate the two is the challenge for future practitioners. Using this philosophy, a template (Figure 5) was developed to help illustrate how well the Ontario Class EA and the Minnesota GEIS integrated science and politics. The foundational science of impact assessment (e.g.,scoping, forecasting, monitoring) is at the centre of the template and is of utmost importance in a well-designed and rigorous regional impact assessment. Interaction among participants within the EA process influences how well the foundational science is parleyed to decision-makers. Foundational science set in the context of an excellent interaction process must further be encompassed by a legislative and political context that will embrace and use the outcome of the interaction process. If any one of the three components is weak or missing, the regional EA process risks having either little relevance at all, or a misguided application.

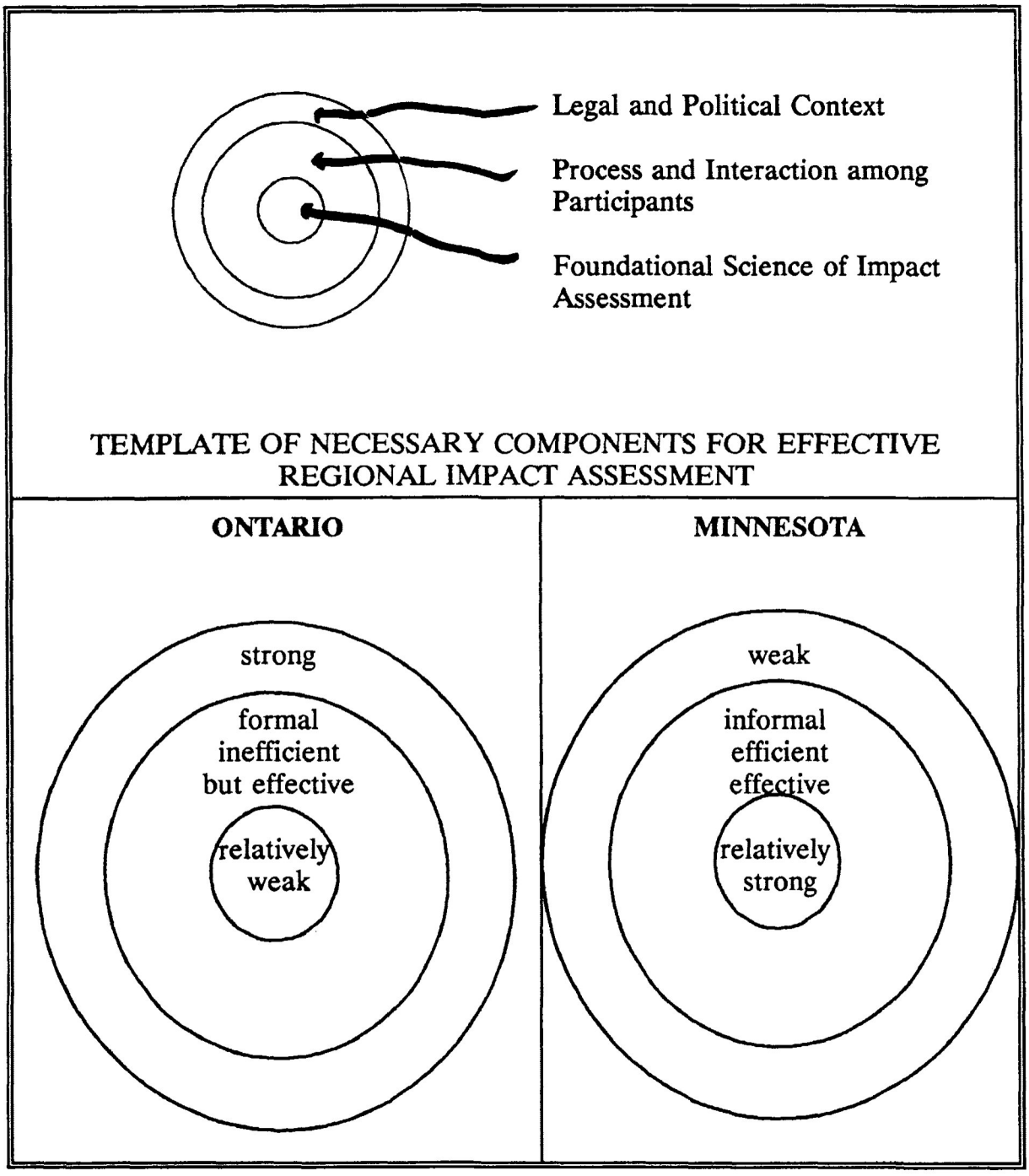

Figure 5. **Relative evaluation of the Minnesota GEIS and the Ontario Class EA against the template of necessary components for effective regional impact assessment.**

4.5.2 The Ontario Class EA

The foundational science that formed the basis for the hearing in the Class EA was weak (see Section 4.4.1). This weakness complicated and caused unneeded delays in the interaction process (the hearing) which was formal and inefficient yet still effective. The legal and political context in which this regional EA evolved was strong. The EA Board's ruling carries the force of law, which means that the terms and conditions associated with program approval must be implemented.

4.5.3 The Minnesota GEIS

The foundational science upon which the GEIS was built upon was relatively strong (see Section 4.1.1). The Minnesota interaction process was informal (e.g. roundtable study groups and community visits), efficient and effective. The overall effectiveness of the GEIS may be compromised because of its weak legal and political context. Implementation of GEIS recommendations depends upon subsequent process and an uncertain socio/economic/political climate.

4.6 LEARNING FROM REALITY: MESSAGES FOR REGIONAL PROGRAM EAs

The proponent in the Ontario Class EA tried to design its regional impact assessment to conform to a provincial EA Act that was inflexible and not designed for it. Most of the impact assessment science that deals with regional and cumulative impacts evolved at around the same time as the Class EA and hearing. The EA guidelines have strict court-like rules regarding how and when evidence is received and what is admissible. Since 1988, when the Class EA went into hearing, the natural resource management world and the OMNR itself have moved far past the narrow timber management paradigm to an integrated forest and ecosystem management approach. Unfortunately the OMNR could not incorporate this fundamental philosophical shift into its EA evidence, because it was already committed to the timber-oriented approach.

Minnesota needs somehow to develop a political context that takes the results of studies like the GEIS seriously. Implementation can only occur with political or legal commitment.

4.6.1 In the Future

Efficient and effective regional, program-oriented EAs, of both forest management and any other resource-management programs, require:

(a) a sound scientific basis, conforming to accepted principles of EA practice (e.g., scoping, forecasting, and monitoring);

(b) a fair, efficient and effective interaction process for participants;

(c) a strong and receptive legal/political context, where senior decision-makers are either compelled to act in accordance with EA results (e.g. as in Ontario) or are sufficiently engaged in and by the process itself to be motivated to act swiftly when results are delivered; and

(d) a documentation and communications program designed to keep the public informed at all stages of the process, and to provide ready access to detailed information in user-friendly forms.

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