FOREST MANAGEMENT IN ALBERTA

REPORT OF THE EXPERT REVIEW PANEL

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May 16, 1990

Hon. E. Leroy Fjordbotten, Minister
Forestry, Lands and Wildlife
403 Legislature Building
Edmonton, Alberta
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Dear Mr. Fjordbotten:

On behalf of the members of the Expert Panel on Forest Management, I have the honour of transmitting our report and recommendations. The panel believes the text and recommendations embody the spirit of public concerns. We hope the report serves as a catalyst for open discussion on issues that affect our forest heritage.

We urge you to carefully consider the recommendations and to ensure that they are implemented as soon as possible.

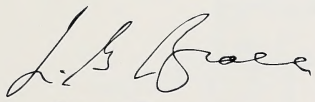
Sincerely,

Bruce P. Dancik
Professor and Chair
Chairman of the Expert Panel
on Forest Management

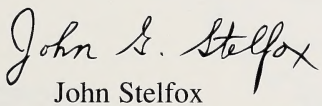
BPD/jj

Enclosure

We, the members of the Expert Panel on Forest Management in Alberta, approve the contents of this report as submitted to the minister of Forestry, Lands and Wildlife.



Lorne Brace



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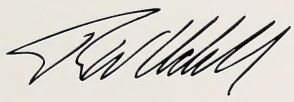

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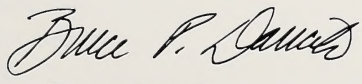

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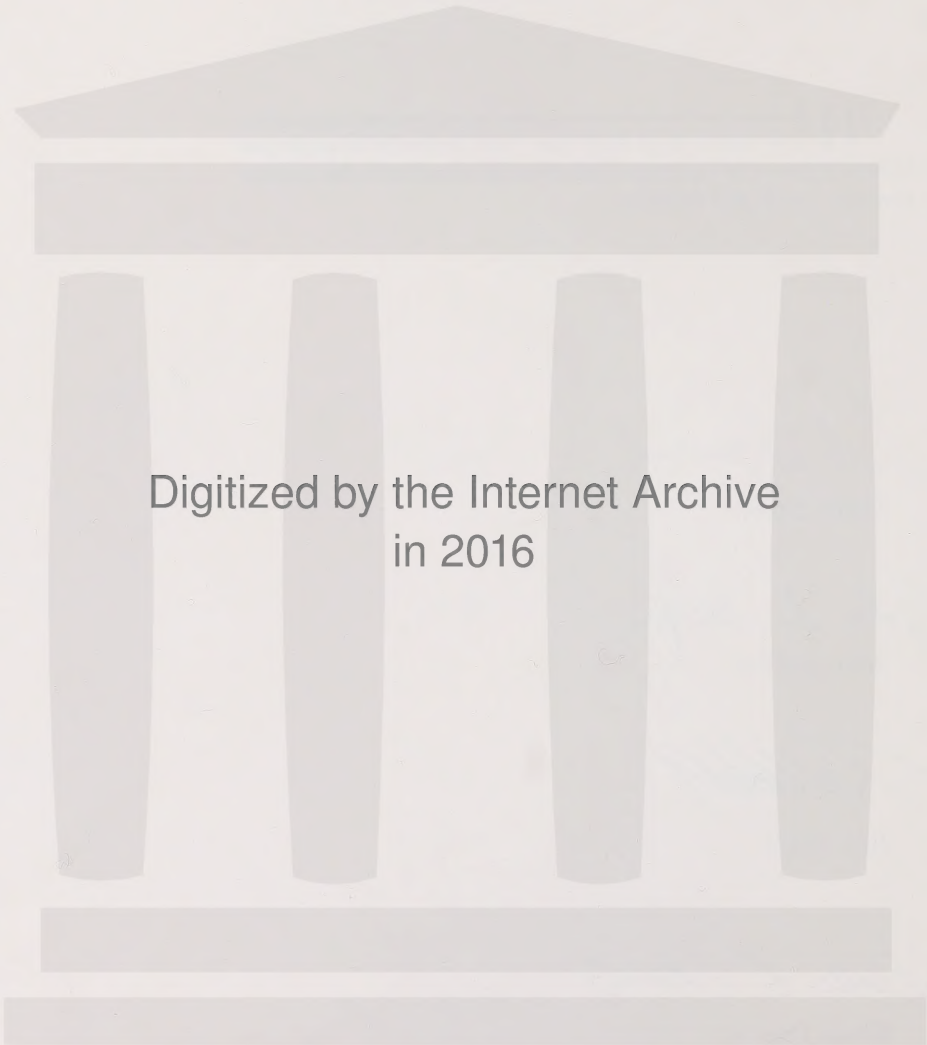

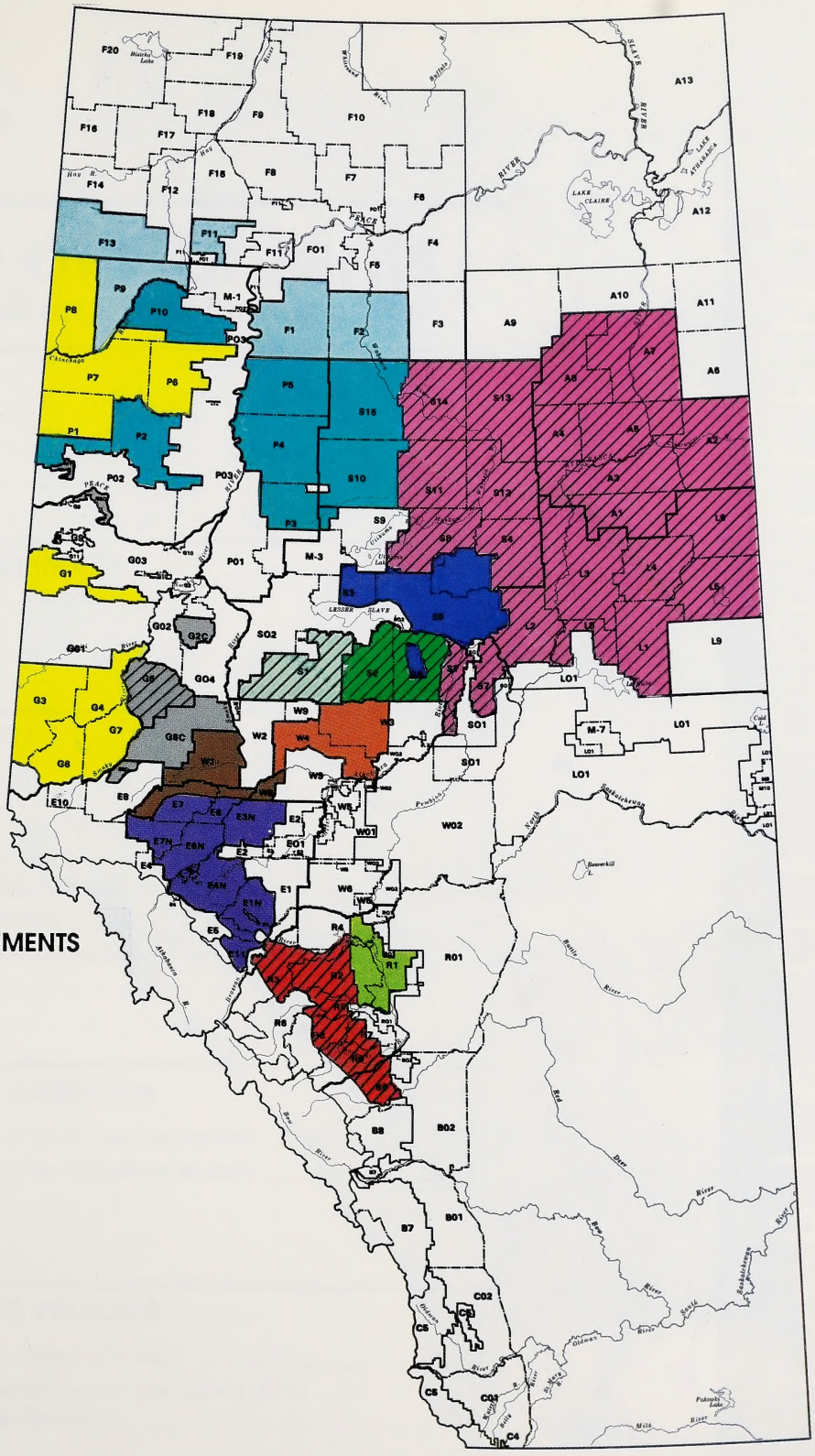

EXISTING & PROPOSED FOREST MANAGEMENT AGREEMENTS

- Indicates Proposed FMAs

- Procter & Gamble
- Canadian Forest Products
- Weldwood (Hinton)
- Weldwood (Slave Lake)
- Alberta Energy Company
- Slave Lake Pulp
- Slave Lake Pulp Reserve Area
- Weyerhaeuser Canada
- Daishowa Canada
- Daishowa Canada Reserve Area
- Alberta Pacific
- ANC Timber
- Sunpine

roposed F.M.A. Boundaries subject to change.

February, 1990

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Expert Panel on
Forest Management
in Alberta

1.0 EXECUTIVE SUMMARY

The Expert Panel on Forest Management was appointed to provide advice to the minister of Forestry, Lands and Wildlife on public concerns about the expanding forest industry and about the state of forest management in Alberta. Public concerns about the impact of pulp mill facilities on the environment were addressed by the Alberta-Pacific Environmental Assessment Review Board.

Major subjects addressed, as raised by the public, were: forest practices, the forest management agreement process, fish and wildlife management, integrated resource management, and environment conservation. Issues not addressed were outside the mandate or expertise of this panel.

The panel was made up of Lorne Brace, a forest research scientist; John Stelfox, a wildlife research scientist; Bob Udell, a professional forester; and Bruce Dancik (chair), a University of Alberta forestry professor.

The report is based on the knowledge and experience of panel members, scientific literature, relevant government policies, acts, and regulations, and contractual agreements. The panel also met with individuals, interest groups, and corporate and government representatives and had access to the report of Concord Scientific on public meetings and open houses, and to the briefs submitted during the open house process.

The major conclusions arising from panel deliberations follow.

General Issues

Much of the concern over the disposition of forest lands to new forest industries relates to the process used. The public should have had input and involvement before dispositions were granted, and should have ongoing involvement in the development of forest management plans.

Forest research is declining in Alberta and requires new direction and funding. The strategic direction is being developed, but funding is urgently needed.

Regulatory Agencies

The public expects the Department of Forestry, Lands and Wildlife to be the effective steward of forest resources in Alberta. We believe the department's ability to accomplish this task is seriously limited in the areas of staffing, funding, inventory, resource knowledge, and integration of department activities from the policy to the operational level.

The panel recommends a reorganization of the provincial departments that have a role in stewardship of public lands, to form a new Department of Natural Resources that would include most of the present Department of Forestry, Lands and Wildlife and part of Recreation and Parks.

The Planning Process

As Canada and Alberta have endorsed the principles of the World Conservation Strategy and the Brundtland Report, we recommend that the government immediately complete the Alberta Conservation Strategy, especially for the forest sector. Department and division policies consistent with this strategy should be developed.

To effectively implement an integrated resource management program that includes public input at the initial planning stage, we recommend two levels of forest management advisory boards to assess and advise the government on forest policy and on matters such as planning, management, ground rules, inventory, and staffing. The panel concludes that environmental impact assessments (EIAs) of the type used for mills and other industrial development are an inappropriate means to deal with environmental impacts in forest landscapes. These impacts can be addressed most effectively by expanding and refining the ground rule process and by periodic audits of forest management by the Environment Council of Alberta.

Technical Aspects of Management Planning

Current resource inventories are inadequate, particularly respecting fish and wildlife species and their habitats. There is a need for inventory systems that will provide knowledge essential for integrated resource planning and management of forest ecosystem components.

More attention should be given to the development and use of yield tables for regenerated stands. Growth trajectories in regenerated stands should be better

linked to yield forecasts. There is a need to incorporate ecologically meaningful site information into forest-level planning tools and to expedite its use in stand-level planning tools and procedures.

Secondary priorities on land allocated for timber production can be more effectively addressed by the department and industry through improved resource allocation and management techniques. Committed allowable cuts should be maintained by providing reserve areas for future land withdrawals and by appropriate intensification of management on selected areas.

Environmental Impacts of Harvesting Operations

The panel concludes that no single harvesting system best regenerates the forest and safeguards the environment, including other resources. The system used should be determined by consideration of ecological characteristics of the forest land, the priorities assigned by resource specialists, and by public input.

The panel urges increased consideration of the impact of forestry operations on the populations and habitats of fish and wildlife. Inventories are inadequate, monitoring is weak, and fish and wildlife considerations must be more effectively integrated into the forest planning and operation process. Several draft programs have been developed by the Fish and Wildlife Division to address these issues. They should be reviewed, updated, and implemented.

There is a particular need for information on the habitats and populations of rare, endangered, and threatened wildlife species in northern boreal areas, and the impacts of development on these species must be examined.

A policy should be developed for the designation and management of old growth forest ecosystems under the Alberta Conservation Strategy.

The panel calls for boreal wilderness areas to be set aside and feels this should have been done before the extensive allocations of boreal forest management areas were made.

Integrated Management

Integrated management of natural resources on forest land in Alberta is good conceptually but deficient in application, in part because of the lack of a comprehensive forest conservation strategy. There should be more input from the public. Forestry development should recognize and accommodate legitimate interests of other resource users including recreation, tourism, and trapping. In particular, appropriate access management should be incorporated into detailed forest management plans. This should be done in the initial planning stages.

Ground rules provide a means of delivering integrated management at the operational level. Their effectiveness could be significantly improved by more timely and balanced input from all concerned resource specialists and by better training programs for equipment operators and supervisors.

Reforestation

Regeneration of commercial tree species on cutover areas in Alberta is generally adequate, but stocking and growth of conifers is of concern, particularly on some mixedwood, wet, and high-elevation sites. The panel feels the new provincial reforestation standards address these concerns, but there is still a need for more realistic mixedwood standards and the refinement of growth criteria for all species.

It is commercially and ecologically important to retain conifers in reforested areas. There is a need for a policy decision and evaluation of the cost and effectiveness of all tools and techniques including herbicides for achieving this in an environmentally acceptable manner.

Harvesting and silvicultural operations should be integrated. The choice of a harvesting system can have a significant impact on the environment and on reforestation success.

2.0 INTRODUCTION

2.1 Background

Ecosystems are sets of interacting plants and animals, within their environment of soil, water, and air, that can be viewed as comprehensive, functioning units. Forest ecosystems are complex biological communities, dominated by trees, but including much more. Together with rivers and lakes, large and small animals, birds, and plants make up a dynamic community. Planning for forest land use must reflect the complexity of the ecosystem; all components of the ecosystem must be considered and integrated into the planning process before the land is allocated.

Ecosystems evolve over time. Changes occur naturally, with or without human influence. For example, old-growth forest that is left undisturbed may remain as a dynamic, functioning mature forest. But often in the boreal forest, natural disturbances such as wild fire, insect infestations, or drought destroy this mature timber, which is then replaced by a young regenerated stand.

The forests of Alberta are a public resource. The land and the timber on it are owned by the people and managed by the government of Alberta. No development may take place without long-term land and timber commitments between the government and private companies for forest management. As owner of the forest resource, the public has a right, if not a duty, to express concern about these commitments and to request clarification of the terms and conditions of agreements with forest companies.

In the case of the proposed forest developments in northern Alberta, the public is asking important questions. Is the forest renewable after harvest? What are the important resources and where are they? Will there be provisions for boreal wilderness areas? What will be done to protect the fragile caribou habitat of northern

Alberta or critical arctic grayling spawning areas? Will there be enough old-growth forest left? Will it still be possible to have a genuine wilderness experience in northern Alberta? What about the families who depend on traplines?

Forest management involves decisions made to influence, control, or manage the forest landbase. The basis for evaluating such decisions may vary, depending on the land management objectives. Many decisions involve value judgments. For example, decisions must be made whether to preserve certain areas as wilderness or old-growth reserves or whether to manage them with multiple-use objectives, including timber harvesting. Each alternative has negative and positive environmental components, yet what is at issue is more subjective: what will the forest that remains be like? Do we want extensive production forests with maximum yield of high quality fibre? Do we want a vast wilderness area with stringent regulations to protect habitat and promote recreational tourism values? Can we find an acceptable balance?

The stated policy of the Alberta government is integrated resource management. A major tool in implementing that policy is the forest management agreement (FMA), which is a contract between a private company and the government that, in return for investment in a production facility, provides secure tenure on a forest and sustained yield management. These commitments lay the foundation for many future land-use activities and set the pattern for many decades. Some decisions, once made, can never be changed; developed land is no longer wilderness, although it may be a healthy ecosystem with many resources. While each FMA has a term of 20 years, it contains provision for further renewals.

The importance of forest management agreements to the future of the province makes it essential that there be good communication among the FMA holders, the public, and government decision makers. The decision-making process must be open to those who seek to understand it. The values and concerns of the owners of the land — the people of Alberta — must be identified, and be addressed early in the process, before commitments are made.

The calling of public meetings and the appointment of this panel to tackle forest management issues did not occur until after the announcement of major timber commitments in the boreal forest was made (see map inside front cover).

2.2 Mandate

The Expert Panel on Forest Management was appointed by the minister of Forestry, Lands and Wildlife following the announcement of the new FMAs in northern Alberta. A series of public meetings and workshops were held in northern Alberta; the mandate of the panel is to review questions, concerns, and issues raised at these meetings and open houses. The mandate also includes review of any other forest land management issues in Alberta from the perspective of the panel's collective expertise.

Although there are environmental impacts of forest management activities, the greatest environmental impacts are likely to arise from pulp mill facilities and their consequent river and air pollution. These concerns are outside the mandate of this panel, and have been dealt with separately by the Alberta-Pacific Environmental Impact Assessment Review Board.

The panel's recommendations on the state of forest management in Alberta are made to the minister of Forestry, Lands and Wildlife in the understanding that they will be made public.

2.3 Scope

This report concentrates on recently announced forestry developments in northern Alberta. Existing FMA and quota operations are considered in the more general forest management evaluations. The landbase is mostly the boreal forest of the Green Area of northern Alberta.

The role of government in allocating, planning, and regulating FMAs, the role of FMA holders in management, planning, and operations, and the role of the public in this process are all outlined and discussed. Technical aspects of forest management, environmental impact, wildlife management, and reforestation are also discussed. This report considers the variety of resources and resource users on the forest landbase and the impact of forestry development on them.

2.4 Major Public Concerns

Concerns addressed in this report focus primarily on four major areas, in order of perceived public, scientific, and technical concern:

1. Forest Management:
   - Reforestation;
   - FMA planning process;
   - Harvest techniques;
   - Disposition of timber;
   - Sustained yield;
   - EIAs for forest operations;
   - Integrated resource planning;
   - Enforcement and regulation of industry; and
   - Access control and public use.
2. Fish and Wildlife Management:
   - Access and overhunting;
   - Habitat;
   - Impacts on fisheries;
   - Rare and endangered species; and
   - General impacts.
3. Environmental:
   - Environmental impacts;
   - Use of herbicides;
   - Soil erosion;
   - Protection of ecosystems;
   - Climatic change; and
   - Technology options.

4. Social and Economic:
   Public involvement in land allocations and resource management decisions;
   Effects on trapping;
   Quality of life;
   Tourism;
   Recreation and aesthetics; and
   Foreign ownership.

2.5 Panel Members

The expert panel on forest management has four members of varying backgrounds and expertise.

Lorne Brace is a forest research scientist with Forestry Canada. He is a boreal and mixedwood silviculturist.

John Stelfox is a wildlife research scientist who was with the Canadian Wildlife Service and the Alberta Fish and Wildlife Division. He was responsible for initiating and continues to be involved in studies on the relationship between wildlife and timber harvesting in the Hinton region.

Bob Udell is a professional forester and is in charge of forest planning for Weldwood Canada at Hinton. Weldwood has a comprehensive forest management program and, under his direction, is the first company to formally participate in an integrated forest resource management system in co-operation with Alberta Forestry, Lands and Wildlife.

Bruce Dancik served as chair of the expert panel. He is a professor and currently the chair of the Department of Forest Science, University of Alberta. He is a forest scientist specializing in genetics and ecology. In 1978-79 he chaired the Environment Council of Alberta forestry panel that undertook public hearings and made recommendations on the environmental effects of forestry operations in Alberta.

2.6 Development of the Expert Panel Report

In early 1989 the minister of Forestry, Lands and Wildlife called a series of open houses and public meetings to answer questions and convey information about recently announced forestry developments and the role of the Department of Forestry, Lands and Wildlife in management of Alberta's forests, public lands, and fish and wildlife resources. These meetings were organized by the staff of the Alberta Forest Service in the Peace River, Grande Prairie, Lac La Biche, Whitecourt, Slave Lake, and Athabasca forests. Meetings took place in more than 40 communities in northern Alberta and also in Fort Smith, N.W.T. The panel attended a few of the public meetings. The remainder were attended by staff of the consulting firm Concord Scientific who recorded the questions and concerns raised by the public, both in the meetings and through written response on distributed questionnaires (see Appendix II) and provided the panel with its report (1989). Concord Scientific also provided the panel with analysis of local, regional, and provincial newspaper articles covering the period June 1988-May 1989 to provide information on public

opinion. The panel met to consider these public concerns regarding forest management and to evaluate current forest management practices.

The development of this report included meetings with employees of the Department of Forestry, Lands and Wildlife to discuss management and policy issues and environmental concerns. It is recognized that bureaucratic and organizational constraints, even if well intentioned, sometimes limit the ability of department staff to manage the resource in the best possible way. Even with similar management objectives and an equal understanding of the resource, value judgments by different employees may result in a variety of responses, some of which may be better for the resource than others.

3.0 REGULATORY AGENCIES

3.1 The Role of the Alberta Government

With few exceptions, the public views employees of Alberta Forestry, Lands and Wildlife as stewards of the resources in the Green Area and expects them to fulfil this role in all aspects of public land management. The panel appreciates the dedication of department staff in attempting to fulfil this role under difficult conditions of underfunding and short staffing.

Plans for rapid expansion of lands under FMA disposition, from three million hectares in 1986/87 to a projected 19 million hectares in 1997/98, have coincided with recent announcements of budget cuts in the department. This situation has raised doubts about the ability of the department to do an adequate job of stewardship on FMAs and Crown forest management units.

In general, new FMAs are established with higher standards for all aspects of forest management than were older FMAs. Industry is responding by adding staff or contractors to enhance management—for example, through supplementary inventories, juvenile stand surveys, training programs for operating staff, and integration of forestry and wildlife planning. This challenges the department to provide equivalent stewardship on Crown forest management units, but this has been limited by inadequate staff and budgets.

The Fish and Wildlife Division has the mandate for wildlife (including fish) management on both forested and non-forested lands, and is dedicated to stewardship that includes the forest ecosystem as a whole rather than particular species or habitat types. However, the small regional and headquarters staff of biologists is already fully committed to day-to-day wildlife management responsibilities. This deficiency was made clear in the division's submission to Fred McDougall (1987b), then deputy minister, and also by the public, as summarized in the Concord report.

By almost any measure, the division has been understaffed and underfunded; new biological staff must be added and funding increased. Some reorganization within Fish and Wildlife may also help to handle these increased demands; for example, there may be some overlap of responsibilities between the wildlife management and habitat management sections. There also appears to be little interaction between biologists and enforcement staff.

The panel is aware that department staff and funding necessary to address essential management responsibilities on both FMAs and Crown forest management units are declining. We have particular concern about loss of experienced staff. The result is that existing inadequacies can only worsen, including poor application and supervision of timber harvest planning and operating ground rules, and failures to deal with referrals in a timely and effective manner, particularly at the annual operating plan level. Requests from other government bodies for Fish and Wildlife input into decisions must often be processed too quickly, with insufficient attention, or are unduly delayed because of shortfalls in staffing.

There is a clear need for immediate action to increase staff and funding levels, and to improve career opportunities and long-term staff commitments by increasing the number of permanent positions.

The government has a number of choices in facing this combination of staff and funding shortage and increased demands including:

1. Maintaining the *status quo,* with the department attempting to perform its management responsibilities with grossly inadequate information, personnel, and funding; and basing management decisions on guesses, assumptions, and limited knowledge from other parts of the world;
2. Increasing the department's budget and staff to address the deficiencies;
3. Relinquishing some department responsibilities such as fish and wildlife inventory, planning, and management to FMA holders, with the department co-ordinating and supervising the work; or
4. Developing an effective integrated resource management program that incorporates the capabilities of Fish and Wildlife, Alberta Forest Service, FMA holder staff, and competent contractors in all areas of inventory, planning, management, monitoring, and research.

The panel believes the fourth approach is most appropriate. Staff should have a broad background in ecology to ensure an integrated approach; Alberta educational institutions should respond to this need by providing the appropriate broad-based academic preparation.

Recommendations:

1. **More staff, particularly professional and technical positions in government and relevant support groups, should be provided, especially in those forests where rapid expansion of FMAs is underway or anticipated, to a level that will allow the department to meet FMA-related stewardship obligations. Increasing the**

number of professional staff will be of little value unless accompanied by adequate funding to allow these specialists to perform their duties effectively.

2. The department should ensure staffing levels and budgets are adequate to provide a level of inventory, management planning, and operational and reforestation control on Crown forest management units it administers that is at least equivalent to such practices on the best-managed FMA lands in the province.

3. Based on these recommendations, the panel feels that a staff increase of at least 150 is appropriate. At least 15 should be professional and technical wildlife and fisheries personnel. Most of the remainder should go to the forests where new developments are occurring, with emphasis on areas that are currently understaffed, such as hydrology and environmental controls. These increases should be phased in over the next three years.

4. The level of co-ordination and integration of forest wildlife activities should be improved so that the Alberta Forest Service, Alberta Fish and Wildlife, and FMA holders can achieve a cost-effective, efficient, and practical system of forest management.

3.2 The Role of the Federal Government

The federal government has both direct (regulatory) and indirect roles in provincial forestry developments. The federal role is direct with respect to specific environmental impacts. For example: the Fisheries Act regulates practices with an impact on fish habitat; the Navigable Waters Protection Act and the Canadian Water Act include water quality management; and the mandate of the Canada Wildlife Act and Migratory Birds Convention Act includes national interests related to migratory species and to rare, threatened, or endangered species (see Section 7.7). The 1989 Department of Forestry Act (Bill C-29) gives Forestry Canada a co-ordinating role in national forestry issues and relies upon close co-operation between all members of the forestry community and the public to achieve improved forest science and technology, better integrated resource management and utilization, enhanced public awareness, and effective national codes and standards in support of sustainable development. Forestry Canada can be requested to provide expert advice to sister federal agecies on forestry-linked issues that may arise under their legal mandates.

Until recently, federal regulatory interests were represented by provincial government departments under special Canada-Alberta agreements, including environmental impact assessments (EIAs). The recent federal court decisions that halted the Rafferty/Alameda Dam project in Saskatchewan for five months and ordered an environmental assessment of the Oldman Dam project have created increased public concern about, and interest in, provincial EIAs covering other projects, including forestry developments. The public is concerned that these may not satisfy federal environment assessment and review process standards. Alberta

has responded with joint federal-provincial public hearings on the Alberta-Pacific EIA and on the cumulative effects of mill developments on the Peace-Athabasca river system to satisfy federal and public concerns.

If mill site hearings were to "spill over" into forestry operations on FMA or quota lands, the federal government would have no legal mandate, but it may have a valid indirect interest. This arises from substantial public concern about environmental and social impacts resulting from massive development plans over a relatively short time, and the tendency of all of us to make no distinction between political jurisdictions where such issues are concerned. It would appear that stressing jurisdictional differences under such circumstances may well be counter-productive to serving the public interest and maintaining public trust in governments as stewards of Crown lands and resources.

If forest operations were examined for environmental impact there would be an opportunity to raise public awareness of the ground-rule (rather than EIA) approach used by Alberta. Ground rules are commonly used to determine the handling of predisturbance watershed assessment, road construction standards, and stream crossings, for example. The flexibility of the ground-rule approach makes it well suited to deal with dynamic forestry operations, while an EIA is more appropriate for mill-related issues. Work is needed to make the public more knowledgeable about ground rules (see Section 9.3).

Recommendations:

5. **Before any development that may affect federal jurisdictions occurs on provincial lands, there should be a process of more effective inter-government consultation, including public hearings where appropriate.**

6. **In the future, public hearings on the environmental and social impact of forest development should not look at mill site and forest operations issues separately. Examining industrial impacts and management issues together will reduce public frustration and help control the high costs of such hearings.**

4.0 THE PLANNING PROCESS

4.1 Forest Conservation Strategy

A National Forest Sector Strategy for Canada (1987) recommended that forest management planning for industrial raw materials and other benefits of the forest should focus on maintaining the long-term dynamics of healthy, stable, and well-balanced forest ecosystems. This emphasis is consistent with the effort to achieve an Alberta forest conservation strategy. The National Task Force on Environment and Economy was developed from the Brundtland and World Conservation Strategy exercises, which identified sustainable development as the central objective.

The national task force urged signatory provinces to immediately bring conservation into all policies and programs, along with full public participation. This task force report has been endorsed by Alberta and it complements the mandate of the Alberta Forest Service, which is to manage Alberta's forest lands to ensure a perpetual supply of benefits and products while maintaining a high quality forest environment.

It was clear at the public meetings and open houses held in 1989 that forest planning and management must include consideration of all land uses and be conducted under sound conservation principles. The government was criticized for not balancing resource exploitation with conservation.

One submission, that of J. Stan Rowe of the University of Saskatchewan, called for a forest conservation strategy for Alberta that plans and screens economic developments to ensure that they can be sustained environmentally, socially, and economically, "not just for the 25 to 30 years it takes to write off a pulp mill, but indefinitely." The strategy should also address concerns about the environment and forest practices in Alberta expressed in recent public meetings (Concord 1989).

The provincial government has promised a conservation strategy for Alberta by 1992 and has been working on a strategy for the forest sector since the early 1980s. A background forestry discussion paper (Renewable Resources Subcommittee, in press, 1990) provides an informative summary of the history and systems of forest management in Alberta and could form the basis of a forest conservation strategy. The paper focuses on various conservation issues relating to sustained forest utilization, administrative and legislative controls influencing forest resource development, socio-economic benefits associated with forest resource use, and barriers inhibiting the achievement of sustainable development. It argues that the need for an explicit forest sector conservation strategy may be particularly acute in Alberta, because of the rapid growth of the forest industry and because there has been no clear definition of long-term development targets, the criteria for government involvement, and the basis for decisions about large timber dispositions.

Alberta already has some of the basic mechanisms required to meet the objectives of a forest sector conservation strategy, including:

1. Programs to consider different resource users in managing and allocating forest resources;
2. A program for forest renewal and protection;
3. Operating ground rules to minimize the impacts of harvesting on the environment;
4. A system of land designation that protects certain areas from resource development; and
5. A system for incorporating public input into decision making.

This background forestry discussion paper called for improved implementation of these mechanisms and for policies, guidelines, and management philosophies to match evolving social priorities, technology, and environmental/economic circumstances.

The Alberta Fish and Wildlife Policy (1982) has been approved by cabinet, although the Alberta Forest Service and Alberta Public Lands Division policies have not. We believe that the three division policies cannot mesh effectively, ensuring integrated forest management, unless they are developed together under the guidance of a parent department policy and a forest conservation strategy.

Sustained Yield Management for Timber and the Alberta Forest Sector Conservation Strategy

The forests of Alberta have been managed under a sustained yield policy since the 1950s when the first forest management agreement was developed. Such agreements have served as models for timber management in much of the rest of Canada. The agreement holder is required to conduct inventories and to prepare detailed forest management plans for Alberta Forest Service review and the minister's approval. Timber harvest planning and operating ground rules describe acceptable practices to be employed in the course of managing the resource and achieving the required sustained yield management.

The present forest management system includes security of tenure, detailed forest management planning, and reforestation requirements unmatched elsewhere in Canada. However, there are limitations to this system, including a failure to effectively integrate strategies for non-timber uses.

This management system arose from a generally sound timber management strategy and is evolving into an integrated resource management system including public input at the planning stage. This is consistent with the principles of a forest sector conservation strategy.

Recommendations:

7. As Canada and Alberta have already endorsed the principles of the World Conservation Strategy and the Brundtland Report, the panel recommends that the government immediately complete the Alberta Conservation Strategy, especially for the forest sector.

8. A draft Alberta forest sector conservation strategy should be reviewed by forest and wildlife research scientists, the Alberta Registered Professional Foresters Association, and the Alberta Society of Professional Biologists before it is accepted.

9. Once the Alberta forest sector conservation strategy is developed, a department policy consistent with this strategy is required. Division policies must be developed that effectively integrate and complement both the department policy and the conservation strategy.

10. The Province of Alberta should clearly state the strategy used to administer the forests, to grant timber supply areas, and to manage all forest resource interests. This management strategy should combine the necessary elements of various acts, regulations, and policies (such as the Eastern Slopes policy) and define its objectives for forest development within the context of the proposed Alberta forest sector conservation strategy.

4.2 Environmental Impact Assessments (EIA) and Forest Operations

As expressed in public meetings and open houses, the public feels strongly that a scientific and independent environmental impact assessment is needed for each forest management operation within the 100,000 square kilometres of proposed forest industrial activities.

In a brief included in the Concord (1989) report, J. Stan Rowe of the University of Saskatchewan observed that the Alberta government seems to assume that providing a pulp mill with wood will be without problems. He wrote that the Canadian Institute of Forestry (Rocky Mountain section) had tried unsuccessfully to get the Alberta government to formulate a well-thought-out forest strategy for Alberta. He argued that such a strategy is essential as a basis for guiding forest

industry EIAs and noted that the Alberta EIA process has been judged to be one of the weakest in Canada, according to the Canadian Environmental Advisory Council.

The panel, however, believes there are fundamental problems with the EIA process that make the standard EIA of limited use when applied to forest management activities, although appropriate for mills and other industrial activities. There is little agreement on the objectives and what should be done at the applied level of an EIA. Thus, no common operational definition of an EIA has emerged beyond the procedural direction provided by government guidelines, policies, and legislation. The practitioners and reviewers have no common reference standards for gauging the ecological requirements or merits of EIAs. Thus, EIAs tend to be comprehensive but superficial. They lack a recognizable investigative design within which ecological relationships can be studied. The EIA process can be compared to a snapshot: satisfactory for a fixed object like a mill or plant, but failing to give a good picture of a dynamic, evolving forest community.

Any environmental assessment should include a review of various environmental values including:

1. Commercially or recreationally important forest resources;
2. Endangered species and wildlife and fish habitat;
3. The quality of the rural lifestyle and the wilderness experience; and
4. Human health and safety.

The panel agrees with the public's concern that any EIA that covers only the impact of the pulp mill is inadequate and that the impact of forest management practices must also be reviewed. However, we believe that, rather than an EIA, what is needed is a dynamic forest management review and monitoring system, including public involvement, that ensures forest management practices are environmentally and economically sound. It should be a continuous and co-operative process, incorporating review, assessment, information, regulation, and enforcement.

There should be periodic reviews by a co-operative team, including an outside forest management specialist, representatives from citizens' groups and from professional forestry and wildlife societies. Forest operation and environmental impact assessment concerns could be handled by two forest management advisory boards, as outlined in the following recommendations.

Recommendations:

11. The dynamic and flexible ground-rule system should be continued, supported by an effort to raise public awareness of its value.

12. Two types of forest management advisory boards should be established immediately:

(a) An Alberta forest management advisory board similar to those already in place for the other two divisions of Alberta Forestry, Lands and Wildlife. This board would periodically assess and advise the government on its forest management

strategy and matters such as forest policy, planning, management, ground rules, inventory, and staffing at the provincial level.

(b) Regional forest management advisory boards for each forest region that would address forest management concerns and work closely with the provincial advisory board. These boards would be made up of public representatives from various interest groups, plus professional, government, and industry personnel. Because many industries have an impact on forest ecosystems, there should be representation from all major industries active in the region.

13. A forest management review panel should be established immediately, to periodically (at 10-year intervals, for example) assess forest management in light of changes in forest technology and public values and attitudes. This panel should be established by the Environment Council of Alberta, in order to remain independent from the Department of Forestry, Lands and Wildlife and from industry.

5.0 TECHNICAL ASPECTS OF MANAGEMENT PLANNING

Our forest land management and silviculture systems can no longer be judged in terms of sustained fibre yield alone. We need explicit goals at the initial planning stage to sustain all resources on the land.

The public is concerned about the reliability of forest inventories and the preparation of the management plan itself. A reliable estimate of the volume and growth of forest stands is fundamental to the accurate definition of sustainable harvest levels for any FMA, the definition of the production forest landbase and the choice of a rate at which the forest will be harvested and replaced with new regenerated stands. The management planner stratifies the landbase into a priority sequence for harvest and renewal and calculates the level of harvest that is sustainable into perpetuity (the annual allowable cut or AAC).

This approach to landbase determination is applied in Alberta, and is technically sound and appropriate. Errors may arise in its implementation, but the approach is better than that used in many other jurisdictions.

5.1. Inventory

Phase 3 Inventory

The inventory used as a basis for most of the new developments is the provincial inventory, or the Phase 3 Inventory. This inventory, begun in the early 1970s and essentially complete by 1984, is the latest forest inventory of the Green Area, taken from aerial photo interpretation supplemented by some ground surveys. It serves well as a provincial inventory but when it is applied to the management unit level, problems can arise that may require definition and recalibration to adjust the inventory tables to reflect local growing and stand conditions.

Because it was a provincial inventory, field checking of inventory accuracy was often inadequate for local application. The inventory did not provide any habitat information and the site classification was rudimentary at best, relying largely on the interpreter's opinion and experience.

Problems arising from inadequate inventory data in conifer management planning can be expected to be amplified where mixedwoods and hardwoods are concerned because of lower-intensity sampling and less accurate Phase 3 Inventory for hardwoods. Because the accuracy of inventory data has an impact on all subsequent management planning, and deciduous allocations from mixedwood and hardwood stands are proceeding rapidly, there is a special need to upgrade this aspect of the inventory and to keep it current.

In the early years, no attempt was made to distinguish hardwood species, because hardwoods were viewed as weed species. In later years, steps were taken to redress this deficiency and enhance the inventory through an upgrading of the photo interpretation process. In spite of this, the Phase 3 Inventory still does not differentiate between hardwood species with any precision. To be fair, this differentiation is very difficult for even the most experienced photo interpreter. In spite of this difficulty, where aspen is harvested the inventory must be upgraded.

There are special needs for improved inventories of understory white spruce in deciduous and mixedwood stands, as the valuable understory is jeopardized by harvesting of hardwood overstory trees. The problem with this inventory is the difficulty of finding a photo interpreter who can see through trees. The Phase 3 Inventory photos were taken during the summer when trees are in full leaf. Some attempts at upgrading this information are underway, including the interpretation of Landsat imagery and photography taken when the trees were bare. Much of the upgraded information must rely on field checks.

The Alberta Vegetation Inventory (AVI)

In the mid-1980s, Forestry, Lands and Wildlife, facing the need to develop inventory information for the White Area of the province, began to develop a new vegetation mapping standard, the Alberta Vegetation Inventory (AVI), to satisfy the information needs of all three divisions — the Alberta Forest Service, Public Lands, and Fish and Wildlife.

The AVI was applied to a test area of 65 townships in the White Area. When the test was completed and the costs and results analysed, the department was satisfied with both the results and the costs of the expanded inventory. In 1989, the program continued with 543 whole or part townships scheduled, mainly in the White Area, but also including almost 2,000 Phase 3 map sheets in the Green Area.

In 1988, the department convened a meeting of FMA holders to discuss an upgraded inventory approach, based initially on the AVI standards. They saw a need to define a uniform approach to vegetation mapping before the White Area AVI was completed and the Green Area AVI was done.

Geographic information systems have now made it much easier both to share mapping and attribute information by means of computer file transfers. In 1989, a steering committee of senior AFS and industry personnel was established to look at the practicality, cost, and data sharing possibilities of an AVI for the Green Area. A task force of industry and government mensurationists and forest/wildlife managers was formed for technical review and revisions of the AVI standards to match them to the information needs of the forest manager. This work is nearing completion;

standards appear to have been set and agreed on by all parties. The information now supplied by the AVI includes wildlife habitat, shrubs, understory, slope, aspect, moisture conditions, ecoregion, forest type, height, and density.

There has been some suggestion that the AVI interpretation should include biogeoclimatic site classification, but including such information would be grossly inaccurate and prohibitively expensive. Biogeoclimatic site classification, as discussed elsewhere in the panel report, is not designed for mapping and is most useful for stand-level operational and silvicultural planning and decision making — preferably before operations begin in an area. If an ecological classification is desired in the AVI then the best source would be the existing ecoregion maps (Strong and Leggat 1981).

Wildlife and Fisheries Inventories

Wildlife inventory and management was a concern expressed in both public meetings and questionnaires. Specifically, the public questions the capability of the Fish and Wildlife Division to monitor wildlife populations and enforce regulations to protect wildlife (Concord 1989). The question is often heard: "How can you manage wildlife when you don't know what there is?"

A thorough and proper inventory is needed to establish a biological baseline for a fisheries and wildlife mitigation plan including a monitoring, regulating, and reporting program.

Fish and Wildlife agrees that its inventory is inadequate, especially for non-game species. In fact, in 1987 it summarized the problem by stating that:

> The current resource information base is seriously deficient, resulting in allocation and management decisions that are difficult to defend... The Fish and Wildlife Division is frequently frustrated in its decision making by a fragmented and incomplete picture of resource supply, demand, and use. Increasing public and political demands for improved precision in the allocation of the resource to consumptive or non-consumptive benefits requires that the division have a much more complete and precise information base to work from than is currently available... (Alberta Fish and Wildlife 1987b)

The report pointed out that the division has never had comprehensive substantive inventory programming, comparable to the Alberta Forest Service's phased forest inventory programs or Alberta Agriculture's soil surveys. Fish and Wildlife inventory efforts have been, and still are, largely restricted to project-specific, localized initiatives designed to meet short-term needs. Most existing resource information available to the division is in widely scattered, variable-format, manual files and maps that are cumbersome and time-consuming to access and maintain.

Wildlife inventories present special problems not encountered in timber inventories:

1. **Complexity** — there are over 400 wildlife species, most of which are deemed important to society, while timber management is concerned with 15 to 20 tree species;
2. **Mobility** — wildlife species are mobile and require inventories for each season to determine seasonal abundance and distribution for each forest area;

3. **Population fluctuation** — compared to forest vegetation, wildlife populations are subject to greater fluctuation, and are more difficult to census and less well understood scientifically. Therefore, an adequate inventory program requires more time; and

4. **Priority management** — any type of forest management will impair some species while benefiting others. Because most wildlife values to mankind are aesthetic and non-consumptive values, it is difficult to assign relative values to one species over another. However, the public has expressed a definite preference for some species (Phillips et al. 1977; Alberta Fish and Wildlife 1982b).

The Fish and Wildlife Division has determined wildlife habitat requirements for specific big game and game bird species plus furbearers on a province-wide basis. The division is also cooperating with the Alberta Bird Atlas Project to improve inventory of non-game bird species. It recently prepared a draft strategic plan for major wildlife species for the period 1990-1995. However, wildlife management plans and species priorities have not been developed on an FMA basis except for the Weldwood FMA and to some extent for the Procter and Gamble FMA. Until this is done, and population goals (provincial, regional, special area) are developed for both game and non-game species, the wildlife component of management plans will be superficial and ad hoc at best.

The overall Fish and Wildlife objective is to create and maintain a variety of timber stand types and ages, dispersed to meet habitat requirements of most wildlife species and to maintain acceptable population levels. There are also specific objectives to maintain rare, threatened, and endangered species and their habitat in key wildlife areas, ungulate habitat, and a diversity of wildlife habitats. There are no specific plans for accomplishing these objectives for each FMA, although some are in progress. There is also no definitive plan to ensure that an adequate inventory tailored to the wildlife management goals of game and non-game wildlife species and their habitats will be done to complement the timber inventory before forest management plans are approved.

The Fish and Wildlife Division has limited capability (biological staff and funding) for specific forest wildlife management studies and inventory. The greatest effort has been expended in the pilot study in the Weldwood FMA but even there, the regional habitat biologist has insufficient time for the ground surveys required to make rational decisions.

Past fish and wildlife inventories have consisted of sporadic surveys of populations and distributions of specific game species for those forest areas receiving the heaviest harvest. Based on these survey results plus supplementary abundance/distribution information from other government and non-government sources, Fish and Wildlife (1984) released a public document that provided cursory information on abundance, distribution, and population goals for most wildlife species in 1980. That information was updated to 1988 (Fish and Wildlife 1989). This document also provided information on headquarters and regional management priorities for habitat, animals, and people. It also compared trends in populations, habitats, and harvests between 1980 and 1988.

In addition to cursory wildlife data, Fish and Wildlife worked to develop a systematic procedure for quantifying the current and future status of wildlife populations and their habitats. The province was divided into 12 wildlife habitat

regions and 278 subregions, on the basis of climatic and biophysical information (Pedocan 1985). For a few areas, species-habitat relationship studies were conducted to provide baseline information for integrated forest management.

Additional habitat information could be obtained from the Phase 3 Inventory and the new Alberta Vegetation Inventory (AVI). The AVI should cover the entire forest region affected by all forest activities, including the forest industry.

There should be integrated inventories of all resources on forest land by teams representing the various natural resource disciplines. Forest wildlife inventory and management should also include the identification and rehabilitation of rare and endangered species. Wildlife inventories of each forest management unit within an FMA must also be structured to evaluate important habitat requisites such as food, water, cover (escape, hiding, nesting, brooding), and shelter from inclement weather for high-priority wildlife species. These inventories should also identify any critical habitats for preferred wildlife species that will be seriously affected by clearcut logging so these habitats can be deleted from annual allowable cuts or logged by alternative systems having little or no negative impact.

Once wildlife species and their habitats are adequately inventoried on a seasonal basis, a minimum wildlife community must be defined on the basis of the levels of species diversity, density, and distribution necessary to retain the basic integrity of that community. Currently, there are no policy guidelines for a specific wildlife community that should persist during and following forestry operations. Multiple-use management of forested land is deficient not from lack of policy — the concept of multiple-use is acknowledged — but rather from lack of practical application of the policy. The staffing deficit in Fish and Wildlife is one part of the problem. The tendency of some officials to see the Forest Service as having an exclusive mandate to manage the forest and associated resources is another.

A specified minimum proportion of each forest wildlife community should be identified for maintenance throughout the forest harvesting rotation based on comprehensive up-to-date wildlife resource inventories in FMAs and supported by desired target levels and quantities of specified forest wildlife species. Minimum desired objectives for population numbers and associated areas of supporting habitat should be established. Forest harvesting regimes should then be planned to try to meet desired wildlife resource target levels and to ensure that minimum levels are more than met.

Recommendations:

14. **Priority should be given to enhancing current inventories for purposes of management planning, especially mixedwood and hardwood inventories, and inventories of the amount and distribution of spruce understories in deciduous and mixedwood stands.**

15. **The Alberta Vegetation Inventory, incorporating information important for the management of both forestry and wildlife, should be extended as rapidly as possible into the Green Area, with priority given to FMAs where there is a commitment to an**

integrated wildlife/forestry management planning process. The inventory should be designed and guided by specialists representing all affected natural resource disciplines.

16. Inventory enhancement techniques should meet management planning needs and information may be more or less detailed than that provided by the Alberta Vegetation Inventory. Enhancement should be done on a priority area basis and restricted to areas designated for operations within three to five years, to reduce costs and to help keep the information current.

17. The department's inventory and mapping process should be extended to include wildlife species-habitat relationships as quickly as possible.

18. The Fish and Wildlife Division in co-operation with other government and non-government agencies should improve its inventory of fish and wildlife populations, including seasonal distributions and habitat requirements over time, especially for priority non-game species for which there is scant information. This should first be done for land under forest management agreements.

19. The government should implement the proposed Provincial Fish and Wildlife Resource Management Information Program.

5.2 Growth and Yield

Development of Yield Information

Using data collected from permanent sample plots and stem analysis, yield tables are developed and adjusted by region. These localized strata, called volume sampling regions, are areas of land where growing conditions and other factors that affect stand development (elevation variation, for example) are relatively consistent. These regions do not necessarily correspond to management unit boundaries. When these volume tables are applied to the Phase 3 Inventory stand listings, the inventory by management unit is developed. Occasionally, errors may arise and some process to detect and correct these errors should be considered.

While the forest inventory approach adopted by Alberta is technically sound, there appear to have been some isolated problems with the development of stand volume tables. For instance, in at least one volume sampling region, the stand volumes associated with the Phase 3 Inventory types appear to be too high by as much as 30 per cent. This discrepancy would have been evident if the volumes had been compared against volumes for the same forest types in adjacent regions. Companies entering into FMAs are required to collect inventory data and prepare detailed management plans based on those data. Problems could arise if shortfalls are identified after the FMA is signed and the landbase determined.

Development of Growth Information

For the mature forest, the technique used by the AFS to forecast growth for annual allowable cut purposes is to prepare an average yield curve which is then used to forecast volume development over time. This approach is appropriate if the yield curve used is representative of the stands considered. One FMA holder, investigating potential annual allowable cuts, discovered a major discrepancy between the stand volume/age information and the volume/age yield curve used for annual allowable cut purposes.

Regenerated Stand Performance

There is little evidence to suggest that new stands developing after harvesting will emulate the characteristics of stands previously occupying the same landbase. There is considerable evidence to suggest that they won't. The juvenile stand surveys conducted by the AFS in the 1980s demonstrated this very graphically (Drew 1988).

One of the most pressing needs in Alberta is for the development of reliable estimates of regenerated stand growth and yield. In the absence of such estimates, FMA holders are instructed to use yield tables reflecting stand distributions in the original forest as a basis for the projection of regenerated stands in annual allowable cut modelling. Technically, this cannot be supported because the regenerated stands will not duplicate the original forest.

Regenerated stands seem to be more productive than original stands, but we cannot yet forecast by how much. In spite of promising indications of enhanced growth performance in regenerated stands, there are many factors that can impair that performance. Studies by Forestry Canada have indicated that regenerated stands may be affected by insects and disease at proportionately higher rates than are fire-origin stands (Ives and Rentz 1988). Studies by the AFS show that as much as 38 per cent of stands once considered sufficiently regenerated have reverted to an NSR (not sufficiently regenerated) status, largely as a result of vegetative competition (Drew 1988). Research in British Columbia indicates some promising results from non-chemical control of competing vegetation, including the use of mycoherbicides.

There is a powerful incentive for forest managers to quantify anticipated growth increases from regenerated stands. This incentive, referred to as the allowable cut effect, provides for an early harvest of this extra volume if merchantable stands are available to sustain the allowable cut until the new rapidly growing stands are merchantable. Conversely, if growth decreases for reasons such as poor reforestation, excessive competition, fire, or insect damage, the allowable cut will decline.

Site Classification

Height/age site index is currently the functional site-related link between forest inventory and mensurational aspects of forest management planning in Alberta. This site index system uses the dominant height of the 50-year-old stand (age measurement at 1.3 metres) to place the stand on a growth trajectory that will forecast its future height development. It is easily assessed and has served well for purposes of extensive forest management. Once stands, both fire-origin and regenerated, are established and growing, it provides a reliable indicator of future stand performance and volume yield. However, a more refined measure of site defined within an ecological framework is needed for more intensive forest management planning and operations including non-wood products and services.

In 1977, a program to establish an ecologically based (biogeoclimatic) site classification framework was initiated in Alberta. Work has now been completed for a major section of the Green Area in west-central Alberta and is just being completed for the southwestern area. However, it does not cover a significant amount of the mixedwood and hardwood areas currently designated for new development. This system provides a taxonomic key that allows the trained user to classify forest ecosystems or site types in the field and make interpretations of productive capabilities and constraints. For example, the system can be used to predict the impact on soil of logging equipment, to predict silvicultural treatment responses, and to extrapolate results from one area to another.

The biogeoclimatic classification system is particularly suited to on-site assessments at the stand and cutblock level for purposes of intensive timber, wildlife, water, and recreation management and operational assessment. This system is currently used in B.C. to develop pre-harvest silvicultural prescriptions that are now required by law. Similar work is also being initiated in Ontario (a pre-cut survey using the Northwestern Ontario Ecosystem Classification). This system is not a mapping technique and is not, therefore, easily compatible with geographic information systems (GIS) computer technology. However, using this system, sketch maps can be developed for stands or cutblocks to fine-tune treatment prescriptions or assessments and subsequently can be used as input to GIS.

Primary limitations to its use in Alberta appear to be lack of coverage, lack of maps, incompatibility with GIS, difficulty in applying it to non-forested areas, and lack of testing and training programs for its application. Some attempts have been made to link biogeoclimatic site classification to measures of forest productivity, but the results to date have been inconclusive.

In 1989, the department initiated a forest site classification GIS pilot project aimed at testing an alternative to the biogeoclimatic approach. The project was aimed primarily at providing maps and decision support tools for use by the AFS managers. The map products show forest productivity, intensive forest management priorities, reforestation potential and prescriptions, and soil erosion hazard, all developed from available digital and mapped data. The results of this GIS pilot project are still inconclusive though considerable potential has been demonstrated. Map products do not provide cutblock resolution desired by field foresters. There is a need for continued work using more refined objectives from end-users and a database that reflects ecosystem units such as those available in the biogeoclimatic classification by correlating them with mapped information including soils, cover type, and topographic data.

The GIS approach seems to show particular promise for developing planning tools for managers. It is less an alternative than a complement to an ecological site classification framework that provides on-site decision making and assessment capability at a scale and cost not feasible for a map-based system like GIS.

Growth and Yield Research

Reliable estimates of fibre volumes and characteristics depend on good information about what is growing now, how it will continue to grow, and what it will yield. Growth and yield research focuses on the latter two.

Traditional inventories are static representations of dynamic systems and require frequent, costly upgrading to keep them current. Change is particularly rapid in regenerating stands. There is considerable potential for introducing a dynamic

element into the process by developing growth and yield models. Such models can have particular value in regenerating stands, especially mixedwoods, for defining relative growth trajectories, competition status, and yield implications.

Some parts of the forested area are characterized by a preponderance of older, even-aged forest stands. It will take up to a century for some FMA holders to harvest all original stands before harvesting any second-growth forest. As a result, in some areas, the average age of the forest harvested will continue to increase throughout the first rotation. It is vital to the stability of the industry that any future reductions in fibre quality and quantity resulting from the increasing harvest age be identified so that plans can be adjusted to cope with these changes.

FMA holders have been asked to adopt arbitrary growth performance assumptions that cannot now be validated for regenerated stands. To date and for the foreseeable future, the forecasting of regenerated stand performance can only be achieved by predictive modelling. Modelling must be supported by the installation of a replicated system of field trials. Such trials should be designed and used to calibrate suitable models, preferably distance-dependent tree-stand simulators, some of which are currently available, and to compare regenerated stand productivity with that of the previous crop.

It will take some time before these trials will have developed to the point where they provide substantial information. In the meantime, analysis and enhancement of existing permanent sample plot data from regenerated stands on existing reforestation areas could help get the program started. There is an extensive data file of such plots, spanning 30 years of reforestation activity, primarily on Weldwood's Hinton FMA. Considerable analysis has shown promising trends in regenerated stand performance (Udell and Dempster 1987). If forecasting can be refined, the methodology and, to a degree, the results, can be applied to the newer FMAs.

It is important to realize that any forecasting effort must be integrated with a comprehensive system of juvenile stand surveys aimed at linking initial establishment practices with stand conditions that can be projected to maturity.

Organizations such as MacMillan Bloedel and the Research Branch of the B.C. Ministry of Forests (Mitchell et al. 1989) are developing, adapting, and validating microcomputer-based managed stand models to link the growth performance of regenerated stands to the technique of stand establishment. This will be used as a guide for both long-range planners evaluating the effects of management alternatives and for field staff choosing the type of reforestation for a given condition. More recently, two established Alberta FMA holders have embarked on a co-operative project to develop the same capability for their areas.

Recommendations:

20. Stand volume tables for various volume sampling regions should be reviewed and compared against one another. Significant differences should be resolved by field sampling and analysis.

21. Actual volume/age data should be compared to the average yield curves for various volume sampling regions before these curves are used to develop annual allowable cuts. Where

discrepancies exist the average yield curve should be re-calibrated.

22. The use of arbitrary yield tables for regenerated stands should be discontinued. A significant research effort should be directed toward establishing reliable estimates of regenerated stand growth performance and yield, and developing models that simulate performance and project future growth. These should be combined with accurate inventories of regenerated stands and incorporated into timber supply and annual allowable cut models. Until these yield tables are developed, forest management planners should continue to use natural stand yield tables, applied to existing stand conditions and distributions in the regenerated forest.

23. The biogeoclimatic system offers particular utility for stand-level silvicultural decision making, but should be subjected to detailed field testing in west-central and southwest Alberta in coniferous, mixedwood, and hardwood stands. This is required to demonstrate its utility and limitations for application at the stand and cutblock levels before it is extended to other parts of the province.

24. A staff training program should be initiated for the AFS field staff to adequately test the substantial existing biogeoclimatic database for purposes of developing pre-harvest silviculture prescriptions. If the approach is feasible it would enhance the manager's capability to meet operational demands for more intensive forest management.

25. If the biogeoclimatic system proves useful the department should initiate research and development to adapt this system to the classification of recent cutovers and juvenile stands by supplementing the existing database on successional trends.

26. The department should continue the GIS site classification pilot project using better-defined objectives and a database that reflects ecological information currently available only in taxonomic keys.

27. Early attention should be given to testing and scientifically forecasting the growth and yield of stands regenerated under current management practices.

28. Two research priorities should be addressed in natural stands (usually of fire origin):

    (a) Developing the means to forecast trends in stand parameters used for defining the merchantability of stands that are currently unmerchantable; and

(b) Developing information on, and the ability to forecast stability, growth, and decline in, older cover type/age-class combinations.

29. **Recent developments linking regenerated stand performance to silvicultural decision-assistance models appear to hold promise for Alberta. The province should continue and expand its efforts to develop similar capabilities in Alberta.**

5.3 Allowable Cut Determination

A commonly expressed concern at the public meetings was sustainability of the proposed harvest levels. People were concerned that Alberta would run out of wood. This does not appear to be the case for long-term wood supply, for two reasons:

1. In spite of the problems that could be revealed by localized interpretation of Phase 3 Inventory data, new FMA holders have so far, through analysis of available and supplementary forest information, been satisfied that their resource base is sufficient to provide an adequate, sustainable and economic supply of wood as required by the sustained yield policy of the province.
2. Observations and research on regenerated stand performance in older cutover areas of the province indicate that their growth performance will outstrip that of the original stands they are replacing, providing new stands are kept free from competition and are free growing (Udell and Dempster 1987).

At Project Design Stage

Preliminary estimates of annual allowable cut for the new and proposed FMAs were based on the management plans and approved annual allowable cuts developed for the Crown forest management units in the area. Deductions were made for identified timber commitments and any other landbase dedications. In the panel's opinion, this was a reasonable approach to the preliminary determination of annual allowable cuts, although reservations are expressed elsewhere in this report over provisions for upfront planning for future landbase deductions (see Sections 5.4, 6.4, and 6.5).

At Management Planning Stage

FMA holders are required to conduct any necessary inventories fundamental to the preparation of their management plans. Some conduct independent inventories that disregard the Phase 3 Inventory, others use the Phase 3 Inventory, supplementing it with local enhancement to improve its reliability for management plan purposes.

Deletions/Adjustments for Non-timber Resource Use Demands

Demands continue for other uses of forest lands previously committed to timber production within FMA boundaries. The panel recognizes that commitments have been made for fibre supplies, but there may be other legitimate land uses to be considered. The forest sector conservation strategy currently being considered for the province is based on the principle of wise and sustainable use of the forest resources. To sustain their allowable cuts, FMA holders want to maintain the integrity of their production forest landbases. At the same time, many recognize the importance of integrated resource management as one means of maintaining their

rights to manage the forest and are rapidly incorporating integrated resource management principles into their plans and operations.

Stratification of the Landbase

Although an FMA may be divided into prime use designations under the integrated resource planning process, the management forester and the habitat biologist may decide that further stratification of the landbase is necessary. Within a zone classified as prime use for forest production, for example, there will still be areas that are sensitive and important for wildlife production. Some new timber harvest planning and operating ground rules recognize this further stratification and are specific about how the forest is treated within those strata. For example, one area of the FMA could be zoned for preservation of woodland caribou habitat. Here, rotations might be longer, cutblocks smaller, and a three-pass harvest system or a two-pass system with long periods between passes might be appropriate. In another area, fibre production could be given highest priority, and the prescription could be intensive management, including short intervals between cuts, plantations with improved stock, and vegetation control.

Stratification offers the advantage of focusing special measures, which are often expensive, where they are necessary and will do some good. It also recognizes the suitability of more intensive forestry practices where special needs are not present and where forest harvest and renewal are the primary objectives of the management system, as described in the approved forest management plan.

Impact of Future Deletions

The protection of fish and wildlife habitat, including old-growth forests, is of great public concern. No provincial strategy exists for the designation and management of old growth, but when developed, such a strategy is likely to result in landbase reductions from timber production.

The final calculation of allowable annual cut for each new FMA has not, as yet, been tabulated. A tentative annual allowable cut has been identified through the review and combination of existing inventory data from overlapping Crown forest management units, each with its own annual allowable cut. New FMA holders must now refine existing information, collect additional inventory information and develop a new annual allowable cut for their production forests.

In setting aside landbase for each new development, the Alberta Forest Service has made allowance for other prime uses where identified. The preliminary annual allowable cut reflects the reduced landbase. There has been little if any attempt to anticipate and make allowance for future landbase deductions from the production forest such as old-growth or wilderness reserves. The new FMA holder negotiates a landbase on which the annual allowable cut is not completely defined. There is no allowance for land replacement if inadequacies in the annual allowable cut estimation are revealed, and no opportunity to satisfy future demands for withdrawals from the landbase. In the past, FMA holders had the flexibility to accommodate such demands from adjacent forest lands that were designated for that purpose.

The present system of trying to accommodate unanticipated requirements for blocks of mature and old-growth forest after FMAs have been approved is ineffective. It places the FMA holder, the government, and the advocacy group in the position of trying to accommodate new forest land use requests from lands already assigned to the annual allowable cut landbase.

If a reserve area (the panel recommends 10 per cent of the landbase) were included within each FMA, it would act as a bank from which annual allowable cut landbase could be allocated to replace deficiencies in annual allowable cut estimation or land withdrawals that are beyond the control of the FMA holder (e.g., to meet wildlife habitat or wilderness needs). There is little opportunity to establish such reserve areas for the new FMAs, since they are often contiguous. Where such opportunities exist, however, these reserves should be established.

Regenerated stand growth performance is generally better than that of the original forest (with the qualifications mentioned in Section 5.2). This improved growth would increase annual allowable cut (see Section 5.4) and could partially offset future landbase reductions. The extent of the offset would depend on the proportion of free-growing regenerated stands in the remaining annual allowable cut landbase.

There is an attempt to respond to public concerns about the management of old-growth forest on the basis that large areas of mature old-growth forest will be protected in buffer areas, non-productive types such as spruce swamps, non-merchantable forest types, and inaccessible areas too steep to log. These may or may not be appropriate, since they are not the product of a well-thought-out management strategy for old-growth forest.

Old-growth forest is not in a static condition and is inevitably affected by such natural disturbances as fire, insects, and disease. As a result, minimum old-growth requirements will probably change in location and time (see Section 6.5).

Fire Losses

When developing a timber supply forecast for an FMA, the manager must realize that the risk of wild fire is always present and that there are limited means available to mitigate that risk. One approach is to reduce the annual allowable cut to provide a buffer against such loss. Recent investigations, however, have demonstrated that the risk of fire loss increases with the length of time over which the harvest is projected (Dempster and Assoc. 1987). A fire loss allowance is a reduction to annual allowable cut. It therefore extends the number of years required to harvest a given area, and increases the possibility that the forest will be lost to fire before it is harvested.

If a major fire occurs, the annual allowable cut and the management plan must be revised and adjusted for loss of growing stock. Increasingly, fire-killed timber is used in mill processes, and this will offset this loss. For these reasons, the continued application of a fire loss allowance appears counterproductive.

Recommendations:

30. All forest management areas should be assessed for priority land use needs, and stratified accordingly. Within each stratum, management of the priority resource should also embody sound management of secondary resources.

31. FMA holders should seek to develop innovative forest management techniques that will effectively address management needs within different priority zones.

32. **Since optimum fibre production will not be achieved on non-forest priority zones, FMA holders should be encouraged to intensify their forest practices where appropriate within priority production forest zones in order to maintain their allowable cuts.**

33. **In assigning landbase to all present and future forest management areas, wherever possible a reserve area equal to 10 per cent of the total forest management area should be established. This area can be used to replace landbase assigned to other priority land uses in the future (including old growth, see Section 6.5), and to address potential annual allowable cut shortfalls between the preliminary and detailed annual allowable cut determinations.**

34. **Fire losses should not be built into harvest scheduling models, but be accommodated within the periodic management plan revision process. In this revision, historic losses are analysed and the resulting impacts are incorporated into the new timber supply analysis and annual allowable cut estimate. Inclusion of the fire risk allowance in current annual allowable cut development should be discontinued.**

5.4 Sustainable Allowable Annual Cuts

Forestry is a long-term business, and the resource that supports it should be secure.

Many communities in Alberta depend on the forest industry for their economic base. The new developments and the associated growth of small northern communities will add to this dependency. There is a need to provide security of fibre supply from a landbase that is increasingly being requested for and dedicated to other purposes than timber supply. There is a recognizable need to maintain ecological integrity, viable populations of existing wildlife species, and recreational opportunities from the working forest, but there is also a recognizable need to continue the forest's contribution to the economic fabric of its dependent industries and communities.

Jacques and Fraser (1989) estimated the forest sector contributed 834,000 jobs, either directly or indirectly, to the Canadian economy (7.8 per cent of all jobs in Canada). For each 1,000 cubic metres harvested, there were 5.36 jobs created, and the gross domestic product generated was $166,000. The contribution of the forestry sector has grown since these calculations were made. Similar benefits to the Alberta economy can be seen, and tradeoffs that result in a loss of allowable annual cut will have to be evaluated in that context.

The sustainable allowable cut on the landbases assigned to present and proposed developments leaves little to accommodate future demands for land withdrawals. These demands would be easier to accept if the forest industry were assured that no net loss of fibre availability would arise from such changes. Replacement landbase is one strategy for achieving a "no net loss" commitment. The proposed Alberta

forest sector conservation strategy is another. The strategy should help rationalize the management and allocation of resources, and balance conflicting demands.

Recommendations:

35. **Proposed land use dedications that will reduce established annual allowable cuts in working forests should be analysed for their economic and social impact, as well as their intrinsic merit.**

6.0 ENVIRONMENTAL IMPACTS OF FORESTRY OPERATIONS

6.1 Harvesting and Regeneration Systems

In the opinion of the panel, most Alberta forests are suited to some form of even-aged forest management, having originated as relatively even-aged stands following fire. However, there should be a flexible approach to harvesting and reforestation prescriptions, tailored to fit the management goals and situations within which they are to be achieved.

The importance of using the proper harvesting and site preparation equipment for a given area cannot be overstated. For example, certain harvesting equipment such as grapple-skidders can cause severe rutting and compaction on wet upland sites as well as in lowland areas. As operations proceed northward into traditionally winter-operated sites where wetlands are prominent, there is a critical need for harvesting systems that minimize compaction and rutting. This is especially critical if the logging season is extended into the frost-free period. This may happen as a result of factors including high capital costs for equipment, operating problems associated with low temperatures and short days, and the short storage life of aspen, which limits large stockpiles.

The following sections discuss the various harvesting systems that could be practised and their merits and applicability in Alberta.

Clearcutting

There is a perception that clearcutting is a primitive forestry practice. This is not necessarily the case. Clearcutting is a common harvesting and regeneration system throughout most of North America and is used for most of the species of Japan and Europe, particularly Scandinavia. It is often more appropriate than any other method for even-aged early succession tree species such as lodgepole pine and

aspen. While the public perception of clearcutting is of massive harvest areas, the practice includes cuts as small as a fraction of a hectare as well as units of hundreds of hectares.

The forests of Alberta have largely originated following fire. As such, they are generally even-aged, except where hundreds of years have elapsed since the last fire, allowing the forest to have moved through successional stages to approach or achieve the stable or "climax" forest association. The average harvest age used in forest planning is one that is close to the point where average growth peaks and begins to decline. However, clearcutting is not the best method for managing mixedwoods as multi-aged or multistoried stands, nor for meeting such non-fibre-production objectives as the maintenance of adequate habitat for certain wildlife species.

If harvesting and regeneration are to take place in areas designated for prime uses other than timber production, the harvest system chosen should be that which best contributes to the achievement of the prime use objectives for the area. In areas of prime wildlife use, for example, the chosen harvest system may still be clearcutting, but smaller blocks may be used and longer periods between passes, or even three-pass systems may be chosen. Or the shelterwood or selection system could be used to regenerate forests in riparian (streamside) areas while preserving their value for watershed and wildlife.

Choice of a Two- or Three-pass System

The two-pass system of clearcutting can be an ecologically and environmentally sound practice for harvesting and regenerating the principal commercial forest trees of Alberta. (See Figure 1a)

Several people have suggested that the two-pass system be replaced by a system of three or more passes, with longer elapsed time between passes. (See Figure 1b) If the forest age-class distribution could accommodate this approach (and in some cases it cannot), the short-term expansion of road building necessary to develop the FMAs would be expensive. Within 20 to 30 years, every permanent road necessary for access would have to be constructed. This process would normally take 60 to 80 years. This accelerated development could come at some cost in terms of short-term environmental impact and longer-term forest management implications. There would be earlier access to and/or harvesting of some *de facto* wilderness and blocks of old-growth timber. Access control for these areas would become difficult, placing more demands on Fish and Wildlife officers and professionals trying to manage resources as well as more widely dispersed staff. The annual allowable cut for the unit could decline as harvesting priorities shifted and young vigorous stands were harvested while older, slow-growing ones were by-passed. As a result, more landbase could be required to supply the same amount of fibre.

The change to a three-pass system may well be justified in specific parts of an FMA or quota area, and some modifications of layout and cut design within the two-pass system may be adequate in others. In still other areas, a different harvesting and regeneration system, such as shelterwood cutting, may be appropriate.

Current harvesting practices and utilization standards in Alberta result in significant areas of forest that remain uncut for longer periods, or permanently, within harvesting units. These are left for a variety of reasons, including merchantability, age of the stand, accessibility, riparian reserves, wildlife corridors, etc. Some of these deferrals result from changes in the maximum block size between

Figure 1 Cut-block patterns under a two-pass and three-pass clearcut harvesting system.

1(a) Two-Pass Harvesting

1(b) Three-Pass Harvesting

LEGEND

- 1st Pass (or Cut)
- 2nd Pass
- 3rd Pass
- Non-Merchantable Timber, Treed Muskeg, Marsh
- Roads
- Creeks
- Streamside Reserve

Based on actual harvest plan by Weldwood of Canada, Hinton Division.

Cross hatching shows planned harvest blocks by period. Elapsed time between periods is approximately 15 years. The area not shaded represents a variety of unmerchantable forested and non-forested areas that will not be logged. Although not suitable for forest production, they offer a variety of benefits to wildlife.

the initial cut and the second-pass harvest. In the referral process currently used, portions of the landscape within scheduled harvest areas are often reserved from immediate harvest to accomplish other objectives in the integrated management of resources. As a result, the so-called two-pass system is very seldom that and could more properly be viewed as a modification of the three-pass system.

FMA holders in some cases have voluntarily accepted other harvesting systems such as the three-pass system. Harvesting plans within caribou winter range areas are an example of this modification. This co-operation is encouraged and should continue.

Block Size

Block size has been identified as one concern associated with clearcutting. The panel agrees that, in principle, block sizes should be kept to a minimum. Often, however, it is not just the size of the block that is at issue, but the total area finally harvested (in a two-pass system) that is of concern.

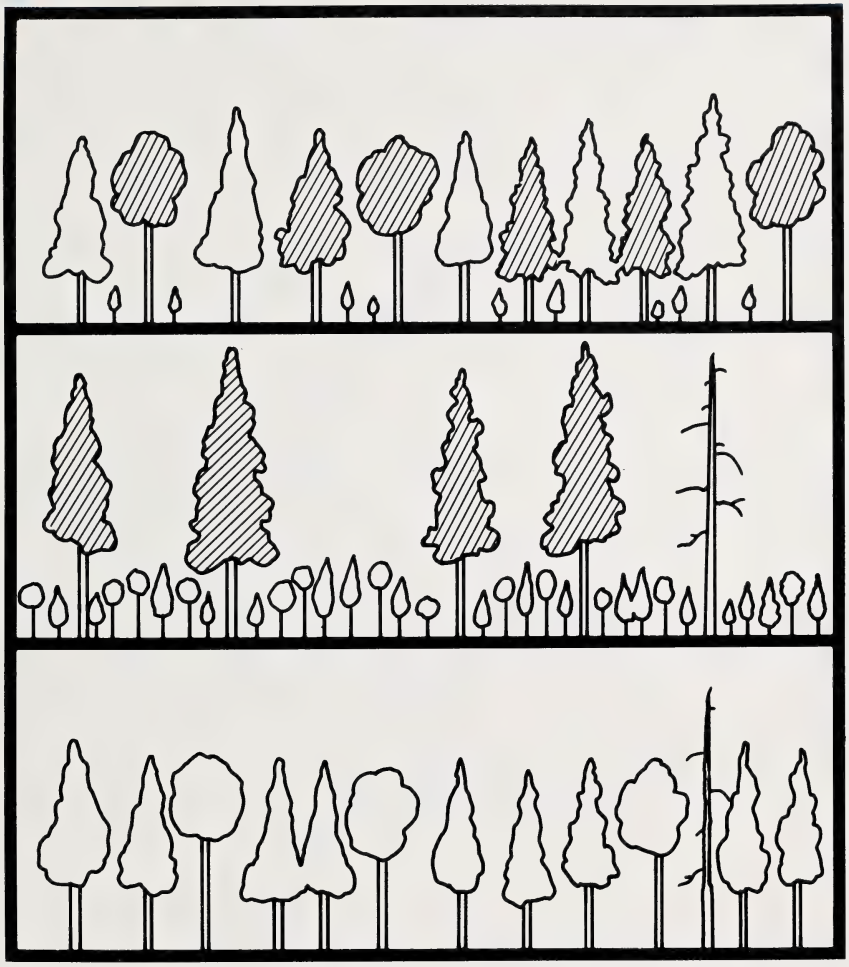
It is important to note that the amount of road developed to harvest an area generally increases as block sizes are reduced. Roads, and stream crossings in particular, are the most common source of erosion and stream sedimentation associated with development. It is important, therefore, to consider all these things when discussing block sizes. The panel believes that flexibility in designing block sizes, within guidelines based on sound multidisciplinary plans, is preferable to rigid block size prescriptions. Block sizes have declined in Alberta during the past decade. In Procter and Gamble's new timber planning and operating ground rules, for example, the maximum block size for pine and hardwood types has been reduced from 100 hectares to 60 hectares. The panel recognizes that there are economies of scale associated with certain ranges of block sizes, and these cannot be ignored. Where forest production is the prime objective of an area, the forest industry should be allowed to choose the most economical block size within the ranges allowed in the timber harvest planning and operating ground rules. Where other uses have priority, block size economies do not have the highest priority, although they are considered.

In multiple-use zones where timber production is a prime use, a number of initiatives have been taken to increase available wildlife habitat through the use of such techniques as type cuts, irregular block boundaries, line of sight limitations, and wildlife corridors. The modifications to the two-pass system discussed earlier also provide some thermal cover and escape requirements. While this may not be the best possible approach from a strictly wildlife perspective, it is a compromise to provide benefits to both uses.

Shelterwood

The shelterwood harvesting system is a method of even-aged forest management that establishes a new crop, usually by natural seeding, before the current rotation is complete. It is done in stages: preparatory cutting to encourage seed production, then major shelterwood cutting, which allows new seedlings to get established but leaves some trees for protective cover, and then removal cutting to take these last large trees to allow the seedlings to grow. (See Figure 2) It is particularly suitable for mid-to-shade-tolerant, windfirm trees, and involves the removal of least desirable species and low-quality individuals first, leaving the best as a seed source and for volume growth until the time for final overstory removal. The shelterwood method is particularly appropriate for maintaining and enhancing wildlife habitat for certain species, protection of erodible areas, and for aesthetics.

Figure 2 An example of the shelterwood system in a boreal mixedwood.



- Shading indicates removal.
- A separate prescription is required for each stand, which could include retention of snags for wildlife and would require specified amounts of supplemental spruce planting and tending, particularly release from aspen competition.

A. Harvest of a proportion of the crop taking most aspen and selected spruce to prepare stand for new regeneration and replace existing advanced spruce regeneration.

B. The regenerating stand ready for removal of remaining larger spruce to encourage growth of younger trees.

C. Regenerated stand returning to condition in "A".

Shelterwood can be adapted to differing levels of management intensity and can be applied in patches, strips, or uniformly over the entire area. In Alberta, white spruce, sub-alpine fir, Douglas-fir and, in some cases, lodgepole pine are amenable to shelterwood management under specific conditions. For shallow-rooted species like spruce that are susceptible to wind damage, it would be necessary to begin such stand treatments as thinning relatively early in the life of the stand to develop wind firmness, if shelterwood is anticipated. The application of shelterwood in areas with priority for timber production is unlikely, because the clearcutting option, with appropriate attention to block size and distribution to achieve even-aged management, is more economical and because the need for a market for substantial volumes of small and/or poor quality material make the shelterwood system impractical at present.

Alberta has practised the shelterwood method in spruce where conditions have permitted (in the Slave Lake Forest, for example). The practice is referred to in the Forestry Act as selective harvest or selective cutting, a term that is also applied to timber stand improvement and usually involves marking of trees to be harvested. This is not to be confused with the negative use of the terms selective or partial cutting referred to below.

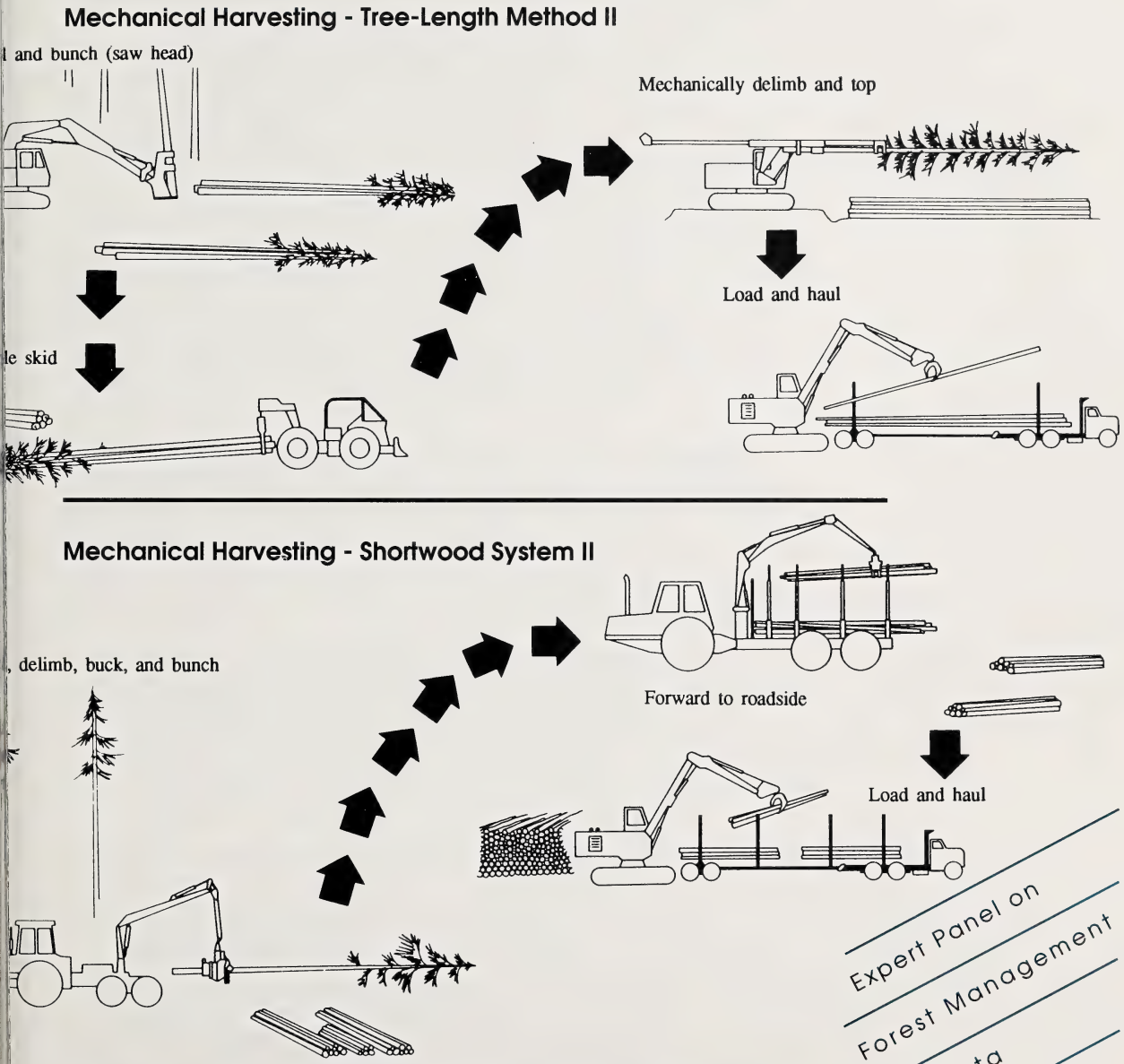
Forestry Canada has experimented with the shelterwood method in mixedwood stands in the prairie provinces over the past 35 years under constraints imposed by a mainly sawlog economy. Uniform two-stage shelterwood showed the most promise. Current harvesting experiments in Alberta to protect understory white spruce while harvesting the aspen overstory are related to shelterwood, and approximate a final removal cut to release the spruce from aspen competition. These experiments, if successful, offer substantial benefits such as the following:

1. By preserving the white spruce understory, another harvest can be taken in 40 to 50 years, instead of the normal 100 to 120 years for white spruce. This can enhance the AAC of the forest;
2. The land is maintained in forest cover, eliminating the need for reforestation under challenging conditions that often require the use of herbicides or expensive manual cleaning to maintain the new crop;
3. The aesthetic appeal of the land is maintained; and
4. Wildlife habitat, including security and thermal cover for big game, can be maintained or enhanced.

The converse to these benefits is the technical difficulty and cost of removing the overstory without damaging the understory, and the challenge of protecting the released trees from windthrow until their root systems can expand to stabilize the trees. Additionally, mixedwood growth and yield models tailored to this form of modified shelterwood management would have to be developed and incorporated into timber supply analysis. Examples of shelterwood use in pure spruce are rare but may be possible if the stands are entered first during early vigorous growth.

The adoption of shortwood harvesting systems that employ low ground pressure tires, carry rather than drag logs, and reduce the need for inblock road and landing construction, will greatly increase the feasibility of shelterwood harvesting techniques in Alberta and have less potential for negative site impacts such as rutting. (See Figure 3)

Figure 3 A schematic comparison of tree-length and shortwood harvesting systems.



The tree length system evolved in North America and is the most common system used in Canada. It is not suitable for all forest conditions, and other systems are being developed for those conditions. The shortwood system, developed in Scandinavia, is one of the new "forest friendly" systems which is rapidly establishing its place in Canadian forest practice.

Selection

Selection is a method aimed at creating or maintaining uneven-aged or multistoried stands of shade-tolerant species by removal of individual trees or small strips or groups of trees at relatively short time intervals so that regeneration can be obtained in at least three distinct age classes — preferably more — and can be perpetuated indefinitely. The trees harvested are usually the oldest and largest, with seed and protection provided by adjacent trees. There is often concurrent intermediate cutting or thinning of associated younger trees.

We are not aware of any true examples of the selection method, experimental or otherwise, in Alberta. It has a place in tolerant hardwood management in eastern Canada and the northeastern United States, particularly in woodlot management; and in areas where high-value individual trees, like black walnut and white oak, are managed.

The selection method — including extensive applications of group selection — is technically complex and costly to apply, and even in Europe is not widely used today. Suitable candidate stands with balanced size and age distribution in Alberta are rare. The more common irregular, uneven-aged stands with three or more age classes, usually composed of species mixtures including spruce, fir, aspen, and poplar, have historically been harvested for sawlogs using "selective" or "partial" cutting, with or without marking of trees to be harvested. This approach — not to be confused with the selection method — has often resulted in removal of the best trees, leaving crooked, deformed, or genetically poor trees to regenerate the stand.

Selection may have limited potential on specific sites that require erosion protection or that must be managed to achieve aesthetic or wildlife habitat objectives. However, even in these areas some form of ~~mod~~ified shelterwood or clearcutting of small blocks or patches would usually be more ecologically appropriate.

Recommendations:

36. **In specific cases where the operational two-pass clearcutting system is in conflict with other important forest land uses — aesthetics, fish, and wildlife habitat, erosion control or other uses — a team of planners/managers with relevant expertise should investigate, plan, and execute a modification to the system, its extension to three or more passes, or a substitution of shelterwood or selection as a means of achieving management objectives.**

37. **In cases where a system of three or more passes is initiated, the environmental impacts on soil erosion and water quality of the additional, early access over a compressed period should be mitigated by special emphasis on application of ground rules and application of special procedures or structures to reduce erosion.**

38. **The logistics and feasibility of large-scale harvesting operations in wetland areas of northern Alberta that have traditionally been**

conducted on frozen soil should be critically examined, with special attention to adopting harvesting technology that uses high flotation equipment to minimize potential long-term site damage.

39. Harvesting systems should be appropriate to management priorities. Where forest management for timber production has priority, the two-pass clearcut system can be environmentally acceptable and appropriate. Where other forest land uses have priority, the normal two-pass system may or may not be appropriate.

40. In areas where timber production is designated as a prime use, the provisions for block size found in timber harvest planning and operating ground rules, and the trend toward smaller block sizes, appear reasonable to the panel. As changes in block size occur, all the implications of those changes, including cost, should be considered. Where other uses such as recreation or wildlife management have higher priority, block sizes should be modified or alternative harvest systems used if appropriate.

6.2 Impact on Watershed and Water Quality

Water yield and quality concerns associated with road construction and timber harvesting in Alberta are addressed in FMA ground rules. The impact should be minor if these rules are wisely applied and followed, but for some new development areas with a high percentage of wetlands, these rules may need special modifications to minimize impacts.

There is a notable lack of water quality monitoring stations in Alberta, particularly in new development areas, and especially in second- and third-order watersheds where the impact of forestry operations is most likely to be felt. This could become an important threat to water quality if severe site preparation activities (the use of the Marttinni plough, for example) are increased to achieve vegetation control in the absence of herbicides. Severe scarification of ephemeral stream areas is a particular source of concern.

The penalty system that covers ground rule infractions provides for a minimum penalty of $100 and a maximum of $1,000, with the ultimate power of operational closure. Current practice is to work with operators to convince them to cease improper operations and clean up problems, and this generally works.

Drainage

Environmental impacts on water quality, soil moisture, and wildlife habitat could be significant if drainage programs in wetlands and peatlands proceed on a large scale. In this context, the term wetlands is used in a generic sense, and includes lands that are characterized by mineral soils and have historically carried commercial forest cover. They are often difficult to regenerate following harvesting because of rising water tables, suggesting drainage as a treatment. Peatlands are areas

characterized by organic soils of varying depths that historically have carried non-commercial forest cover but are seen as potential sources of commercial wood if drained.

The Alberta Forest Service initiated a research program into peatland drainage in 1975 to assess the potential for increasing the conifer wood supply to offset withdrawals of productive coniferous landbase for other uses. It is estimated that Alberta has about 13 million hectares of peatlands, about four million (11 per cent) of which could be suitable for drainage and conversion to productive forest. There are now a total of eight research trials in Alberta, the three most recent being initiated under the Canada-Alberta Forest Resource Development Agreement in 1985. Forest growth data on existing forests and/or plantations and environmental impact data (such as ground temperature, chemical water quality, stream sedimentation, and groundwater table profiles) are being collected on four of the more recent sites. Ditching equipment tests have also been an integral part of these projects (Hillman 1987).

A project underway to develop a wetland classification system for forestry to delineate areas capable of conversion to productive forest and to develop the capability to identify sites subject to post-harvest flooding is still at the research stage (S. Zoltai, personal communication).

The government should review the potential conflict between its wetland drainage program and strategies to reduce the impact of the greenhouse effect on Alberta's forests (see Section 8.7).

Recommendations:

41. **Water quality monitoring should be incorporated into forest management planning and operations on second- and third-order watersheds to provide a database for assessing environmental impacts of forestry operations.**

42. **The potential impact of scarification on soil erosion and water quality, particularly severe scarification to achieve vegetation control, should be assessed with special regard for impacts of scarification on ephemeral streambeds. (This monitoring and research would be made possible by the staff increases called for in Recommendations 1 to 3.)**

43. **Water should be managed on cutblocks to produce or maintain moisture conditions to aid the establishment and growth of new forest crops and for other environmental benefits. This will require pre-harvest planning as well as site preparation planning for on-site water management. The panel believes that in many cases herbicide use will cause much less damage than severe scarification.**

44. **The panel has serious concerns about widespread drainage to convert peatlands to commercial forest. Before any conversion**

is done, additional research should be done on chemical and physical water quality, carbon storage, streamflow, peat subsidence, moisture content of unsaturated zones (above water table) in drained sites, and the impact on wildlife habitat for ungulates, birds, and furbearers. The research should detail all ecological, environmental, social, and economic values of peatlands in their present and converted state.

45. Possible conflicts between peatland drainage and a strategy to mitigate effects of climatic change in Alberta should be assessed (see Section 8.7). Peatlands are a sink for both water and carbon, and probable climate change in the boreal forests of Alberta means that such areas should be maintained to mitigate potential warming and drying trends in the next few decades.

46. In new development areas with large areas of wetland, the adequacy of ground rules for watersheds, road development, and stream crossings should be fully assessed, particularly with respect to maintaining channel stability in ditches, sediment control, and drainage characteristics of peatlands in particular (damming effects).

47. Commercial forests on mineral wetlands can be difficult to regenerate to new stocking and growth standards. However, drainage to aid reforestation may be a threat to water quality and wildlife habitat. Such areas should not be harvested until they can be successfully reforested and the impacts satisfactorily explored and the consequences accepted.

6.3 Soil Erosion and Productivity

Soil erosion concerns related to forestry and other activities in the Green Area have been reviewed in the past, especially for areas of industrial activity such as northwest and west-central Alberta, and the southwestern portion of the Eastern Slopes (Schultz and Co. 1973; Environment Council of Alberta 1976, 1979).

In most cases FMA ground rules reflect these concerns. However, there may be a need to ensure that ground rules are adequate for conditions in the north and northeast where new forestry developments are proposed.

In general, soil erosion from cutblocks is relatively minor compared to road-related erosion, although potential increases in scarification activity in lieu of herbicides for vegetation management may pose soil erosion problems, particularly if scarification activity crosses ephemeral streambeds (see Section 6.2).

The impact of forest operations on such physical soil properties as bulk density, and the creation of ruts that can interrupt drainage or increase erosion, have been reviewed recently in B.C. Estimates are that more than 20 per cent of soil on some harvest areas was degraded, resulting in losses as high as one cubic metre per hectare

per year timber yield (Senyk and Smith 1989). Certain fine-textured soils are subject to similar impact and an effort should be made to adopt logging technology that minimizes the damage. Recent observations of tree-length hardwood removal operations in mixedwoods indicate up to 20 per cent of the areas are affected by landings and skid trails that appear to be having a negative effect on hardwood stocking and growth (see Section 8.2).

Recommendations:

48. **Ground rules that relate to soil erosion should be reviewed to ensure they adequately address operating conditions in the new development areas of north and northeastern Alberta.**

49. **Logging methods and new technology should be matched to site conditions to reduce the impact of logging on site productivity. This is of particular concern as operations move into mixedwood sites that are moist to wet and/or interspersed with wet areas, and where current technology appears to retard stocking and growth of regeneration. Techniques that reduce the number of skid trails, landings, and rutting within cutblocks would be particularly effective in reducing impact.**

6.4 Wilderness and Ecological Reserves, Natural and Protected Areas

The three wilderness areas and Willmore Wilderness are confined to the Eastern Slopes of Alberta. It is likely that other suitable candidates for wilderness areas exist in other parts of the province. The panel supports the recommendation made by the Environment Council of Alberta (1979) for a boreal wilderness area; it regrets that candidate wilderness and park areas were not set aside before new boreal forest developments were proposed or established.

The wilderness area and ecological reserves programs are administered by Alberta Recreation and Parks and jointly managed with Alberta Forestry, Lands and Wildlife. There are currently 11 ecological reserves in Alberta that have been established since 1987. They average about 1,900 hectares and cover various ecological and special features. They are dedicated to preserving natural habitats and are restricted to scientific research. They do not include a representative sample of forest ecosystems, and there are only two reserves within the north and northeast sections of the province. The process of review and approval of candidate ecological reserves includes input from the Advisory Committee on Wilderness Areas and Ecological Reserves. This review process appears to be adequate, but the selection process requires review.

The process for selection of candidate ecological reserves is apparently dependent on interested individuals and groups. This may result in significant ecological features, including representative forest ecosystems, being overlooked for lack of a champion. Ecological reserves are linked to a national network through the

Canadian Council on Ecological Areas (1982) with representatives from both Alberta Parks and Recreation and Alberta Forestry, Lands and Wildlife. The council also provides a communications link to the World Conservation Strategy. The Alberta component of the strategy is currently being drafted by the Public Advisory Committee to the Environment Council of Alberta.

The Natural Areas program was initiated in 1967 and now includes 263 sites averaging about 400 hectares. It is administered and managed by Alberta Forestry, Lands and Wildlife. Natural Areas are used for low-intensity recreation purposes, with no developed facilities. They represent a broad spectrum of natural features, including old-growth forests, but the system used to select them, and to place them in an ecological framework, is not clearly documented.

Protected areas include the protection forest zone of the Eastern Slopes as well as areas like Willmore Wilderness and the Bighorn Wildland Recreation Area. Again the relationship to an overall plan or system requires clarification and the framework of the Alberta Conservation Strategy could be used for this purpose (see Section 4.1).

Recommendations:

50. The selection process for new reserves and Natural Areas should be formalized immediately to ensure that significant ecosystems are represented in appropriate categories. The present selection process is inadequate and rapid development could result in the loss or compromise of important candidate sites.

51. The possibility and location of a boreal wilderness area should be investigated. All the provincial wilderness areas are located in foothill or mountain terrain. The panel believes that a boreal wilderness area of a size similar to the present wilderness areas would be a useful addition to the system.

52. A common reference map such as *Ecoregions of Alberta* (Strong and Leggat 1981) should be used for the various wilderness, ecological reserves, natural and protected areas in Alberta and should be linked to a national reference like *Ecoclimatic Regions of Canada* (Canada Committee on Ecological Land Classification 1989).

53. Support should be given to the selection, protection, management, and status review of representative forest ecosystems throughout Alberta, with input from the Rocky Mountain Section of The Canadian Institute of Forestry, for purposes of scientific study, education, gene pool preservation, and benchmarks for research into management practices. Some forest ecosystems may currently be represented in existing ecological reserves, Natural Areas, or other areas.

54. **A registry of these proposed sites should be prepared (Buckman and Quintus 1972).**

55. **Northern and northeastern Alberta should be a priority in selection of representative ecosystems or unique features, in view of the proposed development. The list of International Biological Program sites proposed previously should be assessed for relevance to this area.**

56. **The size and shape of reserves should reflect ecosystem integrity rather than rigid survey lines.**

6.5 Old-growth Forest Ecosystems

There can be no single definition of old-growth forests because of the range of factors such as species, genetic variation, growing environments, and disturbance history (like fire) that characterizes them (Spies and Franklin 1988) and the varying perceptions of a society whose needs range from non-commodity leisure pursuits to jobs and commodities like lumber and paper.

Old growth is usually described either in terms of entire ecosystems or in terms of attributes (parts of ecosystems). Definitions based on entire ecosystems consider the structure, function, and composition of all elements including trees and their plant and animal associates, living and dead, above and below ground, generally at or near the climax (late succession) stage of development. Such systems tend to be relatively stable and are commonly characterized by large, old trees.

Definitions based on attributes consider only parts of ecosystems, and can be commodity-related (for example, the age and health of commercially valuable trees for timber management) or non-commodity-related (for example, a suitable number of trees with holes for cavity-nesting birds or a forest floor habitat for a particular wildflower).

In Alberta, it may be argued that pioneer (early succession) ecosystems like aspen and lodgepole pine can attain "old-growth" status on the basis of age, size, and condition of the tree component or some other feature as they develop, even though they never reach climax (late succession) stages due either to wild fire or to harvesting and regeneration. There are also climax (late succession) spruce and spruce-fir ecosystems that are usually self-perpetuating through natural regeneration within the old-growth structure. These late-succession forests are most likely to exist in areas where wild fire has been excluded because of moist climatic or soil conditions or topographic features, and can be maintained under effective long-term protective management. Such forests are usually characterized by significant accumulations of organic matter on the forest floor that may comprise a significant proportion of the ecosystem biomass.

Mixedwood ecosystems of aspen and spruce are transitional between early-succession aspen and late-succession spruce, and have characteristics of both systems.

The length of time required to reach old-growth status varies with species and location, being 400 years or longer for coastal B.C. coniferous rainforest species like cedar and hemlock, and as short as 80 to 100 years for aspen in Alberta.

Reasons commonly cited for the need to preserve or maintain and manage old-growth ecosystems include their value for research into ecosystem function and change, preservation of genetic material, benchmark areas for comparison with managed ecosystems, and as critical habitat for particular flora and fauna. Social and ethical aspects of preserving old growth as part of our natural heritage are also cited. This latter aspect is most strongly associated with ecosystems such as old coastal rain forests in B.C. or old high elevation spruce-fir forests in Alberta.

Concerns expressed recently about the need to preserve old-growth ecosystems in Alberta have been primarily related to wildlife, including ungulate habitat (especially woodland caribou), cavity-nesting birds and other boreal bird species, and furbearers. Such interests are both consumptive and non-consumptive. There is little current information on the importance of old-growth habitat for many of our boreal wildlife species. For example, the seasonal abundance, distribution, and habitat requirements of non-game birds that nest in old-growth forests are little understood. Some work on habitat relationships and management of terrestrial birds in northeastern Alberta has been done (Francis and Lumbis 1979). There is current research into the association between woodland caribou and old-growth forest ecosystems in Alberta. One related study (Snyder 1989) suggests that terrestrial lichens suitable for caribou use can be found in regenerated pine stands 20 to 30 years old, an attribute usually associated with much older forests.

Sustained yield forest management recognizes immature, mature, and overmature age classes that reflect relative values for a commercial timber crop. Usually timber is harvested at the mature stage when the maximum amount of usable stem wood is available and harvesting costs per unit area are lowest. Maturity for our commercial Alberta tree species is approximately 60 to 80 years for aspen, 80 to 100 years for lodgepole pine, and 100 to 120 years for white spruce. As trees progress toward an overmature state — which corresponds to old growth — they are less desirable for commercial timber products because there is less usable stemwood. Such forests are often viewed as posing high risks of commercial timber loss from blowdown, insects, and disease.

There is at present no policy designed explicitly for reserving old-growth forest ecosystems in Alberta. Under the present policy of sustained yield management, removal of overmature (old-growth) timber is given priority and the reservation of old growth is incidental to the process of netting out areas such as buffers on lakes and streams, muskeg areas, non-merchantable coniferous stands, and slopes in excess of 45 degrees during management planning. Other reservations of old growth may occur through the referral process (for commercial tourist development, for example). Such reserves tend to be fragmented and not specifically selected to represent intact ecosystems or to address particular attributes of old-growth forest ecosystems. Such reserves are also subject to salvage harvesting under existing forest management policies. Under these conditions, existing FMA holders are now being placed in the position of trying to accommodate deletions from their assigned landbase to satisfy withdrawals for purposes such as old-growth reserves, a situation that could have been avoided by a policy of up-front withdrawals of land for such purposes. At present, companies are compensated for land deletions but compensation cannot substitute for timber when the supply becomes limited.

Aside from the need for a specific policy of reserving old-growth areas, there are many opportunities to accommodate them within existing FMAs and Crown forest management units by revising timber harvest planning and operating ground rules and by establishing creative interdisciplinary planning teams. This is being

done on the Procter and Gamble FMA where caribou habitat requirements are being addressed, and on the Weldwood FMA where a snag management program is being introduced to benefit cavity-dwelling wildlife.

Forest ecosystems in Alberta present opportunities and challenges to forest land managers to accommodate old-growth interests. These range from preservation and protection to active management and maintenance to satisfy both timber and non-timber interests. Possibilities for combining these interests in the same area are only beginning to be explored, as exemplified by recent caribou habitat and snag management programs. Such uses have traditionally been perceived to require exclusive old-growth reserves.

Recommendations:

57. **Ecosystem components that are essential to meet specific consumptive and non-consumptive old-growth criteria should be clearly defined, identifying those that require a preservation approach, and those that are best addressed by conservation and creative management rather than preservation.**

58. **A policy should be developed for the designation and management of old-growth forest ecosystems under the Alberta Conservation Strategy with input from government, non-government organizations and professional forestry/wildlife/environmental societies. Such a policy should address conservation and preservation strategies essential for satisfying consumptive and non-consumptive interests.**

59. **Opportunities to meet old-growth criteria for specific uses through creative planning and management rather than exclusive reservation should be explored. This is exemplified by current efforts to combine timber harvesting with provision of caribou habitat and snags for cavity-dwelling wildlife and can lead to a more effective use of a limited forest landbase.**

60. **Wilderness areas, ecological reserves, natural and protected areas, and parks, as well as areas netted out as buffers and other reserves during management planning, should be assessed to determine their status and suitability as candidate old-growth forest ecosystems.**

61. **A selection and screening process should be developed to add important old-growth forest ecosystems not already represented in existing reserves.**

62. **The level of research activity into the structure, function, and composition of old-growth forest ecosystems should be increased, especially with respect to rare, endangered, or threatened flora and fauna.**

6.6 Fish Habitat and Populations

The public was more concerned with the impact of pulp mill effluent on fish populations and their habitats than on the effects of forest management practices. The overall concern was about water quality and the effects that forest industry activities would have on all life using water in forested areas, especially fish. One 1985 study by the Fish and Wildlife Division also showed that the quality of water that was being fished was the most important factor affecting fishing enjoyment in Alberta (Alberta Fish and Wildlife 1989). In addition to these public concerns, fisheries biologists identified their major concerns about logging in general as: sedimentation, physical deterioration of streambanks and channels, increases in nutrient loads and water temperature, barriers to fish passage, loss of vegetation on streambanks, and the effect of widespread forest removal on streamflow.

Alberta Fish and Wildlife is not given the opportunity to conduct fisheries inventories or management-oriented research before FMAs are signed. There is some information from ongoing surveys of game-fish species for general fish management purposes. For game species, the major concern is inadequate resource management information. In the division's draft management plan (Alberta Fish and Wildlife 1989), the major fish management strategies are:

1. Continuing with habitat enhancement and development programs, increasing surveillance, habitat monitoring, and habitat inventory;
2. Mitigating losses and working toward a "no-net-loss" mitigation policy;
3. Improving the database to determine limiting factors with a view to increasing natural production;
4. Encouraging more catch-and-release; and
5. Discouraging access to headwater streams, decreasing illegal harvest, and increasing information, education, and public involvement.

Alberta Fish and Wildlife co-operates with the AFS in developing ground rules for streamside buffers and stream crossings, but their involvement in the field, on a site-specific basis, is low. There is concern that the rule that regenerated stands must be two metres tall before adjacent blocks may be harvested (under the two-pass system), may not adequately protect stream flows for fisheries purposes. The future impact is uncertain as there are no assurances that merchantable coniferous and deciduous trees will be retained within streamside and lakeside buffers, except within the Eastern Slopes region where this is currently required. Fisheries biologists recommend that until we have studies that reveal benefits from the removal of mature riparian (streamside) vegetation, we should maintain stream channel and riparian areas in a natural state.

A major problem concerns implementation of the timber harvest planning and operating ground rules. These ground rules have evolved into an excellent system, but if they are not followed and there is insufficient or inadequately trained staff to monitor and enforce them, they might as well not exist. The panel is concerned that the staff available cannot adequately handle these demands. For the resources to be properly protected and maintained and for the stewards of the resources to have credibility with the public, it is imperative that an adequate number of well-trained staff be involved in this activity (see Recommendation 1).

There is a need for a fish management plan for each Fish and Wildlife region and for each FMA. These plans should be developed in co-operation with the AFS and forest industry planners. Plans cannot be developed satisfactorily unless inventory information is adequate. Information is also required on the effects of logging on fisheries. Previous attempts by Fish and Wildlife to obtain this information has been largely thwarted by a lack of funds, manpower, and department support.

One- or two-pass logging with rapid reclamation of extraction roads sounds ideal for fisheries, but in practical terms many roads are not reclaimed because they are needed for various forest management reasons (regeneration surveys, planting, tending, and protection) as well as for other users. Because many of these roads will remain open, minimizing damage to the fishery depends on well-designed alignments combined with high construction standards and regular periodic maintenance. Angling regulations (with education) must prevent overharvesting of the fish resource and maintain quality angling. If these conditions are met, multipass logging is a desirable alternative for fisheries management.

A 1977 study of the effects of clearcut logging on stream flows in the Hinton region showed an increased water yield of 27 per cent following logging, mainly during spring runoff. Storm peak flows also increased by 150 to 200 per cent in logged compared to unlogged basins and predicted changes in flow regimes would continue for about 30 years (Swanson and Hillman 1977).

Recommendations:

63. **Studies that accurately monitor the effects of various harvesting and regeneration systems on fish habitat are essential and should be implemented and supported by the department and forest industry for a period long enough to measure the impact, beginning before initial logging and extending until the alternate cutblocks in the surrounding areas have at least reached the immature stand stage.**

64. **Regional fisheries biologists in forested regions of Alberta should be allocated the funds and time necessary to prepare both regional and FMA fisheries management plans, in co-operation with the Alberta Forest Service and the forest industry.**

65. **Greater efforts should be made by the industry, at the field level, to minimize soil and vegetation degradation and overland water movement. Not enough is done during harvesting and reforestation to reduce the energy of water flow on logged areas.**

66. **There should be a formal water quality management policy for forested lands that gives the AFS some management responsibility in addition to that of Alberta Environment. This should be written into the forest sector conservation strategy.**

6.7 Wildlife Habitat and Populations

The fish and wildlife concerns rated as most important by the public were those dealing with the effects of forest development on road access, overhunting and decreased populations, on wildlife habitat, and on the wildlife resource in general.

There was also concern about the inadequate wildlife and habitat inventory on which to base forest-wildlife management decisions and determine impacts of forest management on the wildlife resource.

The impact of forestry operations on wildlife habitat and populations depends, among other factors, on the forest harvest system, site preparation, regeneration, access management, and the extent to which forest management ground rules are followed.

The Two-pass System

The two-pass clearcut harvest and regeneration system may be beneficial to a wide variety of wildlife species providing:

1. The clearcuts are small enough that wildlife species using them for forage are close to mature forests they require for escape cover and shelter from inclement weather (Stelfox 1988). Fish and Wildlife recommends that for big game species (moose, deer, elk) clearcuts should be no larger than 16 to 80 hectares and no wider than 200 metres to ensure close proximity to escape cover (larger clearcuts may be needed to meet the habitat needs of sharp-tailed grouse and some other priority species);
2. Where wildlife needs are not met in initial planning, the second pass of logging that removes the remaining mature timber does not occur until regeneration on the first cutblocks has matured sufficiently to provide adequate winter escape cover and shelter; and
3. Clearcuts are designed to maximize "edge effect" that will encourage an abundance of wildlife species that frequent forest edges.

Public concern over the deleterious effects on wildlife by the two-pass clearcut system stems mainly from seeing large clearcuts little used by conspicuous wildlife species. They are also aware that often the second cut occurs before adequate escape cover and thermal shelter are available in the initial cut. This results in extensive logged areas receiving little wildlife use, especially during winter when requirements for escape and thermal cover are paramount for wildlife at this northern latitude.

FMA ground rules call for conifers to reach a minimum height of two metres before the second pass. Biologists recommend a height requirement of three metres, to ensure that minimum thermal shelter requirements are met. The AFS and forest industry normally plan on the second cut 15 years after the first cut. Regenerating lodgepole pine generally provides minimum winter cover and shelter for big game species by 15 to 20 years after logging. However, coniferous regeneration in white spruce and mixedwood clearcuts are considerably slower and may not provide adequate wildlife winter shelter until at least 30 years after logging (Stelfox 1988).

Where access control is important to ensure wildlife populations are not overharvested or unduly harassed, the two-pass system has the advantage of

requiring fewer roads, with activities concentrated on only two periods of the timber management cycle. More roads, open for longer periods, are required for shelterwood or selective logging systems, or for clearcut systems of three or more passes.

The Three-pass System

The three-pass system has the advantage of maintaining approximately two-thirds of the merchantable forest in the mature stage after the first cut, compared with 50 per cent for the two-pass system. This is an important consideration at this latitude where shelter and cover are more important than forage in determining if forest lands will be used during winter by wildlife species (Stelfox 1988).

A major advance has been made in the 1988 timber harvest planning and operating ground rules for the Weldwood FMA; plans exist for modifying the two-metre, two-pass clearcut system within important wildlife areas. This and other modifications being made to the two-pass system in the FMA of Procter and Gamble and the quota area of Grande Cache Forest Products are commendable and should be encouraged elsewhere. A three-pass system may be implemented at the time of the second pass but it would be preferable to identify and plan for areas that should be logged using the three-pass system before any harvesting is done. Ground rule changes sometimes result in a bastardized three-pass system.

Selection and Shelterwood Systems

Forest cover and associated microclimate can be maintained and snag habitats for birds and mammals can be preserved under selection or shelterwood systems. These systems (often referred to as selective logging) are appropriate for many big game winter ranges, especially those along major valleys. There are a number of advantages of these systems compared with clearcutting:

1. They provide a better mix of trees of all size classes including larger trees;
2. Damage to naturally regenerating conifers and to important individual trees or clumps of trees is less than by large-scale clearcut techniques; and
3. The desirable mixture of food, cover (escape, nesting, brooding), and shelter from inclement weather is maintained throughout the entire logging cycle for a wider variety of wildlife species and for a longer period than with the standard two-pass clearcut system.

Recommendation:

67. Government and FMA holders should use greater flexibility in determining which harvesting and regeneration system is best, after considering forest type, location, and land use priorities. Recognizing the need for land use zoning on the basis of management priorities, the system used should ensure that all land use interests are effectively integrated into forest management planning. This will require enlarging the body of expertise on forest planning and negotiating committees.

7.0 INTEGRATED MANAGEMENT

7.1 Integrated Planning

In general, resource planning begins with good inventories of the resources and a method of setting priorities for specific planning areas. There must also be monitoring to ensure that the essential components of the plan are carried out effectively.

The Integrated Resource Planning (IRP) process provides a practical, appropriate definition of land use priorities. Within the framework provided by these plans, detailed forest management plans are developed by the forest management agreement holder. These detailed plans may further stratify the landbase for management within the broader zones identified in the IRP.

Most FMAs include a clause that identifies a prime use of the area as the growth and harvest of timber, although these areas are often designated as multiple-use under the IRP. FMA holders are directed to recognize the IRP zoning and must adjust their plans to accommodate other prime uses described in approved IRPs. To describe all the remaining area as multiple-use, having no particular priority or recognition, is to ignore the statutory commitments already given for that landbase and to discourage zoning and appropriate use. Official recognition under the IRP that timber management is a prime use on that portion of the FMA is important for both the public and the FMA holder.

This observation is similar to that of the 1979 Environment Council of Alberta (ECA) report on environmental effects of forestry operations. Implicit in any of the Eastern Slopes zoning is the concept of multiple-use. Not one of the classifications excludes all other uses. The Eastern Slopes Policy identified the various zones on the basis of their prime purpose and use. All other uses must be within that prime use framework. By identifying forest lands sufficient to supply the new developments

in Alberta, the government has in effect recognized their prime use dedication and this recognition should, in the opinion of the panel, be reflected in the IRP zoning.

There appears to be a special need for integrated planning and management of forest lands "netted out" during the definition of productive landbase and calculation of annual allowable cut, as well as forest lands currently included in parks and natural areas. Even in those areas excluded from timber production, trees are an essential component of the vegetation complex and ultimately some type of vegetation management may be required. For example, mature trees may need to be cut to control insect and disease problems or to prevent blowdown where fire risk or public safety is an issue. Within the timber producing zones of the forest there are a number of other resources that require inventories, management strategies, and programs.

The relative roles of government and industry in integrated planning and management should be explored, defined, and recognized by all players. Generally speaking, FMA holders can manage for vegetation-related needs and opportunities (for example, forage, hiding, escape, and thermal cover for big game animals). They do not, however, have the mandate to manage other factors that can have an impact on these non-timber resources. For example, the FMA holder cannot generally limit access or harassment of animals, dictate seasons or conditions of licensing for hunting, or regulate off-road vehicle use. These powers rest with the government of the province, yet without the exercise of these management tools, vegetation management can be both frustrating and fruitless.

The panel recognizes that integrating timber management with that of other resources involves considerable costs that are directly attributable to those other resources. FMA holders are in the business to make a profit, as they should be. There is no direct revenue generated for them by such resources as wildlife and recreation, although the provision of such amenities within a working forest could be seen as an insurance policy toward the retention of the rights to manage for timber production and therefore, some investment of money and time is justified. Tax incentives and grants could also be used to encourage the participation of FMA holders in the process.

Also, there may be greater benefit from the parties working together than if each acted independently. The FMA holder, for example, has personnel and equipment in the woods. The province could take advantage of this situation to implement projects that would otherwise require considerable extra funding for transportation of people and equipment.

The FMA holder can manage the forest to achieve significant benefits for other resources. When times are lean, however, FMA holders may be forced to limit their financial commitment to the management of other resources as a condition of continuing in business. FMA holders are not required to participate to the extent that some have done, although they are all required under the terms of their forest management agreement to practise multiple-use forestry.

Recommendations:

68. Within the multiple-use category of Integrated Resource Planning areas, some areas should be identified as having a

priority use for timber growth and harvesting by reclassifying them as forest production.

69. Forested lands without management plans should have integrated plans developed by an interdisciplinary team of resource specialists.

70. In recognition of the real costs and benefits of achieving integrated resource management objectives, funding of these initiatives should be rationalized and shared between the province and the FMA holders.

7.2 Operational Control/Ground Rules

The team approach to integrated management has been developed at the planning level in regional, sub-regional, and local integrated resource plans and in management level planning with the referral process incorporated.

Plans that are put into effect require guidelines (such as ground rules), monitoring, and control. Alberta has a set of general ground rules covering pre-disturbance watershed assessment, stream crossings, road planning and construction, timber harvest planning and operations, and forest landscape design.

Detailed ground rules specific to each FMA are negotiated and embodied in the agreements. This is a good approach and its refinement, extension, and effective application should be encouraged. However, monitoring and control of ground-rule applications are deficient in some respects, particularly regarding resources other than timber. The inspection work is routinely done by a forest officer alone, acting without needed expertise on behalf of such other resource interests as wildlife, fisheries, and recreation. This situation has been addressed by the Alberta Forest Service since 1986. They have developed in-house and company staff training programs using slide presentations and brochures, and have encouraged the public to participate by reporting perceived ground-rule infractions.

The scale of operations is increasing substantially in some forests to the point where there may well be insufficient government staff and resources to achieve adequate timber-related monitoring and inspection, and monitoring of non-timber interests can be expected to be even less effective. The consequence will be a further erosion of public confidence in the department's stewardship role.

Recommendations:

71. The provincial government and forest industry should be encouraged to continue refining and extending ground rules to meet the specific needs of each quota area or FMA. These rules should be effectively communicated to supervisors and workers, with ongoing training and supervision to ensure that the intent of the ground rules is achieved and is seen to be achieved.

72. **For operations where there are a variety of resource interests and objectives, the principal contributors to the integrated plan should be represented both in the development of training manuals and in the instruction of operating staff, and, in especially sensitive areas, be involved in operational monitoring and control.**

73. **The public should be better informed about ground rules, to understand the roles of both the department and industry in resource stewardship and also to encourage informed public involvement in monitoring ground-rule compliance.**

74. **The Alberta Forest Service and Alberta Fish and Wildlife should co-operate further as partners with industry in the development and implementation of forest management plans and operating ground rules. Such an approach is evolving on the Weldwood and Procter and Gamble FMAs.**

7.3 Access Management

At recent public meetings the most frequently expressed fish and wildlife concern was that improved access from the construction of logging roads could lead to overhunting and overfishing as well as harassment of wildlife. Suggestions made to minimize the access problem included:

1. Developing a method to offset and control easy access provided by logging roads to minimize wildlife disturbance and poaching; and
2. Developing an access management plan to disperse rather than concentrate hunting, fishing, and other recreation pressure including seasonal road closures of critical wildlife areas (e.g., fish spawning grounds and big game winter ranges).

Representatives of native groups stressed that any plan to restrict hunting and fishing access should not impede the exercise of aboriginal or treaty rights.

Studies in North America have shown that increased human access to forested lands has caused major decreases in big game populations as well as changes in distribution, behaviour, and metabolic requirements. Forest industry activities represent only one of several land use activities (oil and gas and mining are others) that create vehicle access to forest regions.

Recommendations made from previous studies to reduce the negative effects of increased access on big game populations include:

1. There should be total or seasonal road closures, and designated routes for public use, seasonally or throughout the year;
2. There should be public education on reasons for access control;
3. Wildlife preserves or sanctuaries should be established adjacent to roads traversing major big game ranges;

4. Forest operations, including larger clearcuts, should be designed to minimize the number of roads required; and

5. Joint studies should be conducted by government and forest industry agencies to increase knowledge of the impact of road access on wildlife, forest, and environmental interests and to submit recommendations on road access management.

Alberta Fish and Wildlife in 1983 studied the issue of access and road closures and provided a summary of possible categories of road classification with restrictions to meet various resource needs. The division recognized the need for improved public consultation, to win co-operation by helping the public understand the rationale for road closures.

The panel stresses that an effective access management plan cannot be developed until there is adequate information on fish and wildlife abundance, seasonal distributions and habitat preferences, and migratory routes within each forest region. An accurate assessment of the seasonal impacts of various activities on wildlife, including all-terrain vehicle activities away from primary and secondary roads, is also required.

The plan should strive to disperse rather than concentrate hunting, fishing, and other recreational activities but include seasonal access control for prime fish and wildlife habitats. Where roads are required in prime wildlife habitats, protection of wildlife from harassment and from hunting outside the regular harvest seasons may require special legislation.

It is important that an access management policy and plan be based on the present or potential impact of all forest land use activities, including public use, petroleum, and mining, rather than on the forest industry activities alone.

Effective resource management is not possible without some means of controlling access to and harassment of wildlife species. No single group should have preferential access when restrictions are applied on a site-specific basis to address identified resource management concerns.

In addition to access control, other strategies should be used to reduce overharvest and disturbance of wildlife. These include restrictions on hunting or other activities, increased enforcement, habitat management, and concentration of forest operations.

Recommendations:

75. The effects on fish and wildlife species of road access and various vehicular activities should be assessed. As an interim measure in new development areas, restrictive bag limits for fish and wildlife harvest should be adopted and wildlife sanctuary corridors along all roads and seasonal road closures seem appropriate.

76. An access management plan should be incorporated into each detailed forest management plan under the guidelines of a department policy. This access management plan should fairly

represent the interests of all natural resources and resource users, while protecting wildlife and fish from overharvest and harassment, and minimizing environmental degradation.

7.4 The Impact of Forestry on Tourism

Tourism was noted as a minor public concern associated with the forest industry. We note that tourism is an important economic resource in Alberta and should be given careful consideration in any forest management plan. The panel is concerned that statements used in the promotion of the tourist industry and statements about the relative value of jobs created by the tourist industry are biased. The panel does, however, encourage the department to manage and promote this forest resource by developing such marketing initiatives as the recently published *Alberta Wildlife Viewing Guide* by Alberta Forestry, Lands and Wildlife (1990) and the older Eco-tour program of Forestry Canada.

Recommendations:

77. **Recreation and tourism is an important land use and has to be part of the ongoing integrated management process.**

78. **Allocations for significant recreation opportunities (parks, wilderness areas, heritage rivers, potential trophy fishing waters, etc.) should be made before forest management agreements are signed.**

79. **The FMA allocations and other forest management decisions should be made in the context of the integrated resource planning system to which the government is committed. Within this context, tourism concerns should be well represented.**

80. **Opportunities to provide recreational experiences and facilities within managed forests should be explored and expanded. Those industries that benefit from the resulting revenue and good will should contribute to the cost of providing and maintaining facilities.**

7.5 The Impact of Forestry on Trapping

Many concerns were raised that the livelihood of trappers would be placed in jeopardy by forest development, through depletion of furbearer populations and by vandalism to trappers' cabins and equipment. There is also concern that trappers would have little or no say in FMA decisions that affect the furbearer resource, and that little or no compensation would be forthcoming for damages to property or to the fur resource.

Forest companies are required to contact trappers at various stages of harvest planning on areas that overlap their traplines. Response from trappers to these contacts is often minimal, indicating a need for review of the contact procedure.

In 1986, Fish and Wildlife prepared a draft position paper on fur management policy that had input from the Alberta Trappers' Association. This in-house document has not been developed into a final policy and in 1990 no fur management plan is available. Furbearer abundance is being monitored through annual questionnaires sent to registered trappers. In 1987 the results to date were compiled (Alberta Fish and Wildlife 1987a). No compilation or analysis has been done on questionnaires completed since then.

Furbearer abundance and distribution information prepared by trappers could be very useful for improving the department's scant inventory data and thereby improving integration of timber and wildlife management.

Habitat requirements and limiting factors for three furbearers (beaver, river otter, marten) have been prepared and presented in the report of the Wildlife Resource Inventory Unit (Alberta Fish and Wildlife 1985).

Currently, staffing and funding for fur management is almost non-existent. There has been no comprehensive population inventory since the Alberta Land Inventory of three map sheets in the mid-l970s that was done for a few furbearer species. Much of that information is badly outdated and information is required on all furbearer species for the entire forested region of Alberta.

Because of the lack of a fur management plan and policy, fur management is not comprehensive but consists primarily of setting harvest seasons for each species and compiling fur harvest records. Similarly, the effects of timber harvesting activities on furbearers in Alberta is not well understood. One long-term forest wildlife study indicated that furbearers in general declined sharply following clearcut logging and remained scarce for at least the first 17 years in spruce, pine, and mixedwood forests. Some furbearer species thrive in old-growth forest (marten, for example) while others (coyote and beaver, for example) do well in disturbed or young forests. Clearcut logging can improve the habitat and abundance of most furbearers if a wide variety of forest-age classes (including mature and old growth) are retained in close proximity so they fall within the cruising radius of each species. The selection system or small-scale clearcut logging, using at least a three-pass system, will favour furbearers more than the conventional two-pass clearcut system.

Recommendations:

81. The government and the forest industry should endeavour to accommodate the trappers' concerns within the integrated resource management plan.

82. The 1986 draft position paper on fur management policy should be updated in co-operation with the AFS and reviewed by the Alberta Trappers' Association and the Alberta Forest Products Association. It should then be finalized and implemented as soon as possible.

83. **The Alberta Trappers' Association should work closely with the forest industry and Alberta Forestry, Lands and Wildlife regional planners to identify important sites (including cabins, trails, and major furbearer habitats) within each registered trapline and where necessary, to negotiate for modifications to the forest management plans.**

84. **If registered trappers are to be eligible for mitigation from the forest industry, they should be required to provide annual fur return data and revenue for a stipulated period (5 to 10 years, for example), to demonstrate they are legitimate trappers and to provide information on which a mitigation claim can be based.**

7.6 Integration of Wildlife and Forest Management

There is public concern that the integration of fish and wildlife management with forest management is hampered by staff and funding shortages within Fish and Wildlife (see Section 3.2). In the Concord (1989) report the public supported the establishment of a formal system to integrate wildlife into annual forest operating plans.

The department's integrated resource planning program is a multi-agency and public involvement program (Alberta Fish and Wildlife 1989). It is not part of the department's internal referral system although the plans provide a guide for the department's resource managers.

Fish and Wildlife begins working with the AFS and the forest industry following the signing of an FMA agreement. Through the department's referral system, Fish and Wildlife reviews the timber harvest plans, primarily through regional habitat staff. Each staff member is responsible for one or more FMAs and spends up to 20 per cent of his or her time on timber issues. Regional biologists provide some background data on wildlife populations. An inordinate amount of biologists' time is diverted to non-resource management activities (public education, public relations, office duties) especially in the southern half of Alberta where hunting and fishing pressure is greatest.

An example of the practical integration of wildlife and forestry interests at the planning and operating levels is found in Nova Scotia (Nova Scotia Department of Lands and Forests 1989). Definitive guidelines are provided for the size and shape of clearcuts, the percentage of the forest to be in openings and old-growth forest, wildlife corridors, riparian forest management, snag and cavity-tree management, etc., as well as legislation and policies.

In Alberta, the first application of integrated forest-wildlife management occurred in the Weldwood (Hinton) FMA (Champion Forest Products (Alta.) Ltd. 1987). Weldwood deserves credit for being in the forefront of integrated resource management in Alberta. For this FMA, the Alberta Forest Service, Fish and Wildlife, and the company have established an integrated resource management

steering committee to co-ordinate the development of integrated management plans. This includes development of fish and wildlife habitat and population goals and identifying procedures and tactics for implementing goals. Other tasks are providing a forum for information exchange, issue discussion and conflict resolution, development of monitoring and public information programs, incorporation of feedback, and identification of knowledge gaps and research requirements. For this Weldwood FMA, Fish and Wildlife is co-operatively managing forests for wildlife with the forest industry and the AFS on the basis of feature species (elk and caribou), endangered and scarce species, and is planning to manage on a species-habitat dependency grouping system.

But, as noted above in the discussion of forest wildlife inventory, even in the Weldwood FMA the regional habitat biologist can only spend four to five days on ground surveys for every compartment plan or cruise order. For other FMAs, Fish and Wildlife has much less input because of professional staff and funding constraints.

Although the concept of integrated resource management is in place and the government's referral system permits Fish and Wildlife to make recommendations concerning FMAs, this input remains primarily a reactive process in which Fish and Wildlife attempts to minimize the impacts of forest activities on the fish and wildlife resource *after* the Alberta Forest Service has done the planning and developed the ground rules. Fish and Wildlife recommendations are handled through the Habitat Branch and channelled through the AFS, which decides whether the recommendations will be included in timber harvest planning and operating ground rules for an FMA.

Fish and Wildlife should have direct representation on the negotiating committee for timber harvest planning and operating ground rules as they did recently for the Procter and Gamble FMA at Grande Prairie. This was unique and contrary to the procedure for other FMAs where Fish and Wildlife is not an effective partner with the AFS in forest management planning.

Recommendations:

85. **Fish and Wildlife should be an integral partner with the Alberta Forest Service in forest inventories, planning, and management.**

86. **Baseline inventory information on fish and wildlife resources and their habitats should be improved to a level satisfactory for developing sound forest-wildlife management plans.**

87. **Fish and Wildlife should develop a comprehensive and realistic strategy for meeting its resource management information needs in forest regions over the next 10 to 20 years. This strategy should complement and mesh with a forest sector conservation strategy as well as government and non-government programs.**

7.7 Rare, Endangered, and Threatened Wildlife

The public is concerned about the effect of new forest development on rare, threatened, and endangered wildlife species and about the ability of Fish and Wildlife to inventory and manage these species to ensure their future well-being.

The 1989 draft *Strategic Plan for Management of Alberta's Wildlife* provides goals, status, and management (objectives, concerns, strategies, priorities by region) for endangered, threatened, and vulnerable species. It includes a specific objective to "support the maintenance and recovery of rare, threatened, and endangered species of wildlife. This support may take precedence over other forest uses" (Alberta Fish and Wildlife 1989).

Fish and Wildlife lists 12 endangered, threatened, and vulnerable (rare) wildlife species that it attempts to manage in co-operation with federal wildlife and non-government agencies. It has also listed "scarce" wildlife species for three forested regions (Eastern Slopes, northeast, Peace River) as follows:

Endangered: Peregrine falcon, whooping crane, wood bison, swift fox;

Threatened: Burrowing owl, ferruginous hawk, woodland caribou, shorthead sculpin; and

Vulnerable: Piping plover, mountain plover, trumpeter swan, white pelican.

Fish and Wildlife has been unable to implement the management objectives and strategies recommended in the draft strategic plan because the plan has not received final approval and because there are insufficient biological staff and funding to adequately implement the plan. Some efforts in recent years include:

Trumpeter swan: When nesting sites are located, an 800-metre buffer is established prohibiting timber cutting within the buffer. For other endangered or scarce bird species and for such special features as mineral licks, a 100-metre buffer is established.

Woodland Caribou: Within Weldwood, Procter and Gamble, and Grande Cache Forest Products FMAs the size and shape of clearcuts has been modified for some critical caribou ranges, in co-operation with the government caribou biologist, to minimize the impact of logging on caribou. Grande Cache Forest Products also modified its logging system in some caribou areas to a small-cut, three-pass system in 1985.

Endangered bird species: The major management plan for the eight bird species listed as endangered, threatened, or vulnerable is to monitor populations, assist transplants to establish new populations, and protect the birds and their habitat, especially during the breeding season.

Fish and Wildlife should develop a clear management plan with specific strategies to manage these species. Without this it cannot eliminate or minimize the factors that placed these species in their precarious situation (e.g., loss of habitat or natural and man-caused mortality). Until more is known about species numbers,

distribution, biology, habitat requirements, and vulnerability to forest development and other human activity, little can be done.

Public concerns such as those expressed about the status and management of the pileated woodpecker, Blackburnian, bay-breasted, Cape May, and black-throated green warblers will not be lessened until adequate knowledge is obtained on population status and trend, and on the impact of forest-based industry activities on them.

The Alberta Bird Atlas project is a volunteer-based inventory of bird populations, nesting sites, and migratory species. It will increase knowledge of seasonal abundance and distribution of Alberta bird populations and should also include scarce species expected to be affected by forest industry activities. The panel believes the Alberta Bird Atlas should receive greater support. This project should be eligible for support from agencies such as the World Wildlife Fund of Canada, Wildlife Habitat Canada, and the federal-provincial Forest Resources Development Agreement. Appropriate academic centres plus non-government conservation groups throughout northern and western Alberta could be involved in this project to make best use of existing facilities and qualified personnel as well as to provide training and temporary jobs to students in the field of ecology.

To date, Fish and Wildlife involvement in managing endangered, threatened, and rare wildlife species has been negligible.

Recommendations:

88. **The 1989 draft strategic plan for management of Alberta's wildlife is basically a sound and vital document that should be quickly reviewed, finalized, receive ministerial approval, and be implemented. Following approval, the role of the Fish and Wildlife Division should be strengthened in inventory, monitoring, and management of existing endangered, threatened, or rare wildlife species in addition to those already listed as scarce that are expected to be affected by industrial activities on forest lands.**

89. **The Alberta Bird Atlas project should receive greater support. Federal government (Canadian Wildlife Service) involvement should be increased because of the national implications and a joint co-operative project of inventory, monitoring, planning, management, and research of endangered, threatened, or rare wildlife species in the forested regions should be established. Funding of this study should be shared among various government (federal, provincial, international) and conservation organizations.**

90. **An effective management program should be implemented within each FMA to ensure the survival of endangered, threatened, or rare species, and expedite their removal from these precarious categories.**

8.0 REFORESTATION

Reforestation was the top-ranked concern expressed at public meetings, including regulations governing reforestation, adequacy of reforestation, and the selection of species. This was part of a general concern about the need for sustained yield forest management and preservation of the forests for generations to come.

8.1 Responsibility

Alberta places the onus for reforestation on the shoulders of the FMA holders and the larger quota operators. This reforestation is done at the cost of the operator with no support from the government except, in some cases, a commitment to supply a certain number of free seedlings. In spite of this commitment, the province was hard pressed to supply seedlings needed in 1989.

In other parts of Canada, provinces have experimented with the sharing of reforestation responsibility between government and industry. Invariably, when government has become involved in financial support for operational reforestation, the programs have been affected by political pressure on spending priorities. The result has been either poor reforestation or in some cases no reforestation.

In Alberta, the larger forest firms are responsible for carrying out reforestation at their own expense. This includes all companies, both FMA and quota, harvesting over 34,000 cubic metres per year. Smaller quota operators can pass the responsibility for reforestation to the AFS by paying a reforestation levy of $2.30 per cubic metre harvested for coniferous timber, and 10 cents per cubic metre for deciduous timber on all licences issued after June 18, 1974.

Within two years of harvest, the licensee is required to perform all necessary reforestation treatments and follow up with a regeneration survey in the seventh year

following harvest. If the area is insufficiently stocked, the work to prepare the area for reforestation must be redone, with a follow-up survey three years later. The survey and treatment continue until the area is acceptable. A reforestation plan is prepared every year and submitted for approval by the Alberta Forest Service.

When the licence holder is responsible for reforestation, failure to perform results in penalties, generally of $25 per hectare per year of non-performance. Continued failure to perform can result in the loss of the FMA or the quota itself. This, in the panel's view, is an effective system.

Recommendation:

91. The responsibility for normal reforestation and stand maintenance should continue to rest with the operator holding the harvesting rights, who should pay the cost of such operations.

8.2 Reforestation Effectiveness

Much concern has been expressed over the results of the juvenile stand surveys conducted in 1987-88 that showed that as much as 38 per cent of areas once designated as sufficiently regenerated are now understocked with conifers. If hardwoods were included, most of those stands would be considered sufficiently stocked. Current forest management regulations require that when coniferous forests are harvested they are replaced with coniferous forests.

The province, in co-operation with the forest industry, has developed a standard of reforestation and regenerated stand growth performance that should ensure that forests, once established, are kept healthy and free growing until they are mature and ready for harvest again. This standard will be implemented in 1990. The panel commends this initiative. Alberta's success in reforestation is generally satisfactory, meeting the statutory requirements under the Timber Management Regulations and the Forests Act. The success with subsequent crop maintenance, which was not previously included in the statutes, has been less acceptable, partly because of competition from deciduous trees and shrubs.

Consideration should be given to the effectiveness and practicality of the new reforestation stocking standard for mixedwood sites (see Section 8.5).

8.3 Reforestation Systems

Effective reforestation techniques vary with the type of trees to be stocked in the reforested area, as follows:

(a) Conifers

In general, reforestation systems based on even-aged management concepts, using clearcutting techniques, are suitable for both pine and spruce in Alberta. Regeneration of spruce, however, can be a problem on large clearcuts and on exposed or dry sites; the species performs better with some shade and protection. Spruce is also amenable

to a shelterwood system for even-aged management and, in some circumstances, to a selective system for uneven-aged management. These methods may be appropriate in areas where regeneration in exposed locations is a problem or where non-timber values have priority as detailed in the Environment Council of Alberta report (1979). It should be noted that successful reforestation methods such as scarification for lodgepole pine can be jeopardized by certain logging techniques (for example, when all cones are removed in full-tree skidding or when all slash is burned). There is a need for better integration of harvesting and reforestation systems.

(b) Hardwoods

The three common hardwoods in Alberta (trembling aspen, balsam poplar, and white birch) are all suited to even-aged management, with reforestation following clearcutting. The site may not be suitable for vigorous hardwood regrowth unless the site is completely clearcut to minimize shading.

(c) Mixedwoods

Historically, mixedwoods have been "picked through" or "selectively cut" for merchantable conifers, and regeneration was left to nature. This usually resulted in an increased proportion of hardwoods in a multi-aged stand and many of these stands now require rehabilitation.

Mixedwood stands currently allocated for harvest of both hardwoods and conifers are being clearcut and assigned to either a coniferous or deciduous regeneration schedule. Many of the stands allocated to conifer production are understocked because of hardwood and grass competition. There may also be reduced aspen representation in new hardwood stands, especially where balsam poplar and white birch are left during the cut.

There have been no proven, large-scale systems developed for mixedwood perpetuation, although mixedwoods could be economical and beneficial for both timber production and other uses. Successful regeneration and maintenance of the mixedwood forest is a challenge, and will require the application of the best skills and knowledge that foresters can muster. It may also require the adoption of modified harvesting techniques, including shortwood systems to provide flexibility in adapting new practices, including appropriate forms of shelterwood.

(d) General

As the forest industry gains experience and demonstrates success in and commitment to achieving the goals of sustained yield, effective reforestation, and integrated resource management, that maturity should bring with it more freedom to make decisions regarding resource management issues including reforestation systems. The forest industry has played a substantial role in the development of reforestation systems and sustained yield management in the province. A proven track record should be recognized in more flexibility of choice.

The AFS should recognize industry experience and commitment and encourage industry to assume more responsibility for its own decision making.

Recommendations:

92. Each forest company should have greater freedom to choose the harvesting and regeneration system that is best suited to

agreed-on management objectives and site conditions, within regulatory constraints.

93. Research should be conducted into effective ways to rehabilitate and reforest previously degraded mixedwood stands.

94. During current and future hardwood/mixedwood harvesting, the utilization of balsam poplar and white birch should be improved to reduce waste and increase the stocking and vigour of the new hardwood crop.

95. New techniques and standards should be developed for reforestation and growth of mixedwood stands. Special emphasis on enhancing natural regeneration of white spruce should be considered.

96. Pre-harvest silviculture prescriptions that integrate silvicultural and harvesting systems in support of management objectives should be required on all FMA and quota lands, followed by post-harvest assessments and tending plans.

8.4 Nursery Capacity

As discussed elsewhere, there is an immediate and urgent need to address the present and upcoming demands for nursery stock to respond to the reforestation requirements of both industry and the AFS.

In September 1989, the minister of Forestry, Lands and Wildlife wrote to the president of the Alberta Forest Products Association, saying that the department is "taking the necessary steps" to meet a forecasted demand for about 103.5 million trees per annum by the mid-1990s. The panel commends this commitment.

The province has estimated that the coniferous harvest of all present and new developments will eventually approach 53,000 hectares per year. In an address to the Alberta Forest Products Association (1988) Dr. John Drew, director of the Reforestation and Reclamation Branch of the Alberta Forest Service, suggested that 65 per cent of all cutovers would require planting to meet new growth performance standards. Industry estimates show this could be even higher, particularly in severe competition areas.

The province has announced that new standards of reforestation and regenerated stand growth performance are being developed and will be implemented in 1990. Failure to provide the necessary seedlings to support the new standards would jeopardize reforestation objectives.

Bottlenecks in the overall regeneration system (in availability of planting sites, for example) and interruptions in planting schedules (through fires, contractor shortages, or unsuitable weather conditions, for example) can have a major impact on nursery operation and inventory. A rapid short-term increase in nursery capacity could be highly risky, especially when FMA projects are just gearing up.

The minister has also announced his intention to increase the nursery capacity to provide approximately 50 per cent of the seedlings from government nurseries

and the remainder from contract growers. This policy has long-term benefits by providing competition in production that should lead to better quality stock as well as flexibility in stock types and quantity.

Traditionally, governments have been unwilling to enter into long-term contracts for services. However, if Alberta is to continue its consistent reforestation effort, trees will have to be grown better than they are now. Experience elsewhere in the country, and to some extent in Alberta, has shown that small-scale greenhouses do not provide either economies of scale nor the quality of stock required. The development of production-scale greenhouses is a multimillion dollar investment, and would not be undertaken by private industry on the basis of a one-year tender offer.

Recommendations:

97. **New nursery capacity should be designed for maximum flexibility to respond to changes in demand and prepare contingency plans for handling, storage, sale, or write-off of excess stock.**

98. **The province should encourage the development of private production-scale seedling capacity by experienced and professional tree growers.**

99. **The province should develop a fine-tuned communication and scheduling system between seedling users and producers that includes a forecast of all controllable factors in the system, (including available planting sites over time) and priority ratings for different stock types in case of production limitations or other contingencies. This could include allocation models with economic criteria built in, and may justify some systems design research and development before initiation**

100. **In principle, stock quality should take priority over quantity in all nursery operations.**

8.5 Reforestation Standards

(a) Conifers

Historically, conifer regeneration has been the focus of reforestation in Alberta. The least successful conifer reforestation has been in wetland areas where high water tables after clearcutting and difficult (highly seasonal) equipment access have created restocking problems that will increase when growth standards are added. Elsewhere, reforestation in terms of stocking has been achieved within specified time limits, but subsequent growth and development has been hampered, particularly by competition from vegetation. At present, reforestation standards set by the AFS are defined in the the AFS Timber Management Regulations and the Regeneration Survey Manual (1979). The new standards will be implemented in 1990.

Spacing criteria for plantations should be considered, to give selection of best microsites on wetlands priority over inter-tree spacing. Until effective methods are

developed, such areas should be reserved from harvest. The same approach should be taken for exposed high elevation sites that are difficult to regenerate.

The Alberta Forest Service has recognized that conifer stocking standards alone are not sufficient. They have negotiated with the Alberta Forest Products Association to add a growth standard and related free-to-grow standards. These new standards will recognize the need to have adequate conifer growth to maintain or increase annual allowable cuts for conifers and will have implications for both reforestation and stand tending. However, growth standards have not been set and will be particularly difficult to define and achieve on wet sites and exposed high elevation sites.

(b) Hardwoods

There is now a keen interest in effective regeneration of hardwoods, particularly aspen, and in development of new reforestation standards for them. The presence of substantial amounts of balsam poplar and white birch mixed with aspen suggests that their regeneration and growth characteristics should also be given consideration.

At present, foresters anticipate few problems with effective aspen restocking of cutovers using a clearcutting system. This is generally true, particularly with complete clearcuts on upland sites, but on sites where substantial amounts of balsam poplar and white birch remain after cutting, coupled with grass and shrub species, and possibly high water tables, effective stocking should not be taken for granted.

In addition, observations of recent hardwood cutovers harvested by conventional systems indicate substantial (up to 20 per cent) site disturbance by skid trails and landings including soil compaction and interrupted drainage. This can result in understocking and relatively poor growth of aspen. Current aspen cutover surveys underway in Saskatchewan, where there are cutovers as old as 25 years, confirm these observations. Consequently, stocking and growth expectations for aspen and combined hardwood species may now be too high, and should be reviewed. It is worth noting that many of our perceptions of aspen stocking and growth come from observations of primarily fire-origin stands that were not subject to soil disturbance by mechanical logging systems.

There are substantial areas of overmature hardwood stands on accessible productive sites in Alberta that require reforestation, and effective means of achieving this should be developed.

Weyerhaeuser in Saskatchewan has recently installed a number of aspen clone and hybrid tests and poplar hybrid tests in designed experiments and operational field trials. Material came from the Institute of Paper Chemistry in Appleton, Wisconsin. Consideration should be given to extending such initiatives to Alberta in view of the rapid commercial exploitation of aspen. Initial investigations are underway at the University of Alberta.

(c) Mixedwoods

Under the new regulations, the AFS will direct industry to reforest mixedwood sites to conifers using a slightly modified reforestation standard. An exception is two-storied stands with a hardwood overstory and a white spruce understory, where a modified hardwood harvesting procedure that preserves the softwood understory is being assessed (see Section 6.1). Failure to recognize a mixedwood landbase has created problems where mixedwoods are designated for conifer regeneration, particularly spruce, since the hardwood and grass components of these communities

are so aggressive. In fact, recent surveys and operational observations confirm a major trend toward hardwoods in all cover types, including many productive pine areas. These softwood stands are becoming mixedwood stands and mixedwood stands are becoming hardwood stands. In the long term, this will lead to reduced annual allowable cuts of both spruce and pine unless cost-effective means of reversing the trend are found.

The value of perpetuating mixedwoods is well recognized from the point of view of aesthetics and wildlife habitat but the regeneration and management of mixedwoods is not well understood. Research aimed at assessing the regeneration and growth of mixedwoods is needed. There is some evidence to suggest that in the long run white spruce production in mixedwoods is more sustainable than in pure plantations (old field spruce in Maritimes, Petawawa spruce plantations, Manitoba spruce plantations) where pathological rotations are being reached as early as age 60. European experience with management of pure spruce stands established as plantations indicates serious problems with wind damage and disease (S. Navaratil, personal communication).

Innovative stand management techniques with small-patch clearcutting or modified shelterwood systems may be necessary to maintain mixedwoods and to get optimum spruce productivity. For example, large aspen may be removed in one cut, with sprouting aspen and remaining spruce left to grow. Once the spruce has matured, it would be harvested, allowing new aspen to grow and spruce to slowly "invade" the stand. New logging technology such as shortwood systems could expedite such management techniques.

Recommendations:

(a) General

101. The Alberta Forest Service and the forest industry should be encouraged to continue developing reforestation standards that include stocking and growth criteria and to link reforestation, juvenile growth, and stand yield.

102. The value of herbicides as tools to maintain both conifer and mixedwood cover types where they are most desirable should be given special consideration.

(b) Conifers

103. Research and development into both stocking and growth is needed to increase the effectiveness of conifer reforestation on wet areas and those that become waterlogged following harvesting.

104. Growth performance requirements for free-to-grow standards should be supported by appropriate research. It is expected that these standards will vary considerably by species, elevation, aspect, and other factors.

(c) Hardwoods

105. Research and development is needed to provide information on the regeneration and growth characteristics of balsam poplar and white birch relative to aspen on hardwood and mixedwood sites. Such information should be incorporated into new hardwood reforestation standards, addressing both stocking and growth.

106. Nursery programs in Alberta should include plans for hardwood production of both pure native species and hybrids for use in reforestation (as does the Weyerhaeuser program at Prince Albert, Saskatchewan). Aspen clones and hybrids should be given major emphasis.

107. A survey of recent hardwood cutovers in Alberta should be conducted to determine the impact of current logging technology on stocking and growth of the new hardwood forest and to consider alternative logging technology to reduce negative impacts.

108. A strategy should be developed for rehabilitating and reforesting previously degraded hardwood and mixedwood stands in Alberta.

(d) Mixedwoods

109. Research and development should be undertaken into ways to enhance the natural regeneration capability of white spruce on mixedwood sites through modified harvesting, fire, or other means.

110. Research into juvenile stand development is needed to provide data on the reforestation and development of mixed stands of conifers and hardwoods to develop effective mixedwood reforestation standards for Alberta. Such data are essential to establishing free-to-grow standards as part of the reforestation standard.

111. New standards for reforestation and development of mixedwoods should be incorporated into pre-harvest silviculture prescriptions, reviewing harvesting equipment appropriate to achieving silvicultural objectives. Shortwood systems should be given special consideration.

112. Application of new conifer reforestation standards and free-to-grow criteria to mixedwood sites where hardwood, and grass competition are severe, should include cost-effectiveness assessments to determine the practicability of such activity.

8.6 Role of Herbicides in Reforestation

Public and political resistance to herbicide use on forest lands has made operational trials impossible and even research trials difficult in Alberta over the past few years. Professional and scientific support for the controlled use of herbicides has done little to change the public perception that links herbicides to environmental degradation and their determination to prevent herbicide use on Crown forest lands. This limits forest managers in Alberta to mechanical, manual, and cultural techniques (such as grazing, and changing the timing of treatments). In contrast to forestry, there is little apparent public resistance to the use of herbicides in agricultural production of food crops or on lawns and gardens. In Alberta, up to four million hectares of food crops are sprayed annually, often using the same chemicals as those proposed for forest use.

From a technical point of view, even the limited number of herbicides currently registered for use in forestry in Canada (glyphosate, Velpar L, Pronone, 2,4-D) could provide a cost-effective means of enhancing site preparation and release operations on specified sites in Alberta. This is particularly true of sites dedicated to conifer production with competition from hardwood, brush, and grass species that are not amenable to cost-effective control over an adequate period by manual and mechanical means alone.

Alberta's forest industry is in direct competition with other forest industries in Canada and throughout the world. In Canada, Alberta is the only province with a major forest industry in which the use of herbicides for control of vegetative competition is not allowed. This places Alberta's industry at a competitive disadvantage with the rest of the country, and with other areas where such use is permitted. In Sweden, where herbicide use in forestry has been largely discontinued, the cost of production has increased substantially so that the Swedish forest industry struggles to remain competitive.

There should be an objective, detailed analysis of forest renewal and management needs that includes an economic assessment of the cost and effectiveness of all available vegetation management tools (including herbicides), and that shows the consequences of different courses of action for industrial forestry in the province. This analysis would help clarify the choices that exist for achieving vegetation control and could strengthen policy and regulation initiatives regarding the use of herbicides and their alternatives, and any related research and development.

The panel has serious reservations about widespread use of herbicides that would limit food and habitat for wildlife. However, the panel does support limited use, with application restricted to once or twice during a 60- to 100-year rotation, on selected sites. The objective would be not to kill all broad-leaved vegetation, but rather to set back competition so that conifer seedlings can get established and thrive.

Recommendations:

113. A clear objective statement of forest renewal and management needs in Alberta should be developed, with the costs and effectiveness of alternative methods of vegetation management as a component of the statement.

114. **A policy and regulations on the critical issue of vegetation management and supportive research and development should be developed.**

115. **If herbicides are to be a component of the vegetation management policy, there is a need for site-specific rate, timing, and delivery technology research and development studies that will ensure minimum dosage and maximum operational control and safety in the use of forestry herbicides.**

116. **Public demonstrations of the cost and effectiveness of different vegetation management techniques should be established as part of a public information/education strategy (see Section 9.3).**

8.7 Forestry and the Greenhouse Effect

The "greenhouse effect" has been the subject of increasing debate in recent years. It is a natural and well-understood phenomenon that has an essential role in regulating the temperature of the earth's atmosphere. The role of forests in changing it and the consequences of change for forestry are still speculative.

Greenhouse gases, mainly carbon dioxide (CO_2), methane (CH_4), and chlorofluorocarbons (CFCs), increase the temperature of the earth's surface by trapping heat radiated from the earth into the atmosphere (Keeling et al. 1982 and Gammon et al. 1985) The two main man-caused sources of greenhouse gases (atmospheric carbon) are the burning of fossil fuels and changes in land use.

Burning of fossil fuels is by far the most prominent man-caused source of greenhouse gases today. (See Table 1) Wiggins and Yurko (1989) have recently assessed impacts on the fossil fuel industry of Alberta that might result from limiting greenhouse gas emissions (especially $C0_2$). They outline strategies for limiting $C0_2$ emissions, and measures to minimize the effects of such actions on the economy. They also noted that global action would be required for significant reductions. It must be stressed here that although the table indicates relatively large natural carbon sources from decomposition, compared to man-caused fossil fuel sources, the natural sources are balanced by natural sinks through regrowth whereas fossil fuel sources are not.

Terrestrial ecosystems such as forests act both as absorbers (sinks) and releasers (sources) of atmospheric carbon. Forest ecosystems store carbon in trees and associated vegetation, in litter (organic matter on the forest floor), and in soil. In addition, carbon is stored in products made from trees, including lumber and paper. Forests also add carbon to the atmosphere, through wild fires and slash fires, for example, and through decomposition and decay in trees, litter, soil, and forest products.

Sustained yield forestry, which requires protection of forest ecosystems from fire and insect damage, prompt reforestation after harvest, and maintenance of young forests in a healthy growing state, should reduce the loss of carbon to the atmosphere, and there is speculation (Wiggins and Yurko 1989) that such practices,

particularly if coupled with afforestation (primarily planting on marginal agricultural land) may even create an effective carbon sink, compensating to some extent for the production of greenhouse gases from primary sources like the burning of fossil fuels. Such speculation urgently requires assessment.

Table 1

Man-caused and Natural Sources of CO_2 Emissions in Alberta (Millions of Tonnes per Year)[1]

Man Caused	
Fossil Fuels	110.8
Non-fossil Fuel[2]	3.5 to 6.5
Natural	
Decomposition[3]	300 to 500
Forest Fires	8 to 10
Human and Other Animal Respiration	15 to 18

[1] Source: Wiggins and Yurko (1989). Tables 1 and 3.

[2] Includes ammonia and lime production and waste burning. Does not explicitly address land use change as a source of greenhouse gas.

[3] Rough estimate for all plant and soil organic material.

Current modelling research being funded by Forestry Canada under the Energy from Forests program is designed to determine the net effect of forests and forest management strategies on the carbon cycle and hence the effect on greenhouse gases. This work should improve our understanding of the role of forests and peatlands in the different ecoclimatic regions of Canada and in the carbon cycle, and their related role in the greenhouse effect.

Changes in land use from forest to urban use or agriculture may result in a significant loss of stored carbon to the atmosphere, particularly if the forests are burned. Agricultural crops store and release carbon on an annual cycle with minimal long-term storage in the ecosystem or in products. If conversion to agriculture takes place in tropical rainforests where soils are nutrient-poor and subject to leaching, the entire system can rapidly degenerate to a very low level of productivity, severely diminishing its ability to support growth (fix carbon). The attendant consequences of reduced ecosystem productivity along with catastrophic loss of rainforest plant

and animal life are of particular concern in the clearing of tropical rainforest. There is no evidence to support comparable concerns about harvesting boreal forests under a sustained yield policy.

Old-growth forests contain significant amounts of carbon in long-term storage. The conversion of such forests to vigorous second growth is sometimes promoted as a means of increasing carbon storage. However, Harmon et. al. (1990) have shown a significant long-term net loss of carbon from old-growth coastal rainforest ecosystems when they are harvested and managed subsequently on commercial rotations. Such losses are proportional to the carbon storage capacity of the trees and the organic material on the forest floor and in the soil, and to the difference between future commercial harvest age (rotation) and the previous age of the old growth (60 vs. 450 years). Applying these criteria to lodgepole pine or aspen and many upland mixedwood forest ecosystems in Alberta, there would appear to be a low probability of such carbon losses as a result of harvesting old-growth (overmature) stands because they usually have little organic material on the forest floor or in the soil due to the history of frequent fire disturbance, and planned future commercial harvest ages (rotation) are not significantly less than old-growth ages (60 to 80 years vs. 100 to 120 years).

By the same criteria, more carbon losses might be expected when old-growth sub-alpine spruce-fir or northern boreal spruce on moist sites are harvested, because they have more significant accumulations of organic material on the forest floor and in the soil and there is usually a larger difference between planned future commercial harvest age (rotation) and the age of old growth (80 to 100 vs. 150 to 200 years). The net carbon balance resulting from conversion of old-growth to second-growth forest ecosystems in Alberta is speculative and not readily comparable to coastal rainforest results. The balance is probably more nearly neutral than either positive or negative, but there is a lack of data to support conclusions.

Forestry Canada is just completing a *Strategic Plan on Climate Change and Its Implication for the Forestry Sector* (Pollard, Zoltai, et al. unpubl.) which will provide a detailed statement of federal concerns and research needs related to Forestry Canada's role. Also, a recent report by Wheaton and Singh (1988) provides an overview of the implications of climatic change for the boreal forest of the prairie provinces and the Northwest Territories, including detailed management strategies and research needs. These issues are also being addressed by the Canada Committee on Ecological Land Classification (CCELC) through its climate change working group (1988), within the context of the new Ecoclimatic Regions of Canada (1989).

The possible greenhouse effects on forestry are both positive and negative. They could be advantageous in areas where available moisture will not be limiting, and negative in areas where combined heating and drying, or rapid change and adjustment, create problems for reforestation and crop growth. On balance, the effects for Alberta would appear to be negative. Current simulation models indicate a strong and sustained warming trend, increasing from the equator northward, with reduced available soil moisture in many areas. The impact is predicted to be particularly strong in areas such as the aspen parkland and boreal forest zones of Alberta within the next few decades.

Specific impacts of the greenhouse effect on reforestation could include improved regeneration on previously cold sites, the failure of regeneration of native tree species near the southern limit of their growth and increased impacts of fire, insects, and disease on forests. There is speculation that in the short term losses may

be offset to some extent by more rapid growth of established forests because of higher CO_2 concentrations and longer growing seasons where moisture is not limiting. There may also be direct conflicts over land use between forestry and agriculture, as marginal agricultural land in the north, currently seen as a source of industrial wood for the forest industry, becomes productive for agriculture and is allocated for that purpose, affecting reforestation programs. The province would benefit from a strategic plan to address these potential impacts.

Action to mitigate such impacts by providing a sink for CO_2, such as maintaining cold or frozen soils or peatland, might work against reforestation by restricting areas of forestry expansion. Data in this area are limited. Wetland drainage programs and strategies to reduce the impact of climate change may be in direct conflict.

In summary, the main man-caused sources of greenhouse gases today are burning of fossil fuels, and deforestation (primarily changes in land use from forest to urban use or agriculture). Both are global issues. Fossil fuels are by far the most important source. In general, sustained yield forest management is probably good carbon management and this, coupled with afforestation, may make the forest sector a net absorber of carbon, and therefore part of the solution to the greenhouse problem. This proposition is currently being addressed by some modelling research but there is a need for specific research into the structure and function of major forest and non-forest ecosystems in Alberta to provide reliable data as alternatives to inappropriate coastal and tropical rainforest data commonly cited at present. If the greenhouse effect develops as predicted, there will likely be significant negative impacts on the aspen parkland and boreal forests of Alberta and strategies are needed to mitigate these impacts.

Recommendations:

117. The government and the forest industry should seek ways to reduce the consumption of fossil fuels in all aspects of forest activity and to discourage the conversion of forest land to other uses.

118. The government should prepare a strategic plan to mitigate the probable effects of climate change in forests. This could include development of monitoring and predictive capability, enhanced protection, and reforestation and afforestation to increase carbon storage. This plan should be linked to the federal strategic plan.

119. The government should support research — beginning with modelling — into the structure and function of all major Alberta ecosystems, both forest and non-forest, to provide ecosystem information relevant to the carbon budget in place of coastal and tropical rainforest information that is often misleading.

120. The government should review the potential conflict between its wetland drainage program and strategies to reduce the impact of the greenhouse effect on Alberta's forests.

9.0 OTHER ISSUES

9.1 Government Reorganization

Much of what we have reported and recommended involves the operations of the Department of Forestry, Lands and Wildlife and communication and co-ordination of efforts among the divisions within the department and between Forestry, Lands and Wildlife and other departments. For there to be wise allocation and use of the varied resources of the forested lands of the province, it seems reasonable for the various players in the appropriate departments to work together more frequently and to have a mechanism for handling everything from day-to-day concerns to major planning and allocation questions.

There are two significant obstacles to this co-operation. First, the organization of Forestry, Lands and Wildlife is vertically oriented, with few people below the deputy minister having responsibility for the multiple resources. Also, jurisdictional units and boundaries are not coincident; for example, an Alberta Forest Service forest headquarters is typically not located with regional headquarters for Fish and Wildlife. Second, some resources (parks, wilderness areas, etc.) are handled by other departments. In addition, Forestry, Lands and Wildlife includes one unit, the Forest Industry Development Division, that has a mandate conflicting with the protective and wise stewardship responsibilities of the rest of the department.

The ideal administrative unit would be a department that had the respect and credibility of the public for the protection and stewardship of all renewable forest resources. Rational planning and integrated management would be facilitated by including the divisions responsible for the management of each of the various resources. When the recommendations that follow were formulated, the panel considered inclusion of Alberta Environment in the new department because it seemed appropriate to include all units responsible for resource stewardship and

protection. The panel decided against including Alberta Environment, however, because of the unwieldy size of the resulting department and because of the lack of management orientation among many of Environment's enforcement units. Although Environment need not be included in the new department, new avenues of meaningful communication and co-ordination should be created between Alberta Environment and the new department.

Recommendations:

121. A government reorganization should occur to form a new department (possibly to be called Alberta Natural Resources) with a mandate for resource stewardship and protection. The new department would include the present Forestry, Lands and Wildlife Department (excluding Forest Industry Development) and that part of Recreation and Parks that handles the land resources, parks and planning (excluding tourist promotion). Forest Industry Development and the tourism promotion section of Recreation and Parks should be transferred to Economic Development.

122. The new department should be reorganized so that there are more integrated resource managers making decisions in the field. For example, regional resource managers (analogous to current forest superintendents) should have expanded responsibilities, including: management of wildlife and fisheries resources; environmental monitoring and protection; timber management; and management of parks, recreation, and wilderness areas in their region. There should be more people at all levels who have increased responsibility for integrated management. Some service functions (the Forest Research Branch and the forest inventory section of the Alberta Forest Service, for example) would have similarly broader responsibility.

123. Administrative units (boundaries and regional offices) should be made uniform among the various divisions of the new department to facilitate co-ordination of resource management.

9.2 Research

In many places in this report, the panel has alluded to the lack of information about particular topics and the need for further research. We don't know enough about managing mixedwood forests. We need more information about the habitat requirements of the fauna of old-growth forests. We need to better determine the subtle environmental effects of man's activities in the boreal forest. We need to know more about the relative merits of intensive and extensive management — how

they can be done and what effects they have on the environment and other forest resources — so we can better zone activities in the forest. We need to know the economic benefits and costs of resource allocation alternatives.

These and many other questions about forest resources (including wildlife, fisheries, and recreation) must be addressed, yet there has been less than token funding from the province for such research. The recent expansion of the forest sector has created further demands on the research community, but there has been no commitment of new dollars to this needed research. There is a very small Forest Research Branch within the Alberta Forest Service to handle the applied research questions raised within the division. There is also the Alberta Forest Development Research Trust, which is an admirable idea with an embarrassingly low level of funding (approximately $85,000/year).

Funding for forestry and related research has largely been unstable and unreliable for a variety of reasons, that may include: the continuing question of federal-provincial jurisdiction in forestry; the lack of continuity and stability in government programs; insecurity of tenure by industry with respect to the long-term nature of much forest research; the lack of strategic direction and coordination of research; the perceived incompatibility between research and corporate objectives; the inability to apply research results; or the lack of a mechanism to take advantage of management gains demonstrated by research; and distant ownership of forest industrial operations.

Forestry Canada, through the Northern Forestry Centre in Edmonton, which traditionally has been a major player in forest research in Alberta, has experienced instability in long-term funding. This has resulted in a shift from primarily in-house-supported research to a situation in which Forestry Canada researchers are competing for scarce and limited outside funds. The Canadian Wildlife Service experienced similar declining funding over the past several years and now faces an uncertain future in its ability to conduct wildlife research. We are concerned about the continued decline in federal funding for forestry research. The importance of the resource and industry in Alberta warrants more federal support.

The forest industry also conducts independent forest management-related research such as the major regenerated stand growth and yield co-operative project of Weldwood and Procter and Gamble. Industry supports some targeted research by other agencies, including the University of Alberta and Forestry Canada.

Industry and government generally support harvesting, transportation, and forest products research fairly well through the Forest Engineering Research Institute of Canada, Forintek Canada, the Alberta Research Council, and individual companies.

The panel applauds the recent partnership program of Forestry Canada and the Natural Sciences and Engineering Research Council, which encourages industrial contributions to forest research. The program is seriously underfunded, and allows for only $700,000 to serve all of Canada.

The Alberta Forest Research Advisory Council was established in 1988 under the Forest Development Research Trust Fund Act. The duties of the council include establishing forest research priorities, co-ordinating forest research, and making recommendations to the minister about allocation of research funds from the trust fund.

The council is chaired by the deputy minister of Alberta Forestry, Lands and Wildlife and has 15 members, most of whom are senior industrial representatives, which strongly suggests that industry is now driving forestry research in Alberta.

The council initially identified four research priority areas (forest management, environment, forest protection, and new product development) and established a task force for each. The task forces will make further research priority recommendations to the council.

The panel believes that the Alberta Forest Research Advisory Council should give equitable consideration to basic as well as applied research and development when it establishes priorities and funding levels.

Recommendations:

124. The Forest Research Branch of the Alberta Forest Service should be substantially expanded to address immediate needs and to include the resources needed to serve the entire Department of Forestry, Lands and Wildlife or its successor. A tripling of staff and necessary project support would be appropriate. Much of the work of the branch should be managed and focused to address immediate, short-term, practical problems.

125. The Alberta Forest Development Research Trust should have its subject mandate similarly broadened, and be renamed the Alberta Forest Resources Research Trust to reflect the change. It should be designed to receive applications from qualified outside scientists, researchers, and graduate students, who would pursue a range of applied and basic research. Funding should be provided by a levy of 10 cents per cubic metre of wood harvested in Alberta, along with matching allocations from the department. At the 1988 level of harvesting, this would produce about $1.6 million. This would give a stable and secure mechanism that would provide a strong foundation for forest research and graduate student education in Alberta.

126. The province should continue to encourage and support research and development by federal agencies like Forestry Canada and the Canadian Wildlife Service with funding support from such sources as the Forest Resources Development Agreement, the Forest Development Research Trust, the Wildlife Research Institute, and Wildlife Habitat Canada, where proposals have technical and scientific merit and relevance to priorities set through the Alberta Forest Research Advisory Council.

127. A mechanism should be established to ensure adequate priority and funding for longer-term and more basic research within the Alberta Forest Research Advisory Council.

9.3 Public Information and Involvement

It has become evident to the panel that there is a serious gap in understanding between the public on one hand and the government and industry on the other. Government and industry do not appear to have realized the extent of the public's legitimate concern about the impact of forest development, while the public seems not to understand the function and process of forest management and the responsibility of regulatory agencies.

The public expressed lack of trust in the work conducted by both companies and government agencies as background to the proposed developments. There is obviously a need for greater public participation in the review process, if the public is to overcome its distrust and begin to understand forest management issues. This need has been recognized by the AFS, and a program of public involvement is being developed in response to that need.

Although public participation has not been a requirement in the past, FMA holders are now required to implement a public involvement process. Some of these FMAs are covered by approved integrated management plans, which incorporate public concerns, to a degree, but do not include the detail of a forest management plan. The minister and FMA holders have agreed that more public involvement is appropriate for integrated resource management.

Forest management plans for Crown management units (those under timber quota rather than FMAs) have generally not incorporated a formal process of public review or input, unless there was vocal criticism of those plans. The AFS has committed itself to a program of public involvement on these lands, similar to that for the FMA areas.

Forest Interpretive Centres

Interpretive centres developed elsewhere in the province have focused on natural history (the Tyrrell Museum of Paleontology); cultural heritage (the Ukrainian Cultural Heritage Village); and on natural resource development (the Fort McMurray Interpretive Centre).

Interest in natural resources and the environment has never been higher in Alberta than it is now, yet public understanding and opportunities for public information remain at a relatively low level despite the efforts of a number of agencies to raise public awareness. The Alberta Forestry Association, for example, has had a public information program for a number of years that includes both school-age and adult components. The National Forest Week campaign, sponsored by the Alberta Forestry Association, has been fairly successful, largely as a result of combined efforts of the Alberta Forest Service, the Alberta Forest Products Association, educational institutions, and industry. The forestry interpretive trailer, and the E.S. Huestis and Jumping Pound demonstration forests all funded by the Canada-Alberta Forest Resource Development Agreement, are all examples of new initiatives in public information. They are commendable, but the panel believes that a major forestry interpretive centre is urgently needed to advertise and complement these initiatives, provide support for them, and go beyond them in providing focused and exciting opportunities for public education.

The panel believes that a major centre highlighting the ecology and history of Alberta forestry and the significance of forests to Alberta's past, present, and future

would make an important contribution to raising the public's awareness of forest issues, and would win support for the wise and sustainable use of forests. It should be located along a well-travelled highway, and be associated with a rest stop including a picnic site and other amenities to encourage the travelling public to stop and visit and, in the process, become aware of the forest heritage of Alberta.

While a forestry interpretive centre would be valuable for public education, its association with a "living laboratory" for tour opportunities is seen as a logical extension of the educational process. For this reason, the panel suggests that the centre should be located in the Green Area, close to ongoing and well-established forestry operations.

Forestry Magazine

Another useful initiative for the Department of Forestry, Lands and Wildlife would be the establishment of a popular magazine to serve as a forum for land use issues and as an information source. Topics could include recent developments, research, and innovative management related to any part of the forest resource, including harvesting, regeneration, wildlife, recreation, or environmental issues. The magazine, while funded by the department, should operate at arm's length, as does the quarterly *Environment Views,* published by Alberta Environment. Independent direction by an editorial board made up of representatives from the public, industry, and government would assure the magazine's credibility, as would balanced coverage of different perspectives on forestry issues. It should be widely distributed. As with other government publications, subscriptions should initially be free. After the first five to seven years, a modest subscription could be charged, and privatization investigated.

Recommendations:

128. The panel encourages Alberta Forestry, Lands and Wildlife and forest management agreement holders to continue to implement a formal public participation scheme, periodically reviewed, with the intent of increasing effective public involvement at all levels of policy making and planning.

129. A forest interpretive centre highlighting the ecology, history, and significance of forests to Alberta's past, present, and future should be established at an existing appropriate rest area along a major highway in the Green Area, to help Albertans, and urban dwellers in particular, understand the forest resource and the industry.

130. The Department of Forestry, Lands and Wildlife should establish and fund an independently directed popular magazine providing a forum for land use issues and a source of information on forest resources.

9.4 Penalties for FMA Infractions

During the public review meetings, the public expressed its concern about the enforcement and regulation of the industry. The suggestion was that penalties for infractions are inadequate and are too seldom applied.

The ultimate penalty for continued infractions of timber management regulations is the loss of the forest management agreement, which would leave the FMA holder without a continuing timber supply. The panel cannot envisage a more serious penalty. The minister should review the appropriateness of lesser penalties (currently fines of $100 to $1,000) in the regulations, with the intention of discouraging repeat violations.

Some of the public concerns about the regulatory process appear to spring from a lack of knowledge of the timber harvesting plans and operating ground rules process. When these were revised in 1986, the AFS incorporated an intensive training program for AFS staff and industry—supervisors and loggers alike. In addition, the public was encouraged to report to the AFS any infractions they detected. These infractions were investigated, dealt with, and reported back to the complainant. The panel commends these AFS initiatives and suggests they be continued.

Recommendation:

131. The minister should review the enforcement of timber management regulations to ensure they are interpreted fairly, supervised adequately, and that corrective action is applied equally in all cases of contravention.

9.5 Professional Responsibility

The forests of Alberta are managed by professional foresters, most of whom hold degrees in forestry. These foresters have formed the Alberta Registered Professional Foresters Association (ARPFA), partly in response to the need to protect the interests of the public in the management of the forest resources of Alberta.

The code of ethics of the association requires professional foresters to regard as their primary responsibility "the maintenance of the integrity of the forest resource, the protection and enhancement of its productive capacity, and the perpetuation and improvement of its utility and value to society." Any forester who knowingly violates the code of ethics faces censure by the association, including loss of RPF status.

Professional associations have a primary responsibility to maintain the standards of practice within their jurisdictions. At present, there is no statutory requirement that registered foresters be used to prepare forest management plans. Membership in the ARPFA is therefore optional although approximately 300 foresters have voluntarily joined the association and agreed to be bound by its code of ethics.

There are certain tasks and functions that require a high standard of professional competence and responsibility. Failure to perform these adequately can have a

negative impact on a public resource; the public needs to be assured that foresters are held to a high standard of performance and that failure to maintain that standard would result in significant penalty. For this reason, the panel believes the next logical step in the evolution of professional forest management in the province should be the restriction of certain types of practice to members of the ARPFA.

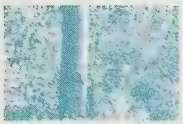
Recommendations:

132. Professional foresters who knowingly and deliberately ignore and contravene the provisions of the timber management regulations, causing damage to the forest resource, should be censured by the Alberta Registered Professional Foresters Association.

133. Membership in the Alberta Registered Professional Foresters Association should be mandatory for professionals performing certain key duties, including the preparation of forest management plans.

9.6 Foreign Ownership

There were concerns raised about companies whose ownership is predominantly non-Canadian (or non-Albertan) or whose head offices are outside Canada, being encouraged or allowed to develop Crown forest resources. People seem to be concerned about profits leaving Alberta or Canada and about non-resident owners not operating with appropriate concern for land stewardship and environmental ethics. On the positive side, people welcomed the investment and jobs supported by "outside money." Of course foreign ownership is not new to the Alberta forest industry. This panel does not believe any particular recommendation in this area is in order, since the government is well aware of the positive and negative aspects of foreign ownership and investment. The outside companies must, however, abide by the same sort of operating ground rules followed by Canadian companies.



RECOMMENDATIONS

These recommendations appear throughout the text with appropriate background information.

1

More staff, particularly professional and technical positions in government and relevant support groups, should be provided, especially in those forests where rapid expansion of FMAs is underway or anticipated, to a level that will allow the department to meet FMA-related stewardship obligations. Increasing the number of professional staff will be of little value unless accompanied by adequate funding to allow these specialists to perform their duties effectively.

2

The department should ensure staffing levels and budgets are adequate to provide a level of inventory, management planning, and operational and reforestation control on Crown forest management units it administers that is at least equivalent to such practices on the best-managed FMA lands in the province.

3

Based on these recommendations, the panel feels that a staff increase of at least 150 is appropriate. At least 15 should be professional and technical wildlife and fisheries personnel. Most of the remainder should go to the forests where new developments are occurring, with emphasis on areas that are currently understaffed, such as hydrology and environmental controls. These increases should be phased in over the next three years.

4 The level of co-ordination and integration of forest wildlife activities should be improved so that the Alberta Forest Service, Alberta Fish and Wildlife, and FMA holders can achieve a cost-effective, efficient, and practical system of forest management.

5 Before any development that may affect federal jurisdictions occurs on provincial lands, there should be a process of more effective inter-government consultation, including public hearings where appropriate.

6 In the future, public hearings on the environmental and social impact of forest development should not look at mill site and forest operations issues separately. Examining industrial impacts and management issues together will reduce public frustration and help control the high costs of such hearings.

7 As Canada and Alberta have already endorsed the principles of the World Conservation Strategy and the Brundtland Report, the panel recommends that the government immediately complete the Alberta conservation strategy, especially for the forest sector.

8 The draft Alberta forest sector conservation strategy should be reviewed by forest and wildlife research scientists, the Alberta Registered Professional Foresters Association, and the Alberta Society of Professional Biologists before it is accepted.

9 Once the Alberta forest sector conservation strategy is developed, a department policy consistent with this strategy is required. Division policies must be developed that effectively integrate and complement both the department policy and the conservation strategy.

10 The Province of Alberta should clearly state the strategy used to administer the forests, to grant timber supply areas, and to manage all forest resource interests. This management strategy should combine the necessary elements of various acts, regulations, and policies (such as the Eastern Slopes policy) and define its objectives for forest development within the context of the proposed Alberta forest sector conservation strategy.

11

The dynamic and flexible ground-rule system should be continued, supported by an effort to raise public awareness of its value.

12

Two types of forest management advisory boards should be established immediately:

(a) An Alberta forest management advisory board similar to those already in place for the other two divisions of Alberta Forestry, Lands and Wildlife. This board would periodically assess and advise the government on its forest management strategy and matters such as forest policy, planning, management, ground rules, inventory, and staffing at the provincial level.

(b) Regional forest management advisory boards for each forest region that would address forest management concerns and work closely with the provincial advisory board. These boards would be made up of public representatives from various interest groups, plus professional, government, and industry personnel. Because many industries have an impact on forest ecosystems, there should be representation from all major industries active in the region.

13

A forest management review panel should be established immediately, to periodically (at 10-year intervals, for example) assess forest management in light of changes in forest technology and public values and attitudes. This panel should be established by the Environment Council of Alberta, in order to remain independent from the Department of Forestry, Lands and Wildlife and from industry.

14

Priority should be given to enhancing current inventories for purposes of management planning, especially mixedwood and hardwood inventories, and inventories of the amount and distribution of spruce understories in deciduous and mixedwood stands.

15

The Alberta Vegetation Inventory, incorporating information important for the management of both forestry and wildlife, should be extended as rapidly as possible into the Green Area, with priority given to FMAs where there is a commitment to an integrated wildlife/forestry management planning process. The inventory should be designed and guided by specialists representing all affected natural resource disciplines.

16 Inventory enhancement techniques should meet management planning needs and information may be more or less detailed than that provided by the Alberta Vegetation Inventory. Enhancement should be done on a priority area basis and restricted to areas designated for operations within three to five years, to reduce costs and to help keep the information current.

17 The department's inventory and mapping process should be extended to include wildlife species-habitat relationships as quickly as possible.

18 The Fish and Wildlife Division in co-operation with other government and non-government agencies should improve its inventory of fish and wildlife populations, including seasonal distributions and habitat requirements over time, especially for priority non-game species for which there is scant information. This should first be done for land under forest management agreements.

19 The government should implement the proposed Provincial Fish and Wildlife Resource Management Information Program.

20 Stand volume tables for various volume sampling regions should be reviewed and compared against one another. Significant differences should be resolved by field sampling and analysis.

21 Actual volume/age data should be compared to the average yield curves for various volume sampling regions before these curves are used to develop annual allowable cuts. Where discrepancies exist the average yield curve should be recalibrated.

22

The use of arbitrary yield tables for regenerated stands should be discontinued. A significant research effort should be directed toward establishing reliable estimates of regenerated stand growth performance and yield, and developing models that simulate performance and project future growth. These should be combined with accurate inventories of regenerated stands and incorporated into timber supply and annual allowable cut models. Until these yield tables are developed, forest management planners should continue to use natural stand yield tables, applied to existing stand conditions and distributions in the regenerated forest.

23

The biogeoclimatic system offers particular utility for stand-level silvicultural decision making, but should be subjected to detailed field testing in west-central and southwest Alberta in coniferous, mixedwood, and hardwood stands. This is required to demonstrate its utility and limitations for application at the stand and cutblock levels before it is extended to other parts of the province.

24

A staff training program should be initiated for the AFS field staff to adequately test the substantial existing biogeoclimatic database for purposes of developing pre-harvest silviculture prescriptions. If the approach is feasible it would enhance the manager's capability to meet operational demands for more intensive forest management.

25

If the biogeoclimatic system proves useful the department should initiate research and development to adapt this system to the classification of recent cutovers and juvenile stands by supplementing the existing database on successional trends.

26

The department should continue the GIS site classification pilot project using better-defined objectives and a database that reflects ecological information currently available only in taxonomic keys.

27

Early attention should be given to testing and scientifically forecasting the growth and yield of stands regenerated under current management practices.

28

Two research priorities should be addressed in natural stands (usually of fire origin):

(a) Developing the means to forecast trends in stand parameters used for defining the merchantability of stands that are currently unmerchantable; and

(b) Developing information on, and the ability to forecast stability, growth, and decline in, older cover type/age-class combinations.

29

Recent developments linking regenerated stand performance to silvicultural decision-assistance models appear to hold promise for Alberta. The province should continue and expand its efforts to develop similar capabilities in Alberta.

30

All forest management areas should be assessed for priority land use needs, and stratified accordingly. Within each stratum, management of the priority resource should also embody sound management of secondary resources.

31

FMA holders should seek to develop innovative forest management techniques that will effectively address management needs within different priority zones.

32

Since optimum fibre production will not be achieved on non-forest priority zones, FMA holders should be encouraged to intensify their forest practices where appropriate within priority production forest zones in order to maintain their allowable cuts.

33

In assigning landbase to all present and future forest management areas, wherever possible a reserve area equal to 10 per cent of the total forest management area should be established. This area can be used to replace landbase assigned to other priority land uses in the future (including old growth, see Section 6.5), and to address potential annual allowable cut shortfalls between the preliminary and detailed annual allowable cut determinations.

34

Fire losses should not be built into harvest scheduling models, but be accommodated within the periodic management plan revision process. In this revision, historic losses are analysed and the resulting impacts are incorporated into the new timber supply analysis and annual allowable cut estimate. Inclusion of the fire risk allowance in current annual allowable cut development should be discontinued.

35

Proposed land use dedications that will reduce established annual allowable cuts in working forests should be analysed for their economic and social impact, as well as their intrinsic merit.

36

In specific cases where the operational two-pass clearcutting system is in conflict with other important forest land uses—aesthetics, fish, and wildlife habitat, erosion control or other uses—a team of planners/managers with relevant expertise should investigate, plan, and execute a modification to the system, its extension to three or more passes, or a substitution of shelterwood or selection as a means of achieving management objectives.

37

In cases where a system of three or more passes is initiated, the environmental impacts on soil erosion and water quality of the additional, early access over a compressed period should be mitigated by special emphasis on application of ground rules and application of special procedures or structures to reduce erosion.

38

The logistics and feasibility of large-scale harvesting operations in wetland areas of northern Alberta that have traditionally been conducted on frozen soil should be critically examined, with special attention to adopting harvesting technology that uses high flotation equipment to minimize potential long-term site damage.

39

Harvesting systems should be appropriate to management priorities. Where forest management for timber production has priority, the two-pass clearcut system can be environmentally acceptable and appropriate. Where other forest land uses have priority, the normal two-pass system may or may not be appropriate.

40

In areas where timber production is designated as a prime use, the provisions for block size found in timber harvest planning and operating ground rules, and the trend toward smaller block sizes, appear reasonable to the panel. As changes in block size occur, all the implications of those changes, including cost, should be considered. Where other uses such as recreation or wildlife management have higher priority, block sizes should be modified or alternative harvest systems used if appropriate.

41 Water quality monitoring should be incorporated into forest management planning and operations on second- and third-order watersheds to provide a database for assessing environmental impacts of forestry operations.

42 The potential impact of scarification on soil erosion and water quality, particularly severe scarification to achieve vegetation control, should be assessed with special regard for impacts of scarification on ephemeral streambeds. (This monitoring and research would be made possible by the staff increases called for in Recommendations 1 to 3.)

43 Water should be managed on cutblocks to produce or maintain moisture conditions to aid the establishment and growth of new forest crops and for other environmental benefits. This will require pre-harvest planning as well as site preparation planning for on-site water management. The panel believes that in many cases herbicide use will cause much less damage than severe scarification.

44 The panel has serious concerns about widespread drainage to convert peatlands to commercial forest. Before any conversion is done, additional research should be done on chemical and physical water quality, carbon storage, streamflow, peat subsidence, moisture content of unsaturated zones (above water table) in drained sites, and the impact on wildlife habitat for ungulates, birds, and furbearers. The research should detail all ecological, environmental, social, and economic values of peatlands in their present and converted state.

45 Possible conflicts between peatland drainage and a strategy to mitigate effects of climatic change in Alberta should be assessed (see Section 8.7). Peatlands are a sink for both water and carbon, and probable climate change in the boreal forests of Alberta means that such areas should be maintained to mitigate potential warming and drying trends in the next few decades.

46 In new development areas with large areas of wetland, the adequacy of ground rules for watersheds, road development, and stream crossings should be fully assessed, particularly with respect to maintaining channel stability in ditches, sediment control, and drainage characteristics of peatlands in particular (damming effects).

47

Commercial forests on mineral wetlands can be difficult to regenerate to new stocking and growth standards. However, drainage to aid reforestation may be a threat to water quality and wildlife habitat. Such areas should not be harvested until they can be successfully reforested and the impacts satisfactorily explored and the consequences accepted.

48

Ground rules that relate to soil erosion should be reviewed to ensure they adequately address operating conditions in the new development areas of north and northeastern Alberta.

49

Logging methods and new technology should be matched to site conditions to reduce the impact of logging on site productivity. This is of particular concern as operations move into mixedwood sites that are moist to wet and/or interspersed with wet areas, and where current technology appears to retard stocking and growth of regeneration. Techniques that reduce the number of skid trails, landings, and rutting within cutblocks would be particularly effective in reducing impact.

50

The selection process for new reserves and Natural Areas should be formalized immediately to ensure that significant ecosystems are represented in appropriate categories. The present selection process is inadequate and rapid development could result in the loss or compromise of important candidate sites.

51

The possibility and location of a boreal wilderness area should be investigated. All the provincial wilderness areas are located in foothill or mountain terrain. The panel believes that a boreal wilderness area of a size similar to the present wilderness areas would be a useful addition to the system.

52

A common reference map such as *Ecoregions of Alberta* (Strong and Leggat 1981) should be used for the various wilderness, ecological reserves, natural and protected areas in Alberta and should be linked to a national reference like *Ecoclimatic Regions of Canada* (Canada Committee on Ecological Land Classification 1989).

53 Support should be given to the selection, protection, management, and status review of representative forest ecosystems throughout Alberta, with input from the Rocky Mountain Section of The Canadian Institute of Forestry, for purposes of scientific study, education, gene pool preservation, and benchmarks for research into management practices. Some forest ecosystems may currently be represented in existing ecological reserves, Natural Areas, or other areas.

54 A registry of these proposed sites should be prepared (Buckman and Quintus 1972).

55 Northern and northeastern Alberta should be a priority in selection of representative ecosystems or unique features, in view of the proposed development. The list of International Biological Program sites proposed previously should be assessed for relevance to this area.

56 The size and shape of reserves should reflect ecosystem integrity rather than rigid survey lines.

57 Ecosystem components that are essential to meet specific consumptive and non-consumptive old-growth criteria should be clearly defined, identifying those that require a preservation approach, and those that are best addressed by conservation and creative management rather than preservation.

58 A policy should be developed for the designation and management of old-growth forest ecosystems under the Alberta Conservation Strategy with input from government, non-government organizations and professional forestry/wildlife/environmental societies. Such a policy should address conservation and preservation strategies essential for satisfying consumptive and non-consumptive interests.

59 Opportunities to meet old-growth criteria for specific uses through creative planning and management rather than exclusive reservation should be explored. This is exemplified by current efforts to combine timber harvesting with provision of caribou habitat and snags for cavity-dwelling wildlife and can lead to a more effective use of a limited forest landbase.

60 Wilderness areas, ecological reserves, natural and protected areas, and parks, as well as areas netted out as buffers and other reserves during management planning, should be assessed to determine their status and suitability as candidate old-growth forest ecosystems.

61 A selection and screening process should be developed to add important old-growth forest ecosystems not already represented in existing reserves.

62 The level of research activity into the structure, function, and composition of old-growth forest ecosystems should be increased, especially with respect to rare, endangered, or threatened flora and fauna.

63 Studies that accurately monitor the effects of various harvesting and regeneration systems on fish habitat are essential and should be implemented and supported by the department and forest industry for a period long enough to measure the impact, beginning before initial logging and extending until the alternate cutblocks in the surrounding areas have at least reached the immature stand stage.

64 Regional fisheries biologists in forested regions of Alberta should be allocated the funds and time necessary to prepare both regional and FMA fisheries management plans, in co-operation with the Alberta Forest Service and the forest industry.

65 Greater efforts should be made by the industry, at the field level, to minimize soil and vegetation degradation and overland water movement. Not enough is done during harvesting and reforestation to reduce the energy of water flow on logged areas.

66 There should be a formal water quality management policy for forested lands that gives the AFS some management responsibility in addition to that of Alberta Environment. This should be written into the forest sector conservation strategy.

67 Government and FMA holders should use greater flexibility in determining which harvesting and regeneration system is best, after considering forest type, location, and land use priorities. Recognizing the need for land use zoning on the basis of management priorities, the system used should ensure that all land use interests are effectively integrated into forest management planning. This will require enlarging the body of expertise on forest planning and negotiating committees.

68 Within the multiple-use category of Integrated Resource Planning areas, some areas should be identified as having a priority use for timber growth and harvesting by reclassifying them as forest production.

69 Forested lands without management plans should have integrated plans developed by an interdisciplinary team of resource specialists.

70 In recognition of the real costs and benefits of achieving integrated resource management objectives, funding of these initiatives should be rationalized and shared between the province and the FMA holders.

71 The provincial government and forest industry should be encouraged to continue refining and extending ground rules to meet the specific needs of each quota area or FMA. These rules should be effectively communicated to supervisors and workers, with ongoing training and supervision to ensure that the intent of the ground rules is achieved and is seen to be achieved.

72 For operations where there are a variety of resource interests and objectives, the principal contributors to the integrated plan should be represented both in the development of training manuals and in the instruction of operating staff, and, in especially sensitive areas, be involved in operational monitoring and control.

73 The public should be better informed about ground rules, to understand the roles of both the department and industry in resource stewardship and also to encourage informed public involvement in monitoring ground-rule compliance.

74

The Alberta Forest Service and Alberta Fish and Wildlife should co-operate further as partners with industry in the development and implementation of forest management plans and operating ground rules. Such an approach is evolving on the Weldwood and Procter and Gamble FMAs.

75

The effects on fish and wildlife species of road access and various vehicular activities should be assessed. As an interim measure in new development areas, restrictive bag limits for fish and wildlife harvest should be adopted and wildlife sanctuary corridors along all roads and seasonal road closures seem appropriate.

76

An access management plan should be incorporated into each detailed forest management plan under the guidelines of a department policy. This access management plan should fairly represent the interests of all natural resources and resource users, while protecting wildlife and fish from overharvest and harassment, and minimizing environmental degradation.

77

Recreation and tourism is an important land use and has to be part of the ongoing integrated management process.

78

Allocations for significant recreation opportunities (parks, wilderness areas, heritage rivers, potential trophy fishing waters, etc.) should be made before forest management agreements are signed.

79

The FMA allocations and other forest management decisions should be made in the context of the integrated resource planning system to which the government is committed. Within this context, tourism concerns should be well represented.

80

Opportunities to provide recreational experiences and facilities within managed forests should be explored and expanded. Those industries that benefit from the resulting revenue and good will should contribute to the cost of providing and maintaining facilities.

81 The government and the forest industry should endeavour to accommodate the trappers' concerns within the integrated resource management plan.

82 The 1986 draft position paper on fur management policy should be updated in co-operation with the AFS and reviewed by the Alberta Trappers' Association and the Alberta Forest Products Association. It should then be finalized and implemented as soon as possible.

83 The Alberta Trappers' Association should work closely with the forest industry and Alberta Forestry, Lands and Wildlife regional planners to identify important sites (including cabins, trails, and major furbearer habitats) within each registered trapline and where necessary, to negotiate for modifications to the forest management plans.

84 If registered trappers are to be eligible for mitigation from the forest industry, they should be required to provide annual fur return data and revenue for a stipulated period (5 to 10 years, for example), to demonstrate they are legitimate trappers and to provide information on which a mitigation claim can be based.

85 Fish and Wildlife should be an integral partner with the Alberta Forest Service in forest inventories, planning, and management.

86 Baseline inventory information on fish and wildlife resources and their habitats should be improved to a level satisfactory for developing sound forest-wildlife management plans.

87 Fish and Wildlife should develop a comprehensive and realistic strategy for meeting its resource management information needs in forest regions over the next 10 to 20 years. This strategy should complement and mesh with a forest sector conservation strategy as well as government and non-government programs.

88

The 1989 draft strategic plan for management of Alberta's wildlife is basically a sound and vital document that should be quickly reviewed, finalized, receive ministerial approval, and be implemented. Following approval, the role of the Fish and Wildlife Division should be strengthened in inventory, monitoring, and management of existing endangered, threatened, or rare wildlife species in addition to those already listed as scarce that are expected to be affected by industrial activities on forest lands.

89

The Alberta Bird Atlas project should receive greater support. Federal government (Canadian Wildlife Service) involvement should be increased because of the national implications and a joint co-operative project of inventory, monitoring, planning, management, and research of endangered, threatened, or rare wildlife species in the forested regions should be established. Funding of this study should be shared among various government (federal, provincial, international) and conservation organizations.

90

An effective management program should be implemented within each FMA to ensure the survival of endangered, threatened, or rare species, and expedite their removal from these precarious categories.

91

The responsibility for normal reforestation and stand maintenance should continue to rest with the operator holding the harvesting rights, who should pay the cost of such operations.

92

Each forest company should have greater freedom to choose the harvesting and regeneration system that is best suited to agreed-on management objectives and site conditions, within regulatory constraints.

93

Research should be conducted into effective ways to rehabilitate and reforest previously degraded mixedwood stands.

94

During current and future hardwood/mixedwood harvesting, the utilization of balsam poplar and white birch should be improved to reduce waste and increase the stocking and vigour of the new hardwood crop.

95 New techniques and standards should be developed for reforestation and growth of mixedwood stands. Special emphasis on enhancing natural regeneration of white spruce should be considered.

96 Pre-harvest silviculture prescriptions that integrate silvicultural and harvesting systems in support of management objectives should be required on all FMA and quota lands, followed by post-harvest assessments and tending plans.

97 New nursery capacity should be designed for maximum flexibility to respond to changes in demand and prepare contingency plans for handling, storage, sale, or write-off of excess stock.

98 The province should encourage the development of private production-scale seedling capacity by experienced and professional tree growers.

99 The province should develop a fine-tuned communication and scheduling system between seedling users and producers that includes a forecast of all controllable factors in the system, (including available planting sites over time) and priority ratings for different stock types in case of production limitations or other contingencies. This could include allocation models with economic criteria built in, and may justify some systems design research and development before initiation

100 In principle, stock quality should take priority over quantity in all nursery operations.

101 The Alberta Forest Service and the forest industry should be encouraged to continue developing reforestation standards that include stocking and growth criteria and to link reforestation, juvenile growth, and stand yield.

102

The value of herbicides as tools to maintain both conifer and mixedwood cover types where they are most desirable should be given special consideration.

103

Research and development into both stocking and growth is needed to increase the effectiveness of conifer reforestation on wet areas and those that become waterlogged following harvesting.

104

Growth performance requirements for free-to-grow standards should be supported by appropriate research. It is expected that these standards will vary considerably by species, elevation, aspect, and other factors.

105

Research and development is needed to provide information on the regeneration and growth characteristics of balsam poplar and white birch relative to aspen on hardwood and mixedwood sites. Such information should be incorporated into new hardwood reforestation standards, addressing both stocking and growth.

106

Nursery programs in Alberta should include plans for hardwood production of both pure native species and hybrids for use in reforestation (as does the Weyerhaeuser program at Prince Albert, Saskatchewan). Aspen clones and hybrids should be given major emphasis.

107

A survey of recent hardwood cutovers in Alberta should be conducted to determine the impact of current logging technology on stocking and growth of the new hardwood forest and to consider alternative logging technology to reduce negative impacts.

108

A strategy should be developed for rehabilitating and reforesting previously degraded hardwood and mixedwood stands in Alberta.

109 Research and development should be undertaken into ways to enhance the natural regeneration capability of white spruce on mixedwood sites through modified harvesting, fire, or other means.

110 Research into juvenile stand development is needed to provide data on the reforestation and development of mixed stands of conifers and hardwoods to develop effective mixedwood reforestation standards for Alberta. Such data are essential to establishing free-to-grow standards as part of the reforestation standard.

111 New standards for reforestation and development of mixedwoods should be incorporated into pre-harvest silviculture prescriptions, reviewing harvesting equipment appropriate to achieving silvicultural objectives. Shortwood systems should be given special consideration.

112 Application of new conifer reforestation standards and free-to-grow criteria to mixedwood sites where hardwood, and grass competition are severe, should include cost-effectiveness assessments to determine the practicability of such activity.

113 A clear objective statement of forest renewal and management needs in Alberta should be developed, with the costs and effectiveness of alternative methods of vegetation management as a component of the statement.

114 A policy and regulations on the critical issue of vegetation management and supportive research and development should be developed.

115 If herbicides are to be a component of the vegetation management policy, there is a need for site-specific rate, timing, and delivery technology research and development studies that will ensure minimum dosage and maximum operational control and safety in the use of forestry herbicides.

116

Public demonstrations of the cost and effectiveness of different vegetation management techniques should be established as part of a public information/education strategy (see Section 9.3).

117

The government and the forest industry should seek ways to reduce the consumption of fossil fuels in all aspects of forest activity and to discourage the conversion of forest land to other uses.

118

The government should prepare a strategic plan to mitigate the probable effects of climate change in forests. This could include development of monitoring and predictive capability, enhanced protection, and reforestation and afforestation to increase carbon storage. This plan should be linked to the federal strategic plan.

119

The government should support research—beginning with modelling — into the structure and function of all major Alberta ecosystems, both forest and non-forest, to provide ecosystem information relevant to the carbon budget in place of coastal and tropical rainforest information that is often misleading.

120

The government should review the potential conflict between its wetland drainage program and strategies to reduce the impact of the greenhouse effect on Alberta's forests.

121

A government reorganization should occur to form a new department (possibly to be called Alberta Natural Resources) with a mandate for resource stewardship and protection. The new department would include the present Forestry, Lands and Wildlife Department (excluding Forest Industry Development) and that part of Recreation and Parks that handles the land resources, parks and planning (excluding tourist promotion). Forest Industry Development and the tourism promotion section of Recreation and Parks should be transferred to Economic Development.

122

The new department should be reorganized so that there are more integrated resource managers making decisions in the field. For example, regional resource managers (analogous to current forest superintendents) should have expanded responsibilities, including: management of wildlife and fisheries resources; environmental monitoring and protection; timber management; and management of parks, recreation, and wilderness areas in their region. There should be more people at all levels who have increased responsibility for integrated management. Some service functions (the Forest Research Branch and the forest inventory section of the Alberta Forest Service, for example) would have similarly broader responsibility.

123

Administrative units (boundaries and regional offices) should be made uniform among the various divisions of the new department to facilitate co-ordination of resource management.

124

The Forest Research Branch of the Alberta Forest Service should be substantially expanded to address immediate needs and to include the resources needed to serve the entire Department of Forestry, Lands and Wildlife or its successor. A tripling of staff and necessary project support would be appropriate. Much of the work of the branch should be managed and focused to address immediate, short-term, practical problems.

125

The Alberta Forest Development Research Trust should have its subject mandate similarly broadened, and be renamed the Alberta Forest Resources Research Trust to reflect the change. It should be designed to receive applications from qualified outside scientists, researchers, and graduate students, who would pursue a range of applied and basic research. Funding should be provided by a levy of 10 cents per cubic metre of wood harvested in Alberta, along with matching allocations from the department. At the 1988 level of harvesting, this would produce about $1.6 million. This would give a stable and secure mechanism that would provide a strong foundation for forest research and graduate student education in Alberta.

126

The province should continue to encourage and support research and development by federal agencies like Forestry Canada and the Canadian Wildlife Service with funding support from such sources as the Forest Resources Development Agreement, the Forest Development Research Trust, the Wildlife Research Institute, and Wildlife Habitat Canada, where proposals have technical and scientific merit and relevance to priorities set through the Alberta Forest Research Advisory Council.

127

A mechanism should be established to ensure adequate priority and funding for longer-term and more basic research within the Alberta Forest Research Advisory Council.

128

The panel encourages Alberta Forestry, Lands and Wildlife and forest management agreement holders to continue to implement a formal public participation scheme, periodically reviewed, with the intent of increasing effective public involvement at all levels of policy making and planning.

129

A forest interpretive centre highlighting the ecology, history, and significance of forests to Alberta's past, present, and future should be established at an existing appropriate rest area along a major highway in the Green Area, to help Albertans, and urban dwellers in particular, understand the forest resource and the industry.

130

The Department of Forestry, Lands and Wildlife should establish and fund an independently directed popular magazine providing a forum for land use issues and a source of information on forest resources.

131

The minister should review the enforcement of timber management regulations to ensure they are interpreted fairly, supervised adequately, and that corrective action is applied equally in all cases of contravention.

132

Professional foresters who knowingly and deliberately ignore and contravene the provisions of the timber management regulations, causing damage to the forest resource, should be censured by the Alberta Registered Professional Foresters Association.

133 Membership in the Alberta Registered Professional Foresters Association should be mandatory for professionals performing certain key duties, including the preparation of forest management plans.

RESPONSES TO QUESTIONNAIRE

TABLE 1

Four major issue areas

Rank	Issue	Number of Times an Item was Raised
1	Forest practices	55
2	FMA process	48
3	Public participation in decision making	41
4	Emissions from plants	37

TABLE 2

Ranking of forest management subjects

Rank	Concern	Number of Times an Item was Raised
1	Reforestation	29
2	FMA planning process	28
3	Negotiations for FMAs	20
3	Government staffing levels too low	20
4	Timber harvest techniques	15
5	Disposition of timber	14
6	Questions regarding sustained yield	11
7	EIA for forest operations	8
8	Integrated resource planning	7
9	Enforcement and regulation of industry	3
9	Access control and public use	3

TABLE 3

Ranking of fish and wildlife subjects

Rank	Concern	Number of Times an Item was Raised
1	Improved access and overhunting	26
2	Habitat protection	16
3	Wildlife impacts	12
4	Inventory and management	9
5	Unregulated native hunting	8
6	Fisheries impacts	5
6	Rare and endangered species	5
7	General impacts	4

TABLE 4

Ranking of environmental subjects

Rank	Concern	Number of Times an Item was Raised
1	Water quality related to the pulp mills	20
2	Pollution (air and water)	10
3	Technology options	9
4	General concern for environmental impacts	8
4	Use of herbicides	8
4	Soil erosion	8
5	Effects on air quality	7
6	Protection of ecosystems	6
7	Climate change	5
8	Risk assessment	1
8	Recycling products	1
8	Protection of archaeology and historic sites	1

TABLE 5

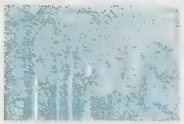
Ranking of social and economic subjects

Rank	Concern	Number of Times an Item was Raised
1	Markets and economic return to Alberta	14
2	Employment opportunities	13
2	Impact of development on trapping	13
3	Native issues and land claims	12
4	Concern regarding foreign ownership of resources	10
4	Agriculture	10
5	General concerns about the quality of life	6
6	Increase in traffic due to log hauling	5
7	Woodlots	4
8	Impact of development on tourism	3
9	Concern for the future of outfitting	1
9	Development effects on recreation	1
9	Concern for aesthetics	1

TABLE 6

Ranking of communication and consultation services

Rank	Concern	Number of Times an Item was Raised
1	Perceived honesty of government and industry	17
2	Public participation in project review	15
3	Positive comments on development	15
4	Request for public hearings on forest projects	10
5	Absence of Alberta Environment at these meetings	7



Glossary of Terms

Afforestation

The establishment of a tree crop on an area from which it has been absent.

Allowable Annual Cut (AAC)

The average volume that may be harvested annually under sustained yield management. Roughly equal to the amount of new growth produced by the forest each year including a proportion of mature volume less deductions for losses due to fire, insects and disease.

Boreal Forest Region

The region comprising the greater part of the forested area of Canada, forming a continuous belt from Newfoundland and Labrador coast westward to the Rocky Mountains and northwestward to Alaska. Most of northern Alberta is covered with a boreal mixedwood forest dominated by white and black spruce and two species of poplar. Jack pine, lodgepole pine, white birch and balsam and alpine fir are also found in some areas.

Carbon Sink

A place of storage or absorption of carbon. Oceans and other components of the ecosystem currently remove approximately one-half of the excess CO_2 released into the atmosphere by human activities. Forests and other vegetation remove CO_2 from the atmosphere through photosynthesis and store it as carbon in their tissues and wood fibres.

Climax Forest

A forest community that represents the final stage of natural forest succession for its site. Often identified as those forests that can reproduce indefinitely (in their own shade).

Cutblock

The basic cutting area of merchantable timber designated for removal in one cutting operation.

Cutover

An area of forest land from which some or all timber has recently been cut.

Ecoclimatic Regions

Typically broad areas on the earth's surface characterized by distinctive ecological responses to climate as expressed by vegetation and reflected in soils, wildlife, and water.

Ecological Reserve

An area established under legislation to retain selected examples of the full range of Alberta's natural environmental diversity for the purposes of preservation and scientific research.

Ecoregion

A geographical area that has a distinctive, mature ecosystem as a result of a given regional macroclimate.

Edge Effect

Generally in reference to wildlife populations this refers to the juxtaposition of two or more habitat requirements (food and shelter for example). For example, at the edge of a cutblock food is available in the clearing and shelter in the adjacent forest.

Endangered, Threatened, and Rare (Vulnerable) Species

Classifications used to describe the status of species populations. An Endangered species is one whose present existence is in danger of extinction within the next decade. A Threatened species is likely to become endangered if the factors causing its vulnerability are not reversed. A Rare (Vulnerable) species is likely to become threatened if the factors causing its vulnerability are not reversed.

Environmental Impact Assessment (EIA)

A detailed statement of a proposed development submitted by the developer or proponent. It must describe in detail the existing environment and identify and analyze the possible impact of the development upon: present land uses, air, water, geology, soils, vegetation, fauna, and human environment. Specific recommendations are made to reduce or eliminate negative impacts. Those that cannot be resolved are clearly identified and must be weighed in final project decisions.

Ephemeral Stream

A stream that flows during and for short periods following rain or snow melt; channels are often not well defined.

Forest Inventory

A survey of a forest area to determine such data as area, condition, timber volume, and species.

Forest Management Agreement (FMA)

A renewable agreement between the Alberta government and a company that grants the company the rights and obligations to manage, grow, and harvest timber on a specific area on a sustained yield basis.

Forest Management Area

The tract of forest land over which the company has been given a Forest Management Agreement.

Forest Management Plan

A general plan for the management of a forest area, usually for a full rotation cycle, including the objectives, prescribed management activities and standards to be employed to achieve specific goals. Commonly supported with more detailed development plans.

Free-to-grow

Stands that meet stocking, height, and/or height growth rate standards and are judged to be essentially free from competing vegetation.

Geographic Information Systems (GIS)

An information system that uses a spatial database to provide answers to queries of a geographical nature through a variety of manipulations such as sorting, selective retrieval, calculation, spatial analysis, and modelling.

Green Area

Forested public lands covering over 50 per cent of the province and managed for forestry and other multiple uses. Permanent settlement, except on legally sub-divided land, as well as agricultural uses other than grazing, are excluded.

Hardwood

Trees belonging to the botanical group Angiospermae having broad leaves, usually all shed annually. Also stands of such trees and the wood produced by them.

Herbicide

A chemical preparation used to kill or inhibit the growth of certain plants, their spores or seed.

Integrated Resource Management

The management of two or more resources in the same general area, commonly including water, soil, timber, range, fish, wildlife, and recreation.

Juvenile Stand Surveys

A survey conducted in stands less than 20 years old to describe the composition with respect to species, density, and height, and including recommendations for future stand tending.

Landsat

The name of a specific series of satellites designed to obtain images of the Earth's surface and natural resources.

Mensuration

The science of forest measurements, concerned with determining sizes, volumes, and ages of trees and the sizes of their products, particularly logs and sawn timber.

Merchantable

Of a tree or stand that has attained sufficient size, quality, and/or volume to make it suitable for harvesting.

Microclimate

The climate of small areas, which may differ significantly from the general climate of the surrounding area.

Mixedwood

Stands consisting of trees belonging to both the botanical groups Gymnospermae (softwoods) and Angiospermae (hardwoods).

Multiple-use Management

The management of land resources aimed at achieving optimum yields of products and services from a given area without impairing the productive capacity of the site.

Multiple-use Forestry

Forest-land management for two or more purposes.

Muskeg

Peatlands, swamps, and bogs supporting very limited tree growth due to excessive moisture.

Mycoherbicide

A fungus used as a biological control for weed species.

Natural Area

Under legislation an area set aside to protect sensitive or scenic public land from disturbance and ensure the availability of public land in a natural state for use by the public for recreation, education, or any other purpose.

Old Growth

A stand of mature or overmature trees. Usually used to describe a complex, mature forest ecosystem of substantial size.

Peatland ***(See Muskeg)***

Phase 3 Inventory

A computer-based forest inventory for management purposes, completed in 1984, including lands in the Green Area of Alberta. It provides detailed description of covertypes and estimates of volume and stem frequency.

Quota

A timber quota is a long-term right to harvest a percentage share of the annual allowable cut in a designated forest management unit.

Referral Process

A formal mechanism for the internal review of land use applications originating from within the Alberta government and from the private sector. Government management agencies concerned or affected by the provisions of an application participate in the review, which is co-ordinated by one agency that forwards this information to the proponent.

Rotation

The number of years required to establish and grow even-aged timber crops to a specified condition of maturity.

Scarification

A method of seedbed preparation that consists of exposing patches of mineral soil through mechanical action.

Shortwood

Pulpwood less than three metres long.

Silviculture

The theory and practice of controlling forest establishment, composition, and growth.

Snag

A standing dead tree from which most of the branches have fallen.

Softwood

Cone bearing trees (conifers) with needle or scale-like leaves belonging to the botanical group Gymnospermae. Also, stands of such trees and the wood produced by them.

Stand

A community of trees sufficiently uniform in species, age, arrangement, or condition to be distinguishable as a group from the forest or other growth on the area.

Story (Understory, Overstory)

A horizontal stratum or layer in a plant community; in forests, appearing as one or more canopies.

Succession

The replacement of one plant community by another in progressive development toward climax vegetation.

Sustained Yield Forest Management

Management of forest land for continuous production with the aim of achieving a balance between net growth and harvest.

Timber Harvest Planning and Operating Ground Rules

Rules that provide direction to the planning and conduct of forest operations. There is a set of ground rules specific to each FMA, which is reviewed and updated every five years.

Understory

That portion of the trees or other vegetation in a forest stand below the main canopy level.

Ungulate

Hoofed mammals, including elk, moose, deer, and caribou.

Volume Sampling Regions (VSR)

An area defined by broad ecological and administrative characteristics; there are 10 VSRs in the province.

White Area

The region of the province adjacent to settled areas and including nearly one-third of the total area of Alberta.

Wilderness Area

Under legislation an area set aside to preserve landscapes judged as containing high quality, unique or representative natural values in its wild and primitive state while allowing for selected wilderness recreation activities.

Yield tables

A listing of volumes of forest products that can be expected per unit of area for a given age, site, stocking, and method of management.

References used to prepare this glossary included:

Bonnor, G.M. 1978. *A Guide to Canadian Forest Inventory.*

Canadian Forest Inventory Committee. 1989. *Forest Inventory Terms in Canada - Third Edition.* Edited by B.D. Haddon, Petawawa National Forestry Institute, Forestry Canada. Minister of Supply and Services Canada.

Society of American Foresters. 1971. *Terminology of Forest Science, Technology Practice and Products.* Edited by F.O. Ford Robertson. The Multilingual Forestry Terminology series No. 1. Washington, D.C.

Mifflin, R.W. and Lyons, H.H. 1979. *Glossary of Forest Engineering Terms.* USDA Forest Serv. PNW Forest and Range Experimental Station.

Forestry Canada. No Date. *Glossary of Forestry Terms.* Forestry Canada, Pacific and Yukon Region, Pacific Forestry Centre, Victoria.

Corns, I.G.W. and Annas, R.M. 1986. *Field Guide to Forest Ecosystems of West-central Alberta.* Northern Forestry Centre, Canadian Forestry Service.

References

Alberta Fish and Wildlife Division. 1982. *Alberta Fish and Wildlife Policy*. Alberta Energy and Natural Resources, Fish and Wildlife Division.

Alberta Fish and Wildlife Division. 1983. "The sport fishery in Alberta: facts and figures for 1975 and 1980." *Fisheries Management Report No. 28*. Alberta Energy and Natural Resources, Fish and Wildlife Division, Edmonton.

Alberta Fish and Wildlife Division. 1984. *Status of the Fish and Wildlife Resource in Alberta*. Alberta Energy and Natural Resources, Fish and Wildlife Division, Edmonton.

Alberta Fish and Wildlife Division. 1985. *Wildlife Habitat Requirement Summaries for Selected Wildlife Species in Alberta*. Alberta Energy and Natural Resources, Fish and Wildlife Division, Edmonton.

Alberta Fish and Wildlife Division. 1987a. *Distribution and Status of Selected Mammals in Alberta as Indicated by Trapper Questionnaires in 1987. Occasional Paper No. 4*. Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division, Edmonton.

Alberta Fish and Wildlife Division. 1987b. *Provincial Fish and Wildlife Resource Management Information Program: A Proposal*. Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division, Edmonton.

Alberta Fish and Wildlife Division. 1989. *Wildlife for Tomorrow 1990-1995: A Strategic Plan for Management of Alberta's Wildlife (2nd draft)*. Alberta Forestry, Lands and Wildlife, Fish and Wildlife Division, Edmonton.

Alberta Forestry, Lands and Wildlife. 1989. *Internal Referral Systems of Alberta Forestry, Lands and Wildlife: Report of the Task Force*. Alberta Forestry, Lands and Wildlife, Edmonton.

Alberta Forestry, Lands and Wildlife. 1990. *Alberta Wildlife Viewing Guide*. Edmonton: Lone Pine Publishing.

A National Forest Sector Strategy for Canada. 1987. Developed at the Canadian Forestry Forum on a National Forest Sector Strategy, sponsored by the Canadian Council of Forest Ministers at St. John, New Brunswick, July 28-30, 1987.

Buckman, R.E. and Quintus, R.L. 1972. *Natural Areas of the Society of American Foresters*. Society of American Foresters, Washington, D.C. 38 pp.

Canada Committee on Ecological Land Classification. 1988. *Newsletter on Climate Change*. No. 17.

Canada Committee on Ecological Land Classification (Ecoregions Working Group). 1989. *Ecoclimatic Regions of Canada - First Approximation*. Environment Canada. Ecological Land Classification Series, No. 23.

Canadian Council on Ecological Areas. 1982. *Newsletter No. 1*. Ottawa.

Champion Forest Products (Alta.) Ltd. 1987. *Integrated Forestry-Wildlife-Fish Resource Management Approach for the Champion Forest Products (Alta.) Ltd. Forest Management Area, Hinton, Alberta*. A co-produced paper between Champion Forest Products (Alberta) Ltd. [now Weldwood of Canada Ltd. - Hinton Division] and Alberta Forestry, Lands and Wildlife, Edmonton.

Concord Scientific Corporation. 1989. *Report on Public Information Meetings on Forest Development in Northern Alberta*. Submitted to the Minister, Forestry, Lands and Wildlife and the Expert Panel on Forest Management, Edmonton. July 1989.

Dempster, W.R. and Associates Ltd. 1987. *Risk Management in Forest Planning*. Published under Canada-Alberta Forest Resource Development Agreement.

Drew, J. 1988. *Reforestation in Alberta: Meeting Shared Responsibilities*. 46th Annual Meeting, AFPA, Jasper, Alta. Sept. 30, 1988.

Environment Council of Alberta. 1976. *Public Hearings on Erosion of Land in Northwestern Alberta*. Series of information bulletins and summary.

Environment Council of Alberta. 1979. *The Environmental Effects of Forestry Operations in Alberta:* Report and Recommendations. ECA Report #13.

Francis, J. and Lumbis, K. 1979. *Habitat Relationships and Management of Terrestrial Birds in Northeastern Alberta*. Prepared for the Oil Sands Environmental Research Program by the Canadian Wildlife Service. Report No. 78.

Gammon, R.H., et al. 1985. "History of carbon dioxide in the atmosphere." In: Trebalka, J.R. (ed.) *Atmospheric Carbon Dioxide and the Global Carbon Cycle*. USDA Department of Energy, DOE/ER-0239: 25-62.

Harmon, M.E., et. al. 1990. "Effects on carbon storage of conversion of old-growth forests to young forests." *Science* 247: 698-701.

Hillman, G.R. 1987. *Improving Wetlands for Forestry in Canada.* Canadian Forestry Service, Northern Forestry Centre Information Report Nor-x-288. 29 pp.

Ives, W.G.H. and Rentz, C.L. 1988. *Life Tables for Juvenile Lodgepole Pine in the Foothills of Westcentral Alberta: a Progress Report.* Can. For. Serv. NoFC. Edmonton, Alberta. File report. 54 pp.

Jacques, R. and Fraser, G.A. 1989. "The forest sector's contribution to the Canadian economy." *Forestry Chronicle.* April 1989.

Jarvis, J.M., et al. 1966. *Review of Silvicultural Research - White Spruce and Trembling Aspen Cover Types,* Mixedwood Forest Section, Boreal Forest Region. Forestry Branch, Dept. Pub. No. 1156. 189 pp.

Keeling, C.D., et al. 1982. "Measurements of the concentration of carbon dioxide at Mauna Loa Observatory, Hawaii." In: Clark, W.C. (ed.) *Carbon Dioxide Review:* 377-385.

Mitchell, K.J., et.al. Unpubl. *Sylver: The Link between Silvicultural Practices and Financial Return.* Paper presented at 70th Annual Meeting, Woodlands Section, CPPA. Montreal, March 1989.

Nova Scotia Dept. of Lands and Forests. 1989. *Forest/Wildlife Guidelines and Standards for Nova Scotia.* 19-page department publication. Nova Scotia Dept. of Lands and Forests, Halifax.

Pedocan Land Evaluation Ltd. 1985. *Wildlife Habitat District Mapping and Inventory Prototype of the Wapiti Map Sheet (83L).* Alberta Energy and Natural Resources, Fish and Wildlife Division, Edmonton.

Phillips, W., et. al. 1977. *Socio-economic Evaluation of the Recreational Use of Fish and Wildlife Resources in Alberta.* Prepared for the aquatic and terrestrial fauna technical research committees of the Oil Sands Environment Research Program.

Renewable Resources Subcommittee. In press, 1990. *Forest Ecosystems: Complexity of Management.* Public Advisory Committees to the Environment Council of Alberta.

Senyk, J.P. and Smith, R.B. 1989. *Forestry Practices and Soil Degradation in B.C.* Paper presented to 69th Annual Meeting. Woodlands Section, CPPA. W.S.I. No. 3071. Can. For. Ind. 1989.

Schultz, C.D. and Co. Ltd. 1973. *The Environmental Effects of Timber Harvesting Operations in the Edson and Grande Prairie Forests of Alberta.* Volumes I and II.

Snyder, J. 1989. *Progress Report on Lichen Regeneration Study.* Presented to the Caribou Tech. Comm. Mtg., Hinton, Alta., Oct. 2, 1989.

Spies, T.A. and Franklin, J.F. 1988. "Old growth and forest dynamics in the Douglas-fir region of western Oregon and Washington." *Natural Areas Journal* 8(3): 190-201.

Strong, W.L. and Leggat, K.R. 1981. *Ecoregions of Alberta.* Alberta Energy and Natural Resources, ENR Tech. Report No. T/4.

Swanson, R.H. and Hillman, G.R. 1977. "Effect of large-scale clearcutting on water yield in western Alberta." In: *Alberta Watershed Research Program Symposium Proceeedings, 1987.* Fisheries and Environment Canada, Can. For. Serv., NoFC, Edmonton, Alberta Inf. Rep. NOR-X-176: 256-271.

Stelfox, J.G. 1988. *Forest Succession and Wildlife Abundance Following Clear-cut Logging in West-central Alberta.*

Udell, R.W. and Dempster, W.R. 1987. *Predicting the Growth and Yield of Regenerated Lodgepole Pine.* Canadian Forest Industries.

Wheaton, E.E. and Singh, T. 1988. *Exploring the Implications of Climatic Change for the Boreal Forest and Forestry Economics of Western Canada.* Summary of a report prepared for Climate Change Digest. A.E.S. SRC Publication E-906-61-A-88.

Wiggins E.J. and Yurko, W.J. 1989. *The Greenhouse Effect and the Alberta Fossil Fuels Industry.* A discussion paper prepared for Alberta Oil Sands Technology and Research Authority. July 31, 1989. 44 pp.

Weldwood of Canada Ltd. - Hinton Division. 1988. *Forest Management Area Timber Harvest Planning and Operating Ground Rules, December 1988.*