The University of Calgary

Conserving Biodiversity on Private Woodlots in Alberta

Ken A. Roberge

A Master's Degree Project submitted to the Faculty of Environmental Design in partial fulfillment of the requirements for the degree of Master of Environmental Design (Environmental Science).

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ABSTRACT

Conserving Biodiversity on Private Woodlots in Alberta

Ken A. Roberge, July 1999

Prepared in partial fulfillment of the Master of Environmental Design (Environmental Science) degree in the Faculty of Environmental Design, The University of Calgary.

Supervised by Prof. Michael Quinn

In 1992, the Canadian Prime Minister ratified the international Convention on Biological Diversity, which lead to the development of the Canadian Biodiversity Strategy. The national strategy recognized the importance of private land areas to the overall goal of conserving national and global biodiversity. In doing so, it indicated the responsibility of private landowners to ensure sustainable management of their land for the long-term maintenance of biodiversity.

Three factors have created an increased focus on woodlot management in the province: recent examples of unsustainable woodlot management due to increases in product demand; the lack of regulations for woodlot management; and the end of the Federal Resource Development Agreements that acted as the primary source of funding for woodlot related projects. As a response, woodlot owners in Alberta have made clear their intention to practice sustainable forest management and conserve biodiversity. To achieve this goal, they indicated the need for better information and the need for an increase in both technical and financial assistance.

There are currently many barriers to practicing sound woodlot management in Alberta. These include: detrimental tax policies, marketing, the dominance of agriculture, private land as "private", and an overall lack of assistance and incentives for conserving biodiversity.

Recommendations for conserving biodiversity on woodlots in Alberta involve a set of best practices for woodlot management. These include recommendations on: 1) woodlot management activities (e.g. inventory, harvesting, stand improvement, reforestation, monitoring, and wildlife programs); 2) educational programs for woodlot owners; 3) economic incentives; 4) social incentives; 5) partnerships; and 6) future research.

Key Words: biodiversity, sustainable forest management (SFM), woodlots, best practices, Alberta.

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I am especially grateful to my supervisor, Dr. Michael Quinn for his patience and valuable advice throughout the project. I also wish to thank my external committee member Dr. Dianne Draper for her contributions to the production of the document. Thanks are due to John Herity and Ole Hendrickson for their suggestions during the initial phases of the project.

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In a very special way this project is dedicated to my father who recently passed away. Dad, you were my first and most influential teacher on the ways of the natural world. For that I am eternally grateful. Who I am, and what I become is in large part because of you.

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ABBREVIATIONS

AAC	Annual Allowable Cut
AEP	Alberta Environmental Protection
AFBMP	Alberta Forest Biodiversity Monitoring Program
CCFM	Canadian Council of Forest Ministers
CFS	Canada Forest Service
FAN	Federation of Alberta Naturalists
FMA	Forest Management Agreement
FRDA	Federal Resource Development Agreements
PFRA	Prairie Farm Rehabilitation Administration
RBZ	Riparian Buffer Zone
RPF	Registered Professional Forester
WAA	Woodlot Association of Alberta

1. INTRODUCTION

Biological diversity or its short form, biodiversity, has become a major focus of both ecological research and natural resource management strategies from the international level to specific site management plans. As a response to the Convention on Biological Diversity, Canada developed the Canadian Biodiversity Strategy which outlines its obligations for biodiversity conservation. The strategy makes specific mention of the role that private lands have to play in conserving biodiversity across the country. This project examines the contribution of one type of private land to biodiversity conservation in Alberta. Woodlots are defined as privately owned forest lands and are managed for a diverse range of values. While they only account for approximately 4% of forested land in Alberta, they are often important areas for biodiversity.

However, woodlots in Alberta currently face pressing management issues related to biodiversity conservation. In particular, three factors are at the forefront of the concern over woodlot management in the province. First, there is concern over recent examples of unsustainable woodlot management practices due to a high demand for wood from Forest Management Agreement (FMA) holders and other market jurisdictions. Second, with the exception of a regulation stipulating the need for a permit when transporting logs off private land, there are currently no regulations dealing with management on Alberta woodlots. Lastly, the end of the Federal Resource Development Agreements (FRDA) in 1997 has led to a lack of funds for woodlot related programs in Alberta. The combination of these factors has important implications for the ecological values of woodlots in the province.

As a result of these concerns there is a substantial interest on the part of government agencies and woodlot owners alike to manage woodlots in an ecologically sustainable manner. In determining the needs of woodlot owners to meet this objective, a recent survey of prairie woodlot owners indicated that education and information on better

woodlot management was critical.[1] Other factors may also be resulting in improper ecological management. The key is to determine mechanisms that will conserve biodiversity while allowing for sustainable use of the resource.

1.1 PURPOSE

The purpose of the project is to develop a set of recommendations for woodlot owners that outline the best practices in ecologically sustainable forestry concentrating on biodiversity conservation. In addition, an implementation strategy will be developed that outlines means of distributing the information and connecting woodlot owners with relevant agencies and existing information sources. The results and recommendations of this project will later be used in the development of a guide for woodlot owners.

1.2 OBJECTIVES

(a) Distinguish critical factors for conserving biodiversity in forest ecosystems.
(b) Define and evaluate approaches to ecologically sustainable forest management that can conserve the above factors.
(c) Investigate existing woodlot management and select examples.
(d) Identify barriers to successful sustainable forest management on private woodlots.
(e) Outline and evaluate existing means of distributing management information and implement recommended management approaches.

[1] Rounds, R.C., B. Milne, and J.M. Rollheiser. 1995. Towards defining a woodlot management program for the prairie provinces. The Rural Development Institute, Brandon University.

1.3 CHAPTER SUMMARIES

CHAPTER 2 – METHODOLOGY

This chapter outlines the various methods used as part of this project. It examines the selection of site visit locations, literature review techniques and the methods used for interviewing woodlot owners.

CHAPTER 3 – PRIVATE WOODLOTS IN ALBERTA

This chapter aims at discussing the concept of woodlots including typical definitions and a discussion of the various types of woodlot management in the province. A review of the general characteristics of woodlots as well as a recent history of events related to woodlots is included. As a secondary objective the chapter examines the various barriers woodlot owners may experience in practising sustainable woodlot management in the province.

CHAPTER 4 – BIODIVERSITY

The overall goal of this chapter is to provide an overview of the concept of biodiversity. It discusses challenges with its definition, its measurement and outlines the reasons why biodiversity is to be valued and thus conserved. It examines the division of biodiversity into genes, species and ecosystems and the role of ecological and evolutionary processes. It also addresses concerns with artificial diversity due to the presence of exotic species.

CHAPTER 5 – SUSTAINABLE FOREST MANAGEMENT

This chapter examines the evolution of forest management to the present push for sustainable forest management. It examines concepts of ecosystem management and ecoforestry and their relation to woodlot management in the province. It also examines the partnership between sustainable forest management and biodiversity conservation. This is achieved through an illustration of the crucial components for biodiversity at the

stand level as well as the landscape scale. Finally it examines the role of woodlots in biodiversity conservation in Alberta.

CHAPTER 6 – BEST MANAGEMENT PRACTICES FOR BIODIVERSITY CONSERVATION

This chapter builds on the previous chapters as well as examples obtained from site visits. It provides a set of best management practices within each of the common divisions of woodlot management: inventory, plan development, harvesting, silviculture treatments and reforestation. It also examines approaches for wildlife habitat enhancement and practices to provide for landscape level components of biodiversity.

CHAPTER 7 – IMPLEMENTATION STRATEGY AND RECOMMENDATIONS FOR POLICY CHANGE

This chapter examines the means of distributing the information from the project. It begins with an examination of woodlot programs in other provinces and some American states. It then looks at the use of education programs, economic and social incentives and alternatives for funding. Recommendations to the Woodlot Association of Alberta (WAA) and the provincial government are also proposed.

2.0 METHODOLOGY

This project is fundamentally about the collection, analysis and organization of information. As such, the methods used to complete the project are qualitative in nature. Information required for the different phases of the project was obtained using a combination of literature review and key informant interviews. The various approaches used for these methods and for selecting the site visits are discussed in the following sections.

2.1 LITERATURE REVIEW

Literature for the project was obtained from several sources. Primary among these was the University of Calgary's library system (CLAVIS). It was used to obtain relevant information from books, government documents and reports. To complement that information, online abstract databases via the university library homepage and the Internet were used to obtain relevant abstracts from journals and conference proceedings. The following represent the primary systems used:

Library Based Search Engines:	**Web-Based Search Engines**
• Biological Abstracts ('90 – present)	* Altavista (www.altavista.com)
• Wildlife Worldwide	* Yahoo Canada (www.yahoo.ca)
• Canadian Periodical Index (CPI)	* Lycos (www.lycos.com)
• Zoological Record	
• ProceedingsFirst	
• PapersFirst	
• ArticleFirst	
• NetFirst	

The secondary means of obtaining literature was by contacting relevant agencies. For example, important information on woodlot management in Alberta was obtained through the Canada Forest Service (CFS) Woodlot Extension Library in Edmonton. As well, woodlot associations and private forestry extension services from other provinces and several states were also contacted to obtain information on their woodlot policy and

management programs. This comparison was performed primarily to obtain examples of woodlot related incentive and education programs from other jurisdictions that could be applied in Alberta. These agencies were contacted via email and those that responded were included in the project.

2.2 SELECTION OF WOODLOT OWNERS FOR SITE VISITS

The selection of woodlot owners for site visits was made in a manner that would include a diverse range of woodlot management styles. There are approximately 12,000 woodlot owners in the province of Alberta (Ross, 1997). To begin the process of identifying potential site visits, an initial list of candidate owners was obtained from the WAA and an advertisement was placed in the WAA newsletter. This initial list was then reviewed and individuals were contacted to determine if there were other landowners in their area that would also be suitable for the purposes of the project.

While most of the visits were to woodlots that were being "intensively" managed, several visits were also conducted with woodlot owners managing their land specifically for wildlife habitat or other "non-intensive" approaches. This was done to ensure that several styles of woodlot management were accounted for in the process.

Criteria that were used in the selection process included:

- Property size
- Management Style (Intensive vs. Non-intensive)
- Location (Natural Sub-regions)
- Forest Type (Mixedwood vs. Monoculture)

These criteria, owner availability, and finances were ultimately used to develop the final list of visits and interviews which involved twenty woodlot owners (see Appendix 1). These sites occurred in five of the seven main natural subregions within which woodlots are found in the province of Alberta (italics indicate the subregion was represented):

Boreal Forest Natural Region	Rocky Mountain Natural Region
Central Mixedwood	*Montane*
Dry Mixedwood	

Foothills Natural Region	Parkland Natural Region
Lower Foothills	*Foothills Parkland*
	Central Parkland
	Peace River Parkland

Two subregions (Peace River Parkland and Central Parkland) were omitted for financial and repetitive information reasons. Figure 1 shows the locations of the various sub-regions visited.

2.3 KEY INFORMANT INTERVIEWS

In addition to the 20 woodlot owners that were interviewed, 23 environmental consultants and relevant professionals were also included as key informant interviews.

The objectives of these interviews were to:

1. Develop an understanding of the current range of woodlot management approaches
2. Provide information to serve as limiting criteria for biodiversity conservation approaches
3. Establish a list of barriers to sustainable woodlot management in the province

Personal interviews were chosen as the best means of obtaining the information required for the purposes of the project. While mail-out and telephone surveys are financially advantageous, they lack several positive attributes offered by personal interviews (Kidder and Judd, 1986):

- Ability to notice and correct the respondent's misunderstandings;
- Ability to probe inadequate or vague responses;
- Ability to answer questions and allay concerns;
- Use of visual aids (aerial photographs, maps, etc.) and
- High data quality and response rate

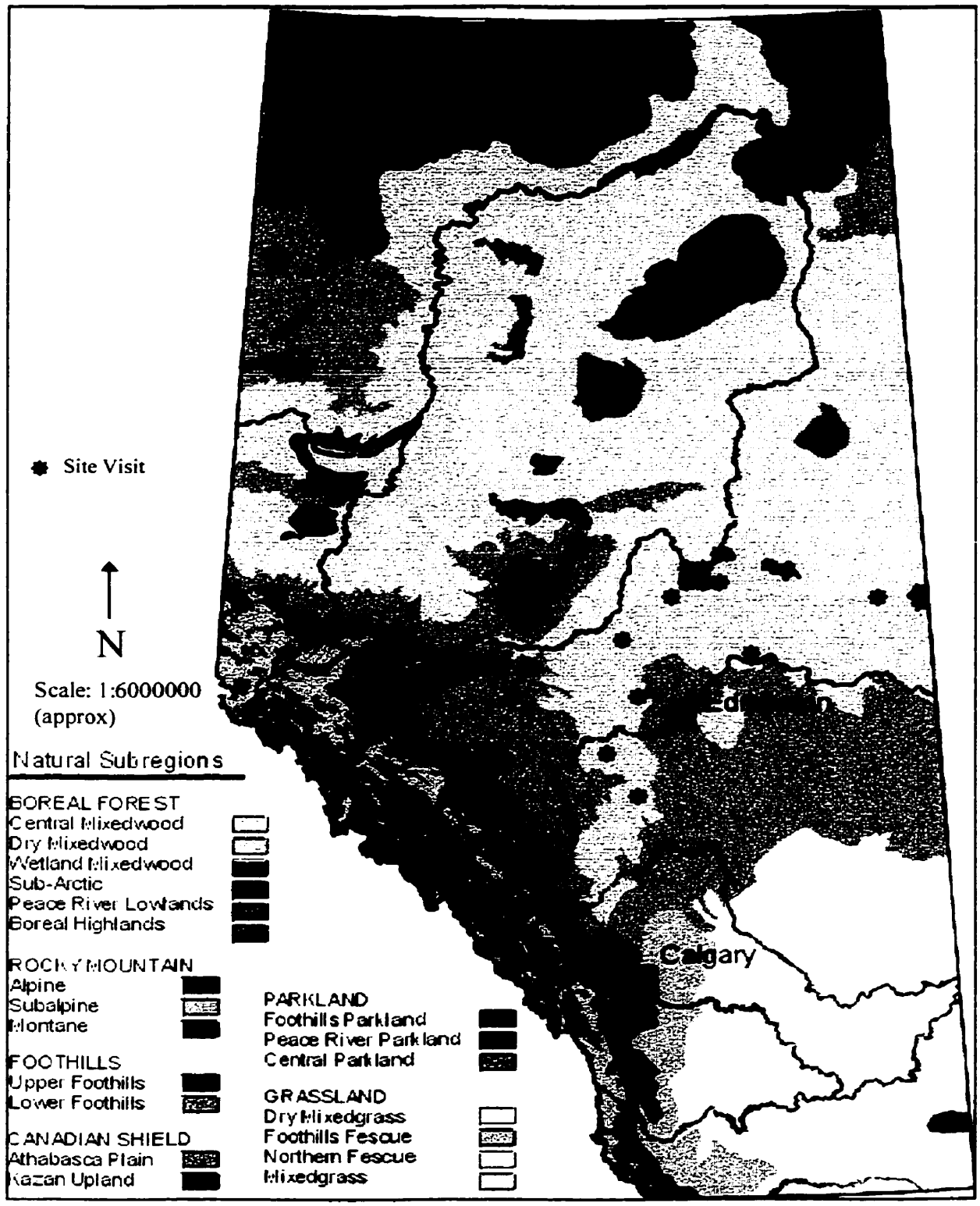

FIGURE 1 – NATURAL REGIONS AND SUBREGIONS OF ALBERTA

Source: Alberta Natural Heritage Information Centre. Natural regions and subregions of Alberta: www.gov.ab.ca/env/parks/anhic/abnatreg.html

Prior to any contact with key informants, approval was obtained from the University of Calgary Ethics Committee to conduct interviews with human subjects. In accordance with this approval, interviewees were made aware of the stipulations regarding ethical conduct before the interview began.

For the interviews with the woodlot owners the style employed is best described as a "focused" or non-schedule-structured interview (True, 1989; Reddy, 1987; Nachmias and Nachmias, 1976). This style of interview uses open-ended questions, which result in highly detailed answers (Sanders and Pinhey, 1983). Because the aim was to get a broad "feel" for how the individual managed their woodlot and their philosophical perspective on many issues this highly detailed approach was sufficient. The focused style allows interviewees the chance to express their thoughts freely without being limited by pre-set answers (Nachmias and Nachmias, 1976).

Because the project has a specific focus on biodiversity conservation it was important to select questions that did not lead the interviewees in any way. Wording for questions was chosen in a manner that would promote understanding of the main issues. For example, many project specific concepts such as biodiversity are unfamiliar and typically poorly defined. Such concepts, if deemed critical to the focus of the interview or for explaining the project purpose were defined to prevent confusion and possible bias during the interview. Woodlot owners were contacted in advance and informed of the nature of the project and interview process. Notes during the interview were recorded by hand and supplemented by pictures taken during the site visit.

The following represents an example of some of the questions asked during these site visits:

GENERAL INFORMATION

What is the size of the property?

What are the dominant tree species on the property?

Has an inventory been conducted and updated?

What are the goals and objectives for the land?

How much time is spent on the woodlot?

What information is used for managing the woodlot and where is it obtained?

What is the best form and distribution for management information?

What are the barriers to sustainable woodlot management?

HARVESTING INFORMATION

Is harvesting conducted on the woodlot?

What silvicultural methods are used?

What criteria are used for selecting trees?

What machinery is used during harvesting practices?

Is there any retention (e.g. biological legacies, patches of trees, etc.)?

Is the Annual Allowable Cut known?

What forest products are produced by the woodlot?

BIODIVERSITY INFORMATION

What species of wildlife occupy the property?

Are there any rare species on the property?

Are there any special habitat areas on the property? (e.g. wetlands, riparian areas, etc.)

Are other species groups on the property known (e.g. plants, fungi, insects, etc.)?

MANAGEMENT PRACTICES

What practices are conducted to sustain biodiversity values on the property?

Are any wildlife management projects in place or planned?

Is monitoring done?

These questions were used to guide the interview in a general manner. They were not used as a strict interview guide, and as a result, other questions and areas of concern were addressed if relevant to the particular woodlot owner or were brought up as important.

While woodlot owners composed the majority of key informants, others, including consultants, government employees and relevant non-governmental personnel were also contacted and interviewed for specific purposes. Because these interviews were conducted to obtain specific information, a strict set of questions was followed for each with some room for adaptive change during the interview. The type of information obtained from these interviews included:

- Information on the Federal Resource Development Agreements
- General statistical information regarding woodlots in the province
- Woodlot program history and future plans
- Information on the WAA (e.g. funding source, mission, history, programs, and current status)
- Management activities for particular species groups (e.g. raptors, fish, ungulates)
- Presence and status of incentive programs for conservation activities on private land

These individuals were especially important for confirming specific facts about woodlot management in the province. Many of the statistics dealing with woodlots in the province were confirmed with these individuals through personal communication.

3.0 PRIVATE WOODLOTS IN ALBERTA

This chapter serves two main purposes:

1. Introduce the concept of woodlots and outline the range of current management approaches within Alberta and;

2. Discuss the variety of barriers that woodlot owners may experience with regard to practicing sustainable woodlot management in Alberta.

3.1 WHAT IS A WOODLOT?

According to the WAA (1995), a woodlot is an area of privately owned land with any amount of trees, regardless of their size. By this definition a woodlot could be anything from a large area of continuous forest to a planted shelterbelt. On the other hand, the draft Alberta Forest Conservation Strategy defines a woodlot as "privately-owned wooded areas that are managed to provide wood fibre on a long-term basis" (Alberta Forest Conservation Strategy, 1997). This definition is quite narrow and fails to recognize that woodlots in the province are managed to provide a variety of values, including, but not limited to, wood fibre.

The number of woodlot owners in Alberta has been estimated at approximately 12,000 (Ross, 1997). Rounds et al. (1995) conducted a survey of woodlot owners in Alberta to determine the defining characteristics of Alberta woodlots and their owners. The following statistics summarize their results:

- Farmers and ranchers comprise 52% of woodlot owners with retirees being a distant second (12%).
- Approximately 60% of woodlot owners live on their woodlot and 17% live within five miles.
- The average owned property size is 274 ha (53 ha treed)
- Commercial quality trees are present on 11-30% of woodlots in agricultural areas while woodlots near forest fringe areas show a much higher market value.
- Reasons for retaining treed acres are primarily for shelter of residences, wildlife habitat, soil and water conservation and heritage.
- Woodlot owners identified grazing and personal fuelwood as the primary values of their woodlots with commercial (sale of products) ranking lowest
- Woodlot income comprises less than 10% of land-based income on 97% of the properties surveyed.

As mentioned, woodlots occur on private land. Alberta is divided into two main zones: the Green Zone, which is provincial crown land and the White Zone which contains a mixture of agricultural and settlement land (Figure 2). Forested areas are primarily located along the White/Green Zone boundary (Andries, 1996).

According to calculations by Alberta Agriculture and Alberta Environmental Protection (AEP) private forests cover 1.5 million ha (4% of total forest land), with timber-productive forests estimated at 1.2 million ha (6.1% of timber-productive forest land) (Ezra Consulting Limited, 1996). There is also a significant proportion of forested land on public lands within the White Zone. An Alberta Agriculture Land Base Study estimated the amount of unimproved woodland in the White Zone at approximately 2.9 million ha (Ross, 1997). This means that approximately half of the forested land within the White Zone is on public land, primarily in the form of grazing leases. Currently, the rights to timber resources on grazing leases are not conveyed with the lease (Andries, 1996). This issue is currently under study to determine the feasibility of managing these forest

resources by way of timber permits (Pharis, pers. comm). As such, public land forest resources in the White Zone were not considered as part of this project.

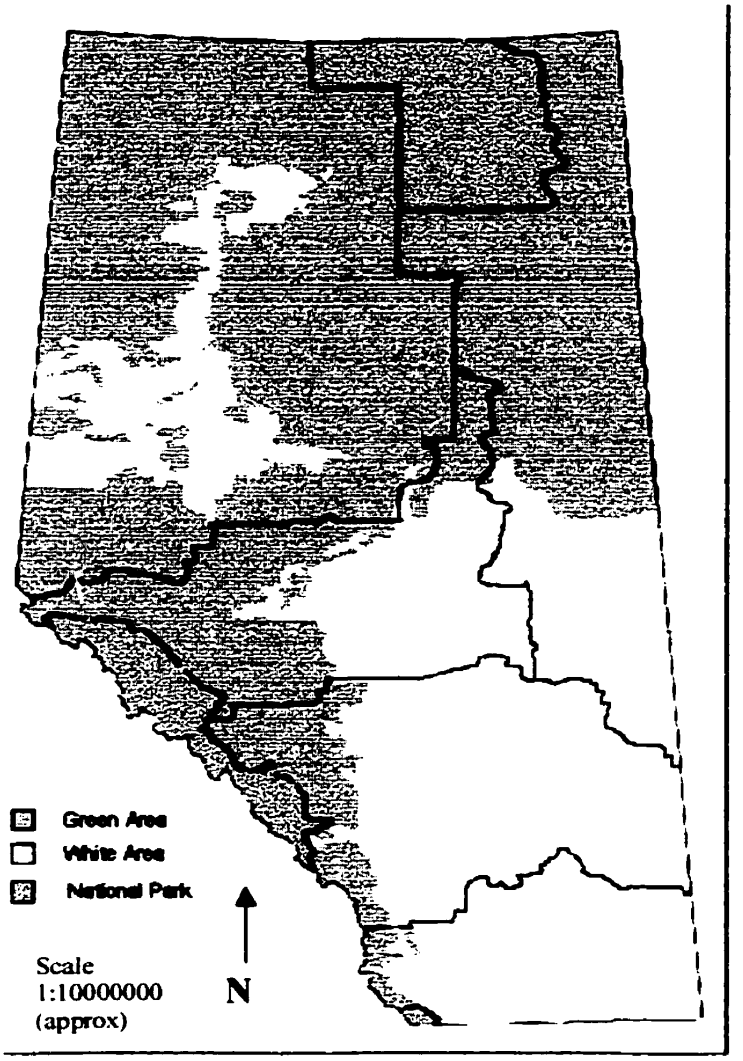

FIGURE 2 – WHITE AND GREEN ZONES IN ALBERTA
Modified from: Alberta Environmental Protection. 1996. The status of Alberta's timber supply. Edmonton, AB.

For the period of 1991-1994 the timber harvest on private land was estimated to be 1 million m^3, while for the period of 1994-1995 this figure increased dramatically to 2.3 million m^3 (948 000 m^3 coniferous and 1 364 000 m^3 deciduous) (Alberta Environmental Protection, 1996). This increase was primarily due to a leap in prices offered by mills in British Columbia and Montana. This means that during 1994/1995 approximately 13.2%

of all harvesting in Alberta was done on private land (15.1 million m^3 was cut on crown land).

3.2 TYPES OF WOODLOT MANAGEMENT IN ALBERTA

According to the definition offered by the WAA, the term woodlot can apply to a wide range of management approaches. Depending on factors such as individual owner objectives, forest type, land size, and economic considerations, a woodlot can take on many forms. In order to understand the range of woodlot management approaches twenty sites were visited. The results of these visits played a significant role in the following classification of Alberta woodlots:

Woodlots can be roughly divided into those that are "intensively" managed and those that are "non-intensively" managed. This division deserves some explanation. The use of the term does not imply that those that are non-intensively managed are any less important. While the focus of this project is on conserving biodiversity and therefore more often on intensively managed woodlots, many of the tools discussed in later chapters are also applicable to non-intensively managed woodlots.

3.2.1 INTENSIVELY MANAGED WOODLOTS

I have chosen the term intensive to characterize woodlot management styles that require regular inputs of time and energy and have fibre production as their primary objective and other values as secondary objectives. It does not imply that these woodlots are managed unsustainably. Intensively managed woodlots can be subdivided into two groups:

3.2.1.1 Sustained Yield Woodlot Management

Woodlot owners practicing sustained yield woodlot management are best described as individuals practicing small-scale forestry. The majority of these woodlots exist in areas with characteristic mixed-wood stands. Most, but not all, of these individuals have

conducted formal inventories of their properties or have had consultants do so for them. The Annual Allowable Cut (AAC) is typically known and most have a written management plan or at the very least a good mental plan for the long-term direction of their land. Silvicultural practices such as harvesting, thinning, pruning and reforestation are evident on most of these sites. Many of these owners own their own equipment including: portable saws, firewood splitters, and tractor skidders.

The interviewees in this group had a good understanding of forestry principles and of the physical make-up of their land. These owners were adamant about the feasibility of woodlot management as a business venture. They voiced their concerns over the prominence of forested land conversion to other land uses and were quick to point out the social benefits that come from owning a woodlot. The overall land ethic or philosophy of these owners is one of being "one with the land". Four of the five interviewees in this category regularly take the time to enjoy the range of benefits their land provides, including berry picking, mushroom collecting, sphagnum moss harvesting, hunting, hiking and cross country skiing.

Only one of the interviewees in this category obtained more than 50% of their income from their woodlot, either directly from selling timber resources or by custom cutting for others. The other four interviewees obtained a maximum of 10-15% of their income from their woodlots. For purposes of comparison, the percentage of income derived from the woodlot for all of the other management types was found to be less than 5%.

The land objectives commonly held by owners in this group were:

- management to allow for a continual flow of timber and non-timber products
- maintenance of wildlife habitat and aesthetic value
- provision of recreational uses such as hiking and cross country skiing

3.2.1.2 Sustainable Woodlot Management and Agriculture

Similar to sustained yield woodlot management this approach blends the practice of small-scale forestry with agriculture, most often grazing. In most cases these woodlot owners allow cattle to exist within the woodlot, at least for certain periods. Many of these owners have land objectives similar to the first group with the addition of goals such as conservation of prairie grasses and water resources.

In this type, the woodlot often serves as a source of income to supplement agricultural uses and as a shelter for cattle during harsh conditions. Materials such as posts and rails for fencing and dimension lumber for farm buildings are obtained from the woodlot thus deferring the cost of purchasing them elsewhere. Large, commercially viable trees are also harvested on a selection basis to provide income to offset the costs of the farm. Some owners of this form of woodlot use horses or mules to skid logs which can be both an economically and environmentally superior method to more mechanical methods.

The feasibility of this approach depends largely on factors such as soil type, tree species present and the number of cattle. The incorporation of grazing in wooded areas must be carefully managed as it has been shown to be detrimental in many areas by damaging or killing native vegetation and accelerating soil erosion or compaction (Fleischner, 1994). Riparian areas are particularly sensitive and vulnerable to cattle-related environmental degradation (Fitch and Adams, 1996).

3.2.2 NON-INTENSIVE WOODLOT MANAGEMENT

Non-intensively managed woodlots are those that do not require regular inputs of time and energy. They are typically characterized by the absence of formal inventories, harvest management plans or significant reforestation efforts. However, their continued presence on the landscape serves an important function in conserving biodiversity over the long term. Land objectives for non-intensive woodlots focus on wildlife habitat, aesthetics and

non-intrusive recreational based activities. As a result, interviews with woodlot owners in these groups focused on these values and their personal reasons for owning the woodlot.

3.2.2.1 Recreational Use/Firewood Collection

Woodlots of this type are characterized by a style of management that is best described as "hands-off". Use of these woodlots is typically limited to recreational activities and the collection of dead wood for firewood. Fallen trees, snags and coarse woody debris are usually left in the woodlot unless they present a fire hazard. These woodlots make good candidates for conservation easements to protect their long term biodiversity, aesthetic, and recreational values. Owners of this type of woodlot tend to live on their woodlot and are usually employed in non-forestry related fields or are retirees. Some owners in this group purchased their woodlot and harvested all of the commercially valuable trees at one time. After this initial harvesting they have focused on leaving the land for habitat purposes.

3.2.2.2 Future Use (Investment)

This group is characterized by woodlot owners who own land for future woodlot management. Factors such as the lack of commercially viable timber or in many cases market prices for species such as aspen prevents owners from intensively managing their land at this time. Woodlots in the aspen dominated areas of the province fall into this category. Current management activities often include practices such as thinning to increase the future value of the land.

3.2.2.3 Personal Use Cutting

These woodlots are similar to the sustained yield group except harvesting is done on an "as-needed" basis. Personal use products such as posts, rails, dimension lumber for buildings, and firewood dominate the products of this management approach. Woodlot owners in this group rarely sell their products for profit. In some areas such as Athabasca,

some landowners still heat primarily with wood and as such, their woodlots are used as the source for fuelwood.

Some forms of agro-forestry that allow cattle to use the woodlot for shelter also fall into this category. While some posts and rails are taken for fencing, typically the woodlot is not a continual source for timber resources like with the agriculture-forestry group discussed earlier.

3.3 RECENT HISTORY OF WOODLOTS IN ALBERTA

In order to understand some of the issues surrounding woodlot management in Alberta a brief history and more recent timeline is provided which outlines some of the key events for private land forestry.

Woodlands on agricultural land in Alberta have decreased by 82% over a period of 55 years from 1.56 million ha in 1931 to 0.29 million ha in 1986. The area in the Parkland and Grassland natural regions occupied by woodland decreased by at least 63% between 1971 and 1986 (AEP, 1997). One example provides a sobering example of the rate of deforestation along the White-Green Zone boundary. The Peace River lowland, which covers an area of approximately 45,000 km^2 is Canada's fastest advancing agricultural frontier (Government of Canada, 1991). During the period of 1961-1986, approximately 20% of the forested land was cleared for agriculture – an annual rate of 0.81%. This is comparable with that of Amazonia, which had an annual rate of clearing of 0.87%. Nearly 55% of the land in the region has a high capability to support more than one resource sector. For example, 40% of the land has a high capability for both forestry and agriculture while only 5% has a high capability solely for agriculture. Even Green Zone areas are still being sold to settlers with the proviso that they "improve it" (i.e. clear its natural forest cover) (AEP, 1998).

The following timeline gives a brief history of the significant events related to woodlot management in the province.

1993

- AEP and CFS create the woodlot extension program for landowners. The program provided free information regarding timber and non-timber resource management and was funded primarily by the Canada-Alberta partnership agreement in forestry.

1993 – 1995

- Timber supplies tighten in British Columbia and Montana causing timber prices to increase dramatically which results in extensive clear-cutting and exporting of high volumes of timber from private lands in Alberta (Ross, 1997). For example, from 1991-1994 timber harvest on private land averaged 1 million m^3 while for 1994-1995 they were estimated at 2.3 million m^3 (Ross, 1997).

- The Prairie Farm Rehabilitation Administration (PFRA) heads a White Zone Vegetation Inventory with the purpose of identifying forest areas and providing stand level information such as stand composition, tree height, density and site moisture. The project was just recently completed (Gary Bank, pers. comm).

- The first municipal controls over logging on private lands were imposed by the M.D. of Pincher Creek. The controls included the need for a development permit with specific conditions attached. The conditions typically involved the requirement of a management plan produced by a Registered Professional Forester and aspects of soil and water conservation that had to be met in order to begin logging operations.

1995

- AEP introduced a permit system for transporting coniferous logs (above 2.2 m in length) harvested on private land (Alberta Environmental Protection, 1995)

- Due to opposition from interest groups, the MD of Pincher Creek rescinded its logging guidelines which stipulated the conditions under which logging could be carried out. The permit is still required but conditions may no longer be attached.

- The WAA was formed by a group of landowners concerned with sustainable woodlot management.

1997

- The conclusion of the FRDA in forestry caused the demise of the private woodlot program. Woodlot owner assistance is left primarily to the fledgling WAA that does not currently have the budget to continue the program at previous levels (Grundberg, pers. comm).

- The final report of the steering committee for the Alberta Forest Conservation Strategy indicates the need for a provincial woodlot management program to ensure sustainable woodlot management in the province (Alberta Forest Conservation Strategy, 1997).

3.4 BARRIERS TO SUSTAINABLE WOODLOT MANAGEMENT

The following section deals with factors that stand in the way of achieving long term sustainable woodlot management in Alberta. These barriers are divided into economic and social/political factors. Reduction or elimination of many of these barriers will be required to ensure the long-term conservation of biodiversity on private woodlots in Alberta.

3.4.1 ECONOMIC BARRIERS

Economic barriers are financial considerations that behave as disincentives to long term woodlot management. Primary among these is the issue of how woodlots are taxed, both for property assessment (provincial/municipal level) and for purposes of income (federal

revenue taxation). Various groups of woodlot owners have formed to attain positive changes in current taxation policy at both levels of government.

3.4.1.1 Federal Income Taxation Policy

Under the Current *Income Tax Act* woodlot owners are not formally recognized as a distinct group of taxpayers. Their tax regime is outlined in a series of bulletins, information circulars and other releases issued by Revenue Canada. This has made the whole procedure of woodlot income taxation extremely confusing and difficult (Ross, 1997; Good and Gervais, 1996). Woodlot owners engaged in farming activities generally receive the benefits of preferential tax treatment customarily offered to farmers (e.g. cash basis filing, optional inventory allowance and a $500,000 capital gains exemption). However, those that are not farming do not qualify for these benefits. As well, standing timber sales are treated as a source of income rather than a disposition of capital, while one-time sales from timber cutting are treated as capital dispositions. In other words, landowners that clear their woodlots actually benefit from a capital gains exemption while those that manage it on a sustainable basis do not. The following example shows a comparison of income taxation of capital gains versus business income (Good and Gervais, 1996):

Capital gains of $80,000
Taxable capital gains = $80,000 x 2/3
=$53,333
Average tax rate of 36 per cent
tax liability = $53,333 x .36 = $19,200
Net after tax income
=$80,000-tax liability
=$80,000-$19,200
=$60,800 after tax dollars

Business income of $80,000
Taxable income = 100% of
$80,000=$80,000
Average tax rate of 36 per cent
tax liability =$80,000 x .36 = $28,800
Net after tax income
= $80,000-tax liability
=$80,000 - $28,800
=$51,200 after tax dollars

3.4.1.2 Municipal/Provincial Property Assessment Taxation

The 1995 *Municipal Government Act* divides properties for the purpose of taxation assessment into three categories: 1) residential; 2) non-residential and 3) farmland. Under this assessment woodlots are assessed at market value since timber harvesting is not defined as a farming operation. Woodlots that are farmed such as those mentioned previously do benefit from being assessed at the lower rate for farmlands. This issue is particularly important for woodlots located near urban centres where their potential developmental value is high (Kerr, pers. comm.).

3.4.1.3 Current Market Value

The impact of market pricing as a barrier deals primarily with the low prices currently available for aspen. For woodlot owners in aspen dominated regions of the province, this factor plays a large role in determining the feasibility of managing a woodlot over the long term. For many woodlot owners it is simply not possible to economically justify any input of time because of the current market situation (Grundberg, pers. comm). Therefore the woodlots serve as an investment for future consideration. Silvicultural activities such as thinning or planting can be used in these cases to increase the future value of these properties.

3.4.2 SOCIAL – POLITICAL BARRIERS

In addition to the economic barriers mentioned there are also social and political barriers that can serve as disincentives to conducting sustainable woodlot management in the province.

3.4.2.1 Agricultural Dominance

The physical appearance of the landscape in private land regions is dictated by the objectives of the individual landowners that compose that region. The dominance of

agriculture based land objectives is clearly seen in many areas of the White Zone. In these regions woodlots are often islands among large areas of range and cultivated lands. If this has resulted from a conversion from forest cover to agricultural land uses it presents a difficult scenario for biodiversity conservation, particularly at the landscape or regional level.

Twelve of the twenty (60%) woodlot owners interviewed expressed situations where neighboring land owners simply did not understand their woodlot management objectives. In particular, neighboring land owners could not understand why woodlot owners kept standing trees on the land when it could be cleared and put into pasture. In many areas of the White Zone forests are seen as obstacles to agricultural development (Andries, 1996; Kerr, pers. comm). In many respects the issue is one of culture. Many landowners see a long term investment in timber as "culturally different", one from which they could not benefit. This fact, combined with the economic barriers mentioned above, has lead to an excessive liquidation of forest cover in certain areas.

Past agricultural policies, including subsidies that were determined based on the amount of land under cultivation have further served to encourage land clearing. Education will play a key role in promoting an understanding of the benefits of managing woodlots for the values they provide instead of envisioning them as obstacles. This will need to be accompanied by certain changes to government policy and legislation to ensure a balance between agriculture and private forests in the White Zone.

3.4.2.2 Private Land as "Private Land"

There is a common conception that private land is just that: private. This can pose problems for conservation efforts on private land. In particular it makes legislative efforts very difficult. In addition, the lack of enforcement renders most of the potentially influential federal and provincial legislation inapplicable (Ross, 1997). Many landowners want to be able to solely decide how they manage their land. This fact can be viewed as

both a positive and a negative. From a positive stance, this desire to solely manage the land implies that landowners want to take the responsibility for their land. If the "right" stewardship philosophies are in place this can be beneficial for biodiversity conservation on private land.

On the other hand, private landowners do not have to manage their land in any particular way. They could clear their land and convert it to another land use based on the factors mentioned above. A crucial distinction between private land and Crown land is that in the case of private land the full effect of any land management is directly experienced by the landowner. However, the lack of accountability over large areas can have devastating results as was witnessed during the rise in timber prices and increased pressure from external markets.

3.4.2.3 Lack of Assistance and Incentives for Protecting Biodiversity

Why should woodlot owners conserve biodiversity? Biodiversity is what is commonly known as a non-market benefit. Since there is no direct market for biodiversity in the strictest sense, landowners have no economic incentive to provide these goods. With a lack of incentives to promote the values of biodiversity, alternative management techniques may be chosen that can have detrimental effects on its long-term preservation (Phillips and Wellstead, 1996). In others words why should landowners cover the costs of a value that benefits society as a whole? Unless we recognize the important role of woodlot owners in protecting biodiversity we may see a continuation of habitat loss and fragmentation in many areas.

Also, the end of FRDA funding in 1997 created a scarcity of funds for woodlot management in the province. The WAA currently has only one full-time staff member, and woodlot related programs have been seriously reduced. Both economic and political assistance is required to ensure the success of the WAA in continuing the woodlot program in Alberta.

4. BIODIVERSITY

The role of this chapter is to provide an overview of the biodiversity concept. Challenges with its definition and measurement and the major reasons why biodiversity is valued are addressed.

4.1 WHAT IS BIODIVERSITY?

What exactly is biodiversity? Thirteen years after Walter G. Rosen coined the term for the National Forum on BioDiversity in Washington, D.C. (Perlman and Adelson, 1997) the answer to this seemingly simple question remains complex. Definitions abound, and each is somewhat unique (Box 1). Despite this, it has become a popular term, occupying a considerable presence in the scientific literature, governmental policies and land management strategies. Similar to the terms 'sustainable development', 'ecosystem management' and 'ecological integrity', the key to unlocking the nature of biodiversity is in the interactions of its component parts or themes. In other words, it is a term that is better explained than strictly defined (Perlman and Adelson, 1997).

Most definitions recognize that biodiversity is present at various levels of biological organization with the most common divisions being genes, species and ecosystems. Some definitions go further and recognize the contribution of the evolutionary and ecological processes responsible for both the creation and alteration of biodiversity. Returning to the original question, we find that biodiversity is basically the totality of life in its entire splendor. From the genes that act to define physical form, to the species with which we share the planet, and the ecosystems they combine to create, biodiversity is the variety of life and the processes that sustain it.

Box 1: WHAT IS BIOLOGICAL DIVERSITY?

- variety in the web of life on Earth – *(Environment Canada, 1995)*
- the variety and variability among living organisms and the ecological complexes in which they occur – *(Office of Technology Assessment, 1987)*
- the variety of the world's organisms, including their genetic diversity and the assemblages they form – *(Reid and Miller, 1989)*
- "The variety of genetically distinct populations and the species of plants, animals and microorganisms with which Homo sapiens share the earth, and the variety of ecosystems of which they are functioning parts". – *(Paul Ehrlich in Takacs, 1996)*
- The sum of the earth species including all their interactions and variations within their biotic and abiotic environment in both space and time – *(Terry Erwin in Takacs, 1996)*
- variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems. – *Convention on Biological Diversity*

Noss (1990) offers a more comprehensive explanation of biodiversity by subdividing it into four scales and three components:

Scales	**Components**
Genetic Diversity	1. Compositional
Species Diversity	2. Structural
Ecosystem Diversity	3. Functional
Landscape Diversity	

Figure 3 illustrates the interrelatedness between these different scales and components of biodiversity. Compositional diversity refers to the types and numbers of each of the scales present in a given area. When many people talk about biodiversity they are really discussing compositional species diversity, primarily within a select group of taxa such as plants and animals.

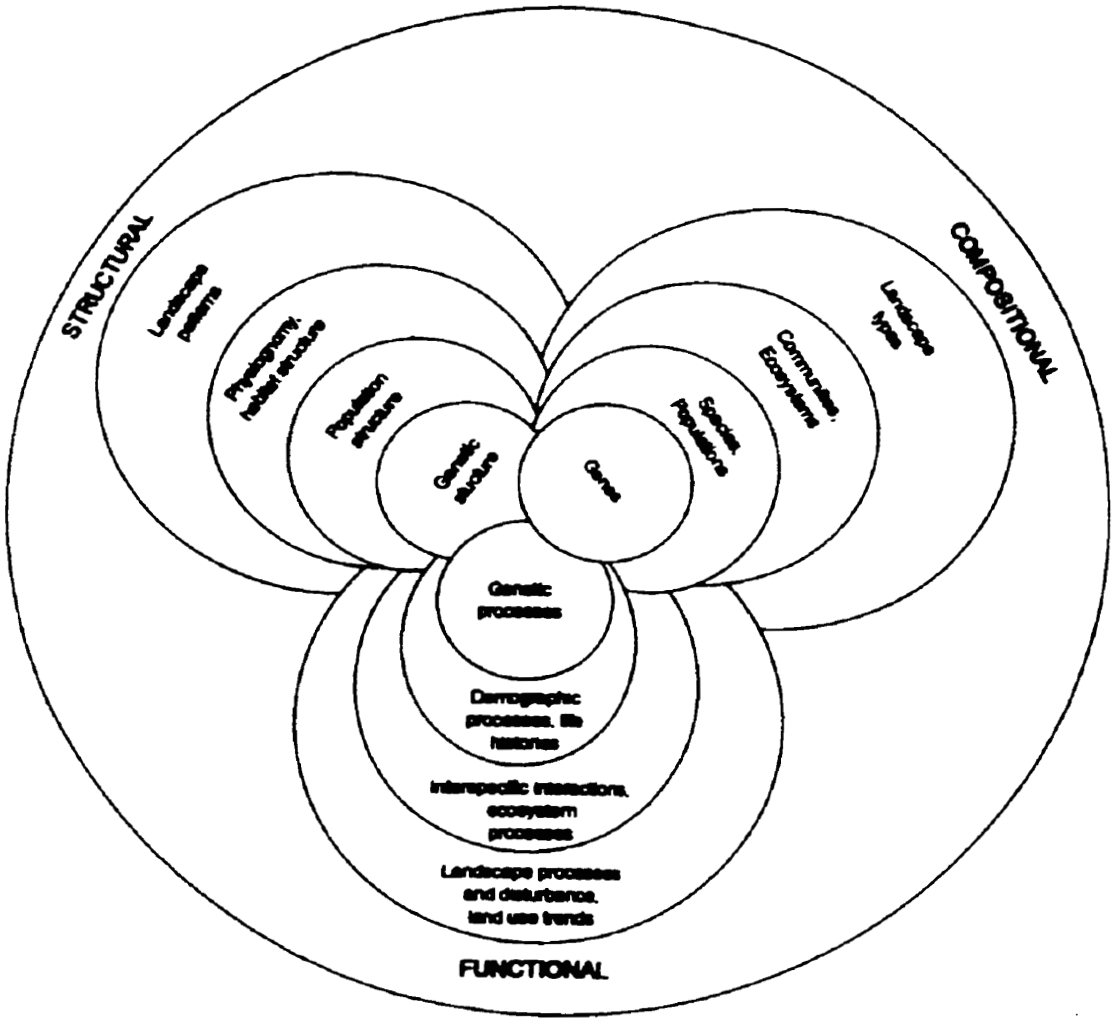

FIGURE 3 – RELATIONSHIP BETWEEN THE COMPONENTS OF BIODIVERSITY (Noss, 1990)

Structural diversity refers to the way the compositional component is distributed over a particular area. For example, the structural arrangement of vegetation in a forest is a crucial factor in determining overall forest biodiversity (Franklin et al., 1997). Lastly, functional diversity refers to the critical ecological and evolutionary processes within each level of organization. These latter two components of biodiversity initially did not receive as much attention as compositional diversity, but have lately begun to receive attention in the literature for their importance in conserving biodiversity (Risser 1995; Walker 1995; Lindenmayer and Franklin, 1997).

4.2 GENETIC DIVERSITY

Genetic diversity is defined as the variation of genes within individual species (World Resources Institute, 1992). Figure 4 illustrates this concept within a population of rabbits.

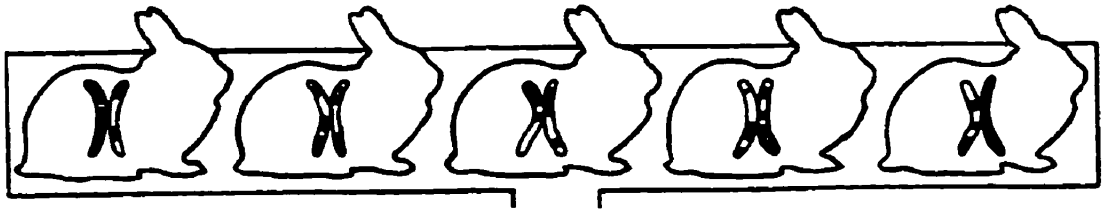

FIGURE 4 – GENETIC DIVERSITY WITHIN A RABBIT POPULATION

Diversity in the gene pool, the total array of genes and alleles in a population, is responsible for the ability of populations to adapt to changing environmental conditions. However, genetic diversity is often viewed in two ways (Perlman and Adelson, 1997):

1. Specific genes with specific roles (e.g. disease resistance) are important and therefore worth conserving

2. The whole of genetic diversity is important for the survival of a population by preventing factors such as inbreeding depression and the accumulation of harmful recessive traits in small populations.

Much of the focus on genetic diversity in natural resources management falls into the first category. Agriculture and forestry emphasize the importance of certain genetic traits for crop or forest production through the use of seed banks and the selection of specific traits. In forestry, factors such as wood yield, quality and disease resistance are major

considerations in genetic research (B.C. Ministry of Forests, 1993). Both viewpoints of genetic diversity are valid and need to be considered in conservation strategies.

The conservation of genetic diversity is a challenging task. The costs and uncertainty associated with cataloging genetic diversity in a region are extremely sizeable. For example, the Human Genome Project undertaken by the U.S. to catalog the genes of the human species is expected to cost around $3 billion and take over 15 years to complete (Perlman and Adelson, 1997). This demonstrates the challenges of analysing the genetic diversity of only one species. Wilson (1988) illustrated that the number of genes in other species range from around 1,000 in bacteria, to 10,000 in some fungi, and up to 700,000 or more in many plants. In addition to the sheer numbers of genes, the cost of monitoring genetic diversity as part of a conservation strategy is often excessive and therefore monitoring is limited to zoo populations of rare species or commercially important species (Noss, 1990).

For this particular project, the possibilities are even fewer. Cataloging genes on a woodlot is clearly not in the interest of woodlot owners due to the economic and time constraints, to say nothing of the technical expertise required. Considering these problems, the question arises: What can woodlot owners do to conserve genetic diversity? The approaches and tools that are discussed regarding this question will deal primarily with reforestation practices. This is the one area with respect to genetic diversity that woodlot owners have some control. Concepts such as provenance, or the area from which the seed of a particular tree species has been collected (Kimmins, 1992), are discussed with respect to its relevance to genetic diversity. Other approaches that can act as surrogates for conserving genetic diversity are also discussed.

4.3 SPECIES DIVERSITY

Species diversity represents the range of evolutionary and ecological adaptations of species to particular environments (Primack 1993). Species diversity (particularly

compositional species diversity) is the component of biodiversity that most people think of when they think of biodiversity.

But even at this level there is a certain degree of bias. For example, are all species considered equally when considering species diversity or are some species such as mammals, birds and plants considered more than others like fungi, invertebrates and bacteria? Wilson (1987) questioned this bias, indicating that the sheer magnitude of invertebrates points to a need for further exploration of the smaller groups of biodiversity to gain a better understanding of overall biodiversity. Figure 5 illustrates the various phyla at different scales to demonstrate the discrepancies in the numbers of species present in each group. Despite the fact that invertebrates are the largest in number, most approaches for biodiversity conservation focus on the more obvious groups of flora and fauna.

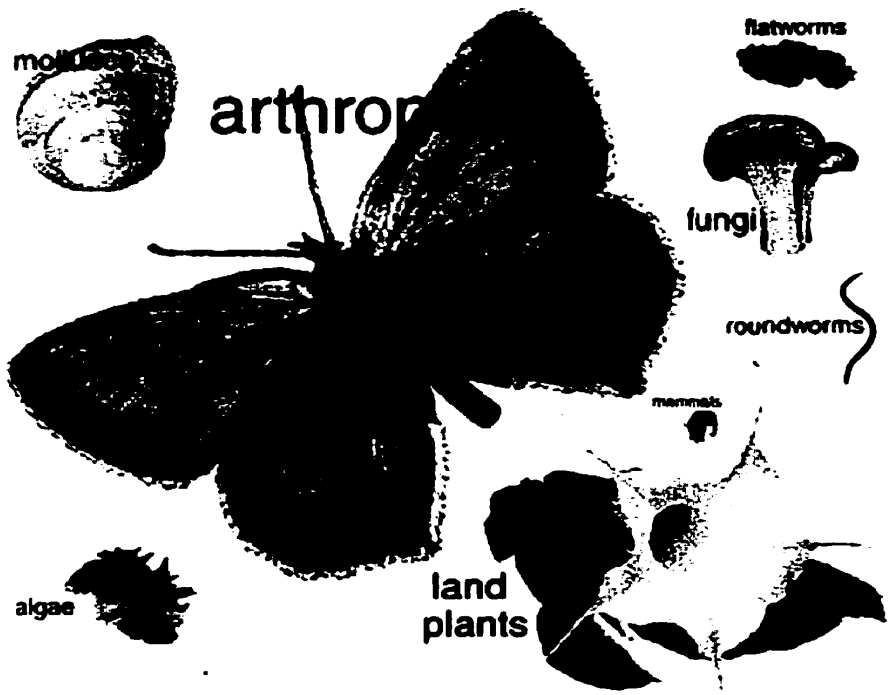

FIGURE 5 – RELATIVE SIZE OF SOME COMMON GROUPS OF SPECIES
(University of California Berkeley, 1993:Internet)

Why is this? While it is clear that more work is needed to incorporate groups such as invertebrates, bacteria and microorganisms, the challenge that presents itself is quite

ominous. The reason most conservation strategies dealing with biodiversity focus on vertebrates and plants is simply that it is more straightforward. There is more information on these species, enabling better decision making ability. On the other hand, our understanding of the other groups is currently very poor, and until that situation improves, conservation strategies will most likely continue to focus on the vertebrate world.

Another reason is that funding and public support for research on vertebrate species is often easier to obtain because of the CCC factor. Species that are cute, cuddly and charismatic convince people of the need to save them much easier than those that are not. For example, if you were to show a picture of a panda bear and a nematode to someone, which one would the person want to save? While this example may be a little extreme, the point is that education is needed to change such narrow perceptions of biodiversity. This will be necessary to facilitate support for the non-CCC species.

However, under existing situations, with existing knowledge bases, there is little choice but to follow those before and focus on certain species groups such as mammals, plants and birds. This project attempts to incorporate other groups where possible to try to bring a more holistic viewpoint to the problem of biodiversity conservation. Methods to conserve these other species are often only surrogates and we cannot be sure of their success, but they are currently our best tools and should be used where possible.

One commonly use surrogate is the "focal species" whose requirements for persistence define the ecological characteristics that must be present if an area is to meet the requirements of the species that occur there (Lambeck, 1997). In this method, a suite of species is selected to represent a range of conditions that are necessary. The needs of these species are then used to develop guidelines regarding the composition, structure and function of the habitat patches in question. There are several categories that can serve as representatives within the focal species concept:

- dispersal limited
- disturbance limited
- demographically limited
- geographically limited

Other important species to be used either as focal species, or as surrogates include: keystone species, which are species critical to ecosystem structure and function, economically important species, contaminant sensitive species and umbrella species. Umbrella species are those whose requirements for persistence are believed to encapsulate those of an array of additional species (Lambeck, 1997).

There are other problems that have been identified regarding the use of species as a conservation target. A species is defined as a group of individuals that can potentially breed among themselves and do not breed with individuals of other groups. This definition has been subject to considerable debate (Rojas, 1992). Despite this, Wilson (1992) states that it works well enough for most situations, most of the time. One of the main problems regarding the use of species as conservation targets is that it is often only a handful of species that are considered. This project tries to take a more holistic point of view by incorporating a wider range of species into every tool or approach. Ecosystems are composed of interactions between many species, why should conservation strategies be any different?

4.4 ECOSYSTEM DIVERSITY

An ecosystem is defined as the combined whole of the biotic components and their abiotic living environment (Tansley, 1935). Difficulty arises when we try to delineate the boundaries between different ecosystems. For example, by Tansley's definition an ecosystem could be anything from an anthill to the entire planet. An examination of ecosystem diversity would be quite challenging for private woodlots in the province. Most woodlots constitute only one ecosystem in and of themselves, or in some cases they are only a component of one. Exceptions would include properties with agricultural fields, wetlands, or riparian areas. Exceptions such as these are considered in this project

to the extent that the other community is a part of the woodlot itself. For example, for the purposes of this project, agricultural fields are considered a separate entity while riparian areas and/or wetlands are often within the woodlot portion of the property. An ecosystem approach to managing such areas would dictate that the entire community (e.g. wetland) is considered as opposed to individual species within that community. Approaches for conserving biodiversity that are discussed reflect this fact.

Another important aspect of ecosystem diversity is the area at the boundary of ecosystems known as an ecotone. While in the past wildlife managers emphasized the creation of this "edge", it is now under debate as to which criteria need to be present for this area to be profitable for biodiversity. Often species richness is higher in these ecotone areas than in adjacent areas because of the additive factor of gaining species from neighbouring areas.

Representation analysis is one tool used to ensure representation of enduring features such as major vegetation types/associations and landforms as well as critical ecological processes such as natural disturbances, herbivory, host-parasite relationships, and predator-prey relations. Within each natural region there will be a set of these features that are representative for that region. These features are therefore important considerations in conserving biodiversity.

4.5 ECOLOGICAL PROCESSES/INTERACTIONS

Ecological processes are the creative forces for ecosystems throughout the world. They work to provide the conditions that some species require to flourish, while others decline in numbers allowing other species to take over. Prevalent examples of such processes include natural disturbances, competition, predation, nutrient cycling, and mutualistic interactions. Often, however, they do not receive the attention that they deserve.

The approaches proposed as part of this project consider these relationships where possible. There is still a lot of research required to effectively use the information from

these interactions within conservation strategies. Where possible, landscape level interactions or processes are addressed with surrogate methods such as wildlife corridors to facilitate movement linkages between like habitat patches.

4.5.1 NATURAL DISTURBANCES

"For the ecologist, by far the most reliable strategy for achieving sustainability is to understand the historic forces that have shaped ecosystems and to work within the mechanisms by which ecosystems sustain themselves."[1]

Natural disturbances are defined as "events that cause a significant change in the existing pattern in a system" (Forman, 1987). In ecosystems such as the boreal forest, fire plays an important role in the renewal of forests and in determining the species of which they are comprised. The concept of minimum dynamic area is used to indicate the minimum area required to withstand a disturbance of intermediate size and frequency. Unfortunately, woodlots are not large enough in area to meet the minimum dynamic area for the boreal zone. Therefore, this project does not deal with large-scale disturbances such as fire, despite their importance at the landscape scale.

There is a range of sizes of natural disturbances in any ecosystem. Typically, natural disturbances are thought of as large, catastrophic events such as crown fires. However, smaller scale disturbances also play important roles within the ecosystem. As a result, this project deals with smaller stand-level processes such as tree death and wind, which are important for gap formation, providing the conditions necessary for understory diversification. As an example of the importance of small scale disturbances, Franklin et al. (1987) outlined the important ecological changes associated with tree death:

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[1] Perry, D.A. and M.P. Amaranthus. Disturbance, recovery, and stability. Pages 31-56 *in* Kohm, K.A and J.F. Franklin (eds). Creating a forestry for the 21st century: The science of ecosystem management. Island Press. Washington, D.C.

- altered tree population structure
- altered community structure
- shift from biomass to necromass
- resources released (light, nutrients, moisture)
- resources stored by decomposers
- resources created (habitat for decomposers, snags, complex organic compounds)
- work carried out (e.g. killing other trees, mixing soil)

4.5.2 ECOLOGICAL INTERACTIONS

There are various interactions among and between species that are important processes for biodiversity. The following represents a cross-section of some of the more common interactions.

4.5.2.1 Predation

Predation is defined as occurring when individuals eat all, or part of other live individuals (Caughley and Sinclair, 1994). It can be divided into four categories:

Herbivory

Herbivory refers to the process of animals feeding on green plants through grazing or defoliation. It may involve feeding on leaves, fruit or seeds. In a community of plants, different species will have a range of tolerances to herbivory. As a result, there has been some discussion on whether herbivory may play a role in increasing evolutionary fitness.

Parasitism

Parasitism refers to the process where a parasite feeds on a host and often does not kill the host. Parasites and pathogens can cause conservation problems by reducing the density of

conservation targets. However, they can also be used to control pest species. In any event, they are important considerations in any conservation strategy.

Predator-Prey (Carnivory and Cannibalism)

The relationship between predators and their prey is an important ecological consideration. Prey may be held at low density by predator regulation and under certain circumstances this can lead to local extinctions. The relationship between the two is a complex one however, and varies by species and region.

4.5.2.2 Mutualistic Relationships

Mutualistic relationships provide us with a view of the interrelationships between species. Too often, such relations are ignored in conservation approaches, resulting in the elimination of important species. Box 2 provides a look at some of the more common mutualistic relationships.

BOX 2 – Mutualistic Relationships (from Willson, 1996)

Plants and Animals
- Flowering plants and animal pollinators
- Seed plants and animal dispersal agents
- Woody plants and protective arthropods
- Vascular plants with extrafloral nectaries and animal protectors

Plants and Fungi
- Mycorrhizal associations
- Endophytic fungi that decrease attacks on host by natural enemies
- Lichens

Plants and Microorganisms
- Nitrogen-fixing microbes and angiosperms

Animals and Other Animals
- Plant-feeding insects and ants
- Interspecific flocks and herds

Animals and Fungi
- Spore dispersal of mycorrhizal fungi by small mammals
- Leaf-cutter ants and fungal gardens
- Wood-boring ambrosia beetles and fungal gardens

Animals and Microorganisms
- Digestive aids
- Surface-dwelling microbes that help protect vs. pathogens

4.6 MEASURING BIODIVERSITY

Because most of the concentration on biodiversity has been on compositional species diversity, the measures of biodiversity occur primarily at this level. One of the most famous empirical relations is the species-area relationship that came from research on island biogeography by MacArthur and Wilson (1967). The following equation represents this relationship: $S = cA^z$ where S is the number of species, A is the area of habitat and c and z are constants. This relationship was originally applied to oceanic islands but was later applied to continental islands in protected areas theory. The general relationship is that the number of species increases with area.

Species abundance is typically measured by diversity indices such as Simpson's index, the Shannon-Weaver index, Margalef's index, and the evenness index. However, most of the time, species richness is the measured property. The following represent ways in which species richness is measured.

4.6.1 ALPHA DIVERSITY

This measure is basically the number of species found in a homogenous ecological community (species richness). This is the most commonly used measure of biodiversity, with particular emphasis on vertebrate species. Tools such as checklists and diversity indices are used to define this measure of biodiversity. In this simple measure of species richness, if an area, A, has 3 species and a second area, B, has 4, area B would have a higher alpha diversity.

4.6.2 BETA DIVERSITY

This measure is the degree to which species composition changes along an environmental gradient. An area with high beta diversity is one where the cumulative number of species recorded increases rapidly as additional areas along an environmental gradient are censused. For example, if plant composition changes at successively higher elevations on a mountain, beta diversity is high, while if the same species occupy the entire mountain beta diversity would be low.

4.6.3 GAMMA DIVERSITY

This measure is similar to beta diversity except that it applies to larger geographical scales and is defined as the rate at which additional species are encountered as geographical replacements within a habitat type in different localities.

4.6.4 HOW MANY SPECIES ARE THERE?

In order to conserve something it is first necessary to figure out how much you have. Estimating the number of species that exist on earth is an incredible task. As a result, current estimates vary widely.

One estimate (Gaston 1991; May 1992) considered that the number of species remaining to be discovered must be at least twice the number of species known, which Wilson (1985) placed at around 1.7 million, offering an estimate of 5 million species. Because insects appear to be the most diverse of all species, others have decided that estimating insect diversity is the key to determining total species diversity (Erwin 1982; Wilson 1991). By sampling trees with insecticidal fogging techniques in the tropics, Erwin attempted to push the estimate of 5 million species higher (Box 3). However, the process Erwin used is largely based on speculation and therefore the 5 million figure is more commonly accepted. Despite the ongoing debate on the total number of species, many scientists agree that they are not confident of the total number of species to even within an order of magnitude.

Box 3 - Erwin's Total Insect Species Estimate:

In Panama, 1200 species of beetles were collected from the canopy of one tree species. Approximately 800 of these were herbivorous. Erwin estimated that 20% of these herbivorous beetles (160 sp.) are specialized feeders on that particular tree species. Since beetles represent 40% of all insect species, there may be a total of 400 species of specialized insects that feed in the canopy of each tree species. He then estimated that canopy species represent only about 2/3 of the insect species on each tree species suggesting that there are 600 insect species specializing on each plant species. Since there are about 50,000 species of tropical trees, there may be as many as 30 million species of insects.

In a recent document discussing provincial initiatives supporting the Canadian Biodiversity strategy, AEP offered the following approximation of species totals for the province (Table 1):

TABLE 1 - SPECIES TOTALS FOR ALBERTA

SPECIES GROUP	SPECIES RESIDENT IN ALBERTA
MAMMALS	91
BREEDING BIRDS	250
FISH	60
AMPHIBIANS	10
REPTILES	8
INSECTS	>20,000 (thousands more unclassified)
FLOWERING PLANTS	1,650
MOSSES	650
FUNGI	450
LICHENS	650

Source: Alberta Environmental Protection. 1999. Sustaining Alberta's biodiversity: An overview of government of Alberta initiatives supporting the Canadian Biodiversity Strategy. Government of Alberta. Edmonton, AB.

Of the first five species groups, 90% are currently secure, while approximately 25% of the native plant species in the province are considered rare.

4.7 WHAT BIODIVERSITY IS NOT: EXOTICS OR ARTIFICIAL DIVERSITY

If one measure of biodiversity is the number of species in a community, does adding exotic species (i.e. non-native species or introduced species) serve to increase or decrease biodiversity? Technically, the number of species in the community would increase by one and therefore it would have a higher species richness. But it is important to consider the effects of the species on the ecosystem. Exotic species often have detrimental effects on ecosystems such as out-competing or even completely replacing native species. Artificial

diversity can take place at other levels of organization, including genetic (by gene transfer) and at the landscape level (by fragmentation) (Angermeier 1994). Angermeier argues that artificial diversity should not be considered a substitute for native diversity. This is particularly evident when considering ecological function.

Many exotic additions (e.g. purple loosestrife, water hyacinth, and crested wheatgrass) result in the extirpation of native species. For other species, the limited knowledge of ecosystems prevents a clear understanding of their effect. It is best to err on the side of caution (i.e. apply the precautionary principle). This principle states that management activities should not be implemented when the probable results are not well understood. As well, the principle stresses that where there is a threat of significant reduction or loss of biodiversity, the lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat. The goal of biodiversity management is not simply to achieve the highest species diversity per unit area but rather to maintain natural levels of diversity despite human impacts (Willson 1996).

4.8 WHY SHOULD WE VALUE BIODIVERSITY?

It is difficult to assign value to something as complex as biodiversity. As discussed, it is not known how many species inhabit the earth. Norton muses over the situation:

"*Pretend we're having an ice cream social on an improved version of the space shuttle. Someone looks down and says, "What's the value of the life on that planet down there?" The closest guess wins a door prize.*"[2]

Despite this apparent difficulty, a broad classification of values for biodiversity has been developed. This classification can be divided into instrumental value (anthropocentric value) and intrinsic or inherent value. An additional reason to conserve biodiversity is the responsibility of signatories to international and national biodiversity policies.

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[2] Norton, B.G. 1988. Commodity, amenity, and morality: The limits of quantification in valuing biodiversity. *in* E.O. Wilson (ed). BioDiversity. National Academy Press. Washington, D.C. pp 200-205.

4.8.1 INSTRUMENTAL VALUE

Instrumental value is the value that something has as a means to another's ends (Meffe and Carroll, 1994). It can also be seen as anthropocentric value or the value that humans attribute to biodiversity. It is divided into utility, aesthetics, recreation, ecological/scientific, and spiritual values, each of which is considered briefly, below.

4.8.1.1 Utility

Utility value or economic value is the most commonly cited reason for valuing biodiversity. The discovery of new medicines from natural sources is a particularly important component of utilitarian value. For example, vincristine, a chemical used in the treatment of childhood leukemia was extracted from the Madagascar periwinkle. The plant is largely found in an area that was expected to be developed (Farnsworth, 1988). While this example stands out, there are many other aspects of biodiversity that serve important roles in national economies. At the woodlot level, the multitude of forest products including fibre production are utilitarian values of that property. Table 2 illustrates the wide range of services that biodiversity provides and their corresponding economic values for the United States and the World. To better illustrate the relative contribution of these figures they were compared to the Gross Domestic Products of the United States and the world. This comparison reveals that biodiversity accounts for 5% of the American GDP and 11% of the world's GDP (Pimentel et. al., 1997). Canadian figures also demonstrate the value of biodiversity to the country. For example, in 1991 $5.6 billion was spent on activities such as wildlife photography, bird watching, hunting and fishing (Environment Canada, 1995).

TABLE 2: ECONOMIC VALUES OF ENVIRONMENTAL SERVICES

Activity	United States (x$10^9)	World (x$10^9)
Waste Disposal	62	760
Soil Formation	5	25
Nitrogen Fixation	8	90
Bioremediation of Chemicals	22.5	121
Crop Breeding (genetics)	20	115
Livestock Breeding (genetics)	20	40
Biotechnology	2.5	6
Biocontrol of pests (crops)	12	100
Biocontrol of pests (forests)	5	60
Host Plant Resistance (crops)	8	80
Host Plant Resistance (forests)	0.8	11
Perennial Grains (potential)	17	170
Pollination	40	200
Fishing	29	60
Hunting	12	25
Seafood	2.5	82
Other Wild Foods	0.5	180
Wood Products	8	84
Ecotourism	18	500
Pharmaceuticals (plants)	20	84
Forest Sequestration of CO_2	6	135
TOTAL	$319	$2,928

Source: Pimentel, D., Wilson, C., McCullum, C., Huang, R., Dwen, P., Flack, J., Tran, Q., Saltman, T., and Cliff, B. 1997. Economic and environmental benefits of biodiversity. BioScience 47(11):747-757.

4.8.1.2 Aesthetics/Recreation

The aesthetical value of biodiversity is particularly important for many woodlot owners. Whether it is the chance to watch a pileated woodpecker or to experience a diversity of colorful fungi, nature provides a wide array of beauty every day. Many authors voice their thoughts on the beauty of natural objects (Leopold, 1953; Wilson, 1984; Norton, 1987). However, it is important not to think of aesthetics as only the "beautiful" objects of the world. It is better seen as a sense of variety, awareness of complexity and an inner feeling of wonder (Kellert, 1984).

"Barring love and war, few enterprises are undertaken with such abandon, or by such diverse individuals, or with so paradoxical a mixture of appetite and altruism, as that group of avocations known as outdoor recreation."[3]

The recreational value of biodiversity is also very important to many woodlot owners. As indicated, many woodlot owners live on their woodlots and use them for recreational purposes. Many woodlot owners design and build trails to be used for cross-country skiing and hiking. Such trails provide them with the opportunity to experience the aesthetical value of biodiversity on their land. Others simply enjoy the diversity of fauna and flora with which they share their woodlots.

4.8.1.3 Ecological/Scientific

The study of biodiversity provides an incredible amount of information for the advancement of the life sciences. Biodiversity can be seen as a library of knowledge, and the current destruction of biodiversity as thoughtless book burning (Takacs, 1996). Leopold (1949) stated that the precondition of intelligent tinkering is to save all the parts. For instance, the emerging field of restoration ecology which uses principles of community ecology to restore degraded ecosystems depends largely on the information biodiversity provides.

There is still a great deal about biodiversity that remains unknown to science. It is therefore, as Leopold indicated, a necessary task that we save everything we can in order to better understand life. This "argument from ignorance" is the main tactic of those that voice the scientific value of biodiversity.

The collection of information about biodiversity is not restricted to scientists. Private citizens like woodlot owners play a crucial role in collecting information on their own properties (Kellert, 1984; Leopold, 1949). Often, private landowners collect information on flora and fauna that would otherwise never have been obtained. Such information could play a role in regional monitoring schemes. One might argue that most landowners do not have the expertise to identify the diversity of species that occupy their land. In

fact, a lot of landowners do have a substantial knowledge of the species occupying their land. As well, because many live on their land year round they can observe patterns and record information at times beyond that normally recommended by monitoring programs.

4.8.1.4 Spiritual

"Every farm woodland, in addition to yielding lumber, fuel, and posts, should provide its owner a liberal education. This crop of wisdom never fails, but it is not always harvested."[3]

Many people value biodiversity as a critical component of their spiritual system. Norton (1988) talks about the amenity value of biodiversity, where the existence of species improves our lives in some non-material way. Wilson (1984) takes this argument one step further, stating that biodiversity is an inherent part of human nature. This concept, known as *biophilia*, proposes that humans have an innate tendency to focus on life and lifelike processes that is a natural adaptation selected during our course of evolution. In this light, nature provides us with a chance to better understand ourselves through direct experiences with nature. Not every person will admit to having an unseen bond with nature or biodiversity, but as it serves an important value to many people it should not be dismissed in favor of other values such as utility.

4.8.2 INTRINSIC VALUE

"It is inconceivable to me that an ethical relation to land can exist without love, respect, and admiration for land, and a high regard for its value. By value, I of course mean something far broader than mere economic value; I mean value in the philosophical sense."[3]

Intrinsic value is the value that biodiversity has in and of itself. In assigning this value, one is promoting the idea that all biodiversity has the right to exist. Ehrenfeld (1988) argues for this approach by arguing against the use of instrumental value. He indicates that by placing instrumental value on biodiversity we legitimize the processes that are destroying

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[3] Leopold, A. 1949. A Sand County almanac and sketches here and there. Oxford University Press, London, UK.

it. In his view, the value of biodiversity does not depend on the properties of the species in question or the uses to which it may or may not be put.

Intrinsic value also serves a role in offering protection to those species with no apparent instrumental value. If one were to assess all the species on the planet there would still be many with no instrumental value. This further stresses the importance of intrinsic value, as without it these species would be assigned less value and may be lost as a result. Primack (1993) outlined the major ethical arguments that surround the foundation for the intrinsic valuation of biodiversity:

- *Each species has a right to exist*
- *All species are interdependent*
- *Humans must live within the same ecological limitations as other species*
- *People must take responsibility for their actions*
- *People have a responsibility to future generations*
- *Resources should not be wasted*
- *A respect for human life and human diversity is compatible with a respect for biological diversity*
- *Nature has spiritual and aesthetic values that transcend economic value*
- *Biological diversity is needed to determine the origin of life*

The intrinsic value of biodiversity is still debated, which results in a reliance upon instrumental value to convince people of the importance of biodiversity (Myers, 1983). What is needed is an approach that combines components of both categories. Because people have different value systems, a combined approach will be ultimately more effective in convincing people of the value of biodiversity and the need for conservation.

4.8.3 INTERNATIONAL AND NATIONAL BIODIVERSITY POLICY

While they do not directly attribute value to biodiversity, national and international policies offer additional reasons for its conservation. In 1992, the Prime Minister of Canada ratified the United Nations Convention on Biological Diversity, which lead to the development of the Canadian Biodiversity Strategy. Among the strategy's goals, four directly relate to the scope of this project:

1. Conserve biodiversity and use biological resources in a sustainable manner;
2. Improve our understanding of ecosystems and increase our resource management capability;
3. Promote an understanding of the need to conserve biodiversity and use biological resources in a sustainable manner; and
4. Maintain or develop incentives and legislation that support the conservation of biodiversity and the sustainable use of biological resources.

The vision statement of the Canadian Biodiversity Strategy is stated as follows (Environment Canada, 1995):

"A society that lives and develops as part of nature, valuing all life, taking no more than nature can replenish and leaving to future generations a nurturing and dynamic world, rich in its diversity of life."

With respect to private landowners, the national strategy recognizes their contribution of managing significant proportions of the land base. As a result, the active participation of landowners is recognized as a critical component of biodiversity conservation in Canada.

4.9 CONCLUDING REMARKS ON BIODIVERSITY

Every woodlot owner has their own definition of biodiversity, based on their own individual value system. This project recognizes this fact and attempts to be flexible to

meet this challenge. For the purposes of this project, biodiversity is largely based on species diversity. However, it surpasses other species-based approaches in that it incorporates compositional, structural and functional aspects to species diversity. It also addresses genetic and ecosystem diversity within the limitations of the project focus. Many people, based on the strict definition of biodiversity, stress that it is an unattainable conservation goal. However, others note that the tools will appear and progress will be made so long as we have the desire to try.

"*If you are convinced that retention of biodiversity is a worthy goal, don't wait for the high priests and gurus to point out the way. Do the best you can with what you have at your disposal. Don't wait, start now.*"[4]

[4] Jack Ward Thomas, 1996. Foreward *in* Szaro, R.C. and D.W. Johnston, eds. Biodiversity in managed landscapes: Theory and practice. Oxford University Press. New York, NY.

5. SUSTAINABLE FOREST MANAGEMENT

"Our purpose is to promote leadership in sustainable forest management by increasing awareness of the forest's inherent social, economic, and environmental values."[1]

Woodlot owners in Alberta have stated their interest in practicing sustainable forest management as a means of maintaining biodiversity while promoting a sustainable flow of resources. Examination of the concept of sustainable forest management for the purposes of this project raises two important questions. First, what exactly is sustainable forest management? Second, what are the key factors within forest management that are important for the long-term maintenance of biological diversity? This chapter is an examination of the concept of sustainable forest management and its relation to biodiversity conservation on a woodlot scale. In doing so, it examines both stand level factors as well as the landscape level factors that play a role in biodiversity conservation.

5.1 THE EVOLUTION OF FOREST MANAGEMENT

Today's society recognizes a diversity of values within forest ecosystems. This recognition reveals both the overall shortcomings of "traditional" forest management and its inherent failure to provide for the maintenance of these values.

The philosophical basis for traditional forest management is largely based on the premise that the land and its components are mere commodities for human consumption as opposed to a living system with a much broader function (Leopold, 1949). During the period of 1940-1980 strategies for natural resource management were mechanistic or reductionistic in nature (Botkin, 1980). Forest management was viewed as similar to agriculture where the forest was characterized in terms of its capability to yield desired products (NRC, 1990). Under this view, the forest has a theoretical sustained yield and to achieve it involves an apparently simple balance between growth and harvest (Behan, 1990). These past views stressed economics as the deciding factor in the choices made

[1] Woodlot Association of Alberta Mission Statement

within the forest. New understanding of the complexity of ecosystems has proven this assumption incorrect.

With timber seen as the primary output, sustained-yield management became the common approach for forest management in Alberta. Sustainability under this system is defined as keeping certain species within a defined age structure and rotation, in perpetuity, using volume-based approaches such as the AAC. The end result of a sustained yield approach is a regulated or normal forest. With a normal forest there is a balance between yield and maturity such that the net harvest is equal to the net growth of the forest. In these forests, age class groups are of equal area and the oldest class is cut every year (i.e. the net volume increment is cut every year) (Figure 6). MSY on the curve corresponds to the maximum rate of recruitment into the population and K is the carrying capacity for the environment. The premise is to harvest such that the population is kept at K/2. This is difficult as populations are typically not defined accurately by such curves and K is difficult to identify, as it is not a constant as implied. Further, there is no allowance for old growth, loss of wildlife habitat, or the presence of natural disturbance regimes.

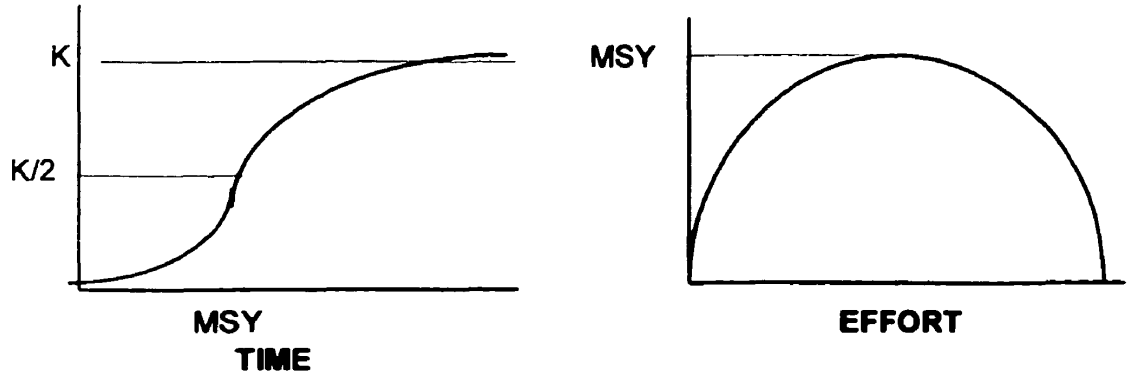

FIGURE 6 – MAXIMUM SUSTAINABLE YIELD (MSY) CURVES (Meffe and Carroll, 1994)

Because of the importance placed on economic factors and certain ecological factors (e.g. dominant disturbance type), clearcutting is the preferred harvesting method in Alberta (Cooper, pers. comm.). It is accepted that some shade intolerant species such as

lodgepole pine (*Pinus contorta*) and trembling aspen (*Populus tremuloides*) require the light levels that clearcutting affords. However, the method has many detrimental qualities:

1. By removing all vegetation from the site, including canopy dominants, clearcutting compromises the genetic benefits these trees offer under natural regeneration systems (Camp, 1997).

2. Clearcuts reduce structural diversity by reducing the recruitment of coarse woody debris and removing standing trees (both alive and dead) (Primack, 1993). For example, in the Pacific Northwest, studies have shown that large trees/snags were 3-5 times denser in unharvested stands than on clearcut plots (Hansen et. al., 1991).

3. Stand development is altered by halting succession at the end of the stage when growth rates level off (Spies, 1997). This decreases the proportion of patches across the landscape occupying late seral stages upon which some species depend.

4. Clearcutting leads to habitat fragmentation at the landscape scale. As well, the increased edge to interior area ratio has serious implications for many species.

Recent knowledge on the importance of ecological processes and ecosystem structure to biodiversity indicates that the simplification effects of exclusively clearcutting are in direct contradiction with the preservation of biodiversity.

A broader and more comprehensive approach to forest management is therefore required to conserve the long-term integrity of forest ecosystems. Such a new paradigm would not diminish the importance of products and services, but rather treat them within a broader ecological and social context (Kessler et. al., 1992). This broader view of forest ecosystems, would involve moving from an emphasis on sustained yields to ensuring healthy forest ecosystems (CCFM, 1998).

5.2 WHAT IS SUSTAINABLE FOREST MANAGEMENT?

Interest in sustaining the long-term ecological integrity of forest ecosystems has promoted the need for a new approach to resource management. Ecosystem management is currently being viewed as such an approach. Grumbine (1997) points out that while traditional resource management is concerned primarily with the production of selected resources, ecosystem management is focused on the conservation of their sources: natural ecosystems. Ecosystem management is a more holistic approach to resource management that assumes intergenerational sustainability as a precondition to the production of goods and services (Christensen et. al., 1996). Ecosystem management is not an all-encompassing methodology that is applied universally to address current difficulties within resource management. It is more of a set of principles used to guide natural resource planning and management in a more balanced and constructive manner.

Grumbine (1997) states the ten themes of ecosystem management as:

1. Hierarchical Context
2. Ecological Boundaries
3. Ecological Integrity
4. Data Collection
5. Monitoring
6. Adaptive Management
7. Interagency Cooperation
8. Organizational Change
9. Humans Embedded in Nature
10. Values

These themes provide a framework that can be applied to individual ecosystems in order to evaluate their potential for the various resource management sectors such as forestry. It is hoped that such an approach will aid in incorporating the range of values in today's forests; i.e. values that traditional forest management has failed to accommodate. The ecosystem approach is a broader view of forest lands that includes soils, plants, animals, minerals, climate, water, topography, and the ecological processes that link them together. In this way, ecosystems are viewed as living systems that have importance beyond traditional commodity and amenity uses (Kessler et. al., 1992).

Sustainable forest management tries to incorporate these themes and can be defined as "an attempt to follow ecologically sound practices that maintain ecosystem integrity, productivity, resilience and biodiversity" (CCFM, 1998). Two crucial components of sustainable forest management are accurate inventories and an adaptive management approach that relies on scientific information (CCFM, 1998). Inventories provide an understanding of the baseline or starting point. The adaptive management approach considers this information and continues to update management approaches based on incoming information about the system in question.

Table 3 is an attempt to incorporate the discussed components of biodiversity with the guiding themes of ecosystem management to promote sustainable forestry on private woodlots.

Unfortunately, too often the term sustainable forest management is used interchangeably with sustained-yield management. In an attempt to eliminate this problem, a new approach to forest management is evolving known as ecologically sustainable forestry or ecoforestry (Drengson and Taylor, 1997; Hammond, 1997a).

Currently, it is being implemented on smaller parcels of land at small scales of production, which make it a suitable model of sustainable forest management for woodlots. This approach recognizes that sustainability must consider not only the trees but also the ecological processes such as nutrient flow that are critical for their survival (Weeks, 1997).

TABLE 3 - INCORPORATION OF THE THEMES OF ECOSYSTEM MANAGEMENT INTO WOODLOT MANAGEMENT

EM Guiding Themes	Woodlot Management
Hierarchical Context	Traditionally, woodlot management occurs at the stand level. However, the need to address landscape components of biodiversity necessitates partnerships with adjacent landowners to address sustainability at all scales.
Ecological Boundaries	Components of biodiversity are dependent upon ecological boundaries. The nature of woodlots places them within human-derived land boundaries. Ecological boundaries should be used within the region to determine goals for the region. Woodlot management can then attempt to fit within larger scale goals.
Ecological Integrity	By stressing the importance of the stand and landscape components of biodiversity, ecological integrity will be maintained.
Data Collection	Inventory work should be expanded to include factors such as those discussed within the stand-level section (e.g. fungi, coarse woody debris, etc.)
Monitoring	Due to the close link between owner and woodlot, monitoring is typically ongoing. It should be expanded to include information on additional factors as mentioned for data collection.
Interagency Cooperation	Relationships with adjacent landowners will prove invaluable to achieve landscape level features of biodiversity. Also, relationships between agriculture and forestry need to be improved.
Humans Embedded in Nature	Diversification of products and increases in value added approaches would help to stress the ties between the owner and their woodlot.
Adaptive Management	The small-scale of woodlot management lends itself well to the application of adaptive management.
Organizational Change	Changes in the two related departments of agriculture and forestry are required to ensure long term sustainability in the White Zone.
Values	By expressing their desire to practice sustainable forestry, woodlot owners in the province have expressed their values. Ensure continued support for biodiversity as a prominent concern in forest management.

The three guiding principles of ecoforestry are (Camp, 1997; Hammond, 1997a):

1. Forest ecosystem activities must be based on addressing the needs of the forest first.
2. Only trees that are selected for removal through the natural selection process are candidates to take from the forest to serve human needs.
3. Any removal of forest goods or products or other activities must retain the ecological function of all forest elements at all scales.

Based on these overriding principles, a set of operational guidelines has been developed that serves as a means of applying the themes of ecosystem management to forest management (Box 4).

BOX 4 - OPERATIONAL GUIDELINES OF ECOFORESTRY

1. *Focus on what to leave rather than on what to take.*
2. *Apply the precautionary principle.*
3. *Design plans on large temporal and spatial scales.*
4. *Respect the ecological limits of various ecosystems to human disturbance.*
5. *Protect, maintain and where necessary restore natural biodiversity including compositional, structural and functional features.*
6. *Diversify activities.*
7. *Constantly review and evaluate.*
8. *Respect indigenous cultures*
9. *Leave riparian zones intact.*
10. *Use the lowest impact removal methods possible.*
11. *Maintain beauty and other natural aesthetic qualities.*
12. *Always look at the forest as a whole and how each part contributes to the needs and health of the whole in which it resides.*
13. *Rely as much as possible on local people and markets.*
14. *Humans are a part of the overall web of life.*

Modified from: (Drengson and Taylor, 1997; Hammond, 1997a).

Ecoforestry represents a more humble approach to forest management than the tradition sustained-yield model. Ecoforestry recognizes that our understanding of nature is imperfect and we need to approach the complex relationships within nature with humility (Minckler, 1975). As mentioned, ecoforestry is an evolving model of sustainable forest

management. It is by no means in a complete form that could be universally applied. However, it does provide a set of guiding principles, as well as a toolbox of specific management approaches for this project. This project recognizes that each woodlot owner will apply different approaches to their land, with varying results. The information from this form of experimentation should be shared among woodlot owners to facilitate the evolution of sustainable forest management on woodlots in the province. This point is stressed later in Chapter 7.

5.3 SUSTAINABLE FOREST MANAGEMENT AND BIODIVERSITY CONSERVATION

"To the extent that maintenance of biodiversity and sustained productivity including the production of timber are linked, then it is clearly in the best interest of landowners to understand and find ways to address biodiversity in their overall management plans."[2]

Dudley (1996) introduced the term authenticity as a means of measuring the effect of forest management on biodiversity. Authenticity is defined as the extent to which a forest corresponds to a naturally functioning forest in terms of composition and ecology. As its criteria authenticity emphasizes the importance of the three divisions of biodiversity described previously: composition, structure, and function. However, it is difficult to quantify, for comparison purposes, a naturally functioning forest. Applying this to woodlot management would prove problematic. Many woodlots are remnants of once larger forested areas. To compare these to the original natural forest in terms of biodiversity would obviously prove pointless. The concept is based on a solid idea however. To understand how to conserve biodiversity in managed forests it is first necessary to examine natural forests as models. What features of a natural forest play crucial roles in maintaining compositional, structural, and functional diversity?

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[2] Rochelle, J.A. and L.L. Hicks. 1996. The role of private industrial forest lands in the management of biodiversity. pp. 656-664 *in* Szaro, R.C. and D.W. Johnston (eds.). Biodiversity in managed landscapes: theory and practice. Oxford University Press. New York, NY.

Most conservation strategies dealing with sustainable forest management recognize biodiversity as a vital component. For example, the National Forest Strategy for Canada (CCFM, 1998) states: "The sustainable use and management of forest ecosystems must maintain their essential ecological processes, biodiversity, productivity, resilience, and capacity for renewal". All of these goals are directly related to biodiversity. Biodiversity is therefore reliant upon sustainable forest management. For example, 2/3 of the species known in Canada are found in forests or depend on forest habitat (CCFM, 1997). This raises a simple but obvious idea of sustainable forest management. The continued presence of forests on the land is in itself a significant contributor to biodiversity (Rochelle and Hicks, 1996). This emphasizes not only the importance of proper regeneration of stands but also careful management of forest cover at a landscape scale. The current concern over woodlots becoming smaller and more isolated due to agricultural expansion is a significant concern.

In addition to this loss of forest cover there are concerns over the activities taking place in the remaining forest areas. Biodiversity is affected by silvicultural activities that reduce, fragment, or isolate forest habitats, simplify stand structure or eliminate structural and functional attributes (Rochelle and Hicks, 1996). Therefore, it is important to focus the efforts for biodiversity conservation at two levels: the stand and the landscape.

At the stand level, habitat and biodiversity goals are determined by forest structure and species composition. Stand structure includes the vertical and horizontal arrangement of trees, shrubs, herbs, grasses and nonvascular plants as well as snags and coarse woody debris (Tappeiner et. al., 1997). Recent research reinforces the importance of structural complexity to biodiversity (Franklin 1993; Bormann and Likens 1979; Swank and Crossley 1988; Franklin et al. 1987; Maser et al. 1988; Harmon et al. 1986).

The landscape is also important for biodiversity conservation. Biodiversity does not adhere to the socio-political boundaries applied to ecosystems. As difficult as it is to

manage woodlots at the landscape level, there will be a need to try to implement some key approaches to help maintain their role at the landscape level.

5.3.1 STAND LEVEL COMPONENTS OF BIODIVERSITY

"The importance of higher-order constraints should not suggest that monitoring and assessment be limited to higher levels. Lower levels in a hierarchy contain the details of interest to conservationists, and the mechanistic basis for many higher-order patterns."[3]

Maintaining biodiversity at the stand level is based largely on decisions of what to leave behind during silvicultural treatments. Recent studies in the Pacific Northwest have demonstrated the importance of retaining biological legacies and the consideration of species level factors such as mutualistic relationships. For example, studies have shown that despite differences in vegetative composition between unmanaged young, mature and old growth forests they were still highly similar in terms of animal composition (Hansen et. al., 1991; Primack, 1993). This was due largely to the retention of biological legacies such as coarse woody debris and wildlife trees. The main difference in animal composition was in groups of species such as cavity-nesting birds that are dependent on later seral stages. As a result of this new knowledge, the creation and maintenance of structurally complex managed stands is being promoted as the primary approach to managing forests for multiple, complex objectives, including production of wood products (Franklin et. al., 1997). Lindenmayer and Franklin (1997) discussed the three primary roles that conservation of structural and floristic elements play within harvested sites:

1. Lifeboating

Retention of biological legacies may allow species to persist on logged areas from which they would otherwise be eliminated. This is particularly important for species that display long-term site affinity, remaining on an area despite disturbance. Examples include mycorrhizal forming fungi and important soil microorganisms.

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[3] Noss, R.F. 1990. Indicators for biodiversity: a hierarchical approach. Conservation Biology 4:355-363.

2. Connectivity

Retention of cover within harvest areas will enhance dispersal of some species, particularly small mammals.

3. Buffering

Retention provides for some buffering effects from adjacent areas, thereby decreasing the edge effect and increasing the effective proportion of interior forest habitat.

Other factors also play a role at the stand level. For example, choice of which tree species to regenerate can affect species composition. The continued retention of hardwood trees in mixed-wood stands has shown to be particularly important for many wildlife species (Thomas et. al., 1975; Harris, 1980). All stages of forest management, from harvest method to post-harvest site preparation to regeneration, play a role in defining the stand (Rochelle and Hicks, 1996).

5.3.1.1 Biological Legacies

Perry and Amaranthus (1997) defined biological legacies as "anything handed down from a predisturbance ecosystem, including green trees, surviving propagules and organisms (e.g. buried seeds, surviving roots, and mycorrhizal fungi)". For purposes of organization, I have divided them into the following classes:

- Large Standing Trees (Canopy Dominants)
- Standing Dead and Decaying Trees (Snags)
- Coarse Woody Debris
- Pits and Mounds
- Understory Vegetation

Harris (1984) states that the longevity of individual habitat structures such as den trees and decaying logs is probably an important stabilizing factor to individuals and family

lineages of wildlife. In many locations, species can be completely eliminated from a harvest stand when these structural components are removed. In fact, many species can tolerate the often-harsh conditions of a harvested area so long as some of these components are present (Franklin et. al., 1997; Seip and Parker, 1997). Unfortunately, there is little empirical evidence for exactly how much structural retention is necessary for biodiversity conservation (Franklin et. al., 1997).

Large Standing Trees (Canopy Dominants)

Large living trees left on harvested areas serve as critical habitat for many wildlife species and are often referred to as "wildlife trees". Some insects and small mammals live out their entire lifetimes solely within a single tree (Hammond, 1997b). In addition, they are used as roosting and perching sites for many bird species and as food sources such as pollen and nectar (Lindenmayer and Franklin, 1997). Larger trees often contain larger cavities that are of value to mammal cavity nesters (Harris, 1984). As well, standing broken-top trees also contribute as habitat value. Large owls, for example, because of their size cannot use cavities created by woodpeckers and therefore depend on such features as broken-top trees (Harris, 1984). Other species such as invertebrates, epiphytes (e.g. mosses, lichens and liverworts), and microbial organisms also depend on large living trees as habitat (Franklin et. al., 1997). In addition they serve as hosts and energy sources for a wide variety of soil organisms, including the fungal species that form critical mycorrhizal relationships (Perry 1994).

Canopy dominants serve to regulate the movement of precipitation vertically through the canopy due to their extensive foliage area thereby providing adequate rates of flow for proper absorption into the soil. Furthermore, canopy dominants serve as excellent genetic stock for natural regeneration due to their long-term survival characteristics. And ultimately, large living trees are the future source of large diameter snags and coarse woody debris.

Standing Dead and Decaying Trees (Snags)

Similar to large standing live trees, snags provide habitat for many wildlife species. This is particularly true for species with specific habitat niches such as cavity nesting birds, bats and some fur-bearing mammals (Seip and Parker, 1997). These niches often change over time as the wood softens allowing other species to use them. For example, where initially a snag is used by a woodpecker, as it softens, it becomes habitat for other species like pine marten. Snags are required in addition to large standing trees as some cavity nesters only excavate holes in dead wood.

Snags provide benefits for biodiversity beyond basic habitat requirements. For example, the presence of snags creates an opening in the canopy that allows light penetration, which aids in the diversification of understory vegetation. They also provide a source of deadwood for arthropods which in turn enhances the food base for insectivorous birds (Harris, 1984). They also serve a role as perching sites for many birds including raptor species.

There are certain operational and safety considerations involving snags that should be considered within the harvest approach. The instability of many snags presents a hazard to individuals working around these trees. Therefore, care should be taken when working around snags. This fact may dictate the location and number of snags left on a site to allow for safer conditions for future harvest or site maintenance.

Coarse Woody Debris

Coarse woody debris such as fallen logs and brush-piles serves several important roles within the forest stand (Drengson and Stevens et. al., 1997). In addition to supplying habitat for small mammals and basking sites for reptiles, coarse woody debris provides:

- water storage and filtration
- a mechanism for the prevention of soil erosion
- additions to forest soil organic matter (Harmon, et al., 1986; Harvey et al., 1987)
- nursery sites for ferns and mosses
- sites for the development of mycorrhizal fungi (Harvey et al., 1979)

There are also individual species that utilize coarse woody debris for various parts of their life cycle requirements. For example, ruffed grouse make use of downed logs as drumming sites (Maser et. al., 1979) and ground-nesting birds rely on them for protection (Bowman and Harris, 1980). Many species also use fallen logs as travel lanes through thick second growth.

Pits and Mounds

Pits and mounds form on the forest floor when trees are wind-thrown and uprooted (Lompart et. al., 1997). By lifting roots and soil out of the ground mineral soil is exposed which provides sites for new trees to germinate. Mounds form as the root mass decays over time. They provide food and habitat for fungi, lichens, mosses, insects, amphibians, and plants. Root masses provide dens for a variety of mammals and reptiles.

Understory Vegetation

While traditional forestry practices aim to eliminate understory vegetation from harvested areas to reduce competition, ecoforestry recognizes its importance to biodiversity conservation. The quantity and type of ground cover is highly correlated with the presence and abundance of a range of small mammals (Lindenmayer and Franklin, 1997). Greater foliage height diversity has been shown to correlate with bird diversity and some arboreal vertebrates (Harris, 1984). In addition, understory vegetation serves vital roles in the facilitation of ecological processes such as nitrogen fixation and calcium deposition in the topsoil. Some species of understory vegetation also act as pioneering species, which

allow the subsequent colonization by other vegetation species (the "island effect"). Angiosperms also produce all nectar consumed by nectivores such as hummingbirds, and the majority of fruits and seeds for granivores and omnivores (Harris, 1984).

Understory vegetation is influenced by harvest method. For example, methods that allow for openings in the dominant canopy provide opportunities to diversify the understory. As well, the frequency of silvicultural burning and fertilization and the level and frequency of thinning also influences the amount and composition of understory vegetation (Rochelle and Hicks, 1996).

In addition to biological legacies, other species-level factors play a role in supporting ecosystem structure and function important for the preservation of biodiversity. Mutualistic relationships and insects are common examples of such factors.

5.3.1.2 MUTUALISTIC RELATIONSHIPS AND THE ROLE OF INSECTS

A mutualistic relationship is one in which two species benefit each other by their presence together (Primack, 1993). The two species tend to reach higher densities when found together. Examples of such relationships include flower-pollinating insects and flowering plants and fruit eating birds and plants with fleshy fruits. At the extreme of mutualisms are symbiotic relationships, in which the two species cannot survive without each other. Some species of mycorrhizal forming fungi exhibit this type of relationship. Because of their importance for ecological integrity, ecoforestry attempts to understand these relationships and preserve them for subsequent forest cycles.

Mycorrhizae act as an extension of the root system and are divided into three groups: ectomycorrhizae, vesicular-arbuscular mycorrhizae and ericoid mycorrhizae. Ectomycorrhizae are common in temperate coniferous forests because they are obligate with the families Pinaceae and Betulaceae (Schowalter et. al., 1997). Mushrooms, truffles, and cup fungi are the dominant forms of this type of mycorrhizal relationship.

Ericoid mycorrhizae are also quite common as they form with species in the ericaceous family (heathers) which are common understory components (Schowalter et. al., 1997).

Certain groups of insects and pathogenic fungi also play important roles in the forest ecosystem. Phytophageous (plant-eating) insects and pathogenic fungi act to kill large trees which changes the character of the overall forest. They also kill small, weak trees which serves to maintain ecosystem fitness by reducing competition (Schowalter et. al., 1997). As well, many species of shrubs, herbs and some trees require pollination by insects such as butterflies, moths, flies, bees, wasps, ants and beetles (Schowalter et. al., 1997). Insects also act as important agents of disturbance, especially between stand-replacing events such as fire. In systems where fire is absent, insects often take over a role as one of the major disturbance types. By killing single trees, or small groups of trees, gaps are formed which help to diversify the understory and add to coarse woody debris. However, there is a need for balance, as insects can often become a problem for resource managers if unchecked.

5.3.1.3 RIPARIAN ZONES

Riparian zones are defined as the lushly vegetated zones around bodies of water. Riparian areas are extremely important for biodiversity. For example, 80% of the wildlife in Alberta use riparian zones for all or part of their life cycle requirements (Adams and Fitch, 1995). Because of the unique moisture conditions in the riparian zone, they typically contain a suite of species that do not occupy adjacent areas. In many ways they are like ecotones, in that they may contain a complement of species from both systems. The following represents an outline of the role of riparian vegetation (Department of Fisheries and Oceans, 1990; Western Resource Management Associates, 1992):

1. Control of shoreline erosion

The presence of vegetation and their roots helps to stabilize stream banks and minimize shoreline erosion.

2. Maintenance of water quality

Water quality is maintained as the vegetation acts to filter runoff and sediments which could otherwise cover spawning habitat and suffocate fish eggs. Also, by shading the water, it reduces water temperature thereby increasing the levels of oxygen for fish.

3. Reduction of flood peaks and facilitation of groundwater recharge

By trapping snow along the banks riparian vegetation allows for a slower release of water in the spring which acts to reduce flood peaks and recharge groundwater supplies.

4. Wildlife and fish habitat

Riparian vegetation is excellent wildlife habitat due to its unique diversity of plant life. Also, by attracting insects which may end up in the stream it can provide food for fish. As well, the improvement in water quality is critical for the survival of fish species.

Forest harvest practices can cause significant alterations in aquatic ecosystems or riparian areas including (Gregory, 1997):

- sedimentation and mass slope failure
- stream temperatures
- hydrologic regimes
- channel structure
- floodplain processes
- amount of woody debris
- aquatic plant production
- terrestrial litter input
- invertebrate, fish, and wildlife populations

As a result, management of riparian areas tends to focus on a set of related factors (Gregory, 1997):

1. Width of riparian buffer zones (RBZ)
2. Retention of live trees and snags within the zone
3. Extent of shade cover
4. Floodplain protection
5. Yarding corridors
6. Culvert dimensions

7. Road crossings
8. Felling Techniques
9. Erosion Protection

5.3.2 LANDSCAPE LEVEL COMPONENTS OF BIODIVERSITY

"Small-scale habitat conservation strategies, such as structural retention, are not panaceas, however. Some taxa require conditions associated with large blocks of intact forest habitat."[4]

It has become evident that factors such as disturbance regimes, evolutionary processes and inter-relationships are important for maintaining biodiversity. In addition to occurring at the stand level, they also occur at the landscape level and therefore management initiatives must include this broader scale to be effective. It is important to recognize the need to manage areas as a whole rather than dealing with individual parts (Manning, 1992).

Landscapes are heterogeneous land areas or mosaics composed of different ecosystems, conditions, organisms and resources that interact and repeat in form throughout (Hansson et al., 1995; Noss, 1990). Critical factors for conserving biodiversity at this scale in forested ecosystems are:

- complete, unfragmented environmental gradients
- interactions between landscape components
- ecological and evolutionary processes

Habitat fragmentation was introduced as part of the theory of island biogeography. This theory considers species diversity on an island to represent a balance between immigration and extinction. Larger islands, close to a source of colonists, are predicted to have the highest levels of biodiversity (MacArthur and Wilson, 1967). Areas in isolation will tend

[4] Lindenmayer, D.B. and J.F. Franklin. 1997. Managing stand structure as part of ecologically sustainable forest management in Australian Mountain Ash forests. Conservation Biology 11(5):1053-1068.

towards extinction because of poor genetic resources and/or the inability to disperse in response to short and long term change. Various species of songbirds have shown evidence of this lack of dispersal ability in areas fragmented by clearcutting. It is therefore necessary to maintain contiguous habitat patches and link isolated patches together wherever possible to allow for the continuation of evolutionary processes.

Woodlots often lack an important component within the theory of island biogeography. There is often no source population nearby to provide colonists during times of extinction. In this case, the islands (woodlots) themselves play the role of individual source populations, though fairly small in size (Harris, 1984). Thus, the distance between these small source populations plays a critical role in determining the long-term survival of biodiversity in the overall region. In many cases in Alberta, woodlots are experiencing a combination of fragmentation and attrition where the patches are getting both smaller and further apart. In other areas, woodlots are still the matrix whereas other land uses are in patches. When dispersal among residual islands is limited, they may begin to experience problems associated with small populations (Hunter, 1997). These include demographic, genetic, environmental and catastrophic stochasticities (Shaffer, 1981).

Individual species groups respond to this fragmentation in different ways. Forest songbirds have been showing a decline due to forest fragmentation (Robinson et. al., 1995). The deciding factor for the survival of many species populations is determined by their ability to move across inhospitable habitats (Fahrig and Merriam, 1994) and the distance between patches. The majority of studies in forest ecosystems has focused on the movement of birds. One study showed that gaps of less than 30 m in distance had little impact on bird movements while distances of 70 m and 100 m were 3 times and 8 times less likely to be crossed (Desrochers and Hannon, 1997). In general, conservationists tend to ask four questions involving species movements (Hunter, 1997):

1. Can animals move freely over an area large enough to find the resources they require?
2. Can animals migrate freely between seasonal ranges?
3. Can organisms disperse among subpopulations and habitat patches? (i.e. are enough dispersers going to sinks to make them viable?)
4. Can organisms shift their geographic ranges in response to environmental change?

A common response to this issue of movement is the concept of wildlife corridors. Studies have shown the effectiveness of corridors in facilitating the movement of songbirds (Haas, 1995; Machtans et. al., 1996). However, the importance of woodland strips as wildlife corridors has not been without controversy (Wegner and Merriam, 1979; Noss, 1987; Simberloff and Cox, 1987; Mann and Plummer, 1995). While the benefits are usually clearly stated, the potential disadvantages are often not considered. For example, corridors can act to facilitate the spread of disease and exotic species. For this project it is clear that in some regions, where woodlots are reasonably close to one another, corridors may work to provide some connectivity. However, in other areas, where woodlots are more isolated, the use of corridors may have limited effectiveness in maintaining landscape biodiversity components.

Ecotones, areas that act as a critical balance between two adjacent ecosystems, are also important considerations at the landscape scale (Camp, 1997). These regions, which are typically higher in biodiversity than adjacent ecosystems, act as buffers and serve as habitat for many species which prefer open areas next to cover. Artificial creation of edge habitat has been used as a means of mimicking ecotonal areas. However, this is often detrimental to the interior forest microclimate. The creation of edge habitat due to the isolation of patches is also problematic. There is usually a change in the microclimate near edges, which is problematic for many amphibians and plants (Ranney et. al., 1981; Chen et. al., 1992). This microclimatic influence can penetrate up to 200 metres into the woodlot (Lompart et. al., 1997), affecting species that require a specific set of interior habitat conditions. It has also been shown that edge effects leads to increased predation on bird nests, particularly within an agricultural matrix (Bayne and Hobson, 1997). While this

edge effect does not detrimentally affect every species, because of the isolated nature of many woodlots in Alberta there is already a lot of edge habitat. By managing for more interior woodlot habitat, species that depend on interior conditions will also be conserved.

The following factors represent essential commonalities for conserving biodiversity at the landscape scale:

- connect unharvested areas with forested corridors wherever possible
- maintain genetic diversity through natural regeneration
- vary cutblock sizes and shapes to match natural disturbance patterns

Since some species are seral stage dependent, it is important to maintain a variety of stages across the landscape (Perry and Amaranthus, 1997). For example, many species of mycorrhizal fungi are dependent on late seral stages. While some species prefer mature stands, there are also those that benefit from early aged stands, such as large ungulates (e.g. moose and elk) and some passerine birds (e.g. yellow warblers and forest sparrows) (CCFM, 1997). Because of this, it will be necessary to determine the proportions of particular successional phases in the landscape to determine natural variation for these proportions. Each phase with its particular compositional and structural features plays a role in biodiversity at the landscape scale.

5.4 THE ROLE AND IMPORTANCE OF WOODLOTS

Woodlots are smaller than most management units in forest management areas. They are therefore unique in their contribution to biodiversity and as pieces of the landscape. The National Forest Strategy recognizes woodlots as reservoirs of biodiversity, important wildlife habitat, carbon sinks and sources of clean water (CCFM, 1998). The previous section discussed the aim of keeping various patches across the landscape in different age ranges. Woodlots by their nature of diverse landowner objectives, geographical locations, and species complements can play an important role in satisfying this goal. For example,

many of the woodlots that do not experience regular levels of harvesting could serve roles as pockets of old-growth timber.

As mentioned, most woodlots are or are becoming isolated small source populations. As more of the surrounding lands are put into conflicting land uses, these woodlot islands become more and more distinct. Unfortunately, as the distance between woodlots increases, the probability of species extinction increases which further stresses the need to focus at the landscape scale. As patches of habitat, woodlots can also serve a role as stopover points for migratory species. Migratory species tend to prefer movement paths with at least some favorable habitat. On a social level woodlots and their owners serve as examples of how we can maintain our attachment to nature, something that in a province where 2/3 of the population live in urban centers (Thomas, 1994) needs to be maintained. Woodlots also play a small role in carbon sequestration. While clearly their size prevents them from playing a significant role individually, the combined effect over the landscape may be of benefit. This role could play a role in determining incentives for maintaining forest cover.

The smaller size of private woodlots is more appropriate for achieving the stand level factors mentioned previously. As well, since many woodlot owners are not solely interested in timber production, the approach put forth by ecoforestry will be attractive.

Private woodlots serve as special cases for forest management in the province. Since the conditions for logging in the M.D. of Pincher Creek were rescinded, there are currently no regulations for timber harvesting in the province. There are also several financial disincentives for maintaining forest cover. The lack of regulations can also be seen as an advantage since it is solely up to the landowner as to how timber is harvested. A recent survey has shown that a significant portion of private woodlot owners in the province place a high degree of emphasis on maintaining the ecological integrity of their woodlots (Rounds et. al., 1995). Finally, since the results of management practices directly affect the owner, there are implications for promoting stewardship. Adaptive management

approaches that allow a continual learning process for the woodlot owner could be quite effective.

6. BEST MANAGEMENT PRACTICES FOR BIODIVERSITY CONSERVATION

The aim of this chapter is to build on the information from previous chapters and provide a set of practical approaches for individual woodlot owners. Examples have been drawn from both the literature and from the project site visits. Throughout the chapter, boxes are used to highlight those best management practices that were obtained in large part from site visits.

Because of the range of management types, not every approach will be applicable to every woodlot. The use of a specific approach is dependent on individual circumstances, the type of woodlot in question, and landowner objectives. For example, the sections on harvest methodology and silvicultural treatments will be of limited use to those woodlot owners that are not harvesting on their land. However, other sections, such as those dealing with woodlot management plans, inventory, and wildlife habitat programs could be applied to any woodlot regardless of their dominant management approach. Thus the application of the approaches in this chapter is strictly dependent on the woodlot owners' land objectives and personal goals. The approaches will not be followed in a cookbook manner where every piece of information is part of a step-by-step procedure. The woodlot owners ultimately decide which approaches they will put to use on their land or apply to a given situation.

6.1 THE APPROACH

This section describes the overall approach that can be followed to conserve biodiversity on private woodlots. Because of the range of management types included, the approach is generalized. Only the degree of detail within each phase varies among individual properties. For example, a retiree who owns their woodlot for aesthetical and wildlife value, only taking wood for firewood purposes, will require a much less detailed inventory of their land than someone who is intent on harvesting at a sustained level. Differences in

management lead to a variety of patch sizes and characteristics that are important for landscape level biodiversity. The approach is typically guided by a broad guiding objective for each property. An example might be that the management applied does not lead to significant habitat alteration or result in the loss of certain species from the property (O'Connell, 1996). This goal is obviously difficult to measure, but at this point serves more as a driving force than a strict rule. By staying broad at this stage it is feasible to come up with a stepwise process for integrating biodiversity concerns into each of the woodlot types.

Figure 7 outlines a modified version of such a process developed by O'Connell and Noss (1992) to address biodiversity concerns on private land. Using this model, the following describes the various stages as applied to woodlot management.

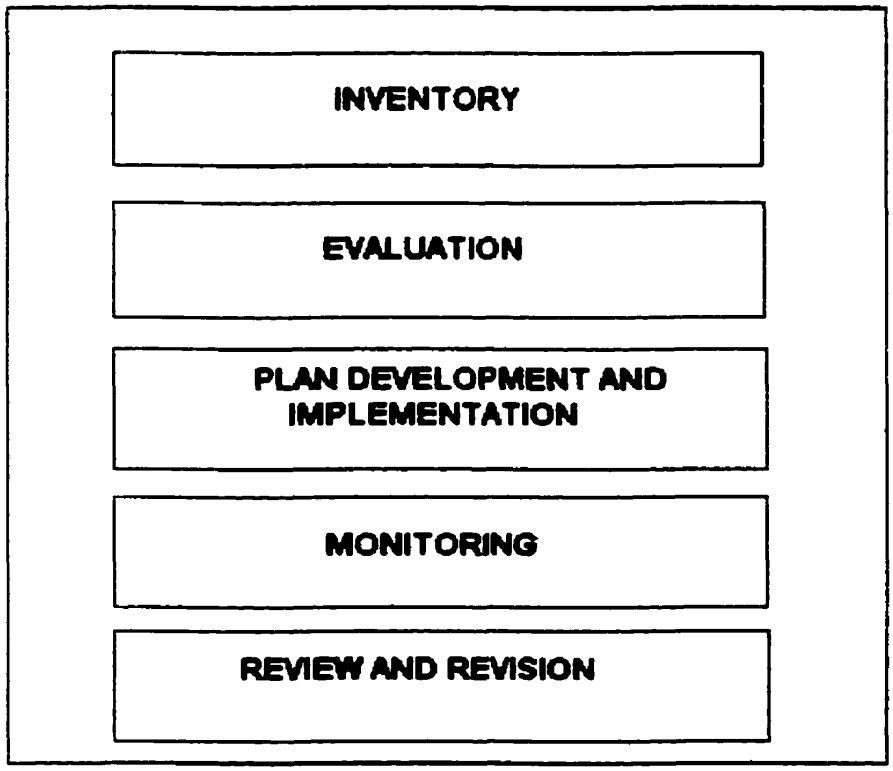

FIGURE 7 – ADDRESSING BIODIVERSITY ON PRIVATE LAND

The inventory stage involves the physical description of the woodlot. Depending on the management approach it may include such information as tree species, wood volumes,

property information (size of land, location, etc.), wildlife and plant species checklists, and information on biological legacies. The evaluation stage takes the information from the inventory stage and, using the woodlot owner's goals and objectives, establishes a system of areas or compartments on the woodlot based on management tasks, or differences in ecological community. The next stage involves the development and implementation of a woodlot management plan. For each of the compartments determined in the evaluation stage, a set of tasks or activities is identified for an appropriate period of time. Finally, regular monitoring and adaptation of the management plan are continual aspects of the overall approach.

The rest of this chapter examines the best practices for conserving biodiversity within the typical set of woodlot management activities: inventory, plan development, harvest methodology, silvicultural treatments, reforestation and wildlife habitat projects. The different approaches are taken from a complement of scientific literature, existing programs and examples from site visits.

6.2 GOALS AND OBJECTIVES

It is important for landowners to have a set of goals and objectives that drive the management of their land. Within the woodlot management plan these goals should be recorded right at the beginning of the document as they essentially direct all the work on the woodlot. The goals and objectives should be made clear to any consultants or contractors hired to conduct property inventories or conduct harvest work on the property. For example, if a woodlot owner's goals include both wildlife and timber values there will be a need to balance the two to satisfy the woodlot owner's desires. This balancing will affect factors such as the calculation of the AAC and specific harvesting details. The goals and objectives should be both clear and practical so there is no confusion as to their application in certain situations.

6.3 WOODLOT INVENTORY

As mentioned, the degree of detail that an inventory should contain will vary with the form of management that is being conducted on the woodlot. In many cases an inventory is always assumed to be a formal timber volume inventory where the AAC is determined and specific harvest methodologies prescribed for each block of commercially viable timber on the property. This is only one aspect of what is needed to understand the woodlot for biodiversity purposes. Woodlots in the intensive management category, those that are managed at a sustained rate, should all have some form of this type of traditional inventory. It is quite common for such an inventory to be performed by a registered professional forester (RPF). Regardless if the inventory is done by a RPF or by the woodlot owner themselves, there are several aspects that can be improved within the typical inventory.

BEST PRACTICE 1 – IMPROVING INVENTORY INFORMATION

Before doing the woodlot inventory the components that will be included should be specified. Along with the typical information on dominant tree species, wood volumes, timber harvesting strategies and reforestation information, the following should also be part of the process:

1. INFORMATION ON WILDLIFE HABITAT ON PROPERTY (E.G. WINTERING AREAS, NESTING SITES, FOOD SOURCES)

Information on the location of over-wintering areas for ungulates, nesting sites and unique habitat types provides important information that will drive other activities such as timber harvesting and stand improvement treatments.

2. PRESENCE/ABSENCE OF SNAGS, CAVITY TREES, BRUSH PILES, COARSE WOODY DEBRIS, DENS OR DUG HOLES, PITS AND MOUNDS

As discussed, biological legacies are a crucial stand level component for biodiversity conservation. The inventory should identify the current status of these features. For example, if the inventory finds that the number of snags on the woodlot is lower than it should be, management activities can be prescribed to increase their presence if this is a desired factor of the woodlot owner. Important wildlife trees should be marked so they are not selected during harvesting activities.

3. RIPARIAN AREAS AND RIPARIAN HEALTH

All riparian areas on the woodlot should be assessed to determine their class as a watercourse for management purposes. The following table (Table 4) represents the classification system used as part of the Alberta Provincial Ground Rules:

Once the riparian areas have been classified, the woodlot owner or a consultant should conduct a riparian health assessment of all riparian areas on the property. Box 5 represents an example of the assessment used as part of the Cows and Fish program in Alberta. This program functions primarily in the agricultural regions of the province and aims to rehabilitate riparian areas on private land as a means of balancing the needs of cows and aquatic wildlife. Riparian health information is important for managing riparian areas and ensuring their integrity.

TABLE 4 - ALBERTA WATERCOURSE CLASSIFICATION SYSTEM

Watercourse Class	Physical Description	Channel Information	Portion of Year Water Flows
Large Permanent	Major streams or rivers. Well-defined flood plains. Valley usually exceeds 400m in width.	Unvegetated Channel Width > 5 m	All year.
Small Permanent	Permanent streams. Often small valleys. Bench (floodplain) development.	Well defined banks and channel. Width 0.5 - 5 m	All year but may freeze completely in the winter.
Intermittent	Small stream channels. Small springs are main source outside periods of spring runoff and heavy rainfall.	Distinct, usually unvegetated channel. Width up to 0.5 m. Some bank development	During wet season or storms. Dries up during drought.
Ephemeral	Often a vegetated draw.	Little or no channel development. Channel usually vegetated.	Flows only during or immediately after rainfall and snowmelt.
Water-source Areas (except muskegs)	Areas with saturated soils or surface flow.		All year. May or may not freeze in the winter.

Source: Alberta Environmental Protection. 1994. Alberta timber harvest planning and operating ground rules. Alberta Environment, Edmonton, AB.

BOX 5 – RIPARIAN AREA HEALTH ASSESSMENT

STREAM CHANNEL	YES	NO
• active downcutting evident	____	____
• stream channel becoming wide and flat	____	____
• stream channel actively moving and eroding banks/floodplain	____	____
• many new sand/gravel bars appearing	____	____
• increased sediment on stream bottom	____	____
• stream unable to overflow banks during annual spring runoff	____	____
• stream flow intermittent in late-summer/fall or stream dries up	____	____
• increased stream width and decreased stream depth	____	____
STREAM BANKS		
• active stream bank erosion from exposed soils	____	____
• reduction in stream bank undercuts	____	____
VEGETATION		
• reduction in stream bank vegetation	____	____
• poor plant vigour	____	____
• change in plant species composition to drier, upland types	____	____
• trees and shrubs hedged	____	____
• reduction in overhanging vegetation into stream channel ____	____	
• all trees or shrubs are old, no young trees and sprouts	____	____
• no trees or shrubs	____	____
• noxious weed invasion	____	____
WILDLIFE		
• fish are no longer abundant or have disappeared	____	____
• nesting song bird numbers are low	____	____
• wildlife species rarely linger in riparian areas	____	____

Modified from Adams and Fitch (1995) with permission.

4. TRACKS, DROPPINGS OR TRAIL SIGNS OF WILDLIFE SPECIES

Tracks, droppings and trail sign are good indicators of the presence of specific wildlife species on the property. All of these should be noted during the initial inventory but are also something that should be recorded during walks through the woodlot to monitor changes to the presence of species. This type of information can be helpful in determining the density of wildlife on the property and alert the owner to crucial wildlife use areas.

Such information is important for wildlife habitat programs, harvesting activities and silvicultural treatments.

5. WILDLIFE MOVEMENT CORRIDORS

Wildlife movement corridors are an important landscape component of biodiversity conservation. It would be beneficial to determine the movement patterns of wildlife species throughout the region to help in developing habitat corridors. For example, if the property is close to a major water source and wildlife is moving through the property to get to that source, maintenance of this corridor will ensure the long-term preservation of this movement path.

6. PRESENCE OF RARE FLORA AND FAUNA

Knowledge of the presence of rare species on the property is particularly important information. As discussed, woodlots may play a role in facilitating habitat for such species, as they are often insular islands amongst unfavorable habitat. The Conservation Data Centre is one beneficial resource for determining information on rare species in Alberta. Appendix 2 identifies the current status of wildlife in Alberta and is a helpful information tool for woodlot owners in the province. If a species known to be rare or threatened is identified on the property the appropriate agency should be contacted to determine the correct management approaches to ensure its continued existence.

Such additions to the traditional inventory are also important for those woodlot types that are not intensively managed for timber purposes. The majority of this information can be determined by the woodlot owner through the use of information guides and checklists or by contacting local wildlife agencies.

Other information that is important for biodiversity purposes is to have a general idea of the species on the property and their relative abundance. Checklists are a useful tool for

this purpose and exist for many groups of species. Breeding Bird Surveys are a good example of a method used to determine relative abundance of bird species. Survey routes are travelled once a year and information such as species present, numbers seen and site conditions are recorded. Measures of relative abundance are important as they help to reveal population trends.

Other groups of species are relatively easy to identify with the proper guidebooks (e.g. plants, insects, and mammals) while others may require outside assistance such as local naturalist groups. As an example, having a checklist of the bird species on the property can help to determine suitable harvest methodologies, harvest times, and wildlife habitat projects that could benefit identified species. Species counts are also an important monitoring tool for many agencies. The contribution of woodlot owners to such programs is discussed later.

Once the inventory stage is completed, the information is evaluated and the woodlot divided into management areas or compartments. This division should be tied to the overall goal for the woodlot.

6.4 WOODLOT MANAGEMENT PLAN

A woodlot management plan is the culmination of the ideas, goals, and management activities associated with the woodlot (Lompart et. al., 1997). To help illustrate their ideas woodlot owners can draw a property map with boundaries, map scale, and features such as:

- nearby roads
- driveways, trails or access roads
- buildings
- fences
- ponds
- dams
- windbreaks
- heights of land
- streams
- wetlands
- fields
- corridors

The compartments dissociated in the evaluation stage provide an organised way to manage the activities against each objective and indicate the schedule for doing them (Lompart et. al., 1997). Not all activities or habitat features will occur in all compartments. For example, a compartment may already include an important wildlife habitat feature, and the activity in that case is simply to ensure it is maintained or enhanced. A five-year period for management activities is a useful amount of time in which to plan the woodlot (Lompart et al., 1997).

6.5 HARVEST METHODOLOGY

Harvest methods are typically divided into two types: even aged methods (e.g. clear-cut, shelterwood, and seed tree) and uneven aged methods (e.g. selection cutting) (Smith 1986). In some cases such factors as dominant tree species or desired products define the choice of which system to use. For example, species such as Lodgepole pine (*Pinus contorta*) and Trembling Aspen (*Populus tremuloides*) require the high light levels afforded by even aged harvesting systems. There is no one harvest system that can be recommended uniformly. What is important is the maintenance of a variety of options (e.g. diversity of forest types and ages across the landscape) (Schowalter et al., 1997). What is recommended in this section are modifications to the practices used in order to better facilitate biodiversity objectives. The inventory process generally reveals which harvest systems should be used for the woodlot.

BEST PRACTICE 2 – CANOPY GAP FORMATION TO MIMIC DISTURBANCE

Disturbance forces have been one of the key forces to have defined the forest. A current trend in sustainable forest management is to try to mimic disturbance agents as closely as possible in order to better manage for biodiversity concerns. The dominant disturbance regime in many areas of Alberta is fire. However, due to difficulties with scale, woodlots are better managed with smaller disturbance agents in mind such as:

wind-throw, insects, and tree death (gap formation). Each of these agents plays a role in forming gaps in the canopy which helps to diversify understory vegetation, allow shade-intolerants to remain part of the stand and facilitate structural diversity.

1. GROUP CUTS CAN BE USED TO FACILITATE GAPS IN THE CANOPY

When the canopy closes, light levels in the understory are reduced to a minimum which can affect the diversity of understory plants and trees trying to survive. Many plants require high amounts of light to succeed. By removing small groups of canopy dominants, structural diversity is increased through an increase in light levels. The increased diversity of understory vegetation that results is particularly important for wildlife species such as ungulates. Gap formation also often leads to the development of thickets that serve as good wildlife cover. The creation of these small openings is similar to small-scale disturbances such as insects, root disease and wind (Tappeiner et. al., 1997). The size of the opening, aspect, and the height of surrounding trees all play a role in regeneration success and should therefore be taken into account before undertaking harvest activities.

CANOPY GAP FORMATION: WOODLOT VISITS 2 AND 17

Woodlots #2 and #17 both demonstrated the practice of using small patch cuts (less than 0.5 ha in size) to allow regeneration of shade intolerants such as lodgepole pine and aspen, while diversifying the understory vegetation.

"The patches are large enough to facilitate good regeneration and they create openings in the canopy which are good for ungulates." - Woodlot Owner # 2

2. MODIFY THE SIZE OF CLEARCUTS

Where the use of clear-cut harvesting is required, the size of the patches should be kept small. They should be just large enough to encourage the regeneration of the desired species. This will depend on many factors including aspect, local climate and the tree

species in question, and should be discussed with a RPF. Other beneficial modifications include the use of irregular patch cut boundaries and random patch shapes.

CLEARCUT PATCH DYNAMICS: WOODLOT VISIT 5

Woodlot owner #5 applies the following principles to his pine stand patch cuts to mimic natural disturbance and limit damage due to high winds:

1. Randomness in harvest planning
2. Irregular boundaries on patches
3. No straight lines

BEST PRACTICE 3 – PROTECTING THE SOIL

The soil plays host to a wide variety of microorganisms, mycorrhizal fungi, and organic matter that ensures the success of the forest. It is therefore extremely important to modify harvest practices to maintain soil integrity.

1. TREAD LIGHTLY ON FOREST SOILS

Soil compaction is a significant problem in forest management operations. Whenever possible, the use of heavy machinery should be avoided to reduce the effects of soil compaction. If heavy equipment is unavoidable, the use of flotation tires is recommended. Skidding trees to the processing area can also contribute to soil compaction. Portable bandsaws are beneficial in this sense as they reduce the yarding distance. Horse logging is another suitable alternative for many woodlots. Horses can be used to skid trees to the yard with less impact than most skidders. One of the key rules to protect the soil is to harvest in the winter months when the ground is frozen which lessens the effect of machinery on the ground. Also, to minimise soil erosion, harvesting should not take place on steep slopes (e.g. greater than 45 degrees slope).

HORSE LOGGING: WOODLOT VISIT 12

Woodlot owner #12 chooses those trees that appear to be close to dying, cuts them, and skids them to the landing site in a unique way to much of Alberta. On this woodlot, Belgian horses are used to pull the trees out of the woodlot instead of heavy machinery such as skidders. This practice is a good example of how to reduce soil compaction and erosion during harvesting.

2. LEAVE SOURCES OF NUTRIENTS TO BE PUT BACK INTO THE SOIL

Slash (e.g. branches, leaves, and logs) produced as part of the logging operation plays an important role in the nutrient cycles of the forest. It is often removed to reduce the amount of fuel build up. While this is a concern, some slash material should still be left behind. Small brush piles provide habitat for small birds and mammals and contribute to soil organic matter levels (CWS, 1996). Other materials such as slabwood and sawdust can also remain in small amounts to provide habitat, nutrients and slow the movement of water. They can also be used for road material on the woodlot.

LEAVING SOME BEHIND: WOODLOT VISITS 4, 19, AND 20

These woodlot were good examples of the practice of leaving behind sources of soil nutrients. Slash material, coarse woody debris and brush piles were left where possible within levels found to be acceptable in consideration of fire hazards.

"These materials are great for improving soil quality and they provide habitat for many small mammals, insects, and mushrooms." - Woodlot Owner 19

BEST PRACTICE 4 – ALLOW FOR BIOLOGICAL LEGACIES

Biological legacies are a crucial component at the stand level. Where possible, harvest methods should try to maintain certain proportions of these features for biodiversity goals.

1. NOT ALL CANOPY DOMINANTS SHOULD BE CUT

While they are the best growing trees and often make the best timber products, canopy dominants also play important roles in the woodlot. The retention of large trees, snags, and down logs in some ways mimics the result of natural disturbance by wind (Spies and Franklin, 1991). Small clusters (3-4 trees) of canopy dominants should be left where possible. They are also important sources of future snags and excellent genetic sources for natural regeneration.

2. LEAVE SNAGS AND COARSE WOODY DEBRIS DURING HARVEST OPERATIONS

Guidelines for how many snags to leave per hectare of forest are fairly common and vary with region. Specific numbers will depend on factors such as the type of forest, numbers of cavity nesters present, and the acceptance of risk to the working environment. Hunter (1990) stated that forest managers and biologists from nearly every region suggest that an average of 5-10 snags/hectare is adequate. The Alberta Harvest Guidelines (AEP, 1994) offer a number of 8 snags/hectare. A range of snag sizes and decay levels should be retained. Other methods such as girdling living trees can also be used to increase the number of snags in the woodlot.

SNAGS AND WOODPECKERS: WOODLOT VISIT 10

All of the woodlots visited applied the principle of leaving dead trees (snags) where feasible. The most common reason was for cavity nesters such as woodpeckers.

"My morning coffee just isn't the same without a visit from the local pileated woodpeckers." - Woodlot Owner #10

Snags can be classed into two categories: soft and hard (Backhouse, 1990). Soft snags tend to be more optimal wildlife trees as they are easier to excavate. However, hard snags still have branches, which provide good hunting perches for raptors and serve as a source

of future soft snags and coarse woody debris. Coarse woody debris (> 8 cm in diameter) and small brushpiles should be left scattered throughout harvest areas for small mammals and birds. Pits and mounds can be allowed to develop by letting declining and dying trees fall naturally. Only those that pose a particular safety hazard should be cut.

The issue of safety also plays a role in snag retention decisions. The Worker's Compensation Board points out the three risks posed by snags (Backhouse, 1990):

1. *Felling of unsound snags*
2. *Snags may fall unexpectedly because of ground vibrations from heavy machinery or the impact of trees hitting the ground.*
3. *Felled snags left on the ground can contribute to injuries.*

As a result, care should be taken when working around snags. If the level of risk is found to be unacceptable, alternatives such as nesting structures could be built to serve a similar role (see section 6.11.1).

BEST PRACTICE 5 – TIMING FOR WILDLIFE

Harvesting activities should be timed in accordance with particular periods and locations for biodiversity needs. Information on specific times can be obtained from local wildlife agencies.

1. AVOID CRITICAL NESTING AND BREEDING PERIODS

Bird species have certain times of the year that are crucial to their life cycle. In particular: nesting, fledging, and breeding periods. During these periods disturbances such as logging operations can serve as a deterrent. For example, hawks and owls tend to nest from March through mid-July. For this reason, the winter months (as already mentioned for reasons of soil compaction) make a better time for harvesting.

TIMING FOR WILDLIFE: WOODLOT VISITS 2,4,5, 16 and 17

Each of these owners made it clear that they avoid critical times for wildlife when they determine their harvesting schedule. Whether they know these times from personal experience, or they have to check with local wildlife officials, they feel it is important to work around the life-cycles of local wildlife.

6.6 STAND IMPROVEMENT ACTIVITIES

Stand improvement activities such as thinning, fertilisation, and chemical control can have a variety of effects on biodiversity.

Thinning is often used to manage some insects and pathogens that are sensitive to tree spacing or competitive stress (Schowalter et al., 1997). Early thinning is applied to enhance the survival, growth and value of the residual trees (DeBell et al., 1997). Thinning is typically aimed at leaving commercially valuable trees at even spacing, which increases uniformity, but the reduced density accelerates tree growth, and promotes the development of the shrub and herbaceous understory (DeBell et al. 1997). There are also potential problems with thinning operations. In particular, since thinning keeps the level of competitive mortality down, it may affect the recruitment of snags. However, this could be supplemented by artificial snag creation methods such as girdling live trees, or by using nesting structures. As well, thinning methods that leave stumps or excessive slash may promote the proliferation of some insects and pathogens that colonise stumps and woody debris thereby allowing them to spread (Schowalter et al., 1997). Again, it is important to recognise a balance between the amount of coarse woody debris and slash materials left behind for problems such as fire.

Fertilisation is often used to supplement the amount of nutrients in the soil to improve timber production. Nitrogen, often a limiting factor in soil nutrient levels, is a commonly used fertiliser. Fertilisation can have detrimental effects on soil organism populations. For example, it has been shown that nitrogen fertilisation tends to reduce ectomycorrhizal and

sporocarp formation, and alters the overall composition of fungal species (Menge and Grand 1977, 1978).

Chemical control methods such as herbicides, insecticides and rodenticides also have effects on biodiversity. Herbicides typically reduce plant diversity and only compound current problems. There is constant debate over the effects of chemicals such as Glyphosate (Round-up or Vision), which commonly gets good safety reviews from producers and supporters but little support from conservationists. Insecticides can harm non-target insects and invertebrates which play vital roles in the ecosystem such as pollination. These insects may also serve as food sources for birds, mammals, fish and amphibians, which can lead to problems with bioaccumulation in the ecosystem. Rodenticides used to protect seedlings from damage by rodents can have effects on raptors and other animals that feed on the rodents.

BEST PRACTICE 6 – MODIFICATIONS TO THINNING PRACTICES

Thinning practices can be modified for their selection criteria in order to benefit structural diversity. They can also play a role in canopy gap formation to benefit understory diversification.

1. MODIFICATIONS TO SELECTION CRITERIA

Trees to be thinned should be selected to increase size and species diversity of the remaining trees. This helps to increase the structural complexity of the woodlot. Spacing distances should also be varied to enhance the development of the understory and further add to habitat complexity. Criteria should not include snags, as they are a vital component of the stand unless they are determined to be a problem in other ways (e.g. source of insect pests or a safety hazard).

THE IMPORTANCE OF THINNING: WOODLOT VISIT 17

Woodlot owner #17 makes extensive use of thinning to produce healthier trees and to increase the diversity of his stand. As a former RPF, he emphasizes the need for thinning as a means of increasing the commercial value of the wood and to improve the overall health of the woodloot.

2. THINNING TO CREATE GAPS

During thinning operations gap formation can be accomplished by creating openings of 6-10 metres in diameter or larger. This serves to retain some components of earlier stages and develop patches of younger trees.

BEST PRACTICE 7 – REDUCTION OR ELIMINATION OF FERTILISER AND CHEMICAL CONTROL

The use of fertilisers or chemical control agents is generally not recommended for woodlots. These activities tend to create more problems than they are worth and should therefore be avoided where possible. The following represent ecologically sustainable alternatives to their use.

1. PLANT NITROGEN-FIXING PLANTS

Plants in certain groups have nitrogen-fixing bacteria on their root nodules that convert atmospheric nitrogen into useable nitrogen for the plant. When these plants die, the nitrogen is added to the soil. Table 5 offers a list of nitrogen-fixing plants. Planting some of these shrubs in the woodlot will help to provide nutrients to the soil. The plants chosen should be native to the particular region of the province.

TABLE 5 – NITROGEN FIXING TREES AND SHRUBS IN ALBERTA

Green Alder	*Alnus crispa*
River Alder	*Alnus tenuifolia*
Thorny Buffaloberry	*Shepherdia argentea*
Canada Buffaloberry	*Shepherdia canadensis*
Wolf-Willow/Silverberry	*Elaegnus commutata*

2. ALTERNATIVES FOR WEED COMPETITION

Mowing or mulching (e.g. woodchips) can be used to control other plant species. This practice, particularly late in the fall, can result in the removal of food and shelter for some pest species.

3. PREVENTING ANIMAL DAMAGE

Wire mesh, tarpaper or plastic tree guards can be placed around the trunk of seedlings to prevent damage by rodents. As well, nest sites provided for raptors species can serve as a way of balancing the population of rodents. This also applies to cavity nesters. By providing snags for cavity nesters, insect populations are kept in balance, as cavity nesting bird species are often insectivorous. For more information on the types of animal damage to tree species in Alberta the following book can be obtained from the Alberta Research Council – (780) 632-8211:

Rangen, S.A. and L.D. Roy. 1997. A Field Guide to Animal Damage of Alberta's Native Trees. Alberta Research Council, Vegreville, AB. 58 pp.

6.7 REFORESTATION AND GENETIC DIVERSITY

As discussed, reforestation plays a significant role in determining genetic diversity. Genetic diversity typically is not a clear concept and in fact can incorporate many complex factors – it is not an entity, but rather varies by trait, area, and over time (Friedman, 1997).

Genetic diversity is a crucial factor in determining the long-term success of populations. One example is often discussed: the issue of monocultures. The limited genetic diversity within monocultures of commercially valuable trees, coupled with intensive breeding programs or genetic engineering to increase growth rates, provides a concentrated resource for adapted herbivores and pathogens (Kareiva 1983, Schowalter and Turchin, 1993). However, in some ecosystems, species such as Douglas-fir and Lodgepole pine can develop natural single species stands, particularly after stand-replacing disturbances such as fire. Natural populations of these single species stands are typically genetically very diverse and adapted to local conditions, including small-scale disturbance agents (Schowalter et al., 1997).

Friedman (1997) outlines a population as a matrix with four columns and thousands of rows. The columns are "diversity within an individual," "diversity within populations," "diversity among populations within regions," and "diversity among regions within species." and the rows are the different traits that describe an organism (e.g. needle colour, seed size, frost resistance). Often, debates over whether a certain practice will ensure genetic diversity while others do not simply refer to different cells in the matrix (Friedman, 1997). For example, while the genetic diversity amongst woodlots might be less by using seed material across a landscape, individual woodlots would show greater individual diversity because of the wealth of traits inherent in commercial seed stock obtained from nurseries compared to natural regeneration. Therefore, it is difficult to make concrete decisions as to what will end up contributing the most to maintaining genetic diversity.

Some facts are important when considering natural regeneration. Yazdani et al. (1995) estimated that more than 90 percent of seedlings do not have the closest trees as one of their parents. They also estimate that 0-35% of genes come from trees over 50 m away from the seedling. Therefore seed trees can be located in various locations on the woodlot and do not necessarily have to occur in the area that was harvested. As well, in many different stand types studies have shown that inbred or genetically inferior ovules are suppressed during stand development. In other words, the more diverse genetically individuals are the more likely they are to survive to reproduce (Plessas and Strauss, 1986, Tigerstedt et al. 1982, Yazdani et al. 1985, Hawley et al. 1989). This acts as a self-reinforcing genetic diversifier.

Some key tasks arise in reference to reforestation on the woodlot. First the woodlot owner should ensure seedlings thrive when planted in harvested areas (CCFM, 1997). Also, the seed-source should be considered so as not to expose seedlings to different climatic regimes (e.g. provenance). Most provinces have seed-transfer zones to ensure this is considered (CCFM, 1997).

BEST PRACTICE 8 – REFORESTATION AND BIODIVERSITY

There can be considerable debate over whether natural or artificial generation is a better regeneration method. However, in most cases a combined approach may be the best. For example, if an area is not being adequately reforested by natural sources, it can be supplemented by planting.

1. DEVELOP A MIXED FOREST FOR BIODIVERSITY

Planting conifers in deciduous forests and vice versa can help to develop a mixed forest, which tends to have more habitat for wildlife. It can also add to the economic possibilities on the woodlot thereby ensuring a sustainable woodlot income. In particular, adding deciduous trees to a conifer woodlot can help to balance the acidity that builds up in the

soil with conifer dominated stands. If the woodlot is already mixed it is important to try to keep species in similar proportions as they presently occur. Certain types of harvesting and reforestation can serve to reduce different tree species by favouring others. Also, if it is determined that the woodlot is missing a species that is native to the area, underplanting or interplanting can be used to re-establish it on the woodlot.

KEEPING A BALANCE: WOODLOT VISITS 2 AND 4

These owners stressed the importance of keeping the various tree species on the woodlot. Where on some properties the aim may be to emphasize only the commercially valuable species such as spruce and pine, these owners point out that many of the other species serve equally important roles on their property.

"While some see aspen as a trash species because of its low economic value, I choose to keep it for its importance for wildlife and because it is a natural part of this woodlot." - Woodlot Owner #2

2. GIVE NATURAL REGENERATION A CHANCE

Canopy dominants provide excellent stock for natural reforestation. Natural regeneration with these local seed trees will ensure the traits that are required for success in the immediate area are passed on to subsequent generations. In many locations natural regeneration is all that is needed to ensure successive stands. However, other areas may require some supplemental planting.

6.8 RIPARIAN AREA MANAGEMENT

There is a wide variety of information available for managing riparian zones. One example of a program dealing with riparian zone management is the Cows and Fish program. For more information about this program one of the following groups can be contacted:

- Alberta Cattle Commission
- Trout Unlimited Canada
- Fish and Wildlife (AEP)
- Public Land Services, Alberta Agriculture, Food and Rural Development
- Canadian Cattleman's Association
- Department of Fisheries and Oceans

The previously discussed riparian area health assessment checklist is an excellent tool to make decisions as to whether management is necessary for riparian areas on the woodlot. There are a wide variety of activities that can be used to enhance the integrity of riparian zones on woodlots.

BEST PRACTICE 9 – RIPARIAN MANAGEMENT

The particular type of management required to enhance a riparian area is tied directly to the specific problems involved and the size of the watercourse. However there are general guidelines or basic approaches that can be used to benefit all riparian zones on the woodlot.

1. ESTABLISH A RIPARIAN BUFFER ZONE (RBZ)

Planting a buffer strip of trees and shrubs along streams and riparian corridors will act to prevent shoreline erosion and improve wildlife habitat. The use of heavy machinery in the RBZ is typically prohibited. If trees must be removed from these areas a winch or horse should be used. Table 6 shows the typical RBZ widths in the Alberta Provincial Timber Harvesting Ground Rules:

TABLE 6 - WIDTHS OF RIPARIAN BUFFER ZONES (RBZ)

Watercourse Classification	Riparian Buffer Zone
Large Permanent	60m from the high-water mark
Small Permanent	30m from the high-water mark
Intermittent	Buffer of brush and lesser vegetation to be left undisturbed along the channel. Width of buffer will vary according to soils, topography, water-source areas and fisheries values.
Ephemeral	Buffer of lesser vegetation in wet gullies to be left undisturbed.
Water-source areas and areas subject to normal seasonal flooding	Treed buffers of at least 20m on all streams. No harvest of merchantable trees or disturbance of lesser vegetation.

Source: Alberta Environmental Protection. 1994. Alberta timber harvest planning and operating ground rules. Alberta Environment, Edmonton, AB.

2. STREAM CROSSINGS

Stream crossing can lead to increased sedimentation in the watercourse and therefore should be minimised. If necessary, the following guidelines should be used for the construction of stream crossings (AEP, 1994):

a. have stable approaches;
b. be at right angles to the watercourse;
c. be located where channels are well defined, unobstructed and straight;
d. be at a narrow point along the watercourse;
e. allow room for direct, gentle approaches; and
f. accommodate peak streamflows.

3. EACH WETLAND IS UNIQUE

Wetlands are unique entities and as such should be managed individually. If a wetland is located on the woodlot, professional management advice should be obtained from an organisation such as Ducks Unlimited.

6.9 MONITORING

Monitoring is the intermittent (regular or irregular) or continuous surveillance carried out to determine one or more of the following purposes (Hellawell, 1991):

1. Detecting ecosystem change
2. Assessing the effectiveness of policy or legislation
3. Regulatory (performance or audit functions) e.g. performance monitoring of objectives of forest management plans

Noss and Cooperrider (1994) state "the only way we can begin to understand what we are doing is through long-term, systematic monitoring of biodiversity at many levels of organisation and spatiotemporal scales."

There is a general lack of information on woodlot resources and management in the province. This, combined with delays in updating resource inventories has led to difficulties with managing for biodiversity on private lands, particular at the landscape scale. What is required is a monitoring program that includes woodlots from all parts of the White Zone. The general feeling is that such a program would be acceptable so long as the methods were non-destructive and reports were given to the individual woodlot owners (Grundberg, pers. comm). A critical factor in developing such a program is the role of program coordinator. Many woodlot owners do not trust certain groups and government agencies. To ensure its success, it would be important for the WAA to be involved as much as possible. The Foothills Model Forest is currently undertaking a

province-wide biodiversity monitoring project called the Alberta Forest Biodiversity Monitoring Program (AFBMP). Instead of creating a separate program for private land it would be more sensible to include private land in this program. In this case, the WAA could act as the main contact for the woodlot side of the program.

The goal of the AFBMP is to detect changes in biodiversity that may be caused by human activities, particularly forestry, fire management and petroleum development (Shank and Farr, in prep). This goal is accompanied by the following supporting principles:

1. The program will support existing commitments (local, national, and provincial) for biodiversity monitoring.
2. A common, standardised methodology is to be applied across all jurisdictions within Alberta's forested natural regions.
3. Monitoring will occur in both aquatic and terrestrial systems; an integrated approach is preferred.
4. Monitoring will include ecosystem elements that represent life forms from diverse taxonomic groups and trophic levels.
5. Monitoring will occur across hierarchy of spatial scales.
6. Monitoring will occur in locations having a wide range of land use histories, including those with limited human influence (i.e., reference areas).
7. Estimates of natural variability will be obtained and used to assist interpretations of the significance of observed changes.

This will be accomplished by monitoring changes through periodic sampling at a large number of locations within a set grid (Shank and Farr, in prep). The program combines two separate monitoring approaches in order to achieve its goal. The first applies remote sensing techniques to examine landscape-level biodiversity, focusing on vegetation patterns and watercourses. The second type involves repetitive sampling at sites across the forest network. This will provide data on the long-term trends for selected species,

assemblages, and structures that are measurable at remote locales (Shank and Farr, in prep). This network does not include the parkland natural region.

Woodlots could be included in this program in a number of ways:

1. Areas of the White Zone that are located within the forested natural regions: boreal, montane, and foothills, that contain woodlots, could be included as part of the remote sensing data for landscape components of biodiversity monitoring.
2. Sites chosen for long-term trend analysis could include individual or groups of woodlots. Site visits revealed that woodlot owners are open to the idea of co-operating with monitoring projects, depend on factors such as the periodicity of sampling.
3. Woodlot owners could contribute qualitative data if required (e.g. species checklists, reports on intended management for property, etc.)
4. Representatives from the woodlot sector may make valuable board members to contribute information on trends in woodlot management and relay information back from the monitoring program to the WAA to be shared with individual members.

There are also a wide variety of other programs that woodlot owners could take part in for monitoring purposes. Some are particularly beneficial as they examine underrepresented groups such as invertebrates. Some may have a small fee associated with them but is usually minimal (under $15/year). Some of the programs (e.g. Spring Bird Count and Christmas Bird Count) involve only one day a year and therefore have limited usefulness as rigorous monitoring programs. Others, such as the Alberta Checklist Program allow a participant to contribute information throughout the year. A sample of some monitoring programs can be found in Appendix 3.

Individual woodlots should demonstrate their own monitoring regimes, particularly to assess the effectiveness of management activities. A typical staged process of this practice is included in section 6.9.1 using a riparian area as an example.

6.9.1 ADAPTIVE MANAGEMENT

Adaptive management is defined as: "a formal process of problem assessment, hypothesis development, implementation, execution, evaluation and feedback. The cycle of management activities are crafted as "experiments" to fill gaps in knowledge and provide a stepwise process to managing risk." (Alberta Research Council, 1998). Basically, the premise is that by monitoring management activities it can be determined which are beneficial and which are not and make the necessary adjustments (Holling, 1978).

BEST PRACTICE 10 – ADAPTIVE WOODLOT MANAGEMENT

The following represents the typical process for including adaptive management in a management approach once a problem has been discovered and the initial management response has taken place.

1. IMPLEMENTATION MONITORING

After a management activity is completed the site should be visited occasionally to see that the management activity was accomplished. In other words, did you do what you set out to do? For example, if the management activity was to plant trees and shrubs along a riparian area to improve stream-bank stability, a check should be done to ensure that the plants are establishing successfully.

2. EFFECTIVENESS MONITORING

This process follows implementation monitoring and is used to determine if the end-goal is being satisfied by the management action chosen. In other words did it work? In the example of the riparian area this would mean checking to see if the stream-bank is becoming stable after planting the shrubs. This process will take more time and therefore evaluation monitoring is a long term, continuous process.

3. ADAPTATION

If, after a certain amount of time, it appears that the management activity is not accomplishing the set goal, management activities should be altered accordingly. In the example, another activity that may benefit the stream-bank should be tried.

6.10 LANDSCAPE LEVEL COMPONENTS

Landscape biodiversity components are equally as important as those in the stand. However, management approaches to maintain these components are significantly more challenging for woodlot owners in the province. In this case, there are two distinct approaches that are discussed. This section examines approaches that can be used by individual woodlot owners or a group of landowners to facilitate biodiversity at a landscape or regional scale. The next chapter examines government policy approaches that may help maintain landscape components. In many cases, partnerships will be necessary to address larger regions.

Corridors are often proposed as a means to maintain landscape components of biodiversity, particularly where habitat patches are becoming increasingly isolated such as that for woodlots in Alberta. A landscape corridor is a strip of land or vegetation that differs from the extensive landscape element on either side of it (Barrett and Bohlen, 1991). In Alberta, the landscape element on either side of a wooded corridor is often agricultural in nature. There is currently some confusion over the goal of establishing landscape connectivity. Corridors are often seen as *new* structures on the landscape, while Noss (1991) states that the corridor approach is an attempt to *maintain* or *restore* natural landscape connections, not to build connections between naturally isolated habitats.

Typically, conservation strategies seek to optimise the width and variety of natural habitats in landscape linkages to conserve the full spectrum of native species that will be able to move between habitat patches. Narrow corridors, or corridors comprised of only one form of habitat are often seen as less useful. The two main problems with narrow corridors

is that they do not work for many forest interior species as they are basically all edge habitat and may be subject to increased levels of predation (Wilcove et al., 1986). Windbreaks, hedgerows, and riparian forest strips can all serve as landscape corridors to link woodlots. They have shown promise at smaller scales by facilitating the movement of small mammals and bird species between woodlots (Fahrig and Merriam, 1985; Merriam, 1988). In concert with the retention and creation of landscape corridors, is the reduction of existing barriers to movement.

BEST PRACTICE 11 – STAND LEVEL PRACTICES TO ADDRESS LANDSCAPE CONCERNS

The following represent approaches an individual woodlot owner can use at the stand level to benefit landscape components of biodiversity.

1. FENCING OPTIONS

If fencing is a necessity on the property for livestock or other reasons, fencing that will not act as a barrier to wild ungulates should be used where possible.

2. BLOCKS VS. STRIPS

In general, blocks of woodlands are better than narrow strips in order to reduce the amount of edge effect. Strips such as hedgerows can be used however to connect smaller patches of habitat.

BEST PRACTICE 12 – PARTNERSHIPS AND CORRIDORS

Partnerships between woodlot owners and adjacent property owners are a vital component of any strategy aiming to maintain landscape components of biodiversity. Partnerships will also be required between departments within the provincial government such as forestry and agriculture and are discussed in the next chapter.

1. DISCUSS OPTIONS FOR LANDSCAPE CORRIDORS WITH NEIGHBOURS

The creation of landscape corridors will only be possible with co-operation among several landowners. If a significant wildlife corridor has been identified in the region it will be important to discuss possible strategies between neighbours. This may present challenges if the adjacent landowner is under a vastly different land-use. For example, a woodlot bordering an agricultural operation may have difficulty facilitating wooded corridors. However, options such as locating windbreaks in strategic locations may be feasible.

2. TIMING HARVESTING PRACTICES

A group of woodlot owners may be able to correlate harvesting efforts to increase the patch size of specific age classes of wooded area. Larger patch sizes provide more habitat for wildlife species and could also provide opportunities to share harvesting equipment.

6.11 WILDLIFE HABITAT PROGRAMS

While the previously discussed approaches provide a system based approach to biodiversity conservation there are also some species that will benefit from specific management activities. They have certain habitat requirements that can be met through habitat enhancement programs. While most forest dependent species in Canada are stable, some have shown declines in their geographical distribution. For example in the boreal plains ecozone, species that occupy only a small portion (loss of 50%) of their former habitat (CCFM, 1997) include the silver-haired bat, black backed woodpecker, three-toed woodpecker, barred owl, boreal owl, and varied thrush. These species are dependent on habitat features of mature forest and would therefore benefit from the retention of features such as biological legacies. This association between species and seral stage is worth noting. The following illustrates further examples of these associations (CCFM, 1997):

1. **Young Forest** – moose, elk, lynx, ruffed grouse, hairy woodpecker, snowshoe hare
2. **Mature forest** – caribou, elk, grizzly bear, flying squirrel, varied thrush, barred owl, boreal chickadee, red cross-bill, Cooper's hawk, wolverine, long-eared bat.

3. **Old-growth** – marten, black backed woodpecker, boreal owl, three-toed woodpecker, silver haired bat

This section represents approaches that are useful if certain species are identified on the woodlot owner's property.

6.11.1 NESTING STRUCTURES

In many areas, populations of cavity nesting species are limited by the amount of suitable nesting habitat. If snags are not abundant or have to be removed because of their safety risk, nesting structures can be used as surrogates. This is a particularly effective strategy for secondary cavity nesters, those that use existing cavities for their nests. It may have only limited use for primary cavity nesters (e.g. woodpeckers, nuthatches) (Mannan et al., 1980). Cavities can also be formed in existing trees by den routing or by using a chainsaw to create holes (Carey and Sanderson, 1981; Carey and Gill, 1983). Another approach is to girdle live trees in order to increase the recruitment of snags.

6.11.1.1 Birds (Non-raptors)

The size of the nesting box and the diameter of the entrance hole determine which species can use it. Table 7 shows the dimensions for building nest boxes for a cross-section of birds commonly found in Alberta. The following represent some guidelines for dealing with nestboxes (CWS, 1996):

- Platforms or perches should not be attached outside the box as they provide a way for predators to raid the box, or for young birds to venture out before they can fly
- Nesting materials should not be placed inside the box.
- Guards should be used to discourage unwanted visitors
- The box should be cleaned each fall

- Boxes should be faced to the south for warmth or east to be away from the predominant direction of wind and rain
- Boxes should not be placed on or near utility poles

TABLE 7 – DIMENSIONS FOR NEST BOXES FOR ALBERTA BIRDS

Species	Entrance Hole Diameter (cm)	Entrance Height Above Floor (cm)	Size of Floor Panels	Height of Wall Panels (cm)	Min. Height Above Ground (m)
Bluebirds	4	15	13 x 13	20	2-3
Buffleheads	6	30	15 x 15	37	3
Chickadees	3	15	9 x 9	20	2 – 5
Downy woodpecker	3	15	9 x 9	20	2 – 3.5
Great crested flycatcher	5	15	15 x 15	20	3 – 5
Hairy woodpecker	4	22 – 30	15 x 15	30-35	3-5
House wren	2.5-3	10-15	10 x 10	15-20	2-3
Northern flicker	6	35	15 x 15	40	2-5
Nuthatches	3	15	9 x 9	20	2
Tree Swallow	4	15	13 x 13	20	2-3

Source: Canadian Wildlife Service. 1996. Backyard habitat for Canada's wildlife. Ottawa, ON.

6.11.1.2 Raptors

Cavity-nesting raptors use cavities that occur naturally or that were already formed by other species and they will also use nest boxes (Holroyd et. al., 1995). Table 8 shows the nest box dimensions for four common Alberta raptors.

Nesting platforms are also used by some raptor species such as the Swainson's hawk. Such platforms should be about 120 cm x 60 cm x 20 cm or large enough for three or four

nestlings (Holroyd et. al., 1995). They should be located at least 1 km from one another and from other occupied hawk nests. Records of arrival, nesting and departure dates of the raptors occupying the nest boxes and platforms is useful information for the woodlot owner and for use by local wildlife agencies.

TABLE 8 – DIMENSIONS FOR NEST BOXES FOR SOME ALBERTA RAPTORS

Species	Entrance Hole Diameter	Entrance Height Above Floor	Width of Floor Panels	Height of Wall Panels	Min. Height Above Ground
Saw-Whet Owl; Boreal Owl	6.4 cm	23-33 cm	13-25 cm	25-38 cm	3-6 m
American Kestrel	7.5 cm	23-40 cm	20 cm	30-45 cm	5 m
Barred Owl	20 cm	36 cm	36 cm	40 cm	5 m

Source: Holroyd, G.L., I. Shukster, D. Keith, and L. Hunt. 1995. A landowner's guide: Prairie raptors. Canadian Wildlife Service. 48 pp. Minister of Supply and Services Canada. Ottawa, ON.

6.11.1.3 Bats

Alberta is home to between 7 and 9 species of bats. Largely misunderstood, bats serve an important ecological role by controlling populations of insects (CWS, 1996). Habitat structures can be provided for bats by building a bat house or roost. To obtain plans for a bat house, or to take part in a bat monitoring program, the Bat Conservation Society of Canada can be contacted in Calgary at 860-BATS.

6.11.1.4 Squirrels

Squirrels are often thought of as pests because they chase birds away from feeders and nest in buildings. Often this is because they do not have suitable nesting structures. Nesting boxes can be built which will provide the squirrel with habitat other than woodlot buildings. Instructions for building a squirrel nesting box and for other wildlife related projects can be found in:

Backyard Habitat for Canada's Wildlife

Published by the Canadian Wildlife Federation (1996)

2740 Queensview Drive

Ottawa, ON K2B 1A2

6.11.2 HABITAT FOR BUTTERFLIES

Butterflies absorb the mineral salts they need from moist sand or mud. If butterflies are identified on the woodlot a "soggy spot" can be created for them. A bucket of sand is buried to within 0.5 cm of its rim and occasionally soaked with water (CWS, 1996).

6.11.3 PLANTING FOR WILDLIFE

Wildlife needs a diversity of food sources to survive. Species such as deer, squirrels, grouse and wood ducks all depend on mast trees (trees that produce fruit and seeds) and shrubs. If seed sources for these trees exist on the woodlot they can be encouraged by opening gaps and cutting adjacent vegetation to encourage regeneration. Otherwise, planting will be required to establish them on the woodlot. If any planting is done on the woodlot, native species should be selected where possible. While some introduced species have been studied and have not had major effects on the ecosystem, it is better to apply the precautionary principle and use native species where possible. See Appendix 4 for list of sources of native plants and seeds in Alberta. Table 9 provides some examples of food source trees and shrubs in Alberta.

TABLE 9 – FOOD SOURCE TREES AND SHRUBS IN ALBERTA

COMMON NAME	SCIENTIFIC NAME
Pin Cherry	*Prunus pensylvanica*
Choke Cherry	*Prunus virginiana*
Black Hawthorn	*Crataegus douglasii*
Red-Osier Dogwood	*Cornus stolonifera*
Lodgepole Pine	*Pinus contorta*
Trembling Aspen	*Populus tremuloides*
Wild Red Raspberry	*Rubus idaeus*
Western Mountain Ash	*Sorbus scopulina*
Saskatoon	*Amelanchier alnifolia*
Wild Red Currant	*Ribes triste*
Wild Gooseberry	*Ribes oxyacanthoides*
Wild Black Currant	*Ribes hudsonianum*
Beaked Hazelnut	*Corylus cornuta*
Bog Birch	*Betula glandulosa*
Elderberry	*Sambucus racemosa*
Bracted Honeysuckle	*Lonicera involucrata*

6.12 BEST MANAGEMENT PRACTICES APPLIED EXAMPLES

The following applied examples take real woodlot owners that were met with during the summer field season and illustrate their use of some of the above best management practices. The woodlot owners below were selected because of their excellence in different areas of woodlot management for biodiversity.

6.12.1 JOHN O'BRIEN – WESTEROSE, AB

John O'Brien owns a ¼ section within the dry-mixed wood boreal forest natural subregion. His management approach falls within the sustained yield woodlot management type discussed in Chapter 3. John supplements his income with a portable woodmiser ban saw for custom cutting and a Princess Auto wood splitter for firewood production. The family picks berries for personal use and makes extensive use of a trail system for hiking and X-country skiing.

This section discusses the management practices being implemented on his woodlot that exemplify some of the best management practices for managing for biodiversity.

GOALS AND OBJECTIVES

John stated three primary reasons for initially buying the woodlot:

1. Aesthetics
2. Sustainable income
3. Wildlife/Biodiversity value

WOODLOT INVENTORY

The following resident wildlife species have been identified

Ungulates: White-tailed deer (year round), mule deer, moose (winter along creek)

Carnivores: coyote

Omnivores: black bear (occasional resident)

Herbivores: hares, red squirrel, porcupine

John and his family have identified approximately 66 species of birds (mostly migratory) on the woodlot, including owls and raptors such as great grey owl, short-eared owl, great horned owl, red-tailed hawks, and eagles. The species are accounted for with a list, which is updated occasionally.

As a forester, John conducted his own inventory of the woodlot to determine the allowable timber harvest levels.

HARVEST PRACTICES

The following management guidelines drive harvest practices on the woodlot:

1. Selective cutting predominately, with some patch cutting for aspen.
2. No harvesting is done between March and October in order to avoid nesting/fledging times and to avoid soil compaction which can inhibit aspen development.
3. Small brush-piles that are too small to burn are left in the forest partially as habitat for smaller mammal species
4. Aspens with signs of conks are left for cavity nesters
5. For tree species such as aspen which require patch cutting, openings of less than 1 ac are used with successful natural regeneration
6. Areas recognized as good thrush habitat are left alone where possible
7. All harvesting is done by hand (chainsaw) and skidding is done with a small tractor to minimize soil compaction
8. All roads are built by tractor, kept as narrow as possible, and allowed to grow back when no longer needed
9. Snags are left whenever possible
10. Larger coarse woody debris is left in the forest while most of the mid-range debris is removed.
11. Sawdust is used as fill and for road building

REFORESTATION PRACTICES

1. Seedlings are taken from seismic lines and used as regeneration in cut areas and seismic lines are used as roads when possible to avoid further fragmentation
2. Spruce are planted in burning piles to take advantage of the nutrients

3. Aspen is maintained on the woodlot, despite its economic disadvantage, for other important ecological roles.
4. Grass is used for cover to allow conifer seedlings time to establish
5. Natural regeneration is used, with supplemental planting when absolutely necessary.

6.12.2 HILTON PHARIS – ELKHORN RANCH IN SW ALBERTA

Hilton Pharis own 3 sections and leases 3 additional sections for grazing purposes. He uses his lifetime experience as a rancher and woodlot manager as well as assistance from professional consultants to sustainably manage his land. The property has been in the family since 1918, when his Grandfather purchased it. It is located within the Montane Natural subregion in Southwestern Alberta. It falls within the Sustainable Woodlot Management and Agriculture woodlot management type.

GOALS AND OBJECTIVES

A balance is desired between:

1. Water – property sits on the headwaters of three creeks (Todd, Ernst, and Tetley)
2. Grass – protecting for wildlife reasons
3. Timber Harvesting
4. Wildlife Value

WOODLOT INVENTORY

An inventory was done in 1995 that combined information on timber volumes and environmental values. The above mentioned goals and objectives played a large role in the development of the inventory and subsequent calculations of the AAC. Currently, harvesting is being done below the AAC in order to sustain all woodlot values.

The following resident wildlife species have been identified

Ungulates: White-tailed deer, mule deer, moose (winter along creek) and elk

Carnivores: wolves, and cougar

Omnivores: black bear and grizzly bear

Birding groups use the woodlot occasionally for species specific programs.

Tree species information:

Douglas Fir - 75-140 year old stands (110 ha)

Lodgepole Pine – about 7 ha suitable for logging

White Spruce - 42 ha (32 ha considered commercial)

Aspen and Balsam Poplar – 50-120 years old (94 ha) – no real commercial value

The AAC for the woodlot was calculated at 152 m^3 and later set to 132 m^3 to balance other values. Approximately 1800 m^3 of old-growth Douglas Fir on the woodlot was identified as having a significantly high value for wildlife and is therefore left alone. The entire property is currently under a conservation easement with the Nature Conservancy of Canada primarily as a means to prevent subdivision. The easement is perpetual and was completed approximately 2 years ago. Within the easement is a stipulation protecting the old-growth Douglas-fir area.

HARVEST PRACTICES

The inventory identified the harvest methods to be used for each of the major tree species. The following guidelines are used to drive harvest practices on the woodlot.

1. Selective cutting used predominantly with patch cuts for pine.
2. All patch cuts are kept below 1.1 ac in size with irregular boundaries in order to reduce edge effects and to mimic natural disturbance.
3. All cutting is done by hand and skidded out with a tractor to reduce soil compaction.

4. Almost all harvesting is done in the winter in order to prevent damage to forest soils.
5. Snags and many canopy dominants are left for wildlife.
6. Aspen stands are left alone for wildlife value, despite poor economic worth.

REFORESTATION PRACTICES

7. While fire suppression is tending towards domination by spruce, Hilton is trying to maintain a balance of the tree species currently occupying the woodlot.
8. Natural regeneration is used with supplemental planting.

WILDLIFE HABITAT PROGRAMS

9. Streambank fencing is used primarily to protect riparian areas from cattle and secondarily to protect willows for wildlife habitat. The fencing is partially funded under the Buck for Wildlife Program, a program run by the Alberta Conservation Association that uses revenue from permits and licences to fund conservation activities.

7. IMPLEMENTATION STRATEGY

This chapter begins with a look at the woodlot programs from other jurisdictions to serve as a comparison to the program in Alberta. Programs from both Canada and the western United States are examined. What follows is a set of recommendations for implementing the best management practices from Chapter 6. Areas discussed include educational approaches, incentive programs, recommendations to the provincial government and the Woodlot Association of Alberta. Also included is a discussion of the changes currently being pursued involving federal and provincial tax policy. This section was developed both in consideration of and as a potential solution to the aforementioned barriers to sustainable forest management. Finally, directions for future research are discussed.

7.1 WOODLOT PROGRAMS FROM OTHER JURISDICTIONS

The following section looks at a variety of aspects within other woodlot programs including funding, educational programs, availability of technical assistance and incentive programs such as property tax rebates. The purpose of this exercise was to identify potential tools and approaches that could benefit the program in Alberta. It is worth mentioning that there are significant differences between the various jurisdictions examined in terms of their private forest characteristics. For example, in eastern Canada many of the private forest areas are owned and operated by private forest companies. The monetary figures discussed with respect to private donations to the provincial woodlot program reflect that fact. In British Columbia, woodlots can be a combination of private and public land. Many woodlot owners also lease crown land as a forest tenure to increase the size of their woodlot. Consequently, the primary focus of this section was to gain information on potential programs that could be used in Alberta, not as a comparison of funding for woodlot related issues in the various jurisdictions. In many cases, it would be like comparing apples and oranges.

7.1.1 NOVA SCOTIA

The Private Land Program in Nova Scotia consists of three elements (Whidden, 1999):

- Cape Breton Enhancement Program (CBEP)
- Stand Alone Resource Enhancement Fund – Forestry (REFF) (Funded by REFF)
- Eight Forest Stewardship Programs (Funded by REFF) (Regional programs typically involving a forest company)

All elements receive administrative, clerical, and technical (wildlife and forestry) assistance from the Nova Scotia Department of Natural Resources (NSDNR). Contributions also come from the Department of Renewable Resources and the Corporate Services Unit. In all, the NSDNR dedicates 30 person years to the program (Whidden, 1999). In addition to salaries, the NSDNR provided $3 million dollars in 1998-1999 (fiscal year) for silvicultural treatments on private land (Whidden, 1999). This makes up the Resource Enhancement Fund for Forestry which is divided into $1 million for stewardship programs and $2 million for the Stand Alone REFF. With a CBEP budget of $939,000 from federal sources, the total for the Private Program in 1998-1999 was approximately $6 million dollars. Financing from private interests (mostly private land forestry companies) augments government monies for the Private Land Program. For example, private interests contributed $1.4 million in 1997-1998 and $1.7 million in 1998-1999 (Whidden, pers. comm.).

Eligible treatments under the Stand Alone REFF include (Whidden, 1999):

- mechanical/chemical site preparation
- stock acquisition
- planting
- manual and chemical weeding
- pre-commercial thinning
- commercial thinning
- shelterwood cuts
- site clearing
- seed tree cuts

The assistance rate provides for an estimated 80% of the cost of the work.

Members of the private sector currently enter the forest stewardship programs on a voluntary basis. However, this is scheduled to change, likely in fiscal 2000-2001 (Whidden, pers. comm.). At that time, buyers will be required to contribute $6 per cord of silvicultural work required for forest sustainability. So if a buyer was to acquire 10,000 cords of wood for their mill (5,000 from their land and 5,000 from woodlots), they would be required to ensure that silvicultural work equalling at least $30,000 was done on each tenure.

There is currently no property tax rebate program for woodlot owners in Nova Scotia. The tax rate is a determined constant of $0.25 per acre set for land classed as Forest Resource, which applies to woodlots (Whidden, pers. comm.).

Currently, the department's education efforts aimed at woodlot owners include (Whynot, pers. comm.):

1. **Woodlot Management Home Study Series** - 11 modules covering various aspects of woodlot management, sent to 500 landowners per year.

2. **Other Publications** - forest practice pamphlets and silviculture manuals

3. **Field days** - usually on woodlots that demonstrate harvesting/silviculture systems

4. **Woodlot Owner Recognition** - Woodlot Owner of the Year Program that recognises landowners that manage their property sustainably

5. **One-on-one contacts** - visits to offer advice (upon request)

6. **Equipment** - demonstrations to show small scale equipment suitable for woodlots

7. **Natural Resources Home Page** – Departmental home page outlining the extension service.

The focus of these activities has traditionally been on wood production. However, the focus is changing to account for a range of values based on what woodlot owners want

from their properties (e.g. wildlife, recreation, etc.). Plans include an expansion of current efforts to offer courses electronically, as well as an increase in the number of field days per year (Whynot, pers. comm.).

7.1.2 ONTARIO

A variety of measures are used to foster ecologically sound forest management on private land in the province of Ontario:

- Private Land Resource Stewardship Program
- local stewardship councils
- awareness and skills training for landowners
- promotion of partnerships between landowners and interest groups
- Managed Forest Tax Incentive Program
- Conservation Land Tax Incentive Program
- stewardship agreements between the government and private landowners
- conservation easements
- tree-cutting by-laws
- natural heritage protection policies under the *Planning Act*
- Landowner Resource Center (LRC)

THE LANDOWNER RESOURCE CENTER (LRC)

The LRC is a clearinghouse for information related to private land issues in the province. Among the information is an extensive set of forest extension notes for woodlot owners which can be obtained at the center or online.

THE PRIVATE LAND RESOURCE STEWARDSHIP PROGRAM (PLRS)

Based in southern Ontario, the PLRS program seeks to link landowners with funding, information and expertise to ensure that good management practices flourish on private land. It is made up of 40 stewardship councils, which are volunteer groups of landowners and land interest groups that determine the environmental priorities for their area. Each

council has a stewardship coordinator from the Ontario Ministry of Natural Resources, and is provided with both project and operational funding.

THE ONTARIO MANAGED FOREST TAX INCENTIVE PROGRAM (MFTIP)

The Ontario Managed Forest Program identifies woodlands that are eligible for reduced municipal property taxes as an encouragement for landowners to conserve woodlands and their associated benefits for wildlife, water quality, wood production, recreation and aesthetics. Qualifying persons have their property re-assessed as Managed Forest (MF) and are taxed at ¼ the rate for residential property. Eligibility for the program is based on a number of criteria, including the location (must be in Ontario), land ownership, land area, and the number and size of trees on the property.

If eligible, a woodlot owner must meet the following requirements to qualify for the tax reduction:

- Preparation of a woodlot management plan with a 20 year time horizon, outlining the first five years of activities (staying in the program requires an audit every five years to check your activities and a revised plan every five years)
- The plan must be approved by a Managed Forest Plan Approver

Wood harvest is not a necessary precondition as the woodlot can be managed for a variety of purposes (Lompart et. al., 1997):

- maintaining proper environmental conditions for wildlife
- protection against flooding and erosion
- protection of water supplies
- recreation and nature appreciation
- production of wood and other forest products

7.1.3 PRINCE EDWARD ISLAND

The Private Land Program in Prince Edward Island provides financial and technical assistance to woodlot owners who want to reforest, tend existing plantations or manage natural stands. During the Federal Resource Development Agreements (1992-1997) the program produced between four and five thousand woodlot management plans (Brown, pers. comm.). Since then, like many other provinces, the program has been greatly reduced. The program is currently a forest renewal effort, funded 30% by private interests and 70% by the government. Funding for the program is approximately $1 million ($700,000 funding + cost of seedlings) (Brown, pers. comm.). Nine full time technicians are employed as part of the program for technical silviculture assistance.

While there is currently no guide available for woodlot owners there are other education-based programs. For example, as part of the private land program, the Prince Edward Island Department of Agriculture and Forestry has established six demonstration woodlots. These sites are designed to provide woodlot owners, forest contractors, and members of the public with evidence of the results of proper forest management. These woodlots also help to increase public awareness of Prince Edward Island's forests. They exhibit aspects of current forestry techniques, as well as provide information on natural history, PEI history, wildlife management and forest ecology.

There is currently no provincial tax rebate program for woodlot owners. The issue was reviewed in the past, and was determined not to be a disincentive because assessment rates were reasonable.

7.1.4 MONTANA

The Montana Department of Natural Resources and Conservation assists private forest owners in the state making use of the following:

- Timber Sale/Silviculture Assistance - 1-4 hour consultations
- Timber Sale Contracting - Literature, Sample Contacts, and Phone Consultation
- Water Quality Protection - Departmental booklets and workshops
- Consultant Referrals - Consultant Directory
- Forest Stewardship Workshops - Financial support for workshops, provision of departmental advisors
- Insect and Disease Management - One-on-one consultations, I&D workshops

The state also distributes the Montana Best Management Practices (BMP) which includes information on standards for forest practices.

7.1.5 WASHINGTON

The private forest program in Washington is referred to as the Forest Stewardship Program and is jointly funded by the USDA Forest Service and the Washington Department of Natural Resources.

There are two main financial assistance programs in the state for private forest owners:

STEWARDSHIP INCENTIVE PROGRAM

Provides funds for:

- Hiring a consultant to prepare a Forest Stewardship Plan
- Tree and shrub planting
- Wildlife habitat enhancement
- In-stream fisheries habitat enhancement
- Riparian and wetland enhancement
- Aesthetic and recreational enhancements
- Timber stand improvement (thinning, pruning, etc.)
- Erosion control
- Windbreaks

FORESTRY INCENTIVES PROGRAM

Provides funds for:

- Site preparation and planting
- Competing vegetation control
- Animal damage control
- Precommercial thinning
- Pruning
- Erosion Control

In addition to the financial assistance programs, there are also two social recognition programs:

STEWARDSHIP FOREST RECOGNITION PROGRAM

Landowners who are actively implementing an approved Forest Stewardship Plan are eligible to have their properties recognized as a "Stewardship Forest," including property sign and certificate. The program is sponsored by the USDA Forest Service and state forestry agencies.

AMERICAN TREE FARM SYSTEM

Landowners who are implementing active management practices based on a written forest management plan may qualify to have their properties enrolled as a "Certified Tree Farm" in which they receive a "Tree Farm" sign and certificate. A minimum of 10 forested acres is required to be eligible for the program. Management should be compatible with wood fiber production, but need not be the owner's primary objective. The program is sponsored nationally by the American Forest Foundation, and in Washington by the Washington Forest Protection Association. Members also receive the national Tree Farmer magazine

In Washington, an annual property tax is paid on all forested land. The tax applies to the land only and not to standing timber. Many forest owners can qualify for special "current use" forestry tax rates through the Open Space or Designated Forest Land programs. To

qualify a written forest management plan is required. As part of the program, a multi-year role back penalty applies if land is converted to non-forestry use.

Washington State University runs a Natural Resource Sciences Cooperative Extension Service which provides educational resources for private landowners in the state. This differs from extension services in Canada where they are usually within a government department. The program receives funding in part from the USDA and county governments, as well as the university itself. The program is a combination of courses, tours, and conferences. A newsletter is distributed twice a year and one-on-one consultations are available.

7.2 WOODLOT OWNER EDUCATION PROGRAMS

This section discusses the need for education programs for woodlot owners in Alberta as a means of implementing the best management practices discussed. A survey by Rounds et al. (1996) found that woodlot owners felt that educational programs and an overall increase in information regarding woodlots would be an important component of achieving sustainable development in the woodlot sector. Such an approach will need to be multi-faceted in order to be effective across the various regions where woodlots exist. It will need to include input from several sources including the WAA, individual woodlot owners, universities, AEP and forest companies in the province. Since individuals respond differently to various methods of education, a system incorporating many types is recommended. The following sections examine the various recommended approaches to woodlot owner education.

7.2.1 Workshops

Workshops offer a focused view on a particular subject. They are particularly useful as they offer a hands-on, interactive approach for woodlot owners to try various new

methods of woodlot management, or to learn about specific subject matter. During the period of the FRDA, the WAA ran workshops throughout the province and found them to be quite successful (Grundberg, pers. comm.). Individuals from AEP, forest companies, environmental organizations, universities, etc. could be invited to give talks on various woodlot issues. Workshops would be a particularly good forum for addressing future concerns such as forest certification programs. Other jurisdictions make extensive use of workshops involving subjects such as wildlife and plant identification, silviculture, plan development, and insect and disease management. Other topics, such as special forest products and value-added ventures could also be addressed. Workshops also provide a good opportunity to implement adaptive management approaches to woodlot management in the province. Woodlot owners, by contributing their experiences on their land contribute valuable information for others in how they manage their own properties.

7.2.2 Demonstration Woodlots

Demonstration woodlots provide working examples of sustainable woodlot management practices. Establishing a set of these woodlots in the various natural subregions of the province could provide opportunities for other woodlot owners, forestry professionals, and the public to see sustainable management in action. Appointments could be booked for walking tours or to highlight certain management practices. These woodlots could be selected as particularly good examples of one form of management or as examples of an entire holistic approach to woodlot management.

7.2.3 Web Pages

While the Internet is still relatively new, particularly in rural areas of the province, its use will increase over time. Web pages are used by various provinces to provide both general information on their woodlot program, and specific information including online

documentation or courses (See Appendix 5). The current WAA web page could be improved with the inclusion of the following:

- *access to woodlot related documents on-line*
- *up-to-date information on woodlot events (e.g. workshops, field days, courses); while this information was on the site, the information was over 6 months old*
- *online news on topics of interest to woodlot owners (e.g. progress on tax issues, market pricing, marketing strategies, and value-added products)*
- *links to other provincial and state woodlot associations and extension services*
- *notes from annual general meetings*
- *information on financial and social incentives programs (e.g. conservation easements, habitat stewardship programs, etc.)*
- *profiles on woodlot owners (e.g. woodlot owner of the year, demonstration woodlots)*

7.2.4 Extension Library and Inter-library Loan

Currently, woodlot related information is available through the Canadian Forest Service Extension Library in Edmonton. This material is accessible through any library that uses inter-library loan services. This is currently the primary means of distributing information on woodlot management in the province. As such, this service should continue with the following suggested improvements:

- *Make information available at local agricultural district offices or town school libraries*
- *Copies of small documents and brochure sets could be mailed out to requesting individuals for a small reproduction charge*

7.2.5 Courses

Regional colleges and universities can play a role in offering woodlot related courses to interested individuals. In addition to material on areas such as woodlot management, other material should include ecosystem management, conservation biology, and landscape ecology to educate woodlot owners on the importance of these concepts to woodlot management and biodiversity. Specific recommendations for such courses include:

- *Include, as part of a course, the development of a personal woodlot management plan with the help of guest instructors such as consulting foresters, biologists, etc.*
- *Other important courses might include: marketing timber from private land, habitat assessment, value-added options for woodlot owners, species identification, etc*

7.2.6 Regional Field Days

Regional field days are similar to workshops except they are more family oriented and are typically run by the woodlot owners themselves. They usually occur once or twice a year and are held on individual woodlots or on a group of neighbouring woodlots. They involve events for the family or any interested individuals, which serve to educate on woodlot issues. This could involve poster presentations, walking tours, professional talks, slide shows, and equipment demonstrations. Other provinces and states have used these events with great success.

7.3 INCENTIVE PROGRAMS

One of the barriers mentioned in Chapter 3 for achieving sustainable woodlot management, was the lack of incentive programs. Incentive programs were prominent features of the other woodlot programs examined. Incentive programs include both economic and social incentives for sustainable management of the land. A combined approach is necessary, as woodlot owners will be persuaded by different incentive types

based on a combination of their personal goals and their woodlot management approach. For example, those woodlot owners who own their property for aesthetics or wildlife value may not be persuaded by economic incentives related to timber production. They may respond well to some sort of social recognition of their contribution to wildlife habitat. This is partly due to the economics involved. For example, financial input into silvicultural work on the woodlot is often easier to justify since there will be a resulting increase in financial returns. However, this is clearly not the case for wildlife habitat enhancement projects. Therefore, there must be another driving force behind these projects. Often, it is because the woodlot owner recognizes the intrinsic value of the biodiversity on their property. Other times, it is because of the aesthetical or spiritual benefit they receive from having wildlife on their property.

In all, incentives will act to serve one of two purposes regarding woodlots in Alberta:

1. Maintain or improve existing woodlot management practices.
2. Eliminate or discourage harmful activities such as land clearing.

Most of the incentives discussed in this chapter fall into the first category. However, section 7.7 discusses options for tax reform that falls into the second category.

For an incentive to be effective there must be some aspect of cross compliance. In other words, there must be some factor that ensures the goal (e.g. sustainability or conservation of biodiversity) is achieved. An example of cross compliance is the Ontario Managed Forest Tax Incentive Program's requirement of an approved plan, which is audited every five years.

7.3.1 ECONOMIC INCENTIVES

Economic incentives can be divided into two categories:

1. Direct Economic Incentive

Landowner receives financial assistance to conduct specific practices on their land. Examples include cost-sharing programs and habitat conservation funds.

2. Indirect Economic Incentive

Landowner benefits financially by practicing a certain form of land management. Examples include property tax assessment rebate programs and Conservation Easements.

7.3.1.1 Direct Economic Incentives

The Buck for Wildlife program is an example of a direct economic incentive. The objective of this program is to enhance and conserve wildlife and fisheries habitat for the benefit of all Albertans. The program, run by the Alberta Conservation Association, began in 1973. From a levy placed on provincial angling and hunting licences, a fund is created for habitat enhancement projects in the province. The projects typically include riparian habitat enhancement, purchase or leasing of wildlife habitat, tree plantings, grassland restoration and wildlife species inventories. Woodlot owners with a habitat enhancement project can apply for funding. The stream-bank fencing project used by Hilton Pharis is an example of a Buck for Wildlife program. While the program applies to woodlot owners, it is not specifically tied to private forest lands.

7.3.1.2 Recommendations for Direct Economic Incentives

1. A program similar to Washington's Forestry Incentives Program, should be developed by the province. This involves covering a percentage of the cost of certain types of work on the woodlot (e.g. reforestation and thinning). Criteria for eligibility could

include requirements such as a woodlot plan and a set period within which the work must be done. Revenue for the program could come from levies on timber sales off private land and from donations to the fund by interested parties such as forestry companies.

2. Funds should also be made available for projects that will enhance biodiversity on woodlots in the province. Examples include tree and shrub planting for wildlife, habitat enhancement (e.g. construction of nesting platforms), in-stream fisheries habitat enhancement and riparian and wetland projects, as well as projects involving the creation of landscape corridors.

7.3.1.3 Indirect Economic Incentives

As mentioned, indirect economic incentives are those where instead of directly receiving funds for projects, the woodlot owner would benefit financially in other ways. These may include reduced property taxes or not having to pay taxes on a portion of their land. Currently, the province does not have a property tax rebate program for woodlot owners and this continues to act as a disincentive for woodlot owners attempting to sustainably manage their property. However, an example of the second type does currently exist: conservation easements.

Conservation easements can been seen as a combination of economic and social incentives. Many landowners enter into easements simply to ensure the long-term preservation of the land or to prevent future subdivision. Others recognize the economic advantages of the tax benefits. The objective of conservation easements is to provide a natural legacy to future generations of Albertans through voluntary and legal protection of private land.

Under the Alberta Environmental Protection and Enhancement Act, conservation easements enable landowners to protect parcels of their properties as natural habitat. The easement is recorded and carries with the land title. They can be created for a set period

of time or in perpetuity. Several conservation organizations, government agencies and environmental groups are able to accept conservation easement agreements from private landowners. There are however, some eligibility criteria for conservation easements including a determination of the ecological 'significance' of the property.

Recommendations for a provincial property tax rebate program are discussed in section 7.7.2.

7.3.2 SOCIAL INCENTIVES

For many woodlot owners, economics are not the limiting factor for how they manage their woodlot. Social issues play a larger role in their decision-making process. Social recognition for their contribution to biodiversity conservation may therefore play a significant role in how they manage their woodlots. One example is how private woodlots can lead by example in land-use management issues. Individual woodlot owners can serve as models for their peers and the public forestry sector for harmonizing sustainable production with biodiversity conservation (O'Connell, 1996).

7.3.2.1 The Habitat Steward Program

The Habitat Steward Program is run by the Red Deer River Naturalists Society. The objective of the program is to encourage rural landowners to voluntarily conserve habitat on their property. Landowners who maintain a minimum of five acres as wildlife habitat are eligible to apply to the program. If successful, the applicant is provided with a large gate sign stating: "This landowner conserves habitat for native plants and animals." To date, 128 landowners have participated, representing a total of 14,000 acres of land. The cost of the signs is underwritten by the Telus Corporation.

7.3.2.2 Potential Programs

Other regions of the province should develop programs similar to the Habitat Steward Program. Currently, only private landowners in Central Alberta are eligible for that program. Another program that has shown to be successful in other jurisdictions is the Woodlot Owner of the Year award. The WAA could start a Woodlot Owner of the Year program where woodlot owners in different categories such as wood production, habitat steward, value-added management, etc. could be determined. Recognition could involve a profile in the Log Jam Newsletter and on the WAA webpage. As well, a field day could be held on the woodlot owner's property in honor of their contribution to sustainable woodlot management.

7.3.3 FOREST CERTIFICATION PROGRAMS

Forest certification falls somewhere between economic and social incentive programs. Social aspects are included in that the public recognizes the label as an assurance of sustainable practices and may make their purchase for that reason. For the individual producer, in this case the woodlot owner, it makes good business sense to have every competitive advantage in an increasingly educated market. For them, certification is a way of ensuring that their form of forest management, which seeks a variety of values, including biodiversity, is recognized in the marketplace.

While the production of wood from woodlot sources in Alberta has been lower than several other provinces in the past (Table 10), the increase in 1994-1995 to over 2 million m^3 suggests that certification programs may have some potential in the future.

TABLE 10 – WOODLOT NATIONAL HARVEST, 1990

Province	Roundwood (m^3)	Fuelwood (m^3)	% of Provincial
Alberta	376,000	65,000	4.7
British Columbia	6,123,000	420,000	7.9
Manitoba	80,000	80,000	8.0
New Brunswick	2,827,000	300,000	30.0
Newfoundland	30,700	89,000	5.7
Nova Scotia	2,100,000	290,000	55.2
Ontario	3,200,000	1,700,000	18.9
PEI	135,000	300,000	96.0
Quebec	5,286,000	2,000,000	22.8
Saskatchewan	20,000	135,000	4.7

Source: Forestry Canada. 1991. Private woodlots in Canada. Natural Resources Canada, Ottawa, ON.

There are several factors that will determine the acceptance of certification programs by woodlot owners. First, there must be a clear link between being certified and an increase in the marketability of the product. While currently this link is present in Europe it has been slower coming in North America. Secondly, the cost to an individual woodlot owner to become and remain certified, can act as a significant disincentive. The cost of certification is often quite high. Unless the expectation of an increase in profit due to certification is clear, this factor may prevent its acceptance by woodlot owners.

In Canada, there are currently three major certification initiatives: the Forest Stewardship Council (FSC), the Canadian Standards Association (CSA) and the Pacific Certification Council (PCC).

7.3.3.1 Forest Stewardship Council (FSC)

The FSC is an international Non Government Organisation that promotes environmentally appropriate, socially beneficial and economically viable management through a voluntary accreditation program. The FSC accredits certifying organisations, which, in turn, certify

forest operations. Thus far the FSC has focused on the Maritimes, Ontario and British Columbia.

The program revolves around the core document "Principles and Criteria" which is used to define good forest management. The principles are broad issues that must be addressed in order to be eligible for certification, while the criteria serve to define those issues in detail without actually setting specific standards. The principles are as follows (Forest Stewardship Council, 1993: Internet):

Principle #1. Compliance with Laws and FSC Principles

Forest management shall respect all applicable laws of the country in which they occur, and international treaties and agreements to which the country is a signatory, and comply with all FSC Principles and Criteria.

Principle #2. Tenure and Use Rights and Responsibilities

Long-term tenure and use rights to the land and forest resources shall be clearly defined, documented and legally established.

Principle #3. Indigenous Peoples' Rights

The legal and customary rights of indigenous peoples to own, use and manage their lands, territories, and resources shall be recognised and respected.

Principle #4. Community Relations and Worker's Rights

Forest management operations shall maintain or enhance the long-term social and economic well-being of forest workers and local communities.

Principle #5. Benefits from the Forest

Forest management operations shall encourage the efficient use of the forest's multiple products and services to ensure economic viability and wide range of environmental and social benefits.

Principle #6. Environmental Impact

Forest management shall conserve biological diversity and its associated values, water resources, soils, and unique and fragile ecosystems and landscapes, and, by so doing, maintain the ecological functions and the integrity of the forest.

Principle #7. Management Plan

A management plan – appropriate to the scale and intensity of the operations – shall be written, implemented, and kept up to date. The long term objectives of management, and the means of achieving them, shall be clearly stated.

Principle #8. Monitoring and Assessment

Monitoring shall be conducted – appropriate to the scale and intensity of forest management – to assess the condition of the forest, yields of forest products, chain of custody, management activities and their social and environmental impacts.

Principle #9. Maintenance of Natural Forests

Primary forests, well-developed secondary forests and sites of major environmental, social or cultural significance shall be conserved. Such areas shall not be replaced by tree plantations or other land uses.

Principle #10. Plantations

Plantations should be designed and managed consistent with Principles 1-8 and the following criteria. Such plantations can and should complement overall ecosystem health, provide community benefits, and provide a valuable contribution to the world's demands for forest products.

Standards are defined nationally or regionally. There is currently a lack of standards and therefore accreditors typically certify operations based on site-specific interpretations of the principles and criteria. A key element of the FSC program is the requirement of

clearly documented and verifiable "chain of custody" from the product carrying the FSC logo back to the forest from which it originated.

7.3.3.2 Canadian Standards Association (CSA)

The certification program of the CSA involves two documents. The guidance document outlines the key elements of the standards and the kind of forest management system an organization must implement in order to successfully apply for registration. The specifications document provides a checklist of specific elements that an auditor must assess in the registration process. The key elements are drawn directly from the International Standards Organization (ISO) 14000 Environmental Management series. These key elements are intended to collectively result in a "continual improvement" process.

The CSA guidelines describe a performance framework that is comprised of the following elements: criteria for sustainable forest management (determined by the CCFM), local values and goals, measurable indicators for each criteria, and objectives (Figure 8).

As mentioned, the CSA uses a system of criteria and critical elements designed by the CCFM, one of which is conservation of biodiversity (CCFM, 1997). Within each criteria, there is a process that applies local goals and values to develop a biodiversity indicator and subsequent performance objective.

The following represents an example of the progress from a CSA criteria to a performance objective:

1. CCFM SFM Criteria #1 – Conservation of Biological Diversity
2. Critical Element – Species Diversity
3. Local Value – A healthy population of woodpeckers
4. Goal: Increase the necessary habitat for woodpeckers

5. Indicator – Actual increase in relevant habitat – standing dead trees
6. Performance objective – increase number of standing dead trees in the Rocky Creek Watershed by 10% by December 31, 1998

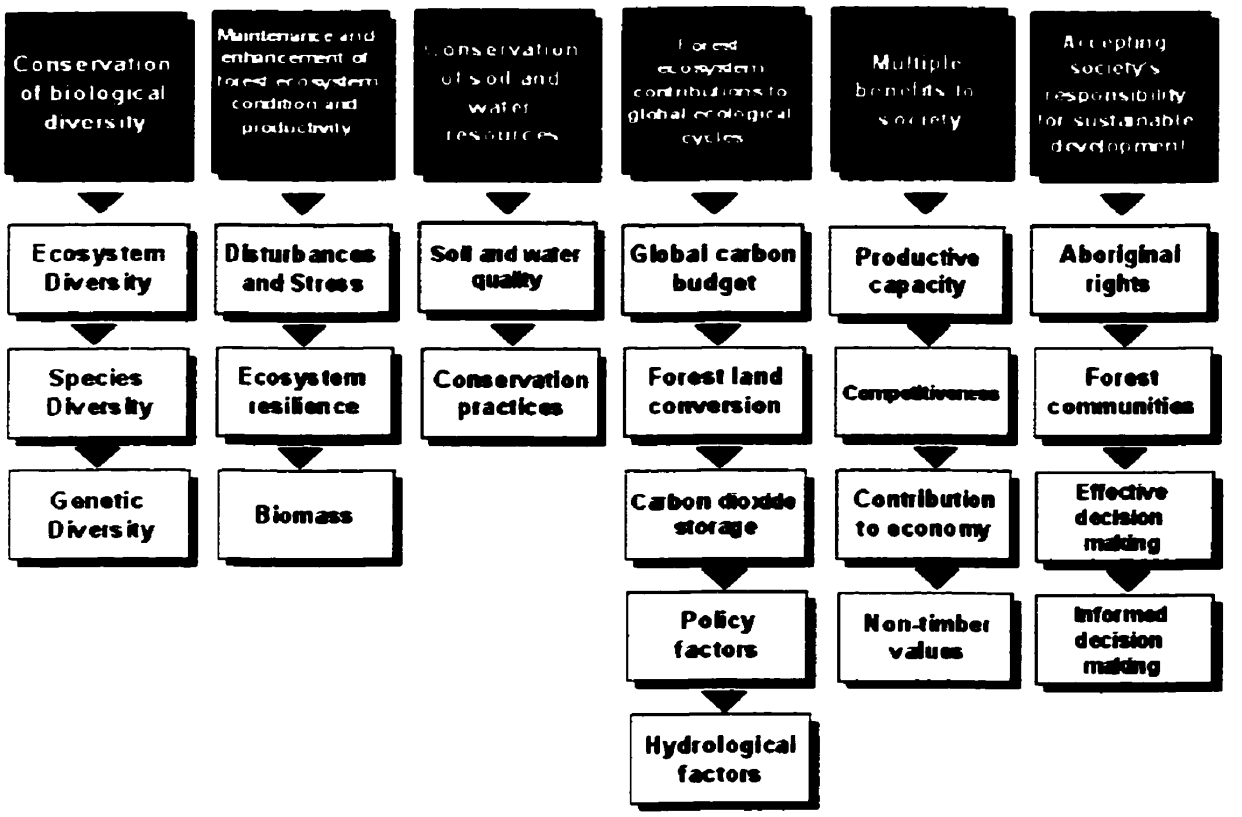

FIGURE 8 – CSA-SFM CRITERIA AND OBJECTIVES (CCFM, 1997)

The system tends to favor larger companies over smaller operators. Firstly, smaller operators do not have the administrative bureaucracy needed to comply with the system requirements, and secondly they often do not have the long-term tenure required to apply for certification in the first place. Woodlot owners on the other hand, are a targeted group. In fact, the CSA Sustainable Forest Management committee included representatives from the woodlot sector. In response to the cost of certifying, the program allows woodlot owners to apply in cooperation in order to reduce costs and to address regional biodiversity issues.

7.3.3.3 Pacific Certification Council (PCC)

The PCC is composed of five Not for Profit Organizations that formed a partnership to promote ecologically responsible forest management in the Cascadia bioregion. All are currently members of the FSC and some are applying for accreditation by the FSC. The PCC is currently in the process of developing principles that will guide standards for certifiable ecologically responsible forest management that are more detail oriented than either the principles of the FSC or CSA. Among the guiding principles are: the precautionary principle will take precedence over economic considerations, natural disturbance regimes will be maintained, and emphasis will be primarily on ecological consideration over socio-economic concerns. The program is aligned with the ecoforestry movement and reflects its overall philosophy of forest management.

7.4 RECOMMENDATIONS TO THE PROVINCIAL GOVERNMENT

The end of the FRDA in 1997 has resulted in large reductions in the amount of silviculture practised on woodlots and the amount of assistance available to woodlot owners. Development of effective means to fill that void remains a major challenge to achieving sustainable development on woodlots across the country. Since 1997, the province has distanced itself somewhat from private forestry matters, leaving it to the fledgling WAA. Despite this, recent provincial policy stresses the importance of private forest lands. For example, the Alberta Forest Conservation Strategy (1997) states:

"*Private and public lands, particularly in the White Area of the province, have tremendous potential for management as sustainable woodlots. Increased government commitment to the sustainable long-term management of those forested lands, combined with an effective education and awareness program for private land-owners and interested parties, could provide the foundation for a successful woodlot program in Alberta.*"

There is currently little sign of any such commitment by the provincial government to an Alberta woodlot program. Financial and technical assistance from the province for woodlot related issues would play a significant role in determining the long-term sustainability of these lands and the biodiversity that they sustain. As a beginning, the province should review the programs from the other Canadian provinces, and more importantly from some of the western United States. The American programs are well developed due to the importance of private forestry in the U.S. From there, it will be important to dedicate an annual amount of funds for a provincial woodlot program. This should also include some staff, dedicated to private forestry concerns. Funding for the program could come in part from matching funds from private concerns such as major Industrial Forest Companies that have an interest in woodlot management. For example, Alberta-Pacific and Weldwood have demonstrated their interest in the woodlot sector by implementing small-scale woodlot management programs of their own. Other opportunities could include levies on stumpage fees to go towards woodlot related programs.

7.4.1 PARTNERSHIPS BETWEEN APPROPRIATE DEPARTMENTS

Partnerships between departments within the provincial government require improvement. The departments of forestry, municipal affairs, and agriculture will need to work together to balance land use in the White Zone.

Kernohan and Haufler (1999) outline the criteria for successful partnerships:

1. Voluntary involvement
2. A broad range of participants
3. Involvement from the onset
4. Identification of mutual goals and objectives
5. Respect for individual landowner objectives
6. Decision making by consensus
7. Trust

The lines of communication between the two dominant departments, forestry and agriculture, is a critical factor for ensuring the long-term sustainable focus of land use in the White Zone. Policies from one department that may affect the other, should be reviewed by the potentially affected department. The creation of a committee for White Zone matters would go a long way to ensuring landscape components of biodiversity are preserved. Such a committee should have representatives from the forestry sector, members of the WAA, the agricultural sector, and relevant municipal districts.

7.5 RECOMMENDATIONS TO WAA

The association is currently the main body dealing with woodlot related issues in the province. By examining woodlot programs in other jurisdictions, some recommendations for potential programs became clear.

7.5.1 PARTNERSHIPS WITH ALBERTA COLLEGES AND UNIVERSITIES

The development of partnerships with Alberta colleges and universities would be a beneficial move by the association. Through coursework or theses, university students could benefit from projects that the association could offer. These may include projects such as the development of individual management plans for woodlot owners or more general reports on subjects such as connecting woodlots together at the regional level. Such projects would be beneficial to both the student and individual woodlot owners and typically would cost the woodlot owner very little. The 702 course within the Faculty of Environmental Design at the University of Calgary is a good example of a course where groups of students work on a project for an external client. In the United States, universities play a significant role in extension services for private land, offering both education and technical assistance to landowners, often at no charge. Development of such programs in Alberta would help to facilitate an increase in woodlot research and knowledge transfer.

7.5.2 CODE OF PRACTICE FOR WOODLOT OWNERS

Currently, woodlots in Alberta are not subject to any provincial regulations for silviculture. To show their dedication to sustainable woodlot management in Alberta the WAA could develop a code of practice for woodlot management. By having the code developed by the WAA, the code would be developed for woodlot owners by woodlot owners. Such a policy could deal with issues such as: wetlands and other sensitive areas, responsible woodlot management activities, forest protection, regeneration methods, etc. The code would serve as a demonstration of the sector's dedication to sustainable development. The woodlot association of Ontario has developed such a code and could serve as an example for Alberta.

7.5.3 IMPROVE CONNECTIONS WITH EXISTING PROGRAMS AFFECTING WOODLOTS IN ALBERTA

Currently, there are several programs that deal with the White Zone of the province. As woodlots are an important component of this area, the WAA should make themselves available for the provision of information or members for committees. As well, the WAA could provide information to existing databases that identify priority land parcels or areas harboring biodiversity. Examples include the Alberta Natural History Information Committee (ANHIC), the Conservation Data Centre (CDC) and the Nature Conservancy of Canada.

7.6 OPPORTUNITIES WITHIN MUNICIPALITIES

As mentioned, municipal districts have some opportunities for ensuring the conservation of landscape elements of biodiversity. Recently, municipalities seem to be receiving an increasing amount of responsibility and power for dealing with regional planning concerns. The provincial government has been offsetting these responsibilities to the municipal districts, expecting them to cooperatively plan for areas of mutual interest (Elder, 1996).

For example, within the Municipal Government Act there exist specific opportunities for addressing landscape level goals. Primarily, there is the potential for voluntary intermunicipal agreements to form intermunicipal planning commissions and development plans. Such agreements could examine issues of future land use in the region and the manner of and proposals for future development. Secondly, there is the requirement that municipalities that are in the process of developing an area structure plan must notify adjacent municipalities and provide opportunity for suggestions.

These features may be the best means of addressing landscape elements of biodiversity. Features such as riparian or wooded corridors, significant wildlife movement paths, and difficulties such as subdivision and the development of landscape barriers can all be dealt with at this level. One example of a promising application of a municipal district to examining regional woodlot concerns comes from the M.D. of Brazeau No. 77. In this municipal district woodlot owners have developed a set of guidelines for woodlot management in the area that deal with landscape components such as corridors and wildlife movement (Van der Schoot, per. comm.).

7.7 CHANGES TO CURRENT TAX POLICY

Issues involving taxes and woodlots in the province have been dealt with extensively by both the WAA and the Canadian Federation of Woodlot Owners. Recommendations for changes to the federal tax system were made in 1994 with little progress to date. The following sections outline the current issues and recommendations for change within the federal and provincial tax systems.

7.7.1 Federal Income Tax Policy

Canada's Income Tax Act does not recognize woodlot owners as a distinct group of taxpayers. The regime is outlined in various interpretation bulletins, circulars and other

publications issued by Revenue Canada. This needs to be clarified to properly outline the situation. For instance, some woodlot owners are considered as engaged in farming while others are deemed to be carrying on logging.

The specific problems with the federal income tax policy were outlined in Chapter 3. As a response to these problems the Canadian Federation of Woodlot Owners proposed a set of recommendations for changes to the current tax system. These recommendations were put forth in a report by the Standing Committee on Natural Resources in 1994. The following represents a summary of these recommendations (Standing Committee on Natural Resources, 1994):

1. Recognition of small woodlot owners as a special class of taxpayer
2. Ability to access unlimited deductibility from income of forest development expenses and deductibility of the cost of timber stands in the year of woodlot purchase.
3. Ability to employ the cash basis of accounting, and to consider a woodlot as an income-earning asset or as a capital asset.
4. Capital gains eligibility
5. Access to a number of tax credits and shelters to promote woodlot purchase and forest development.

Implementation of these recommendations would eliminate the disincentives involved with income tax on Canadian woodlots.

7.7.2 Municipal/Provincial Property Assessment Tax

The Municipal Government Act (1995) assesses woodlots at market value rather than agricultural use value because timber production or the collection of forest products are not defined as farming operations. As discussed in Chapter 3, this provincial property assessment of Alberta woodlots acts as a significant disincentive to long-term sustainable woodlot management.

A program similar to the Ontario Managed Forest Tax Incentive Program would be beneficial in Alberta as a means of eliminating property assessment disincentives. The program should have the requirement of an approved woodlot management plan, and should recognize the diversity of woodlot management types. Such a program could fit within a provincial woodlot extension service and would provide employment opportunities for those interested in becoming accredited as woodlot management plan evaluators.

7.8 RECOMMENDATIONS FOR FUTURE RESEARCH

Beyond the need for overall research on biodiversity there are two main areas related to woodlots that would benefit from more research. The first area is the landscape components of biodiversity and their maintenance on Alberta woodlots. Such research should focus on patch dynamics, examining how woodlots are changing over time, and the driving forces behind that change. Information on the best locations for regional corridors and linkages to protected areas would also be important. The second area of research should look at the decision making process of landowners who chose to clear their woodlots. Why was the decision made? What factors may have changed their mind?

8. SUMMARY OF RECOMMENDATIONS AND CONCLUSIONS

The aim of this chapter is to provide a summary of the recommendations of the project. The different recommendations are divided into sections based on the intended target audiences: woodlot owners, foothills model forest, provincial government, federal government, WAA, and municipal districts.

8.1 RECOMMENDATIONS TO WOODLOT OWNERS

As discussed, the recommendations to woodlot owners act as a set of best management approaches that can be selected from based on the individual management style and the owner's goals and objectives.

GOALS AND OBJECTIVES

- *Personal goals and objectives should be stated clearly at the beginning of the woodlot management plan as they drive the entire management process.*

WOODLOT INVENTORY INFORMATION

- *In addition to tradition inventory information, the following should be included in the woodlot inventory:*

    - *Information on wildlife habitat (e.g. wintering areas, nesting sites, food sources)*
    - *Information on biological legacies*
    - *Information on riparian areas*
    - *Tracks, droppings or trail sign of wildlife*
    - *Wildlife movement corridors*
    - *Information on rare flora and fauna*

WOODLOT MANAGEMENT PLAN

- *The property should be divided into compartments for management purposes*
- *A simple map of the woodlot is a useful component of any management plan*

HARVEST METHODOLOGY

- *Canopy gaps can be created by using group cuts*
- *If clearcuts are used on the woodlot, the following modifications should be instituted:*
    - *keep the patches as small as possible*
    - *use random shapes*
    - *irregular boundaries*

- *The use of heavy machinery should be limited and alternative means of skidding (e.g. horse logging) should be used where possible.*
- *Sources of nutrients (e.g. slash) should be left in moderate amounts*
- *Not all canopy dominants should be cut*
- *Snags and coarse woody debris should be left during harvest operations*
- *Critical nesting and breeding periods for wildlife should be avoided during harvesting*

STAND IMPROVEMENT ACTIVITIES

- *Modifications should be made to thinning selection criteria to create a diversity of species and sizes and a range of spacing distances to increase structural diversity*
- *Thinning can also be used to create canopy gaps to facilitate understory vegetation growth and diversification*
- *Nitrogen-fixing plants as an alternative to fertiliser application*
- *Mowing and mulching can be used to reduce competition from weeds*
- *Wire mesh, tarpaper, and plastic tree guards can be used to prevent damage by animals*

REFORESTATION

- *A mixed forest should be developed for biodiversity goals (unless the stand was originally a single species stand).*
- *Natural regeneration should be used primarily with supplemental planting*

RIPARIAN AREAS

- *Riparian buffer zones should be established to protect critical riparian areas*
- *Stream crossings should only be used when necessary and built correctly*
- *If wetland areas are identified, management assistance should be obtained from a group such as Ducks Unlimited*

MONITORING PROGRAMS

- *A monitoring program should be devised for the property which includes: implementation and effectiveness monitoring and adaptive management*

LANDSCAPE COMPONENTS

- *Fencing that does not act as a barrier to ungulates should be used where possible*
- *Blocks should be chosen over strips as habitat patch shapes*
- *Partnerships should be developed between neighbours to plan harvesting activities*

WILDLIFE HABITAT PROGRAMS

- *Nesting structures can be built for wildlife*
- *Fruit and seed trees should be planted for wildlife*

8.2 RECOMMENDATIONS TO FOOTHILLS MODEL FOREST BIODIVERSITY MONITORING PROGRAM

The following recommendations relate to the Foothills Model Forest Biodiversity Monitoring Program. They examine the inclusion of private land areas in the development and implementation of the province-wide monitoring program.

- *Areas of the White Zone that are located within forested natural regions: boreal, montane, and foothills, that contain woodlots, should be included as part of the remote sensing data for landscape components of biodiversity monitoring.*
- *Sites chosen for long-term trend analysis could include individual or groups of woodlots.*
- *Individual woodlot owners can be contacted for qualitative data if required (e.g. species checklists, reports on intended management for property, etc.)*
- *Representatives from the woodlot sector would make valuable board members to contribute information on trends in woodlot management and relay information back from the monitoring program to the WAA to be shared with individual members.*

8.3 RECOMMENDATIONS FOR EDUCATION PROGRAMS

The main recommended approach for woodlot owner education programs is a multi-faceted one in which several methods are recommended. These programs would be best run by the WAA with funding from the province, WAA fund raising, and private forestry companies.

WORKSHOPS

- *Individuals from AEP, forest companies, environmental organization, universities, etc. could be invited to give talks on various woodlot issues.*
- *Topics include wildlife and plant identification, silviculture, plan development, insect and disease management,special forest products and value-added ventures.*

DEMONSTRATION WOODLOTS

- *Demonstration woodlots should be established in the various natural subregions of the province to povide opportunities for other woodlot owners, forestry professionals, and the public to see sustainable management in action.*

WEB PAGES

The current WAA web-page could be improved with the inclusion of the following:

- *access to woodlot related documents on-line*
- *up-to-date information on woodlot events (e.g. workshops, field days, courses); while this information was on the site, the information was over 6 months old*
- *online news on topics of interest to woodlot owners (e.g. progress on tax issues, market pricing, marketing strategies, and value-added products)*
- *links to other provincial and state woodlot associations and extension services*
- *notes from annual general meetings*
- *information on financial and social incentives programs (e.g. conservation easements, habitat stewardship programs, etc.)*
- *profiles on woodlot owners (e.g. woodlot owner of the year, demonstration woodlots)*

EXTENSION LIBRARY AND INTER-LIBRARY LOAN

This service should continue with the following suggested improvements:

- *Make information available at local agricultural district offices or town school libraries*
- *Copies of small documents and brochure sets could be mailed out to requesting individuals for a small reproduction charge*

COURSES

Regional colleges and universities can play a role in offering woodlot related courses to interested individuals on topics such as

- *woodlot management issues*

- *ecosystem management, conservation biology, and landscape ecology*
- *the development of a personal woodlot management plan with the help of guest instructors such as consulting foresters, biologists, etc.*
- *marketing timber from private land, habitat assessment, value-added options for woodlot owners, and species identification*

FIELD DAYS

Woodlot owner run field days involve events for the family or any interested individuals, that serve to educate on woodlot issues.

8.4 RECOMMENDATIONS TO THE PROVINCE

This section examines the need for an increase in assistance from the provincial government in matters related to woodlots. The first priority among these recommendations is to re-establish an annual fund for woodlot programs in the province. Other aspects, including incentives and technical assistance would follow. Clarification of departmental responsibilites is also a priority to determine the best means of managing woodlots in the White Zone.

- *A program similar to Washington's Forestry Incentives Program, where a percentage of the cost of certain types of work on the woodlot, (e.g. reforestation and thinning) is covered by the government, should be instituted by the province.*
- *Revenue for the program could come from levies on timber sales off private land and from donations to the fund by interested parties such as forestry companies.*
- *Funds should also be made available for projects that will enhance biodiversity on woodlots in the province. Examples include tree and shrub planting for wildlife, habitat enhancement (e.g. construction of nesting platforms), in-stream fisheries habitat enhancement and riparian and wetland projects, as well as projects involving the creation of landscape corridors.*

- *It will be important to dedicate an annual amount of funds for a provincial woodlot program.*
- *This should also include some staff, dedicated to private forestry concerns. Funding for the program could come in part from matching funds from private concerns such as major Industrial Forest Companies that have an interest in woodlot management. Other opportunities could include levies on stumpage fees to go towards woodlot related programs.*
- *Partnerships between departments within the government require improvement. The departments of forestry, municipal affairs, and agriculture will need to work together to balance land use in the White Zone.*
- *Policies from one department that may have affect the other, should be reviewed by the potentially affected department.*
- *The creation of a committee for White Zone matters would go a long way to ensuring landscape components of biodiversity are preserved. Such a committee should have representatives from the forestry sector, members of the WAA, the agricultural sector, and relevant municipal districts.*

8.5 RECOMMENDATIONS TO THE WAA

Recommendations to the WAA deal with incentive programs, connections with agencies related to woodlot matters and developing relationships with Alberta colleges and universities. With financial assistance from the province, the re-establishment of woodlot owner education programs is a definite priority for the WAA. Development of partnerships with universities and local colleges is also a priority and should be implemented as soon as possible.

- *The association could help to develop programs similar to the Habitat Steward Program in other regions of the province.*
- *The WAA could start a Woodlot Owner of the Year program where woodlot owners in different categories such as wood production, habitat steward, value-added*

management, etc. could be determined. Recognition could involve a profile in the Log Jam Newsletter and on the WAA webpage. As well, a field day could be held on the woodlot owner's property in honor of their contribution to sustainable woodlot management.

- *The development of partnerships with Alberta colleges and universities would be a beneficial move by the association. Through coursework or thesis projects university students could benefit from projects that the association could offer such as the development of individual management plans for woodlot owners or more general reports on subjects such as connecting woodlots together at the regional level.*
- *A code of practice could be developed to deal with issues such as: wetlands and other sensitive areas, responsible woodlot management activities, forest protection, regeneration methods, etc.*
- *The WAA should make themselves available for the provision of information or members for committees on White Zone matters.*
- *The WAA could provide information to existing databases that identify priority land parcels or areas harboring biodiversity. Examples include the Alberta Natural History Information Committee (ANHIC), the Conservation Data Centre (CDC) and the Nature Conservancy of Canada.*

8.6 RECOMMENDATIONS TO MUNICIPAL DISTRICTS

The land-use-planning regime of municipal districts has the potential to influence woodlots in Alberta. The following recommendations examine opportunities with municipalities to address woodlot management.

- *There is the potential for voluntary intermunicipal agreements to form intermunicipal planning commissions and development plans. Such agreements could examine issues of future land use in the region and the manner of and proposals for future development.*

- *There is a requirement that municipalities that are in the process of developing an area structure plan must notify adjacent municipalities and provide opportunity for suggestions. This provides opportunities for examining landscape scale components of biodiversity.*

8.7 RECOMMENDATIONS FOR CHANGES TO TAX POLICY

The following recommendations address the federal income tax policy and provincial property assessment tax. Both of these factors are acting as significant barriers to sustainable woodlot management are therefore priority concerns.

FEDERAL TAX POLICY

1. *Recognition of small woodlot owners as a special class of taxpayer*
2. *Ability to access unlimited deductibility from income of forest development expenses and deductibility of the cost of timber stands in the year of woodlot purchase.*
3. *Ability to employ the cash basis of accounting, and to consider a woodlot as an income-earning asset or as a capital asset.*
4. *Capital gains eligibility*
5. *Access to a number of tax credits and shelters to promote woodlot purchase and forest development.*

MUNICIPAL/PROVINCIAL PROPERTY TAX ASSESSMENT

A program similar to the Ontario Managed Forest Tax Incentive Program would be beneficial in Alberta as a means of eliminating property assessment disincentives. The program should require an approved woodlot management plan, and should recognize the diversity of woodlot management types. Such a program could fit within a provincial woodlot extension service and would provide employment opportunities for those interested in becoming accredited as woodlot management plan evaluators.

8.8 CONCLUSIONS

With programs such as forest certification on the horizon, and the potential for an increase in private land harvest levels, achieving sustainable woodlot management is becoming increasingly important. Conserving biodiversity and achieving sustainbility on private forest lands in Alberta will require both minor changes in management by individual land owners and an increase in assistance (financial and educational) from the province. A review of other jurisdictions by the province and the WAA will help in developing the Alberta woodlot program. This program will need to recognize the range of values for which Alberta woodlots are managed. The best approach is to use a wide range of incentives, both economic and social, coupled with a diversity of educational approaches. The WAA should play a large role in the development and operation of the Alberta woodlot program. As the program increases, the WAA might want to divide into regions to better represent woodlot owners from the various natural subregions of the province. Achieving sustainable woodlot management and conserving biodiversity is not an "over-night" task. It will take time, long-term vision, and a humble approach.

What is a course of history or philosophy, or poetry, no matter how well selected, or the best society, or the most admirable routine of life, compared with the discipline of looking always at what is to be seen? Will you be a reader, a student merely, or a seer? Read your fate, see what is before you, and walk on into futurity - Henry David Thoreau[1]

[1] Thoreau, H.D. 1993. Faith in a seed. Island Press. Washington, D.C.

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PERSONAL COMMUNICATIONS

Pharis, H. Private woodlot owner, Crowsnest Pass. July 22, 1998.

Bank, G. District Manager, PFRA, Red Deer, AB. August 23, 1998

Grundberg, B. Private woodlot owner and Forestry Consultant. July 27, 1998

Kerr, G. Private woodlot owner and Environmental Consultant. July 7, 1998

Cooper, B. Alberta Forest Service. Timber Management Branch. February 10, 1998.

Whidden, A., Forest Management Director, Private Land Program (NS), April 7, 1999

Whynot, T., Extension Forester, Private Land Program (NS), April 7, 1999

Brown, B., Manager, Private Land Program (PEI), April 5, 1999

Van der Schoot, P. Woodlot Owner, Breton, AB. July 28, 1998.

APPENDIX 1 – LIST OF WOODLOT SITES VISITED

Woodlot Owner	Date of Visit	Location	Natural Subregion
1	July 7/98	Near Water Valley	Foothills Parkland
		Crowsnest Pass	Montane
2	July 15/98	Near Westerose	Dry Mixedwood
3	July 17/98	West of Cochrane	Montane/Foothills Parkland
4	July 22/98	NW of Lundbreck	Montane
5	July 23/98	Near Beaver Mines	Montane
6	July 27/98	NW of Bonnyville	Central/Dry Mixedwood
7	July 28/98	West of Breton	Dry Mixedwood
8	September 7/98	NW of Athabasca	Central/Dry Mixedwood
9	September 8/98	NW of Larkspur	Central/Dry Mixedwood
10	September 8/98	NW of Athabasca	Central/Dry Mixedwood
11	September 9/98	NE of Athabasca	Dry Mixedwood
12	September 9/98	N of Athabasca	Dry Mixedwood
13	September 9/98	N of Athabasca	Dry Mixedwood
14	September 10/98	E of Athabasca	Dry Mixedwood
15	September 10/98	E of Athabasca	Dry Mixedwood
16	September 10/98	Near Barrhead	Dry Mixedwood
17	September 10/98	Near Whitecourt	Lower Foothills
18	September 11/98	Near Onoway	Dry Mixedwood/Central Parkland
19	September 11/98	Near Edson	Lower Foothills
20	September 12/98	Near Smoky Lake	Dry Mixedwood

APPENDIX 2 – THE STATUS OF ALBERTA WILDLIFE

Source: Alberta Environmental Protection. 1996. The status of Alberta wildlife. Natural Resources Service. Wildlife Management Division. Edmonton, AB.

RED LIST – Species are at risk. Populations have declined to nonviable levels, or show a rate of decrease indicating they are at immediate risk of declining to nonviable levels in the province.

BLUE LIST - Species may be at risk. Includes species that are particularly vulnerable because of non-cyclical declines in population or habitat, or reductions in distribution.

YELLOW LIST – Sensitive species not currently believed to be at risk but may require special management to address low populations, limited distributions, or life history features that make them vulnerable.

A – Category A species have demonstrated declines and may be close to blue listing

B – Category B species may require management to ensure they don't end up in trouble and include: naturally rare but not in decline, naturally rare with clumped breeding distributions; and species associated with habitats or habitat elements that are, or maybe, deteriorating.

RED LIST

Burrowing Owl
Canadian Toad
Great Plains Toad
Northern Leopard Frog
Peregrine Falcon
Piping Plover
Swift Fox
Whooping Crane
Wood Bison

BLUE LIST

Bay-breasted Warbler
Black-throated Green Warbler
Cape May Warbler
Ferruginous Hawk
Grizzly Bear
Long-billed Curlew
Northern Long-eared Bat
Ord's Kangaroo Rat
Plains Spadefoot Toad
Prairie Rattlesnake
Red-tailed Chipmunk
Sage Grouse
Short-eared Owl
Short-horned Lizard
Spotted Frog
Sprague's Pipit
Trumpeter Swan
Western Hognose Snake
Woodland Caribou
Wolverine

YELLOW A LIST

American Bittern
Badger
Baird's Sparrow
Black Tern
Brown Thrasher
Clay-coloured Sparrow
Harlequin Duck
Horned Grebe
Lesser Yellowlegs
Loggerhead Shrike
Long-tailed Weasel
Northern Harrier
Plains Garter Snake
Pied-billed Grebe
Prairie Falcon
Red-necked Grebe
Red-sided Garter Snake
Richardson's Ground Squirrel
Sharp-tailed Grouse
Swainson's Hawk
Thirteen-lined Ground Squirrel
Upland Sandpiper
Wandering Garter Snake
Western Meadowlark

YELLOW B LIST

American Avocet
American Dipper
American White Pelican
Bald Eagle
Barred Owl
Black Swift
Black-and-white Warbler
Black-backed Woodpecker
Black-crowned Night Heron
Black-necked Stilt
Bobcat
Bobolink
Boreal Owl
Brewer's Sparrow
Broad-winged Hawk
Brown Creeper
Bull Snake
Canada Lynx
Canada Warbler
Caspian Tern
Chestnut-sided Warbler
Clark's Grebe
Clark's Nutcracker
Cooper's Hawk
Cougar
Double-crested Cormorant
Fisher
Forster's Tern
Golden Eagle
Golden-crowned Sparrow
Grasshopper Sparrow
Great Blue Heron
Great-crested Flycatcher
Great Gray Owl
Herring Gull
Hoary Marmot
Lark Sparrow
Long-toed Salamander
Marsh Wren
Mountain Goat
Mountain Plover
Mourning Warbler
Northern Flying Squirrel
Northern Goshawk
Northern Grasshopper Mouse
Nuttall's cottontail
Olive-backed Pocket Mouse
Osprey
Pileated Woodpecker
Pronghorn
Ring-necked Pheasant
Rock Wren
Sandhill Crane
Sedge Wren
Townsend's Warbler
Turkey Vulture
Wandering Shrew
Water Vole
Western Flycatcher
Western Grebe
Western Harvest Mouse
Western Painted Turtle
Western Small-footed Bat
Western Tanager
White-faced Ibis
Willet
Winter Wren
Yellow-breasted Chat

APPENDIX 3 – MONITORING PROGRAMS

The following is a cross-section of some monitoring programs including both government and non-governmental programs that may be applicable to your area and species complement. If you feel you would like to contribute to the program in terms of information on the species/group of species in question contacts are listed. Some programs require a service charge to participate.

ALBERTA AMPHIBIAN MONITORING PROGRAM
Contact the Natural Resource Service for information.
Lisa Takats (403) 422-9533

ALBERTA BIRD CHECKLIST PROGRAM
Monitoring program using checklists throughout the year.
Contact FAN for information.
Glen Semenchuk (780) 427-8124 or Trevor Wiens (780) 427-8124

CHRISTMAS BIRD COUNT
Surveys wintering populations of birds throughout North America.
Contact the Canadian Wildlife Service for information.
Brenda Dale (403) 951-8686 or Geoff Holroyd (403) 951-8689.

SPRING BIRD COUNT
Collects information on both breeding and non-breeding species found in Alberta.
Contact the Federation of Alberta Naturalists (FAN) for information.
Glen Semenchuk (780) 427-8124 or Trevor Wiens (780) 427-8124

BAT HOUSE PROGRAM
Bat house owners collect information on species numbers, habitat characteristics, and bat house characteristics.
Contact the Bat Conservation Society of Canada for information.
(403) 860-BATS

SPRING MAMMAL COUNT
Records sightings of all non-domestic mammals while collecting vegetation data for the Spring Flower Count.
Contact FAN for information.
Glen Semenchuk (780) 427-8124 or Trevor Wiens (780) 427-8124

COAST-TO-COAST MOTH AND BUTTERFLY SURVEY
Monitoring of seven butterfly species and two moth species across Canada.
Contact the Canadian Wildlife Federation for information.
Susan Baumgartner
2740 Queensview Dr.
Ottawa, ON
K2B 1A2

LADYBUG SURVEY
Survey of ladybugs across the country.
Contact the Canadian Nature Federation.
Jennifer Benson (613) 562-3448

SPRING FLOWER COUNT
Monitors both native and non-native flowering plants in Alberta.
Contact the Alberta Native Plant Council or FAN
Glen Semenchuk (780) 427-8124 or Trevor Wiens (780) 427-8124

APPENDIX 4 - SOURCES OF NATIVE PLANTS AND SEEDS

ALCLA Native Plant Restoration
3208 Bearspaw Dr. N.W.
Calgary, AB T2L 1T2
(403) 282-6516
Native grasses and wildflowers from seeds and plants

Alberta Native Plant Council
Garneau P.O. Box 52099
Edmonton, AB T6G 2T5
Promotes conservation of native plants

Alberta Nurseries and Seeds Ltd.
P.O. Box 20
Bowden, AB T0M 0K0
(403) 224-3544
Seeds and plants for the north

Grumpy's Greenhouses and Gardens
P.O. Box 2488
Pincher Creek, AB T0K 1W0
(403) 627-4589
Seeds and cuttings from the SW foothills

The Hillson Nursery
P.O. Box 39
Rochester, AB T0G 1Z0
(403) 698-3956
Native woody and herbaceous species

Northern Vigour Seeds Ltd.
P.O. Box 67
Sexsmith, AB T0H 3C0
(403) 532-1344
Plants native to northern AB, especially wetland species

APPENDIX 5 – EXAMPLE WOODLOT WEB-PAGES

New Brunswick Department of Natural Resources and Energy – Forest Extension Service: http://www.gov.nb.ca/dnre/fes/index.htm

Nova Scotia Department of Natural Resources – Private Land Programs
http://www.gov.ns.ca/natr/regional/private/privland.html

Nova Scotia Department of Natural Resources – Home Study Courses
http://www.gov.ns.ca/natr/regional/extension/homestudy.html

Ontario Ministry of Natural Resources Private Forest Lands Site:
http://www.mnr.gov.on.ca/MNR/forests/corridor/private_forests.html

Washington Natural Resources Agency Private Land Stewardship Program
http://www.wa.gov/dnr/htdocs/rp/steward.htm

The Land Stewardship Resource Page
http://www.landstewardship.org

APPENDIX 6 – CONTACTS

The following groups have information or are involved with woodlots and wildlife habitat and may be able to advise you on different aspects of your woodlot.

Alberta Conservation Association

6th floor, 9920 - 108 Street
Edmonton, Alberta
Canada, T5K 2M4
Phone: (780) 427-5192
Fax: (780) 422-6441
E-Mail Address: neraasen@connect.ab.ca

Incorporated as a non-profit society, the Alberta Conservation Association is a separate legal entity, independent of government. Several Alberta organizations joined together to form the Alberta Conservation Association (ACA) and assume responsibility for many of the Fish and Wildlife Trust Fund programs and activities formerly administered by the provincial government. The organizations include: Alberta Fish and Game Association, Alberta Trappers' Association, Federation of Alberta Naturalists, Grand Council of Treaty 8 First Nations, Professional Outfitters Association of Alberta, Trout Unlimited Canada, Western Walleye Council. Major activities include: providing grants to other organizations and agencies to implement habitat conservation projects and wildlife research; co-ordinating the Buck for Wildlife Program; co-ordinating the Fisheries Habitat Program and the Report-a-Poacher Program.

Alberta Environmental Protection – Natural Resources Service

2nd Floor, Bramalea Building, 9920-108 Street
Edmonton, Alberta
Canada, T5K 2M4
Phone: 427-6735
Fax: (780) 422-9560
Website: http://www.gov.ab.ca/~env

A division of this provincial government department that includes: Wildlife Management, Fisheries Management, Water Management and Forestry Management.

Alberta Fish and Game Association

6924 - 104 Street
Edmonton, Alberta
Canada, T6H2L7
Phone: (780) 437-2342
Fax: (780) 438-6872
Website: http://www.afga.org/
E-Mail Address: office@afga.org

An incorporated non-profit provincial organization established in 1908. Major activities: sponsoring hunter education programs and firearm safety; participating in public policy development activities; organizing volunteer conservation programs including the Parkland Stewardship Program, Operation Grassland Communities, and the Alberta Heritage Farmstead Program. The association has also sponsored several videos and other educational resources promoting the conservation of wildlife habitat.

Alberta Wilderness Association

Box 6398, Station D
Calgary, Alberta
Canada, T2P2E1
Phone: (403) 283-2025
Fax: (403) 270-2743
E-Mail Address: awa@web.net

An incorporated and registered charitable non-profit wilderness advocacy organization with two chapters in Alberta, and a provincial office in Calgary. The AWA was founded in 1968. Major activities include: conducting research on Alberta's wild lands; publishing books on wilderness topics; representing members at public hearings and planning sessions; advocating wilderness protection policies; running resource centres; and sponsoring public education workshops and conferences. The association publishes a newsletter called the Wildlands Advocate.

Ducks Unlimited

200, 10720 178 St.
Edmonton, Alberta
Canada, T5S 1J3
Phone: (780) 489-2002
Fax: (780) 489-1856 DU National headquarters: 1-800-665-DUCK (3825)
Website: http://www.ducks.ca
E-Mail Address: du_edmonton@ducks.ca

Ducks Unlimited (DU) is one of the largest wildlife conservation organizations in the world. Its activities in Alberta are concentrated in a package of programs called Alberta Prairie CARE, which is available to farmers and ranchers in landscape areas with relatively high wetland densities. The program offers financial and technical assistance to protect wetlands and implement land management practices that provide benefits to wildlife while improving grass conditions, soil and water resources for agricultural production. The main program tools are: Land-use Exchange; Conservation Demonstrations; Managed Grazing Systems; Conservation Lease Agreements; Delayed Haying; Flushing Bars; Preserving and Managing Prime Wildlife Habitat; Securing and Enhancing Wetlands; Conservation Easements; Maintaining and Enhancing Habitat Diversity; and Installing Nest Structures. DU also has programs for youth and activities for general audiences designed to raise awareness about the importance of wetlands. DU is the co-ordinating agency in Alberta for delivering the North American Waterfowl Management Plan (NAWMP) - a continental wetland habitat and waterfowl recovery effort. NOTE: Please contact the Ducks Unlimited provincial office for general inquiries. For program inquiries, contact the DU regional office nearest you: Grande Prairie 532-7960; Edmonton 489-2002; Camrose 672-6786; St. Paul 645-4767; Red Deer 342-1314; Bashaw 372-3598; Wainwright 842-5225; Tofield 662-3810; Hanna 854-3737; Brooks 362-4827; Strathmore 934-3102; Lethbridge 328-8155.

The Nature Conservancy

Suite 320, 602 - 11th Avenue SW
Calgary, Alberta
Canada, T2R 1J8
Phone: (403) 262-1253
Fax: (403) 515-6987 Note: The national office is located in Toronto, phone (416) 932-3202.
Website: http://www.tnc.org/
E-Mail Address: nature@natureconservancy.ca

A national organisation incorporated in 1962 as a registered, charitable organisation. Its primary purpose is to arrange for the purchase, or receipt through donation or conservation easement of natural lands. The organisation works with interested private landowners and often participates in cost-shared habitat preservation projects with industry, non-government organisations, foundations and governments. It has created over 600 nature preserves, protecting more than 1 million acres. Two major profile projects in Alberta include the Cross Conservation Area outside Calgary and the Elkhorn Stock Ranch demonstration project in south-western Alberta

Federation of Alberta Naturalists

Box 1472
Edmonton, Alberta
Canada, T5J2N5
Phone: (780) 427-8124
Fax: (780) 422-2663
Website: http://www.connect.ab.ca/~fan
E-Mail Address: fan@connect.ab.ca

Established in 1970, the federation represents approximately 12 naturalist clubs in Alberta. It is an incorporated, non-profit society. FAN produces several books on Alberta's natural history, including the Alberta Breeding Bird Atlas. Other major activities include: conducting species counts, May and Christmas bird counts; organizing symposia, workshops, field meetings and conferences; providing public education through displays, field trips and other resource materials.

Nature Trust Alberta

RR2
Gwynne, Alberta
Canada, T0C1L0
Phone: (403) 352-3232

A non-profit charitable land trust organization dedicated to assisting private landowners in conserving non-arable portions of their land as wildlife habitat through voluntary, legally-enforceable private action (e.g. conservation easements). The organization is governed by a Board of Trustees, and funded by private and public sector sponsors

The Southern Alberta Land Trust Society (SALTS)

P.O. Box 327
Pincher Creek, Alberta
Canada, T0K 1W0
Phone: (403) 627-4230
Fax: (403) 627-4230

The Southern Alberta Land Trust Society (SALTS) is a non-profit organisation that utilises the common dependency of both ranchers and wildlife on large unbroken landscapes and a healthy, productive environment to develop innovative ways to conserve natural areas and promote responsible land stewardship. SALTS is a community-based organisation that accomplishes its goals through voluntary agreements and public education. Major activities include: 1) Constructing and administering conservation easements; 2) Encouraging environmentally compatible land use; 3) Fostering co-operation among organisations on land conservation projects and; 4) Educating the public about the environmental, economic, and cultural values of preserving natural landscapes.

Trout Unlimited Canada

Box 6270, Station D
Calgary, Alberta
Canada, T2P2C8
Phone: (403) 221-8360
Fax: (403) 221-8368
Website: http://www.cadvision.com/tuc/
E-Mail Address: tuc@cadvision.com

A federally chartered, private, non-profit organization established in 1985. Major activities include: protecting and enhancing trout streams through habitat conservation and management programs in co-operation with landowners and other conservation agencies; providing input to public policy on water management as it impacts fish habitat, and to government regulation of angling; conducting public education programs including courses, displays, and speaking.

Wildlife Habitat Canada

7 Hinton Avenue North, Suite 200
Ottawa, Ontario
Canada, K1Y4P1
Phone: (613) 722-2090
Fax: (613) 722-3318

E-Mail Address: jfortune@whc.org

A non-profit, national organization established in 1984, dedicated to conserving, retaining and enhancing wildlife habitat in Canada. In addition to its grants program, WHC is also involved in advocating for policy change regarding resource development and conservation issues - especially fisheries, agriculture, and forestry. WHC also offers administrative assistance to other agencies working on wildlife projects.

Woodlot Association of Alberta

Room 101, 10526 Jasper Avenue
Edmonton, Alberta
Canada, T5J 1Z7
Phone: (780) 424-0286

A nonprofit association established by woodlot owners. It is run by a volunteer board of directors representing the various regions of the province. Major activities include: providing opportunities for networking with other woodlot owners, access to technical information and assistance, publishing a newsletter, and presenting on a regular basis tours, demonstrations and seminars for members and other interested individuals. The association is also involved in policy work to advocate for improved sustainability of privately-owned woodlands.