Acadian Forest Stewards:
a literature critique, book composition, and validation of the book concerning forest ecology and Forest management in Nova Scotia

by

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Abstract

The Acadian Forest is an integral part of the social and economic fabric of Nova Scotia. The forestry industry in Nova Scotia generates over a billion dollars a year (National Forestry Database, 1995). As well, forests are important as part our ecological life support system. Historically, forest management has left the Acadian Forest in poor condition (Swift 1983, DNR 1987-91). Forest Management needs to be improved, especially since increasing pressures on the wood supply are making more intensive management necessary. For example, the Nova Scotia Government plans to double the amount of wood harvested, from 3.9 million cubic metres, by the year 2025 (MacFarlane and MacDonald, 1993). As pressures on the Acadian Forest increase it becomes more and more important to have good educational materials available to our high school students who will be the next generation of foresters and citizens. A comprehensive critique of materials presently available to high school students in Nova Scotia shows that such material is not available in Nova Scotia. Thus I have written a book on forestry and forest ecology in Nova Scotia, targeted at the high school comprehension level. This book focuses on a merging of ecological issues with economic realities. The main themes are: Holistic forestry, Stewardship, Integrated Resource Management and Forestry/wildlife issues. The book is written as a story of a family and their woodlot, as well as a text book on forestry, and forest functions and values. To assess the accuracy of the information presented in the book a validation test was conducted. This test evaluates the information in terms of depth, comprehension, accuracy and style. The result of the validation test is an overwhelming endorsement of the book as an educational tool for high school students.

Acknowledgments

To start, I wish to express my sincerest respect and gratitude to my parents for their financial and emotional support throughout my academic career. Throughout the researching and writing of this thesis there have been many people that deserve recognition for their time and energy spent helping me. I wish to thank Dr. Søren Bondrup-Nielsen for his creative and financial support without which this thesis would not have been possible; his patience and good humor helped me struggle through some rough moments in this venture. Dr. Tom Herman for his advice, guidance, and editing. Glyn Bissix for his insight and editing. Dr. Olga Kukal and Tom Allen for their generosity in giving me the time and financial means to complete this thesis. Also, I would like to thank Stora Inc. for their generous financial support for this project. I also wish to thank all twelve reviewers who took the time to read and critique my book. Their time and energy are greatly appreciated. Though I am indebted to all the reviewers there are a few who went the extra mile that made all the difference to this thesis. They are: Dr. Ian Methven, Randy Milton, and Russ Waycott; please accept my sincerest gratitude. I also wish to express my appreciation of and respect for the faculty, staff, graduate and honours students of the biology department who have been a great source of inspiration and support throughout my tenure at Acadia.

Chapter 1: Introduction

Why a Book on Forestry and Forest Ecology in Nova Scotia?

The forests of Nova Scotia are eminently important both as an economic base and as part of our biological life support system. The forests help provide clean air, prevent soil erosion, protect rivers and streams, and filter water; the forest is also an important economic resource. Due to the unique ownership pattern of forested land in Nova Scotia the concerns and problems associated with our forest industry are also unique when compared to those of other provinces. Approximately three quarters of the Nova Scotian forests are privately owned. As pressure on these private woodlots for forest products increases, it is increasingly important that private woodlot owners and the general public become aware of, and educated about, the state of our forests. As we head into the twenty-first century the burden of caring for our forest will fall on our children. The next generation of foresters and citizens will have a great responsibility before them. Thus it is critically important for those leaving secondary school to be educated in matters concerning ecology and forestry in Nova Scotia. The question arises: Are our high school students being taught enough about forest ecology to make wise decisions in the future?

After reviewing the materials available to high school students, and to woodlot owners in general, I have come to the conclusion that more educational materials are needed. We need educational materials that both teach general forest and wildlife ecology and focus on the Nova Scotia forest biome (the Acadian Forest). Thus I have written a book that teaches forest ecology, but also concentrates on the biophysical makeup of the Acadian Forest. This book also addresses the problems and issues facing the Nova Scotia forest industry. This book incorporates ecological concepts with integrated forestry/wildlife management.

The Acadian Forest:

Nova Scotia is part of the Acadian Forest region, which also includes P.E.I., and central and southern New Brunswick (Rowe, 1972). The Acadian Forest marks the transition between the warmer southern deciduous forest and the cooler northern Boreal forest (Davis, 1993). The makeup of the Acadian Forest reflects the influence of both forest types; it consists of many mixed wood and some pure deciduous and pure coniferous stands. Some areas, i.e. the northern plateau of Cape Breton, are boreal in composition (balsam fir), while other regions are dominated by sugar maple/yellow birch stands. Though much work has been carried out on the Boreal forest, little attention has been given

to the Acadian Forest. The variety of stand types and composition of the Acadian Forest present special problems for management. Thus an approach specifically designed for the Acadian region is needed for the Maritimes.

In the Acadian Forest the dominant softwoods include red and white spruce (*Picea rubens* and *Picea glauca*), and balsam fir (*Anbies balsamea*). There are also red and white pine (*Pinus resinosa* and *Pinus strobus*), eastern hemlock (*Tsuga canadensis*), black spruce (*Picea mariana*), and jack pine (*Pinus banksiana*). The dominant hardwoods are yellow birch (*Betula alleghaniensis*) and sugar maple (*Acer saccharum*). There are also beech (*Fagus grandifolia*), red oak (*Quercus rubra*), white elm (*Ulmus americana*), black ash (*Fraxinus nigra*), red maple(*Acer rubum*), white and gray birch (*Betula papyrifera* and *Betula populifolia*), trembling aspen (*Populus tremuloides*), and largetooth aspen (*Populus grandidentata*) (Rowe 1972, DNR 1987). The soil is mostly podsols with slow decomposition rates. The climate is characterized by cold winters with much snow fall with a mean January temperature of - 9° C, and warm summers with a mean July temperature of 19° C (Aber and Melillo, 1991).

The Demographics of the Acadian Forest:

The Maritimes are unique with respect to the ownership pattern of forested land. The National average of privately owned forest land is 9% (MacFarlane and MacDonald 1993, CCFM 1992). In Nova Scotia approximately 70% of the forested land is privately owned (*Ibid*), (this is only exceeded by P.E.I. where approximately 90% of the forested land is privately owned (CCFM 1992)). Of that 70%, in Nova Scotia, over half is owned by small wood lot owners (MacFarlane and MacDonald 1993, and DNR 1989). A small wood lot is classified by the Nova Scotia government as being < 400 ha. (MacFarlane and MacDonald 1993, DNR 1994). Over half of the wood harvested in Nova Scotia is from small woodlots (DNR 1994). There are over 30,000 small woodlot owners in Nova Scotia (DNR 1994).

Due to this ownership pattern the social, economic, and political influences of forestry are quite different from those provinces where most of the forest is crown land. This creates a unique situation for the Nova Scotia forestry industry.

The vast numbers of woodlot owners and the ownership pattern are products of the history of forestry in this province. Unfortunately that history has been largely one of mismanagement and over exploitation of the resource (Swift 1983, DNR 1994, Sandberg 1992). The practice of highgrading in the past has left the forest in poor commercial shape (Ibid). Due to this we may be facing future wood shortages. New and better forestry

practices are needed if our forests and industry are to survive into the next century.

Presently we harvest approximately 3.9 million cubic metres of wood from Nova Scotian forests per year (MacFarlane and MacDonald 1993). By the year 2025 the forestry sector hopes to double the amount of wood harvested (MacFarlane and MacDonald, 1993). To insure sustainable forest management it is important to have educational materials that explain the key issues underlying sustainable forestry in the Acadian Forest. One important strategy is to educate Nova Scotian young people about natural forest resources. This study attempts to validate a book, targeted at the high school level, designed to teach general forest ecology and synthesize forestry and wildlife concerns, while focusing on the Nova Scotia biome.

Outline:

The information vehicle of the book is a story of a family, the MacKenzies, who operate a small (351 ha., or 847 ac.) woodlot in southwestern Nova Scotia. Each family member personifies one of the varying view points concerning the forests, i.e. economy, ecology, and recreation. Through conversations and problem solving the family demonstrates holistic forest management techniques, thus managing for **all** of these forest functions.

In the second section of the book I examine the vital functions the forest community plays. Once these have been established, all other sections will refer back to these functions. This means that all aspects of forest use and management will be judged by their impact on the forest's ability to maintain those functions.

The book operates on several levels: first, the family will discuss problems and concerns about their woodlot; introducing students to management techniques and giving information on forest functions. Second, the text component gives detailed information on forest function and forestry in Nova Scotia. Third, there are boxes, set apart from the general text. These boxes contain detailed technical and scientific information about management techniques and biophysical functions. The reader can approach the book from varying vantage points: a story about living with the forest; an overview of forest function and forestry in Nova Scotia; and detailed information on bio-physical functions and management techniques.

Thesis objectives:

1) To critique existing materials concerning forest ecology and forest management that are written at/for the high school comprehension level.

2) Write an educational text book that: a) teaches the major concepts of forest

ecology and forest management specific to the Nova Scotian Acadian Forest at the high school level; b) demonstrates and teaches holistic forest management, including Integrated Resource Management and forest stewardship; c) write an unbiased, well balanced text that gives the readers the necessary information to form their own opinions concerning forestry issues.

3) Design and conduct a validation test that will evaluate the book's information accuracy and depth, as well as the book's usefulness as an educational text at the high school level.

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Chapter 2: Literature Critique

Critique of available forest educational materials for the High School Level:

The following is a critique of the materials currently available in the curriculum library of the Department of Education of Nova Scotia. The review is not meant to judge the credibility of those materials, but rather to suggest whether or not the materials deal with biogeography, ecology, forestry, wildlife and Nova Scotian issues.

Forest ecosystems, community structure, biophysical functions, and diversity are all interrelated. To teach ecology successfully teachers must convey the concept of the interdependence of natural systems. Therefore the critique will also assess how well these materials integrate general ecological concepts with forestry, recreation and wildlife issues.

Biology: the study of life, third edition, Schraer and Stalatze (1990). This is a general introductory biology text for grades eleven and twelve. Like most general biology texts it covers all the main topics: organization of life, cellular biology, anatomy, animal and plant physiology amongst others. The last chapter is dedicated to ecology. This is a general survey of the basic concepts in ecology, such as diversity, ecosystems, and biomes. There are only two paragraphs that deal with forest issues, on page 717. Wildlife issues receive similar coverage on the same page.

There is inadequate explanation of the function, and importance, of forest communities. Though the text talks about biomes, it does not discuss the biome in which we live (the Acadian Forest); and there is no discussion on integrating wildlife and forestry issues.

Biological Science: An Ecological Approach, sixth edition, BSCS green version, Barman *et al.* (1989). Again this a general introductory biology text. The topics covered are similar to the previous listing (i.e. cellular biology, divisions of life, etc.). Though billed as an 'ecological approach' there is little difference between this and Biology: the study of life. There is, however, more discussion on ecology, community structure, succession, and nutrient cycling than in the previous text.

Even with an ecological tint, this text does not have a substantial discussion on forestry, wildlife, or the Acadian Forest region.

Issues for Today: Canadian environmental concerns, Marean, Ritter, and George (1985). This is a reference text designed to promote discussion on environmental issues. It covers issues such as greenhouse gases and fossil fuels, herbicides and their effect on wildlife. Yet there is no discussion of the impact of industrialization on forest ecosystems, nor is there a discussion of the effects of forestry on ecosystem integrity. In fact there is no discussion of forestry issues at all.

Investigating Terrestrial Ecosystems, Andrews and Moore (1986). There is also a companion book Investigating Aquatic Ecosystems, Andrews and McEwan (1987). This reference text looks at ecology from a 'community structure' perspective. Some of the topics covered are primary and secondary succession, nutrient and carbon cycling, energy flow, and woodlot management. There are field trip suggestions and activities that demonstrate the concepts being taught. This is an excellent introductory guide to field ecology.

In terms of Nova Scotia and the Acadian Forest this book is not appropriate. Though it does discuss particular biomes, this book does not mention the Acadian Forest. The examples used center on the Great Lakes Region of the U.S.A.. The book does, however, attempt to integrate forestry, recreation, and habitat needs. Unfortunately these sections are too brief, and lack sufficient detail. This book is, however, in my opinion, the best book in the Nova Scotian curriculum to date.

The curriculum guide (1990) calls for a biology program that explains community and change, energy relationships and environmental issues as well as basic biological principles. In addition, ecological processes are to be covered. Given these criteria, I argue that students would be better served by a program that focused on the ecology of this region, examples and demonstrations will be already familiar to the student. This will benefit the student in two ways: 1) Familiarity with the area will facilitate learning because the student has a direct connection to the area, and 2) it will educate students about Nova Scotian issues, and thereby provide the intellectual tools to make informed decisions about Nova Scotia in the future.

Other material available to the public, and written at a high school level, is the Woodlot Management Home Study Course, produced by the Nova Scotia Department of Natural Resources. The course is designed to educate woodlot operators about good forestry techniques.

Woodlot Management Home Study Course. Nova Scotia Department of Natural Resources. The Study course consists of seven modules each focusing on a different aspect of forestry. Each module is sub-divided into lessons geared toward instruction in one aspect of forest management. At the end of each lesson there is a True or False quiz. At the time of the review the course consisted of: Module 1: Introduction To Silviculture; Module 2: Harvesting Systems; Module 3: Stand Spacing; Module 4: Wildlife And Forestry; Module 5: Stand Establishment; Module 6: Chainsaw Use And Safety; and Module 7: Woodlot Ecology.

The following is a summary of a critique of the Woodlot Management Home Study Course (Alcorn, 1995): The study course succeeds in explaining harvesting, spacing, and cleaning techniques. Its attention to detail and practical information is excellent. Yet the study course fails in some of its main objectives (to promote IRM and stewardship). The study course concentrates too heavily on harvesting and extraction: Modules 1, 2, and 3 are dedicated to commercial concerns, to the exclusion of all other concerns, i.e. ecological or sustainability. The concepts of integrated resource management and stewardship are not properly defined. Due to this lack of definition the study course fails to promote these 'good forestry' practices. The main problem with the study course is that the sections dealing with ecological and wildlife concerns are separated from the rest of the modules. Modules 4 and 7 (wildlife and ecology, respectively) often contradict the recommendations presented in the other modules. These contradictions of what is good forestry seriously weaken the course's ability to teach and promote good forestry practice. Furthermore, a lack of integration of other forest values with the practical management techniques leaves the study course wanting. The course is fragmented, and this fragmentation of information reduces its ability to promote IRM or forest stewardship effectively. In order to practice IRM and forest stewardship all aspects of forestry and forest needs must be integrated. Therefore the discussions concerning the non-economic values of the forest must also be integrated with the economic management strategies.

There is a fixation on clearcutting, which is deleterious to the goals of the study course, i.e. the promotion of IRM and forest stewardship. This concentration on clearcutting only serves to maintain the *status quo*. Clearcutting is primarily concerned with economic efficiency. For new and better sustainable forestry practices to take hold in Nova Scotia we must promote forestry practices that benefit all aspects of forestry, not just economic concerns. The study course should promote all harvesting systems in their appropriate situations.

The study course fails to satisfy the goals set out for itself in the first module.

Conclusion: None of the books available at the high school level focus on Nova Scotia; most do not explain forestry or wildlife issues. Clearly there is need for such a book! There is a need for education materials that present ecological processes, integrated forestry and wildlife issues in the Acadian Forest. These materials must target the high school level, which will include students and also be accessible to woodlot operators who may or may not have post secondary training. Chapter three of this thesis is such a book, Acadian Stewards: living with and from the trees in Nova Scotia.

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Module 1: Introduction to Silviculture.
Module 2: Harvesting Systems.
Module 3: Stand Spacing.
Module 4: Wildlife and Forestry.
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Module 6: Chainsaw Use And Safety.
Module 7: Woodlot Ecology.

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Chapter 3:

Acadian Forest Stewards:

Living with and from the trees in Nova Scotia.

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How to use this book

This book has been written to optimize learning potential. It operates on several levels. One, it is a pictorial essay of forest functions and forestry in Nova Scotia. On a higher level it is a story of a family, the Mackenzies, who own and operate a small woodlot in southwestern Nova Scotia. They will take you through their forest holdings and discuss forestry and environmental issues. Through dialogue and problem solving they demonstrate holistic forest management. Included in the book, but not necessarily part of the story, are essays on forest functions, values and management techniques. These essays are titled in *italic* to set them apart from the story. Reading these will greatly aid in understanding how the Mackenzies deal with problems on their woodlot. These essays also teach the reader about forest ecology and silviculture. Though these essays are important, they are not essential to the story of the Mackenzies. Lastly there are boxes, or cameos, set apart from the text. These contain specific technical information concerning forest ecology, botany and silviculture. All terms in **bold** are found in the glossary.

Section 1: An introduction to the Acadian Forest.

What is a steward, you ask? O.K. even if you didn't ask. Well, a steward is someone who manages other peoples property, like a large country estate. Though the steward has authority over the estate, it does not belong to them. The steward must manage with the interest of the owners in mind, not just for their own interest. They must consider many interests such as food, domestic issues, grounds upkeep and house maintenance. The steward can not put all their efforts or resources into one interest at the expense of their other responsibilities (otherwise the owners would be unhappy with their performance). Thus the steward must find a balance between all the demands and interest in the estate. This way the estate will run efficiently. So, what does this have to do with forests? Well, we are stewards of the forest. We use it, manage it, but it belongs to all creatures that depend on it. As stewards we too must see the forest from many points of view, and accommodate many different interests. That is, if we hope to continue using it.

The goal of this book is to identify all those points of view, to define the values and functions of the forest and present management techniques that include all of them. That is, to present management strategies that will mange the forests for our use and for the health of the forest and wildlife. Many of the problems with the forests today have been caused by seeing the forest from one point of view - human. This book will present the forest in its many facets.

In this book the Mackenzie family will explore the values and functions of the forest, and demonstrate **holistic forest management** techniques on their woodlot. The family will guide you through assessing, planning, and managing their woodlot. This, I hope, will be an enjoyable and educational trip through the Mackenzie's forest holdings. Though this book is aimed at secondary school students, it is my hope that no matter what your background, be it novice naturalist or professional forester, you will learn something new about the forest, how it works, and how we use it.

The Acadian Forest

What is the 'Acadian forest'? In ecology there are often no clearcut (excuse the pun) definitions of natural systems. In fact nature seems to go out of its way to defy definition. There are many exceptions to general rules and theories concerning forest ecology. Nevertheless there are many characteristics typical of the Acadian forest. The combination of climate, soil types, ratios of softwood (coniferous) trees to hardwood (deciduous) trees, give a picture of the Acadian forest. The Acadian forest is situated on the Appalachian mountain range, which extends

from New England through the Atlantic Provinces ccnsisting of Nova Scotia, P.E.I, Newfoundland, and central and southern New Brunswick.

The Acadian forest is a mixed forest, containing both softwoods and hardwoods, the ratios of each vary all over the region. The dominant softwoods include red and white spruce (*Picea rubens* and *Picea glauca*), and balsam fir (*Anbies balsamea*). There are also red and white pine (*Pinus resinosa* and *Pinus strobus*), eastern hemlock (*Tsuga canadensis*), black spruce (*Picea mariana*), and jack pine (*Pinus banksiana*). The dominant hardwoods are yellow birch (*Betula allghaniensis*) and sugar maple (*Acer saccharum*). There are also Beech (*Fagus grandifolia*), red oak (*Quercus rubra*), white elm (*Ulmus americana*), black ash (*Fraxinus nigra*), white ash (*Fraxinus americana* L.) red maple(*Acer rubum*), white and gray birch (*Betula papyrifera* and *Betula populifolia*), trembling aspen (*Populus tremuloides*), and Largetooth Aspen (*Populus grandidentata*)[1]. The soil, are mostly **podsols** with slow decomposition rates. The climate is characterized by cold, snowy winters with a mean January temperature of - 9° C, and warm summers with a mean July temperature of 19° C.[2]

History (only a little)

Before we can understand the present state of forestry, we need to understand its past. Yes, a *little* history is in order. Canadian forestry as we know it, that is the harvesting and managing of trees, began in the early colonial days of England. Having exhausted their own forests the English navy sought our virgin (never cut before) white pine forests for ship building. With the establishment of colonies in Nova Scotia and New Brunswick, in the seventeenth century, England began to depend on the reliable imports from the colonies. For due to the political climate of the eighteenth century England could not always depend on wood imports from the Baltic states (Poland, Latvia, etc.). Not only was the colonial supply more dependable, but the Nova Scotian virgin forest had superior trees for lumber and masts than those found in Europe. Thus by the nineteenth century imports from the colonies dominated the British market and the Maritimes' position as a resource state was set.

When the Maritime provinces were established as a source of natural resources for Great Britain the forests of North America seemed endless. Given the vastness of these forests and eighteenth century harvesting technology, it was inconceivable that we could ever run out of wood. Thus the cutting of the forests proceeded with abandon and forestry became the backbone industry of the Maritime provinces.

By the late nineteenth century, with the white pines all but gone, the forest industry began cutting spruce and fir for pulp. The pulp was then used to make paper, as it is today. The uncontrolled harvesting of our forests continued into the twentieth century. Early in this century government and industry recognized that the forests were not endless, that management was

needed if industry and the forests were to survive. Thus the modern forestry industry was born. But since there was no financial or political advantage from investing capital into management little was done. Thus, this one-sided management, for wood production, did not stop the degradation of the forests. So it seems a new approach is needed. Today government, industry, and the public are working to develop forestry management techniques that will restore the forest and supply wood for industry in perpetuity (forever).

Our Approach

In the pages of this book are an explanation of forest values and examples for managing for all these values. This approach to forest management is called 'holistic forestry'. Holistic forestry is a combination of forest **stewardship** and **integrated resource management** (**IRM**), also called **integrated forestry**. The idea is to include recreation, timber, pulp, environmental issues, and wildlife habitat needs in our management of the forest. I hope to show that by managing for all the aspects of the forest we can preserve the forest for ourselves, our children, and for all the other creatures that depend on the forest.

In an effort to promote good forestry the Canadian Council of Forest Ministers (CCFM) has developed a national forestry plan, Sustainable Forests: A Canadian Commitment. This is part of an ongoing strategy to improve forestry practices in Canada and the world. The CCFM recognizes the urgent need to protect our vast forest resource. Canada is home to 10% of the world's forest. Needless to say, it is a great responsibility and challenge to care for it; a challenge all Canadians can help meet. Since the 1980s the forest industry in Canada has harvested approximately one million hectares of forest each year[3]. Thats an area nearly twice the size of Prince Edward Island.[4] As staggering as that sounds, the harvest is only one half of one percent of the available forests in Canada. Yet if harvesting continues at the present rate without proper management we could exhaust the merchantable wood supply. The CCFM realizes that to continue harvesting the forests we must act now to preserve them. The plan calls for better techniques for forest inventory, improved harvesting methods, consultation with the public, and a new respect for one of our most precious resources. This book supports their plan.

Most importantly the plan calls for **sustainable forestry**. The CCFM defines the goal of sustainable forestry as:

> ...to maintain and enhance the long-term health of our forest ecosystems, for the benefit of all living things both nationally and globally, while providing environmental, economic, social and cultural opportunities for the benefit of present and future generations. [5]

This statement is a good start, but I would like to elaborate. I wish to expand the definition to include the following:

Use of the forest without impeding the forest's ability to meet the needs of future generations, and without impeding its ability to maintain naturally present healthy, viable forest ecosystems.

In forestry, as with other activities, often we get caught up in buzz words that don't actually mean anything. So far I have mentioned holistic forestry, integrated forestry and integrated resource management. Well what are they? By 'holistic' I mean 'the whole' - Still confused? O.K. try this. Look at the forest, you may see beautiful places to go for a walk or a home for animals. Well, what if you are a forester? You may see timber for lumber or see a long term management plan. How about hunters? They may see habitat for game species. What about the animals? To them the forest is a home on which they depend for survival, not to mention what the trees and plants might think. There are many aspects of the Acadian forest. Each of us, and the other creatures, see it in a different way. Now take all those points of view and put them together; that is what I mean by holistic.

Holistic forestry is the practice of managing forests to include all the different points of view. Now that may seem a daunting task, and it is, yet I believe it can be done. With holistic forestry values decisions are not based solely on growing tall straight trees. Although that is an important factor; holistic means including recreation, wildlife habitat, water areas, endangered species, special places, timber, and ecological concerns in management decisions. Foresters must manage for whole ecosystems, not just one species of tree, which is much more difficult than simply growing and cutting trees. I believe this is the only way to preserve the health and vitality of our forest. Together government, forest industry, and the public can achieve this. The key to holistic forest management is to develop a relationship with the forest that is not destructive, but mutualistic. This is called Stewardship. To be a good steward one must take care of the forest as well as use it. We must protect and insure the health of the forest in our care. With all this in mind this book attempts to explain holistic forest management, and give examples of how it might work on an actual woodlot. So without further adieu let us meet the Mackenzies.

Meet the Mackenzies

The Mackenzie family owns and operates a small woodlot in the Tobeatic region in south western Nova Scotia. Their holdings consist of approximately 351 hectares (847 acres) of woodland. Their land includes a lake, a river and several different stand types and age classes of trees. The Mackenzies harvest the wood for lumber, pulp, veneer wood, and firewood. They also use the forest for its berries and mushrooms, and of course for recreation.

The Mackenzie family consists of Duncan, 43 years old; and Marie-Claire, 40 years old; they are co-owners of the property. Their daughter Emily, 20 years old, is attending Acadia University and is in her second year of environmental studies (go figure!). Their son John, 18 years old, is in a forestry technician program, called Forestry Resources, at the Nova Scotia Community Collage (NSCC Lunenburg campus), and works with his father. Also spending the summer with them is their cousin Peter, 13 years old. Peter is a city boy and has a lot to learn about the woods. Kara, 20 years old, is one of Emily's friends at Acadia University. She comes to visit the Mackenzies later in the book. Finally there is their neighbor and friend Arthur Cormier, 55 years old, who owns an adjoining woodlot. He and Duncan spend much time together working on management plans and discussing the pulp market.

The story begins with the Mackenzie family discussing their woodlot. They need to up date the map and inventory of their holdings so that they have an accurate account of how much wood is available to harvest. The map was first made in 1950 by Duncan's father, who **cruised** the woodlot to get the information needed to make the map. 'Cruising' is simply taking inventory of what types of trees and age classes are on the woodlot by methodically walking, or cruising, through the lot. This is done to asses the value of the woodlot. Their woodlot map was updated in 1970, again in 1984, and now they feel it is time to update it again. Using the new Geographic Information Systems (GIS) maps, obtained from the Department of Natural Resources, the Mackenzies will **ground truth** the map of their woodlot. GIS is a computer system that layers information from data bases to produce maps. The sources of these data for these maps include aerial photography, satellites and geographic surveys. Forest maps in Nova Scotia come from aerial photography. The type of map made by GIS depends on the data source used to make that map, such as roads, forest type or minerals. Maps can be made that use multiple data sources and show a variety of geographic features.

The Mackenzie map shows the different tree stands on the woodlot. To make sure the maps are accurate they will take sample plots of the different stands in their woodlot and compare their results with the map. That is called ground truthing and is done by cruising the woodlot. Updating your map is part of good forestry practice. With integrated forest management in mind the updated property map will include biologically sensitive areas, and special habitats as well as stand types.

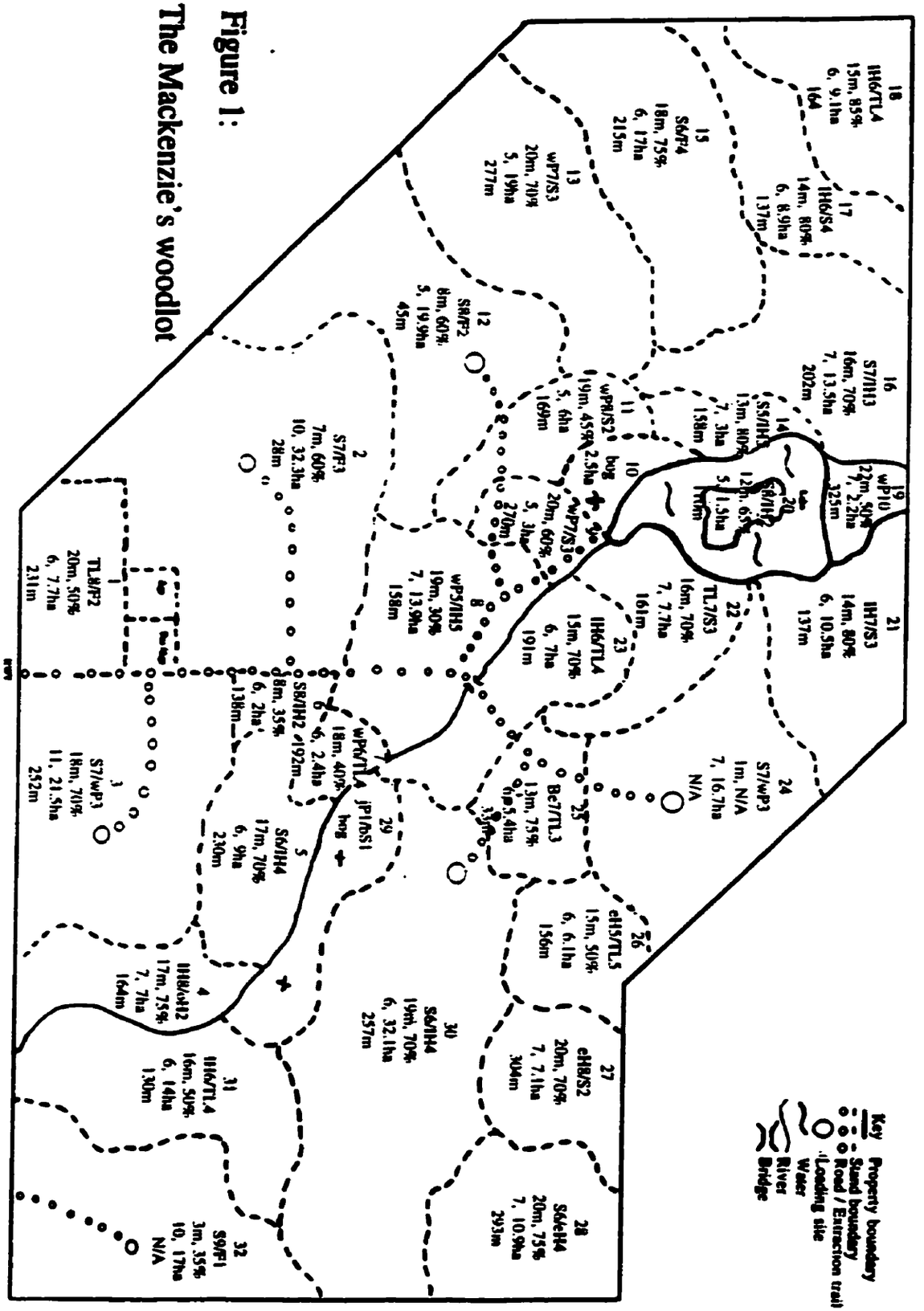

Figure 1:

The Mackenzie's woodlot

Section 2: Forest Functions and Values

The forest plays a multitude of roles for people, animals, plants and other organisms. This section will be an introduction to forest functions and values. I hope to show the importance of the forest to the creatures that depend on it. In other sections we will go into greater depth on some of the topics given here.

"Are you all set, Duncan?" Arthur inquires staring out the kitchen window, finishing his morning coffee. Another fine spring morning he thinks. "we should get to that cruising."
"Sure, Arthur, Sure," Duncan replies putting down the morning paper. "Say do you kids want to come? Might be fun."
"Fun! You just want to put us to work." John spits out through a mouth full of bacon.
"What's 'cruising'?" asks Peter looking up from his plate.
"It's when Dad makes us go out and map the woods for him."
"Now John," says Emily shaking her butter knife at him. "Its taking an inventory of all the types of trees, rivers, and ..ah...special features on our land. We use the map to know what tree stands can be harvested, and what needs special treatment."
"What's a stand?"
"It's an area of the forest that has the same kinds of trees and is different from the surrounding stands of trees, like a red spruce and white pine stand next to sugar maple and yellow birch. When we harvest the trees, that is cut them down, we make our plans for a group of trees. That group is called a stand," answers John.
"Well, there is a little more to a stand than that, John" adds Duncan.
"Will you cut down *all* the trees?!" Peter asks wide eyed.
"No, Peter. Not to worry, there will still be plenty of woods to hang out in."
"Besides," says John, "We won't be cutting any trees today. Today we're updating our map showing which stands can be harvested and which cannot."

Cruising: Cruising is a method of taking a tree inventory on a woodlot. Six to ten points are randomly selected in the woodlot. Some of the trees at those points are recorded. A special lens, called a prism, is used to determine which trees are recorded. This lens has a **Basal area factor (BAF)**. At each of the six points the forester holds the lens at chest height. Looking through the lens you make a 360 degree sweep from one spot. The lens offsets the image of the tree. If the offset image overlaps the real tree then the tree is tallied, if not the tree is not talled. The trees that are tallied are measured at breast height to find their diameter. Other information can also be taken such as species and **crown closure**. All the diameters of the measured trees are multiplied by the BAF (usually 1, 2, or 3). This is used in estimating the volume of wood per hectare, without having to measure every tree. It also tells us what species are present and their frequency.

"...and which areas won't be harvested at all. We'll mark the areas that have rare plants or animals, and the ecologically sensitive areas. Right dad?" insists Emily.
"Sure, Emily, sure. But that's more then a day's work. Today we'll just ground truth the GIS maps. Oh, Arthur and I want to start marking out that new road through both our properties."
"Dad? Why *don't* we cut all the trees down?" John asks straight faced
"What!!"
"I'm just kiddin', Emily..., but how come we don't cut all the mature wood? We'd sure make a lot more money that way."
"There's a lot more to forestry then just fell'n trees." Arthur points out matter of factly.
" I realize that, but in my economics course it says that if prices are high enough and interest rates are high then it might make more sense to cut the trees now rather than ten or twenty years later. We'd make more off the interest in the bank over those years than we will we get from the extra tree growth."
"Cut down all our good trees! You must be crazy," Emily scolds.
"Well," Duncan muses as he puts the paper away. "There are times when felling a whole forest does make economic sense. That is how some of the big forestry companies operate. But we have more to be concerned with than how much money we make this year. After all, this is a long term operation. If I cut all the mature trees now there will be nothing left for you lot when you're older. You'll have to wait thirty years before you can harvest that younger stuff. In the mean time, a lot can happen. Like wood prices could change or interest rates drop. You should plan financially for the long term, not the short term"
"Besides, if you cut down a large area, that will have a huge impact on the forest ecosystems. You might lose a lot of the animal habitat," Emily adds.
"So what? I'm talkin' money, not animals."
"Since this woodlot contributes to our livelihood," continues Duncan "We must take particularly good care of it. The forest has many more values than just money, John. The forest is part of many functions in our lives. Come on, we'll talk more about it as we walk."

With that they leave the table and get ready for a day's stroll through their woodlot. Marie-Claire has been busy tending the garden. She greets them as they all come out. Joining them, Marie-Claire and the rest follow the garden path to edge of the woods.

Stand: An area of forest that has the same composition of tree types, age classes and spacing as well as the same soil type and climate. The understory (smaller plants) and wildlife are also characteristic of the stand. The makeup of the stand sets it apart from adjacent stands, e.g. hemlock in medium dry soil versus red spruce in dry soil. Forestry traditionally manages at the stand level, that is each stand is treated as a separate unit.

Chp. 1: Bio-physical functions

Bio-physical functions in a forest are the biological and physical processes that affect the structure of the forest, such as the growth of trees or running water filtering through a bog. These processes affect the composition and look of the forest.

Through these functions the forest plays an integral role in maintaining human and other natural systems. All things in nature are connected. For instance some insects depend on the trees, the birds on the insects and so on. The trees also depend on the birds to keep the insect populations down which protects the trees from severe infestation. The forests are also important in ways that we may not realize. The ecology of the forest is such that each ecosystem in the forest is dependent on the health of the whole forest. People are also dependent on the forest, as we shall see.

As the Mackenzies enter the forest all stop to acknowledge the familiar beauty of their woodlot. The forest here is a naturally regenerated cut over dominated by red spruce and balsam fir trees ranging from 7 - 10 metres. As they walk, the needle- covered ground softens their foot steps.

"I love the smell of the new growth in the spring," Emily sighs.
"Yes, lovely isn't it," Arthur says in awe.
"Come on, let's get to work," says Duncan.
"You two go ahead, the kids and I will catch up later," suggests Marie-Claire.

Duncan takes his prism, **DBH** tape, and map out of his daypack, and he and Arthur continue down the path.
"How old are these trees, John?" asks Peter staring up at a young red spruce.
"I think this stand is around twenty or thirty years old. They'll get a lot bigger before we cut them"
"Let's head toward the stream, it should be quite high now" Marie-Claire says walking down the path; the kids follow.
"How big will they get?"

Ecology: A field of biology that studies how organisms interact with their environment and each other.
Ecosystem: The interactions of organisms with their physical environment and each other within a continuous area. e.g. The fish, plants, micro-organism, mud, light, and water in a bog.

"Well, that depends on a lot of things" answers Emily. "Trees compete for light to make them grow. The ones that grow faster will be taller, and get even more light so they can become even bigger."
"Light's really important to trees isn't it?"
"Light's important to everything."
"Whaddya mean?"
"Well, most living things are either directly or indirectly dependent on light for survival. Light is energy from the sun. The plants use the light to grow. Some kinds of animals eat the plants and get their energy from those plants. Those animals get eaten by other animals and then they get the energy. This is called Energy flow*. The energy from the sun goes from plants and animals to us. Without the sun there would be no life on earth."
"...and without plants there would be no animals," adds John. "Not just any plant can grow anywhere, though. The amount of light available determines what types of plants can grow here."
"Plus other things like soil and climate," Marie-Claire points out.
"Besides energy, we need other things to live, like nutrients such as minerals," says Emily.
"Do they come from the sun?"
"Well, no. They're in the plants and animals we eat. Nutrients are in the ground and get absorbed by plants. When animals eat the plants they get those nutrients."
"...and when we eat the plants and animals, we get the nutrients."
"Right. Pete!", she continues, "when the animals or plants die their bodies decompose, that means the nutrients in their bodies go back into the ground, where they can be absorbed by plants again. That's called Nutrient cycling*. Its all part of the food web."
"The Food Web?" Peter asks.
"All organisms eat other organisms, to survive, except plants. Plants get their energy from the sun, remember?"
"Uh-huh."
"Well, there is a natural order to what animals eat. That's called the food chain. For example: a rabbit eats grass and a coyote eats the rabbit. Plant eating animals are called 'Herbivores', and animals that eat other animals are called 'Carnivores'. Animals that eat both plant and animals are called 'Omnivores'. People are omnivores."
"Only when aunt Marie makes me eat my vegetables," Peter gripes.
"That's right, Peter," Marie-Claire chuckles.

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*Refer to section 3 for more information on energy flow and nutrent cycling

"All animals" Emily goes on, " are dependent on other organisms and their environment to survive. If we destroy certain kinds of plants or fungi, then any animal dependent on those plants will also perish. Plus any carnivores that eat those animals."
"Trees and other plants provide the base for the food web."
"That's right, John."
"What else do trees do Emily?" asks Peter.
"For one, they produce the oxygen that we breathe. Oxygen is a by product made by the plant as it produces sugars for its food. Without plants the air would be unbreathable. Trees and other plants also purify the air we breathe. Trees act as air filters by taking out pollutants and adding more oxygen..."
"So the more trees, the cleaner the air."
"Right, Peter."
"Forest are important for other things as well," Marie states.
"Like what, mom?"
"The forests perform many other functions that benefit us. For example - water. Plants are involved in maintaining the water quality. The topography of the forest determines where the watersheds are..."
"How does the water get underground, Aunt Marie?"
"Rain water seeps into the ground and the plants draw water up from the ground through their roots. That water is eventually released into the air through the leaves..."
"That's called 'transpiration'. " Emily butts in.
"Yes Emily, ...so the amount of **atmospheric water** available to us is partly determined by the amount of plants in the area. Plants and the ground also purify water. As water passes through the ground, impurities and pollutants are taken out by the masses of roots and the soil particles. Swamps and bogs are great for filtering water. The water plants in the bog act as filters which clean the water as it passes through the roots. Water down stream from a bog is usually cleaner than the water that flows into a bog. Mind you I wouldn't drink bog water because the still water of a bog is home to many microscopic animals, like bacteria, some of which can make you very sick. Luckily, though, these organisms don't like to live in fast flowing streams."
"So the amount of trees affects the amount and quality of water," sums up John.
"Not just that," begins Emily. "Trees are a storehouse of carbon. Woody plants, like trees, contain large amounts of carbon in their trunks. This helps reduce the greenhouse effect."
"Greenhouses?!" Peter inquires.
"There is carbon in the air in the form of carbon dioxide gas. It reflects heat back to earth, too much of it means the earth will warm up..."
"That would be nice in the winter," jibes John.

"...Well the earth's ecosystems are very sensitive to temperature change, even a small rise or fall in the average temperatures around the world could really damage the forests and plants. The more trees there are the more carbon that is absorbed from the atmosphere."
"Yes, and older trees contain much more carbon than younger trees," Marie-Claire adds. "As you can see trees affect our atmosphere. The absorption of carbon and the release of water all affect our climate. The more water there is in the air, the more rain will fall on the forest and the higher the **humidity**. The amount of water available affects what kinds of plants can live in a forest. Also, the weather and rainfall patterns are affected by the forests. Trees absorb up to 30% of the rain and snow[6] and the topography determines where the rest flows. Trees also reflect heat from the ground back to the ground, keeping the forest floor warmer in winter. So, you can see if you remove a large portion of the trees it will affect weather, climate, and the quality and amount of water available to the surrounding area."
"Oh," utters John.
"If you take all these things together, " concludes Emily. "The water, climate, air, nutrients, and so on, you can see how much the functions of the trees and plants affect their environment. They can shape waterways, control water levels, affect the climate, clean air and water, and definitely influence what kinds of animals live there. Wow! they really do affect us."
"Gee, I guess the woods are more important than just for hanging out."
"Yes, Peter. A lot more."

Greenhouse Effect: The Greenhouse Effect is also called 'Global warming'. There are several types of gases in the upper atmosphere that trap and reflect heat radiation from the earth's surface. These gases include carbon dioxide, methane and sulfur dioxide. These gases are normally present in the atmosphere, but current elevated levels can cause environmental problems. The heat reflected back to earth can cause an increase in average global temperatures. Plants are very sensitive to temperature change. An average increase of just 2 degrees Celsius in the global temperature range could result in the extinction of many plant species. It will also result in a massive change of plant species composition all over the world, as the plants adjust to the new temperature regime. The burning of fossil fuels is the prime source of these greenhouse gases, as well as industry and global deforestation.

Chp. 2: Soil

The quality and quantity of soil greatly affects the kind of ecosystems present in a forest site. Traditionally the soil component has been given little attention in forestry, yet soils are very important to forestry and deserve special attention. In this chapter I hope to relay the importance of soils to forestry. The soil is where nutrient and water uptake occur. The types of soil in which trees grow affect their health, and partly determine what kinds of trees can grow there. Being familiar with the soil types in a forest is beneficial because the soil gives a good indication of site fertility. It is also important to know how much water is in the soil, for this also affects the tree health and species composition.

Soils are made, in part, from the weathering of the rock. There are several types of soil: such as brown earth, podsol and peat. There are also varying classes of ground humidity from wet, or poorly drained, to dry soil. The soil type and its humidity affect soil fertility . All three help define a forest site. Chapter three has more information on the different soil types, soil moisture, and fertility.

Duncan and Arthur have gone ahead of the others. They are recording the types and sizes of sample trees in a red spruce stand.
"Here's a nice stand." Arthur says walking off the path into the shade of a mature red spruce stand.
"Yes, they're ready for harvest, lets take some of these out this winter." agrees Duncan
"What do you think will **regenerate** here?"
"Well, the soil here is loamy and moist," says Duncan digging up a shovel full and pressing it with his hands. "White or red spruce would like this soil, but the area is not well drained and white spruce prefer well drained sites."
"Norway spruce would also grow well here," Arthur adds.
"True, I'll keep that in mind."

Chp. 3: Habitat Types

Habitat is the area in which **wildlife** live. Different forest types provide different habitats. Animals need varying types of habitat; some require many types to survive. A young maple/birch stand is suitable for deer to graze in, an abandoned wheat field is great for field mice. Ruffed grouse need young trees for roosting, open areas to find food (foraging) and fallen logs for mating displays. A habitat supplies food, shelter, and protection from predators. In this chapter I will to point out the importance of identifying habitat types for maintaining wildlife populations in the forest.

"Ah, this is one of my favorite spots to pick blueberries," Marie-Claire says as she, Emily, Peter and John emerge from the woods into an old overgrown field. The trail from the house has lead them to an old farm field. The field is overrun with grasses, shrubs such as juniper and blueberry, and has young alders growing in it.
"Look!" Emily says in an excited whisper. "Over by the edge of the wood, there's a deer."
"Where?!" Peter asks excitedly.
"Shhhh," John warns and points toward the deer. "There in front of you about fifty feet. I think it's a doe," he whispers as he moves carefully toward it.
"What's she doing?"
"Browsing on the young shoots in the field."
Just then the doe jumps into the wood, flashing its white tail as it vanishes among the trees.
"Darn. Its gone!"
"You have to be quiet, Peter," Emily points out. "Animals scare easily."
"Over here," John cries. "I've found where she bedded down last night."
"Deer often sleep in tall grasses by the forest edge, Peter," Marie-Claire explains.
"Does she come here a lot?"
"Probably. Deer will browse in the evenings by the forest edge" answers Emily. "It's important to make sure that we leave enough woods and fields for the wildlife to use."
"When your father makes cutting plans he keeps that in mind."
"It's important to save all kinds of animal habitat," Emily says, "so we can conserve **biodiversity**."

Wildlife: For the purposes of this book the term 'wildlife' is used in a very broad sense. It includes all animals, insects, birds, fish, fungi and other organisms that live in and depend on the forest.

"Bio what?" asks Peter.

"Biodiversity. It's all the different kinds of plants, animals, fungi and other organisms, and how many of each kind. The more types of organisms there are the more kinds other wildlife can live off of them.

Biodiversity and the health of the forest are closely connected."

"Like with the food web," John adds. "The more plant and animal varieties the more species that can live off them."

"Right, different animals need different types of habitat. Not every animal can live in a spruce stand. Some need hardwood stands, or fields, or swamps or a combination. Its important we manage for all types," Emily points out.

"Why?" asks Peter. "Why are you worried about bio-di-vers-ity if you're just cuttin' trees?"

"Because in order to have a good tree harvest we need a healthy forest. A healthy forest needs to have all the habitat types that make up that kind of forest. If you remove whole habitat types the forest will be incomplete and the forest ecosystem could weaken. An unhealthy forest may not produce good quality trees for harvest. Besides we're not just cuttin' trees, we're managing a forest community."

"A forest community?"

"Yes, the trees, animals, rivers and us are all interdependent. We're part of a community - a forest community. And that community needs many different habitat types to stay healthy."

"..and cutting makes different kinds of habitat," Marie-Claire interjects. "If an area is properly felled and regenerated, the ecosystem is changed, not destroyed. The site can still support wildlife, just different types of wildlife than were there before. Once the trees grow again the habitat will revert to what it was earlier."

Biodiversity: Is, in part, the measurement of the number and abundance of species of plants, animals and other organisms, such as fungi, algae and bacteria, in an ecosystem. Species *Richness* is the number of species. *Abundance* is the number of individuals per species. Increased biodiversity is associated with greater ecological stability and health. Yet some ecosystems naturally have a low biodiversity and are still healthy, e.g. boreal forest generally have only two or three species of trees. Biodiversity affects ecosystem health by increasing the components of the food web. The greater the variety of plants in an area, the larger the food source for animals. The more herbivores there are present leads to a wider variety of carnivores. Increased biodiversity also increases genetic variability, since there are a larger number of individuals of a species. By increasing genetic variability the health of a species is improved. Biodiversity is also associated with biophysical functions. Being that all plants are not equal in their ability to affect biophysical functions, a high biodiversity means a wider variety of plants for air and water filtration and production, and nitrogen fixation etc..

Biodiversity is more than the numbers of species. It also includes the ecosystems and forest community. High biodiversity means a variety of ecosystem types as well as species types. It means a rich mosaic of forest community structures. Every ecosystem type has different degrees of biodiversity. More biodiversity is not necessarily better. The idea is to preserve the natural biodiversity present in any given ecosystem.

"It's also important that we learn to recognize the rare and sensitive habitats," continues Emily.
"Sensitive?"
"Some forest ecosystems react badly to being used too much by people, or to being cut at all. It might destroy them completely. Those places should be left alone."
"Huh?"
"Look over here," Marie-Claire says standing in the edge between the forest and the field. "See this strip of plants between the woods and field..."
"That's called an **edge** or **ecotone**," Emily replies.
"Yes, it's important because some of the plants, animals, and birds that live here cannot live in the woods or the field. Places like this need to be given special attention." Turning toward the wood she adds: "Come on, lets head for the river." Then she heads back toward the trail.

Chp. 4: Ethics and Aesthetics

Ethics deal with moral values, right and wrong, while aesthetics concerns beauty and form. At first glance you may think that they have nothing to do with forestry. But with further consideration you may realize the important role they play in our perception of the forest. Ethics, like ecology, is very complicated so I will only skim the surface of this in-depth topic. However, I will attempt to present some ideas and points of view concerning the forest that you may not have considered. Also, we will look at forests in a qualitative way; that is with our hearts as well as our minds.

After examining the red spruce stand Arthur and Duncan continue on. Soon the path leaves the shaded woods leading them into the brightness of an open glade by a fast flowing brook.

"This is one of Marie-Claire's favorite spots; she just loves it here. She likes to sit on those big moss covered rocks and watch the water."

"It sure is a nice spot."

"I'm surprised Marie and the kids aren't here yet." He takes a long look at the brook. "I'm sure glad I won't have to clearcut this area, I can just imagine the fuss they'd put up."

"Whaddya mean?"

"Well, the stand beyond the brook is mixed wood, and there's not much that's marketable. Though I do cut down some hardwoods for fuel. Besides it'll be a shame to ruin the view around here. The pleasure it brings the family is worth more than money. Not to mention I like it too. Dad use to take me fishn' here."

"Hi dad, Mr. Cormier," Emily waves as she and the others appear out of the wood.

"The water is so high" Marie-Claire sighs.

"What a cool spot," Peter adds.

"So how's it going, Duncan?" asks Marie-Claire.

"Fine, we've been checking out a few mature stands."

"Are you going to cut these trees down, Uncle Duncan?" Peter asks.

"No Pete, we don't cut all the trees. Especially in places where we like to have picnics."

"There's more to managing the woods than cutting," adds Emily. "In fact, the forest is a source of beauty and spirituality."

"Spirituality?!" exclaims John.

"Yea. My friend Kara, she's Mi'kmaq, has told me all kinds of things. The aboriginal peoples traditionally viewed the forest very differently than most of us. The forest was seen as a source of food, medicine, shelter, and yes - spirituality."

"We use the forest for food and shelter too, Emily."
"Yes, that's true, but there's the difference. They didn't *use* the forest, they lived *with* it. The Mi'kmaq traditionally believed that the forest had a spiritual quality, it is alive; people were part of it, not masters over it. It provided all things and should have been treated with reverence and respect. Many Mi'kmaq still believe and practice these traditional beliefs."
"Emily, are you saying that trees have rights too!"
"Well... I don't know, maybe. It's like what I learned in school. All things have value; the question is what kind of value."
"What?"
"Well trees have value to us, we sell them. That's called extrinsic value. The value of a thing to people. One of the trees' values, to us, is the money we get from them. Intrinsic value is value things have simply because they exist. People have intrinsic value. Even you, John, you have value just because you're a person - well, barely."
"Sooo funny."
"Well trees also have value because they're alive. They have value no matter what they mean to us. That's intrinsic value."
"Does that mean we can't cut them down!"
"No,... it.. ahhh..."
"Perhaps," Marie-Claire interjects, "it means we have to be responsible in the way we manage them. We simply can't go around cutting down trees because we think we have a right to. We must consider the health of the whole forest, our needs, the needs of the animals who live in the forest, and the needs of your children who will work this land after us."
"Oh."
"That's just common sense," Arthur says.
"Yea, then common sense is not so common!" Emily huffs.
"Now Emily," Duncan warns. He then turns to Arthur. "That's just good forest stewardship."
"What's that?" Peter asks.

Extrinsic Value: The value or worth of an item, or living being, placed on it by others. The value is imposed on it externally. For example: a dog may be worth 'x' number of dollars to a pet store. Yet that particular dog may be worth a lot more to you for sentimental reasons. The price of the dog and the emotional attachment are all external values put on the dog.
Intrinsic Value: This is the value a being has that is internal, regardless of value placed on it externally (extrinsic). For example: 'I'm special because I'm me' refers to your intrinsic value. Also your dog has value simply because it is a living being, regardless of how much you like it or do not like it. A being has this value even if it is not recognized by others. Ethically it is important to learn to recognize and respect the intrinsic value of other organisms.

"That's when you properly look after the woods. We use the woods, but we should always make sure there's enough left for the future and that the forest community is safe and healthy."
"Oh, that's a good idea."
"Say...," says Emily heading toward the river. "Lets sit on those rocks and rest a bit."
"Good idea Em," John and Peter follow.

Chp. 5: Parks and Forest Recreation

Though many cultures in the past have had protected areas, the modern idea of parks and protected areas is about a century old in North America. Parks are established to preserve areas with rare species, or unique biota and landscapes. Protection, however, is not the only role of parks. Parks may be used to facilitate education and enjoyment for the public. This chapter will introduce the role of parks in conservation.

Recreation is an important management component of forests in Nova Scotia, not only for our mental, emotional, and spiritual health, but also economically. For example, in 1993 tourism and hunting generated 835 million dollars in Nova Scotia.[7] Nature tourism is becoming a major industry. It would be wise to manage our forest with these needs and economic opportunities in mind.

"This is what it's really all about," John says lounging on a large moss covered rock. In front of him the brook flows quickly by, the late morning sun bathes the three hikers as they rest.
"Whaddya mean?"
"This! Emily. Lying on the moss, listening to the river and soak'n up the rays. That's what the woods are all about - to enjoy"
"Yes, I see your point," she says trying to shove him off the rock.
"Hey! Stop that."
"Sorry, I was just 'enjoying the woods'."
"I love to hang out in the woods," Peter adds. "I hope they'll always be here."
"I'm sure there will always be forests," Emily assures him. "That's what parks are for. Parks are areas that we set aside for nature."
"I like to go camping in them. Say, we should hit Keji* some time soon."
"Sure, John. Just not the marsh sites, the black flies will be murderous this time of year."
"So people can use parks?"
"Sure, Pete, we can camp, and hike, fish, ...and canoe."
".. and hunt?!"
"No, Pete, you cannot hunt in most parks! Parks are for preserving natural beauty and rare places."
"Well...," says John, " lets make parks around all your 'sensitive areas' and then we can log our land without worrying about it."

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* Keji is short for Kejimukjik National Park which is situated near Caledonia in south western Nova Scotia.

"We need to protect more areas than just what is in park land." Emily insists. "Everyone must pitch in and help the environment, not just the parks people. If only our parks had rare species and places, it would be pretty bad for us. Besides parks do more than just 'protect' places, they educate the public. Remember, John? The interpretive walks we went on at Keji last year?"
"Ya, that Hemlocks and Hardwoods trail was really interesting."
"Sure, you just thought the guide was really cute!"
"Right!, Emily, sure."
"So where do we hunt, John?" asks Peter.
"Right here, if you want to. Not now of course, we'll wait for the fall when most game is in season."
"Do you like hunting, Emily?"
"Humph!, I'd rather admire nature's beauty than kill it! I see no sense in hunting."
"Come on Emily, don't get righteous on me," John says defensively. "Hunting's O.K., in fact it's even fun. So long as you hunt responsibly and respect the woods and other hunters I think it's perfectly O.K.. Look at all the money sport fishing and hunting brings to Nova Scotia each year, its in the millions* ."
"Not only hunting makes money, nature tourism is big too. People come here to enjoy hiking and camping all through the province, and all they shoot is a camera!"
"Look, it helps sharpen my woods skills, like tracking and camping. It also helps me learn more about nature. Hey, even **Aldo Leopold** enjoyed hunting."
"Yea, I know. It's just not for me."
"Fine, You're not invited anyway, Just us guys - Pete and me."
"Great! Have fun killing small defenseless furry animals."
"Emily!"
"O.K., O.K., I take that back."
"Well, I'm going to find Dad and the others, how about you Em."
"I think I'll head back toward the house, just follow the stream. Do you wanna come Pete."
"Sure Emily."

Aldo Leopold: (1887 - 1948) An American naturalist and forester; considered by many to be the 'grandfather' of ecology. His essays and philosophy about the environment and ecology formed the bases for the modern concept of forest stewardship. His books are as poignant today as they were when first written. One of the most notable is A Sand County Almanac.

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* Hunting and angling contributed $ 2,662,738 (1990) to the Nova Scotian government alone.[8] This figure does not include money spent at local businsess.

Chp. 6: Commercial Forestry

The forest industry is an integral part of the provincial economy. Forestry generates 22% of the industrial GDP (Gross Domestic Product) and approximately 24% of exports from Nova Scotia [9]. It is an understatement to say that forestry is very important to the provincial economy. Historically forestry played an even larger role in the development of the province. Section 5 deals with the history and economics of forestry in greater depth.

Most of the money is generated through pulp and paper, and lumber. Yet one must not leave out those important, if smaller, industries such as Christmas trees. There are also non-timber industries such as maple sugar and fur trapping. Finally there are value added industries. These are businesses that are centered on making finished products from raw materials, e.g. furniture making, finished lumber, mills, etc.. I hope to show that forestry management must address the concerns and needs of all these different sectors of the forestry industry.

John leaves Emily and Peter and returns to the glade were his parents and Arthur are preparing to continue on. The path from the brook leads over a bridge, and into a mixed stand of birch, oak, and fir. From there the four leave the trail and walk up a small hill to a stand of hemlock and red spruce.

"This stand is well ready to fell, Duncan" Arthur says looking up and admiring the trees.

"Yep, I've already marked this stand on the map for fellin'."

"Should be some good lumber here, Dad."

"I certainly hope so."

"Maybe I'm old fashion" Arthur adds, "But I just prefer cutting for lumber than pulp."

"That's because there's more money in lumber than pulp" Duncan laughs.

"No. That's not what I mean. In the old days there was a lot more lumber harvested than pulp. When I was boy there were still a lot of saw mills around. In my father's day pulp and paper was a 'Johnny come lately' operation. Pulp kind of forced those mills out of operation."

"Now Arthur," Marie-Claire points out. "It was the lack of good lumber and the crash of prices that started the pulp business booming. In fact the pulp companies opened up many areas that had good saw logs. What happened was the large efficient mills forced the numerous smaller mills out of business."

"Never mind that, I just feel better about lumbering than pulp. Lumber used to be very important to the economy, more so than pulp was."

"Well it still is important," Duncan adds. "Its just that pulp is more important."

"Dad?"

"Yes, John."
"I have this bet with a friend. He says that in Nova Scotia, farming brings in more money than forestry. Is that true?"
"Well, that depends. If you look at raw materials, then yes, your friend is right. Agriculture is a larger part of our GDP. But if you're talkin' about manufacturing then he's wrong. There is more manufacturing associated with forestry than with agriculture. Though more agricultural goods are exported than wood products."
"Forestry used to be more important than any thing else in the Maritimes," Arthur reminisces. "Since the seventeen hundreds we've been known for our excellent lumber. Forestry was the backbone of this whole region."
"You make it sound like it's dead, Arthur. Forestry is still very important. Off hand I'd say one fourth of our total provincial exports are wood products."
"Where does it all go, Dad?"
"Well, John, most of it goes to the US, but Nova Scotia has markets all over the world: Europe, England, even the Middle East."
"Speaking of markets, Dad, have you thought about letting me have a site to grow Christmas trees? They're important too, they're worth over ten million a year*."
"You've been do'in your home work. Well we'll see about that tree lot."
"There's more to forestry than lumber, pulp, and Christmas trees, John," Arthur says in a Know-it-all tone.
"Like what Mr. Cormier?"
"Well there are many subsidiary industries that use wood to make other products, like kiln dried hardwood mills, furniture making, musical instruments, construction and so on."
"Yes, Arthur,", Duncan interjects. "Value added industries."
"I remember that from school. Value added is the difference between revenue and the total cost of materials and services, I think."
"Very good my lad," says Duncan. "Value added is very important. It increases the value of each board foot of wood cut in Nova Scotian forests."
"Metre, dad."
"Huh?"
"Cubic metre."
"Oh, sorry...," he continues. "If we harvest and mill a tree here, then someone else, say in Annapolis, makes a chair from some of the lumber, and that chair is sold here or exported the economy gets a lot more money than if we cut the tree and ship it to the States where it is milled,

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* In 1991 the total wholesale value for Christmas trees was $ 11.7 million[10].

the chair is made and it is imported back here. There is more overall employment, more tax revenue, and the money stays here in Nova Scotia."
"I've always said," Arthur adds. "It's a real shame we don't have more wood product businesses around here."
"I think you've all missed something," Marie-Claire says sweetly.
"What hon?"
"There is more to forestry than just timber," she says in a tone mocking Arthur's. "What about non-timber industries, like maple syrup, and more importantly - *my* mushrooms and berries."
"Uh-oh," Duncan sighs.
"One of my favorite spots to pick mushrooms is near here mister," Marie-Claire continues pointing at Duncan. "You best not ruin them with your logging."
"Don't worry hon, I'll be careful not to damage your mushrooms. It's all part of my management plan."
"It better be," she adds in a mockingly serious tone.
Scanning the area Duncan asks: "So John, how do you think we should **scarify** this area after harvest?"
"I dunno, **harrow**, maybe?"
"Sure, sounds pretty good to me."
"What do you think we should let regenerate, Arthur."
"More of the same, or maybe plant some norway spruce."
"Well, we can discuss it later. Right now I want to go to the trail and start marking a new trail, we'll need one to reach this stand."
"Well, I'm going to head back to the house, see ya there." With that Marie-Claire heads back down the path. John decides to follow the stream home. Arthur and Duncan continue on to put flagging tape on the trees marking out a new logging road, called an extraction 'trail'.

I hope it is now clear that the forest has many values. It is a central tenet of this book that proper forestry respects and manages for all these values. Integrated forestry management should be committed to providing for all of them. Proper forest stewardship demands that all functions be protected. Throughout the rest of the book management techniques will be measured and evaluated by their ability to maintain all these forest functions and values.

Section 3: How the Forest Works

In order to manage in a more sustainable manner it is necessary to understand how the physical environment affects the forest. That is, to grasp the interrelations, see how trees affect their physical environment, and understand how plants, animals and all other organisms function together. A forest community is a synergism of trees, soil, plants, micro organisms, animals, water, energy, climate and season. All of these processes and functions are constantly causing change, and this flux influences the forest makeup. Some of these topics have already been mentioned in section 2. In this section I will go into more depth. From the individual tree to the forest landscape the goal of this chapter is to discuss the biology and ecology of the forest ecosystems.

We left Emily and Peter following the stream back toward the house.

"Lets stop and rest here," Emily says dropping herself onto a rock by the rivers' edge.

"Sure, hey - this is a great spot for fishing, Em."

"Yea, John comes fishing here. The deep pools by the rocks are great for brook trout, and the overhanging trees give shade to keep the pools cool. Trout like cold water."

"...And I like trout," says John emerging from the woods.

"Hi John," Peter chirps

"Heading home Em?"

"Yup."

"Yea me too, I didn't want to get roped into marking the trees for the new road. They always take so long."

"Well pull up a rock and rest a bit."

"Thanks."

Chp. 7: *An essay on the anatomy of trees*

In order to manage the forest effectively we should understand how trees function. Understanding what affects their growth will help us make decisions about silviculture treatment. A properly managed forest can be ready for harvest decades before an unmanaged, or improperly managed, forest. The growth of trees is a very important component of forestry. Thus this chapter will examine the internal and external anatomy of trees.

There are many types of trees, and there is no such a thing as an 'average' tree. Yet whether they are hardwood or softwoods all trees share some common characteristics . These traits are important to the growth and metabolic function of the tree.

Systems: A tree can be broken down into three systems: crown, trunk and roots.

A) Crown: The crown is the top portion of the tree which contains the living branches, twigs, and leaves (many conifers lose their lower branches as they grow so all the branches are part of the crown. Most hardwoods retain their branches, but the lower ones will not have leaves and the branch dies.) The crown is where the tree collects light. Light is absorbed by the leaves. If a tree has a lot of room the crown will expand and the tree can grow quickly since there is a lot of light available. A crowded tree will not have as much light available because of competition from trees around it.

Foresters like to strike a balance between too crowded and too roomy. If the trees are spaced very far apart the tree will grow many branches, thus creating a lot of knots in the wood. Knots can lower the quality of lumber. Also the greater the spacing of trees, the fewer trees per hectare available. Trees that are over crowded tend to grow more slowly than trees that are spaced properly. Intense competition for light will cause reduced secondary growth

Softwoods: Softwoods are also called 'evergreens', but their biological name is 'Gymnosperms' or 'coniferous' (conifers) trees. This refers to the cone it produces for reproduction. The seeds are contained in this cone and have no seed coat. Conifers usually have needle like leaves which remain on the branch all year round. Conifers can grow all year round if the climatic conditions permit. Most retain their leaves for several years, slowly dropping off old ones as new ones replace them (hence the term 'evergreen'). An exception to this is the larch (tamarack) which loses all its needles in the winter. Conifers are pollinated by the wind.
Hardwoods: Hardwoods are 'Angiosperms', also called 'deciduous trees'. Their seeds are produced in flowers, not in cones, and have seed coats. Deciduous trees have broad leaves. Most lose their leaves in the fall. Though with some, such as the beech, the dead leaves stay on the branch through the winter falling off when the new shoots appear in the spring. Deciduous trees grow in the spring and summer, but not during the winter months. Each spring, with the increase of light, the young shoots appear to form new leaves. The wood of hardwoods tends to be denser than that of softwoods, hence the term 'hardwood'. This is because the tissues in deciduous trees are different then the tissue in softwoods. Most Hardwoods make excellent fuel wood. Deciduous trees are pollinated by insects, just like flowering plants.

(see below), and stunted growth. This results in slower growing trees, which means a loss of revenue for the woodlot owner.

B) Trunk: The trunk contains the bulk of the tree, it is the wood that supports the crown. In a young tree, or shoot, it is called a stem. The trunk is of particular interest to foresters, for this is where the bulk of the wood is produced. The growth of wood, which is an increase in the girth of the tree, is called secondary growth. Trees must be properly spaced to promote this secondary growth.

C) Roots: The root system is that part of the tree that is mostly underground. Roots serve two main functions: 1) they anchor the tree into the ground. This helps support the tree and enables it to stand up to storms and seismic movement. 2) Roots absorb water and nutrients from the soil. These nutrients are used in the metabolic functions of the tree.

Mycorrhizal fungi are associated with roots. These fungi invade the cells of the root. The fungi help the tree absorb water and minerals from the soil. This spurs the growth of the tree, and provides the tree with a wider area from which to obtain nutrients. For their part the fungi get nutrients produced by the tree. This is an example of **symbiosis** in nature.

Tree functions: Like animals, plants perform certain 'functions' in order to survive. They 'breathe', make food, and transport this food or 'fuel' throughout the whole plant. To make the

Primary Growth: Plants grow all their lives. This is possible because of certain unique attributes that plants have. One of these unique attributes are regions of cells called **meristems.** Meristems are areas of growth where the cells stay in an embryonic form, called undifferentiated cells, until a growth spurt is needed. It is like saying the cells don't become part of anything until the plant orders them to.

When a plant grows in height this is called primary growth. This occurs in areas that have meristem tissue. Primary growth occurs at the terminal bud, which is located at the top of the plant. There are usually other buds, with meristem tissue, called the auxiliary buds. These will only produce primary growth if the terminal bud is damaged or removed. Otherwise they remain on the plant and may produce branches.

Secondary growth: Secondary growth is the increase in diameter, or girth. Only woody plants undergo secondary growth. As the tree increases in height (primary growth) it needs to increase in width in order to support itself and produce new vascular tissue to support the new areas of growth. Vascular tissue is the transport system in the tree. Much like our veins and arteries, the xylem and phloem transport nutrients, water, and food around the tree. The xylem is the system of tubes that the transport water and nutrients from the roots to the leaves. Here the nutrients are used in photosynthesis. The phloem is the system that transports the products of photosynthesis back to the rest of the plant. Both xylem and phloem are produced by the vascular cambium (see diagram below). The vascular cambium produces xylem toward the center of the tree. Here it accumulates, gets clogged and eventually becomes non-functional. This is the heartwood of the tree. This accumulation of xylem, or wood, causes an increase in the diameter of the tree - secondary growth. Phloem, on the other hand, does not accumulate because it is produced in the other direction, the outside of the tree. Eventually it becomes part of the bark and gets broken off.

fuel needed to grow and survive trees use sunlight. The sunlight is used in the process of photosynthesis. This makes sugars which form starch. These sugars are transported throughout the tree via the vascular transport system. The living cells of the tree use the sugar to carry out cellular respiration and other metabolic functions.

To get a feel for all this let's look at a cross section of the trunk of a tree. The trunk of a tree is made of wood and bark, but there is a little more to it than that. From the woodlot owner's point of view, the production of wood is a very important part of their operation. So I will focus on wood to some degree.

There are two kinds of growth in a tree. The growth of a tree upward is called primary growth, and the growth in diameter is called secondary growth. The secondary growth is the increase of wood fiber.

Most of the trunk of a tree is metabolically inactive. That means the cells are actually dead, reducing the need for food. The wood of a tree is old non-functional xylem. Xylem cells are part of the vascular system. The xylem transports water and nutrients from the roots (where they are absorbed) to the leaves. These nutrients and water are used in the leaves (broad or needle) for photosynthesis. The other part of the vascular system is called the phloem. It transports the sugar from leaves, where it is made as a product of photosynthesis, to the rest of the tree.

As the tree grows the xylem and phloem get clogged and damaged so they need to be constantly replaced. This is done by the vascular cambium, a thin ring of tissue that lies in between the xylem and phloem. It produces xylem toward the center of the tree, and phloem toward the outside of the tree. Xylem that becomes non- functional is the wood

Leaves: Leaves are the center of photosynthesis for a tree (see pp. 31 for more information on photosynthesis). Leaves come in an astounding variety of shapes and sizes. There are two kinds of leaves: broad leaves, found on deciduous trees, and needles found on conifers. Leaves have several types of tissue. The outer covering, called the cuticle, is a waxy layer that prevents water loss. Yet the leaf must exchange gases with the surrounding environment. Thus there are openings in the cuticle called stomata. These open and close depending on conditions around the tree. The leaf needs carbon dioxide for photosynthesis and oxygen for cellular respiration. Often there is too much of one and not enough of the other. So the leaf must exchange gases with the outside environment. When the tree needs CO_2 it opens the stomata to allow carbon dioxide in and let oxygen out. When the stomata open there is also some water loss. This evaporation of water from the leaves is called transpiration (see chp. 8, water transpiration). The stomata control the gas exchange and water loss in a plant.

Inside the leaf there is a special tissue called **mesophyll**. Mesophyll tissue contains chloroplasts which absorb light. It is in the mesophyll that the all important process of photosynthesis occurs. Interspersed among the mesophyll tissue are vascular bundles that contain the xylem which brings the raw materials for sugar and starch production, and the phloem which transports the products of photosynthesis (sugar) to the rest of the plant. There are also air spaces in the leaf, which lead to the stomata. This is where gases are stored for use in photosynthesis, or for release into the atmosphere.

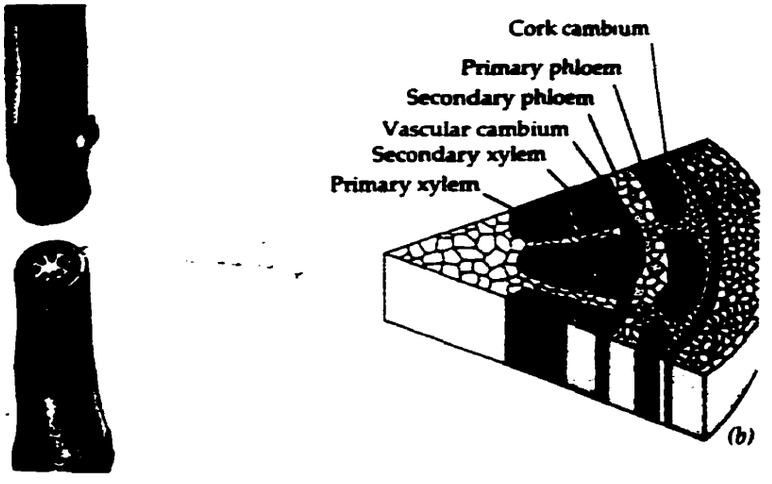
of the tree. Since the cells have ridged walls the 'wood' cells are hard and very strong, even though they are dead. So secondary growth (increase in diameter) is the adding on of more xylem, or in other words - wood!

Phloem also gets added on. But since it grows outward it becomes part of the bark. There it eventually splits and gets sloughed off due to weather, or is eaten by insects or animals. That is why the phloem does not accumulate as much as the xylem does.

Heartwood is the non-functional xylem that is clogged with resin. It is the inner part of the trunk. Sapwood is the functional xylem, vascular cambium, and functional phloem. It is near the bark.

Bark: The role of the bark is to protect the tree from fire, insect and other sorts of damage. It also helps reduce water loss. Bark is made up of two sections, the inner bark and outer bark. The inner bark consist of the old, non functional, phloem tissue. The outer bark consist of cork cells. These are special cells with a waxy substance that prevents water loss. The cork cells are produced from the cork cambium. The cork cambium is a thin layer of tissue between the phloem and the outer bark, which constantly produces cork cells to replace the bark that gets damaged or destroyed.

Figure 2: Cross section of a typical Gymnosperm stem[11]



Heartwood: contains dead xylem cells

Sapwood: functioning xylem and phloem cells.

Vascular Cambium: A layer of tissue between the xylem and the phloem. It produces new xylem and phloem. Xylem grows inward, phloem grows outward.

Cork Cambium: Lies between the old phloem and the outer bark. It produces the cork cells of the outer bark.

Bark: Contains two sections, inner and outer. Inner bark is old non-functional phloem cells. Outer bark consist of specialized cork cells, and forms a protective covering all over the tree.

Chp. 8: Energy Flow, Nutrient cycle, and Water Transpiration.

The resources that we need are not infinite, there is a fixed amount on earth. Yet all the components that we use are recycled; that is all except energy. Energy flow is the progression of light energy from the sun through organisms eventually becoming lost as heat. The nutrient cycle is the endless cycle of life and death. Nutrients are drawn up from the ground by plants, passed on to animals, and returned back to the ground when the plants and animals die. **Water Transpiration** and the water cycle provide the medium for life. Water is drawn up from the ground by plants and is eventually released into the atmosphere. All three combined form the basis of the life cycle for every living organism on Earth. I cannot over emphasize how important these processes are. The three greatly affect our physical environment, air and water quality, and climate. In terms of forestry they are important in determining site quality; that is soil fertility, light availability, nutrient availability, water, and climate. These attributes greatly influence the health of a forest, and the height and quality of trees.

"It sure is hot today," John says staring into the water.
"Ya, it's nice to sit in the shade by the brook," replies Emily.
"Wish I'd brought my fishing rod...I like sittn' in this spot - the moss is like a pillow," Peter sighs. Then he adds. "How come more moss grows here by the river, than in the woods over there?"
"Because there's more sun light here than in the shady woods," John answers.
"Well, John, moss grows in the shade too. It's the moisture by the river that the moss likes."
"Oh, I thought it was the sunlight."
"Well, for a lot of plants it is light that determines where they can grow."
"I heard that sunlight makes us grow," says Peter.
"That's silly - sunlight makes plants grow, not people."
"Well, John, Peter's actually right," Emily counters.
"What!"
"Told ya so," Peter says with pride.
"That's not true Emily; sunlight does not make people grow."
"Well at least not directly," she says laughing. "It is true that we do not directly use the energy from the sun to grow, but indirectly we do. All the energy we get from food first comes from the sun."
"What do you mean?" asks Peter.

"She means that plants use the suns' energy to grow, and then we eat plants, or plant eating animals, and get their energy - right Emily?"

"Right, in university I'm learning about the environment. One of the things I've studied is how energy goes from the sun to plants and animals and then to us; it's called 'Energy Flow'. Plants take the sun's energy, that is sunlight, and change it into energy for the plant."

"That's called photosynthesis."

"Right, John."

"Photosillyness??" Peter giggles.

"PHOTO-SIN-THES-SIS," pronounces John.

"Oh, what is that?"

"Well," says Emily, "the plants absorbs the light from the sun. They use sunlight to make food by combining it with carbon dioxide and water. This forms glucose, which is a type of sugar. The plants store the sugars and when we eat the plants we get food energy from those sugars."

"That were made with sunlight, Emily?"

"Right!"

"What happens to the energy then?" asks John. "Is it just used up?"

"Not exactly; energy cannot be 'used up'. That's the first law of thermodynamics: energy cannot be created or destroyed."

"Then what happens to it? Once I've used the food energy from breakfast does it just hang around outside?"

"Sort of," she chuckles.

"Ya, I've seen it," insists Peter.

"The energy is eventually converted to heat. This happens in your body, from moving muscles or thinking..."

"You do too much of that," interjects John.

Photosynthesis: The process where plants convert sunlight (energy) into food for the plant. The sunlight is absorbed by colour absorbing pigments called chlorophyll. The chlorophyll absorbs light in the 680 - 700 nm (nanometres) wavelength range, the yellows and reds. It reflects green light, 550 nm, that is why leaves look green; the green light is reflected back toward our eyes.

The energy from the sun fuels the food making process of the plant. Carbon dioxide, water, and light energy are combined to form glucose (sugar). This process is called conversion, the light energy of the sun is converted to chemical energy by the plant. The plant stores this chemical energy as sugar in the form of starch and cellulose. Cellulose is a major component of wood. When animals eat the plants the starch is broken down and converted to usable sugars by the animals. Only some animals, like cows, can break down cellulose to usable food. They have this ability because of special bacteria that live in their stomachs. These bacteria break down the cellulose for the cow.

The oxygen we breath is a by-product of the conversion process. Water (H_2O) is split so the hydrogen can be used in the conversion process. The left over oxygen is released into the atmosphere as O_2, which we need to live.

"...the heat is released from your body. Since heat is the lowest form of energy it cannot be converted to be used again. So it just goes off into space, I guess. All energy will eventually become heat. That's the second law of thermodynamics: energy moves to a random state. That means it will become heat, because heat is the most random form of energy."

"There must be a lot of random energy out there," Peter adds thoughtfully, "because it sure is hot today".

The three lounge on the rocks by the river.

"Wow, I never realized how much plants did for us," Peter says looking at a fern by the river with new reverence.

"They do even more important things," Emily adds.

"Like what?"

"Well," answers John. "You remember earlier, when we were talking about the food chain, well its all based on plants."

"Plants", Emily interjects, "are primary producers. That means they make food energy by taking up minerals and nutrients from the ground, which combined with light energy makes sugar. Then animals eat the plants and the nutrients are passed onto them."

"Then," John adds, "other animals eat the plant eating animals. That's the food chain."

Energy Flow: Sunlight is energy. Most of the sunlight that reaches the earth is reflected back out into space, yet some is absorbed by plants and algae that contain photosynthetic pigments called chlorophyll. These plants convert the sun's light energy into chemical energy. Thus these plants are called 'primary producers'. Only 1% of the energy is maintained after conversion by the plants. Energy is also given off, by the plant, in the form of heat from **metabolic processes.** The converted energy is available to animals in the form of sugars stored by the plant as starch and cellulose. Plant eating animals, called herbivores such as rabbits, convert the starches and cellulose back to sugars. Thus the plant eating animals are called 'secondary producers'. Carnivores, which cannot break down the plants cellulose, eat the herbivores. The food energy they get from the herbivores originally came from the plants. So it can be seen that the conversion of light energy, by plants, is absolutely necessary to maintain life on earth.

Like plants, animals also give off heat due to metabolic activity. Fully one third of our energy is lost as heat. Once energy is converted to heat it is no longer usable to plants or animals. Heat is the 'lowest' form of energy and is radiated back into space. Thus energy is not a cycle, it flows from the sun to plants, to animals, to people, and then is lost as heat. Energy is never consumed, it just changes form. The two laws of thermodynamics describe the nature of energy. 1: Energy cannot be created or destroyed. It can, however, be converted from one form to another. 2: Energy moves toward randomness (disorder), from organized patterns to random patterns, i.e. heat.

"When an animal or plant dies," Emily says, "its body decomposes, that means that some of the minerals and nutrients go back in the ground. Tiny organisms called bacteria and fungi break down the animals tissues. These organisms are called decomposers; they are very important. With out decomposers most of the nutrients would be locked up in dead bodies and would be unavailble to other organisms, like us. Once the nutrients are back into the ground they are available for plants to use again. Then the whole cycle starts over again. Nutrients go from the ground to plants to animals to other animals and back to the ground again."

"Neat!" Peter exclaims.

"Different habitats have different amounts of nutrients in the ground. It depends on the type of plants there are and the kinds of animals living there, and the kinds of rocks that make up the ground. So it is important to protect all types of habitat to insure that there are enough of all the types of nutrients available to the plants."

"Yea, Emily, but cutting doesn't ruin the amount of nutrients available. If the cut and regeneration is done properly there won't be any **leaching**. In fact the cut helps speed up the nutrient cycle. Since there are less trees; fewer nutrients are being used. Tree roots and branches rot to create more nutrients, since most of the nutrients are in the bark and leaves. The ground gets warmer, because there is no canopy to block the light, which speeds up the decomposition. So all the nutrients are available for the new trees that are planted."

"What's leaching?" Peter interjects.

"True," Emily continues, ignoring Peter, "but we must be careful to replant a variety of trees, and to encourage other plant growth right after the cut. Since different plants use nutrients in varying degrees, we need a wide variety to insure the soil stays fertile."

"What's leaching," he asks again.

"That's when the nutrients and minerals are taken, or 'leached', out of the ground. Heavy rain fall can cause erosion which will wash the fertile soil away. Also sometimes, due to rain and poor ground cover, the minerals and nutrients sink down into the earth out of reach of the plants. Sometimes this runoff ends up in the rivers and upset the delicate ecosystem in the river." She turns to John.

Leaching: Leaching is the passing down of nutrients from the upper soil levels (FF and A) to the lower levels (B and C, see pp. 40). In order for leaching to take place the chemical nutrients must be in ionic form. There must also be an excess of water percolating into the soil. Clearcutting can cause an excess of water on the cut site soil by affecting the water table. This can cause leaching of the nutrients needed for the regenerating trees. Adding fertilizers can also cause leaching by the addition of sulfate and nitrate ions that will bond with other ions in the soil as they pass through the soil layers with the water. Leaching causes an overall degradation of the soil's fertility by removing important nutrients from the soil layers that the plants can reach.

Acid rain causes leaching because the hydrogen ions (H^+) in the acid rain water attach to the minerals (-) in the soil. As the water seeps down into the ground it takes the minerals with it, out of reach of the roots.

"Speaking of water, that's another factor you must consider. Soil humidity affects its fertility, and the kinds of trees which grow on a site. Cutting can cause the ground water level to rise since there are no trees to absorb the water. This can change the conditions of the soil. One thing it does is raise the soil water level. That can alter the forest ecosystem on that site because increased water levels affect what types of trees will grow there. The species of trees that were cut in that site may no longer be able to grow there because the soil is too damp."
"Yea, but cutting can also decrease the water levels too. If a large area is clearcut the water level may drop because there are fewer trees drawing the water up. Also the ground is exposed to direct sun light, this increases soil temperature, and that will increase the evaporation rate."
"Right John, I guess it's real important to keep soil humidity in mind when planning a cut. Like everything else in forestry it tends to be **site specific**. Varying soil types and water levels will partly determine what size the cut will be, especially if you want to replant with the same species."
"So the amount of water around is important?" Peter asks.
"Very important," John laughs.
"Water greatly determines the makeup of a forest," Emily adds. "Like nutrients, water also moves in a cycle. When it rains water is spread over the forest. Some of that water stays on the leaves of plants and evaporates back into the atmosphere, where it forms clouds, when the sun comes out. Some of the rain reaches the ground and sinks into it. That water gets drawn up by the roots of plants. Plants use the water in photosynthesis and it is then released into the atmosphere..."
"That's called 'transpiration'."
"...Right, John. Some of the water that reaches the ground runs off into rivers and from there to the ocean. Eventually it evaporates back up into the atmosphere where it comes down as rain again."
"The amount of rain fall in an area determines what kind of plants will grow there. Like desert plants are adapted to areas with little rain fall..."
"...and," Emily continues, "...the kind of plants in an area affect the amount of rain fall and the humidity."
"Huh!?"
"Well, trees release water into the atmosphere. That affects the amount of water in the air around the trees. The environment around a tree is called micro-climate. Micro-climate affects the soil and everything else."
"Do trees really add that much water?" Peter asks.
"One large tree can transpire over three hundred liters of water on a dry hot day. Imagine how much water a forest can release in a day. It certainly does affect the humidity in a forest. Have

you ever notice that when you go into a forest from a field that the air seems damper and cooler. well that's because of the trees and their effect on water and light."
"So...," John hesitates, "...what you're saying is that the amount of rain affects the trees and can even determine the kinds of trees that will grow in an area. And the kind and amount of trees in an area affect how much rain falls and the humidity."
"Right."
"That sounds confusing," says Peter.
"It just goes to show how the trees and their environment are interrelated. One affects the other. To alter one is to alter the other. We must keep these relationships in mind when making management plans."
"It seems...," Peter points out, "...that water, minerals, and light, and stuff are really important to the forest."
"That's right, Pete," Emily answers.
"Ya' know, I'm gettn' kinda hungry," John sighs. "Think I'll head home for some chow, it must be well past lunch time."
"Ya, me too."
"O.K. I'll come too," Emily says hopping off her rock and heading for the path home.

Once home, Emily decides to review some of her papers from Acadia University. She realizes that Mom and Dad are going to make their harvesting plans soon. She wants to review what she has learned so that she can help them in their management strategies. She knows that John will help out, and she doesn't want to be shown up. In an effort to help with the management plan Emily is preparing a list of topics she wants to talk over with her parents. This list includes ecological concerns that she hopes they will address. It is very important that the forest be managed in a way that respects and protects the biological functions inherent in it. After all, the quality of the trees depends greatly on the health of the overall forest ecosystem.

Emily makes a list of topics of ecological importance to forest management: soil, habitat, micro-climate, succession, disturbance, and seasonal effects. Now she needs to flesh this out. She hopes to present a list of forest needs and the effect of cutting on each of these forests conditions. This is what she has come up with...

Chp. 9: *An essay on the types and fertility of soil*

Soil contains the mineral nutrients and water that plants need to grow and survive. The type of soil at a site greatly affects the health, growth rate, and species composition of that site. As a forester it is not necessary to know the soil type of every square meter of your land, but it is a good idea to familiarize yourself with the general soil types on your woodlot. Knowing the soil types will aid in management decisions concerning replanting and **ground treatment** after cutting. With that in mind this chapter will look at soil makeup.

"An organized approach!" Emily thinks to herself. "Must present this logically. First I'll break it down into sections and explain each one."

Soil Function: Soil serves two important functions for plants. 1) It serves as a foundation or substrate for plants to anchor into, using its roots; and 2) It provides the water and nutrients necessary for the plants survival.

Formation: Soils are made from the bedrock of an area. Soils vary from place to place because the parent rock material (the rocks that make the soil) varies from place to place. These rocks get 'weathered' (broken down) by rain fall, temperature extremes which cause cracking, and even from acids produced by the plants themselves. The rock breaks down into small particles. The size and mineral composition of these particles depend on the type of rock being broken down, that is the parent material. Different rock types form different soils.Some are very fertile while others are poor. The reason for this range in fertility will hopefully become clear as you read on.

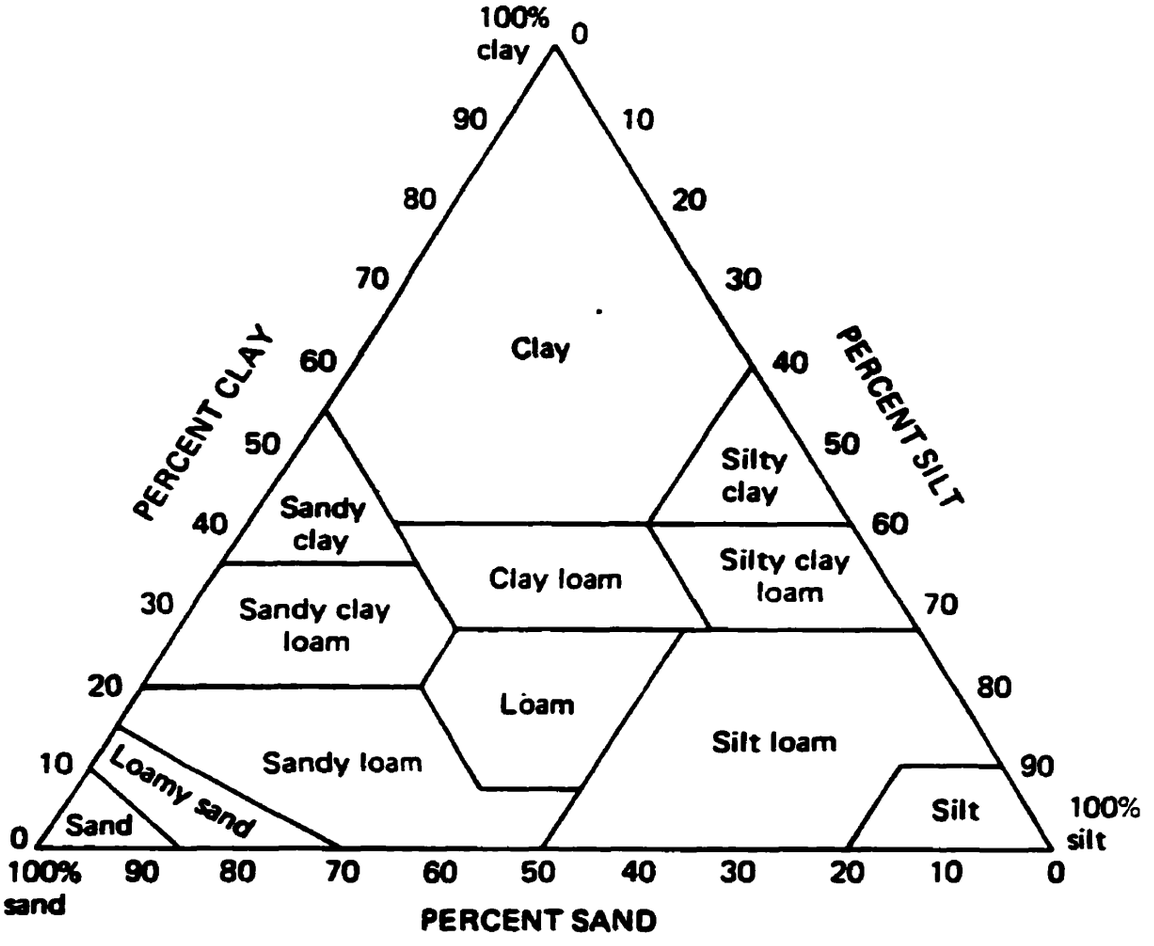
Figure 3: Parent rock chart[12]

Some common types of rock, and the material, soil, and fertility that weathering creates.

Weathering ability	Rock type	The rock type, after weathering, primarily produces:	Soil	Fertility
Soft	1. Limestone	Clayey till with fine soil	Brown earths	Very high
↑	2. Greensands, i.e. hyperite, diabase/dolerite and amphibolites	Sandy and fine-sandy till	↑	High
	3. Granite	Granites create coarse sandy till with large numbers of boulders and stone		Average
	4. Gneiss	Gneiss tills are sandier, and contain less stones than granite till		Average
	5. Lepsite Hellaflinta Porphyrite	Coarse, sandy till. Often stony		Low
↓	6. Sandstone and Quartzite	Coarse, sandy till	↓	Very low
Hard			Podsols	

The types of particles made from the rock can be sandy, clay, or loamy. Each of these type of particles holds water and nutrients differently. Clay particles hold water much better than sand. The water available to plants is trapped in spaces between these particles that make up the soil. The bigger the spaces the easier it is for the water to leach down and out of reach of roots. Sand has large spaces and clay has small spaces. Rocks that make clay soils break down easily and therefore more readily provide minerals than hard rocks such as granite.

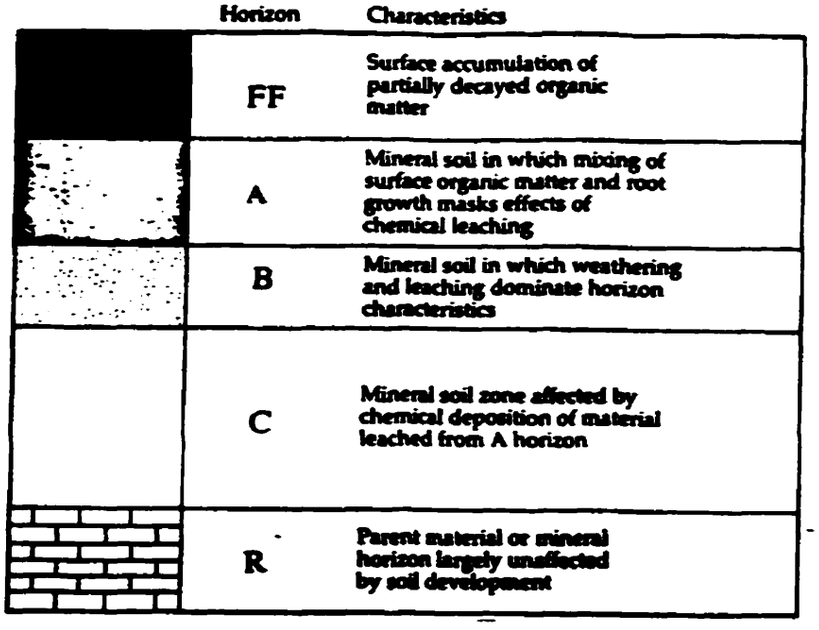
Figure 4: Soil composition triangle[13]



This triangle gives the percentage of material in a soil. The amount of silt, clay, loam, sand, or silt in a soil greatly determine the soils fertility and it's ability to provide water to plants.

Soils are made up of layers called 'horizons', soil horizons are called: FF, A, B, C, and R. The chemical and mineral makeup of each layer is influenced by the layer above it, and also by the plants living off the soil. The depth and composition of each horizon vary between each soil type.

Figure 5: Soil Horizons[18]



Soil Horizons:

FF: This is the top layer, the layer we walk on. It is made up of the forest litter (fallen leaves and branches etc.), and partly decayed organic material. It can be anywhere from a few millimeters thick to 10 centimeters or more.

A: This is the upper mineral soil layer. Here humus (decayed organic material) from the FF layer mixes with the mineral soil (from the parent rock). Some weathering of minerals takes place. Roots dominate this layer and is the habitat for many invertebrates (insects), and fungi, involved in the break down (decay) of organic material.

B: The mineral soil layer. Weathering of soil takes place here. Also this layer collects many of the nutrients leached out of the top layers.

C: This layer contains mineral soil and is affected by leaching from the upper layers.

R: This is the parent rock from which the soil is made. It has not been affected by the soil forming process.

There are many types of soil ranging from brown earths to podsols. The type of soil affects soil fertility. Clay, or brown earth soils, tend to be the most fertile, while sandy podsols tend to be the least fertile. Since the Acadian forest contains mostly podsols we will only concern ourselves with those soil types. Podsols occur in cooler temperate areas where the decomposition of organic matter is slow, compared to a tropical area. The cool temperatures, high precipitation, and slow decomposition contribute to the podsolization (section 4 has more information concerning the soil conditions of the Acadian forest).

Soil Humidity: The amount of water contained in the soil also affects its fertility and partly determines what species of trees will grow in that site. In Nova Scotia there are six classifications of soil moisture:

1) Rapidly Drained: water is removed from soil rapidly in relation to the rate of supply (rain), usually course textured and/or shallow soils.
2) Well Drained: Quick removal of water, yet it remains longer in soil then with 'rapid', medium coarse textures soils.
3) Moderately Well Drained: water removed slowly from soil, yet soil will become dry, medium textures soils with compact B horizon.
4) Imperfectly Drained: water runs off slowly enough, in relation to supply, that the soil remains wet for most of the growing season, all types of textures.
5) Poorly Drained: slow removal water causing the soil to remain wet most of the time when it is not frozen, wide range of soil textures and very organic.
6) Very Poorly Drained: water removed so slowly that the water table is at the surface of the soil. There is exposed ground water.[14]

The humidity also affects the soil formation process and influences the soil type formed.

Treatment: Soils are very sensitive to disturbances. Some hardy fertile soils can withstand considerable impact from a forestry operation, while some thin soils may become non-productive from a single harvest. For example a hill with exposed bedrock and thin soil would be very sensitive to harvesting, especially mechanical harvesting. An area like this should be classified as a bio-sensitive area. Heavy machinery also compacts the soil. One needs to be careful in wet areas, where skidders can destroy the malleable soil by mixing the horizons. Harvesting in winter is easier on soils when the ground is frozen. Less damage is likely to occur due to compacting.

Soils need to have the nutrients replaced to stay fertile. When whole trees are removed from an area, most of the nutrients and minerals go with them. It is a good idea to leave the tops, branches, and stumps on the cutting site. Most of the nutrients in a tree are contained in the twigs and leaves. This helps replenish the soil with nutrients. Of course care should be taken to not

leave too much slash so as to cause a fire hazard. Trees should also be left standing to preserve the soils integrity. If a large area is clearcut soil erosion may result. The roots of living trees keep the soil in place. The amount of trees needed to prevent erosion will vary from site to site. For example thin soil on a hill will need many trees, whereas deep damp soil on a flat plane will need fewer.

To prepare a cut site for replanting it may be necessary to treat the soil, that is, turn it over or make furrows in it. The type of treatment depends on the soil type, and the species of tree being planted. Soil treatment of this type, called **scarification**, is covered in section 5.

Hopefully it is now clear that soil is very important to the health of trees, and that different soils affect plants in different ways. Also plants affect the soil. For example the needles from coniferous trees raise the acidity in the soil. This influences what plants can live there, i.e. plants that are sensitive to low pH values would not grow there, and it also affects what animals can live there. Many fungi and invertebrates cannot survive in acidic soils. Once again we see that trees and their environment are interrelated.

Chp. 10: *An essay on habitat*

As discussed in section 1, habitat is the physical environment in which wildlife live. It provides food, shelter, protection from predators, dens or nests, and all other materials an animal needs to survive. This chapter will elaborate on the topics mentioned earlier: the need for varying habitat types, the importance of diversity, that animals need specific habitat, and recognizing rare and endangered habitats.

"Hmm...," Emily thinks to herself. "I must show Dad that it's really important to protect all types of wildlife habitat. That a healthy forest needs a diversity of tree species and age classes. And more importantly that a forest with diverse habitat is a healthy forest...Well lets see, I'll begin by explaining habitat and take it from there."

A matter of scale: When given some thought habitat is a vague term. It can mean a whole lake, or even an ocean, or as small as a leaf on a twig. The size of the habitat needed depends on each particular plant or animal. A leaf mining mite would live its whole life on a single leaf, whereas a blue whale will travel thousands of kilometers in search of krill.

A single tree provides several types of habitat for a variety of fungi, lichen, moss, insects, birds, and mammals. As the tree grows the habitat it provides changes and so do the kinds of plants and animals that depend on it. A sapling will provide habitat for many insects, and browse for deer, whereas an old pine will provide nesting sites for birds and dens for squirrels. Different species of trees will host different plants and animals. It is important to maintain a variety of tree species and age classes of trees present in the forest so as to maintain a wide variety of plant and animal habitat. The more natural diversity the healthier the forest will be as a whole.

No place like home: a forest landscape can also be seen as habitat. A large forest region with many stand types provides the elements necessary for larger mammals. Deer and other mammals need a variety of forest types to survive. For example, deer will graze on the young nutrient rich shoots of hardwood trees, yet in winter they rely on the evergreen stands for shelter. Ruffed grouse need young dense coniferous stands for nesting, and mixed-wood for mating rituals, and edge zones for food. If any of those habitat types is missing the grouse cannot survive in that area

All animals depend on specific habitat types for survival. Not all wildlife can live in an old growth forest while others, like the flying squirrel, might perish without it. Some animals have evolved to utilize the habitat of specific forest stages. This is called specialization. The Barred owl needs the open understory of an old growth stand to see prey, and the tall trees in

which to build nests. A prime example of specialization is the Forked Fungus beetle. Its entire life cycle takes place on the hoof fungus. This fungus grows primarily on dead and fallen birch trees. Furthermore it only lays its eggs on this fungus. The eggs hatch and burrow into the fungus. There the larvae develop. When the larvae reach maturity they eat their way out of the fungus and emerge as adults. This beetle cannot survive in any other habitat.

Often, cutting practices destroy the dens and nesting areas of animals. This cannot be avoided. Contrary to popular belief, animals cannot just 'pack up' and move elsewhere when their habitats are destroyed. Forests contain many creatures all vying for the same resources. Each one of them has worked out a niche in their area. A nich is the division of resources amongst the organisms in an ecosystem, both spatially and temporally. The total area used by an animal is called its 'home range'. When an animal's home range is destroyed it simply cannot move on to another. The surrounding areas may already be host to other animals (of the same species). More often than not a displaced animal dies after its home has been destroyed because it cannot compete with the already established animals in another area.

If harvesting methods are ecologically sensitive, the damage they cause can be kept to a minimum. Also, if harvesting is kept on a small scale it is quite possible that an animal living in a tree will be able to find another den in the same home range it has always lived in. There are many harvesting methods that are sensitive to the concerns of the forest inhabitants*.

A variety of habitats: there are many kinds of biomes, from deserts to ponds to forests. Each offers a variety of habitats. The Acadian forest consists mostly of mixed (hardwood and softwood trees) with some purely hardwood or softwood forests. The habitat provided by deciduous trees is vastly different from that provided by conifers. Generally speaking a deciduous forest has more biota (things living there) than a softwood forest. There are many reasons for this. The needles of conifers contain chemicals that make them less palatable to animals and insects than broad leaves. These needles are also high in organic acids. Thus the soil is high in acidity due to the needles that fall to the ground. This acidic litter is not liked by most fungi, insects, and bacteria that inhabit other soil types. These acids also leach out many of the nutrients in the upper layers of the soil.

In the spring light easily penetrates the deciduous forest since there is no canopy stopping it, thus the soil warms quickly. In the coniferous forest light is intercepted by the evergreen needles. Thus spring is delayed because the soil takes longer to warm up. Since fewer species of plants can grow in the darker, acidic coniferous forest, there are fewer animal species there to eat them. Thus there is an overall lower species richness. However, this does not mean the

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* Harvesting methods, and their impact on the forest, is covered in section 5, pp. 81-85.

coniferous forest is a waste land. There are many species that are solely dependent on it, and compared to Arctic tundra, it is a cornucopia of life.

Some habitats are very fragile and sensitive to human incursion. Rivers are delicately balanced. If too much silt builds up in the water its conditions change and fish habitat is destroyed. Harvesters must be careful not to cause runoff (erosion) that will ruin rivers (see section 5). Areas like bogs, rock out croppings, river edges, and rare species habitat all deserve special consideration. If these areas are harvested it may result in the permanent destruction of that ecosystem, thus affecting the forest as a whole. Biologically sensitive areas are called **special management zones** (SMZ). SMZs should be left untouched or managed with the utmost care and consideration.

Harvesting trees obviously affects the habitat type. Some people say it destroys habitat. This is not necessarily true. Harvesting unarguably changes the habitat, but if a cut is carried out properly with considerations given to the forest's ecosystems, the cut area will still be very productive. In fact in some case more productive, in the short term, than before. When a site is harvested the canopy is opened up, there is more light available, the soil gets warmer, more water is available, and (if limbs and stumps are left) more nutrients are available. Such a site provides excellent conditions for new plants and trees to grow. If a mature stand is cut the opening will see a flurry of activity. The area will be more biologically productive than the surrounding mature stand. The type of habitat provided by a cut over is very different than the one that has been removed. Different species of plants and animals will flourish there. *It is of the utmost importance to maintain all types of habitat so as to provide for all forms of wildlife that depend on them.*

Chp. 11: *An essay on macro and micro climate*

Climate is the weather condition in, around, and over a forest. It is a combination of the effects of the natural elements. Climate includes: precipitation (rain fall), evaporation, humidity, available light, temperature ranges, and wind. Climatic conditions partly determine the growing season, tree composition, and the general size and health of the forest. This chapter will be an investigation into the effects of climate on the forest.

Climate is divided into two types: macroclimate and microclimate.

Macroclimate: This is the overall climatic conditions of a region. For example the climate of Nova Scotia, or the climate of the Tobeatic region. Generally speaking we, as individuals, have no effect on macroclimate conditions. It is important, however, to understand them for macroclimate determines the overall amount of light and precipitation the region receives.

Microclimate: This is the climate conditions on a smaller scale, from a tree stand, or single tree, or even an ant hill. The climatic conditions can vary a great deal within the forest. Forestry activities can affect some of these microclimatic conditions.

Microclimate has a large impact on the forest environment. The humidity and temperature in a forest stand partly determines what kinds of trees and plants can grow there. Some trees prefer dry conditions while others like damp conditions. This affects the animals living in the forest, for the types of animals in a forest are determined by habitat which is in turn affected by the climate.

Climate also affects the soil and nutrients. Damp cool sites, like temperate coniferous forest, have slow decomposition causing the creation of podsols. Lots of rain and organic acids cause leaching of nutrients which makes for less fertile soils. And, as discussed earlier, soil fertility greatly affects the vegetative makeup of the forest.

Microclimate can vary greatly from one tree to the next, or from the ground up. Thus the makeup of plants and fungi etc. can also vary greatly in a small area. For example, a small hill will provide well drained soil for a white pine, whereas the area around it may be too damp for it to grow in. These microclimatic conditions should be kept in mind when making management decisions concerning replanting and **regeneration.**

As well as being influenced by microclimate, trees also affect the microclimate. If you walk from a field into a mature coniferous forest you may notice several changes. Less light penetrates the canopy, the air is more humid, the temperature is cooler, and the wind is greatly reduced. These conditions are caused by the presence of the trees themselves. So the trees partly determine the conditions in the forest and hence the types of plants that can grow in the **understory**.

Trees also affect the rate and direction of water flow. The positioning of trees influences the movement of water runoff through the forest. The root masses slow the movement of water through the ground. This regulates the flow of rain water to a river. This regulation protects the river ecosystem by reducing flooding, erosion and siltation. Once again we can see how environmental conditions are a two-way street. Trees are influenced by their microclimate and the microclimate is influenced by the trees.

The variation of microclimate can be more fully appreciated with this example: a single tree will have several different microclimates and therefore provide various habitats due to that variation. The crown (top of the tree) is windy and dry, the humidity is lower and there is more sun light than in the lower branches. Lower down it is darker, more humid, cooler, and less windy. This contrast of conditions provides different types of habitat for different types of wildlife. So, along the vertical stratification of a tree you will find different animals utilizing the various conditions provided by the tree.

Once the tree is dead and has fallen over a whole new set of climatic conditions emerges. Large dead fallen trees retain their moisture. This is very important to young plants growing on it. The fallen dead wood provides nutrients from wood that has been broken down by bacteria, fungi, and insects. It provides substrate in which the new plants can anchor their roots, and water essential for their growth and development. Since the fallen dead wood retains its water, trapped in the wood fibers, it can provide water for young shoots even during drought periods in the surrounding forest. The microclimate in the fallen log is very humid, a condition favorable for the growth of a young sapling.

Management considerations: Climatic conditions should be considered in management decisions. Though it is impossible to predict the changes in macroclimate, it is a good idea to know the average conditions around your woodlot. Often microclimate is too subtle to notice, and it would be impossible to record all the variations in a forest, for they are constantly changing. It is, however, important to keep in a mind a few rules of thumb about microclimate when making harvesting decisions.

When an area is clearcut the microclimate is drastically altered. This is because the trees, which influence the microclimate, have been removed. Generally speaking a clearcut area will become warmer, windier, have increased evaporation, higher risk of frost damage and soil erosion, and more available sun light.

When planning a cut, it is necessary to predict what these changes will be and how they will affect the productivity of the site, and the habitat provided by the site. For example an owner may wish to regenerate a cut stand with the same species. Yet due to microclimate change the site

may no longer be suitable for that species. Predicting site conditions will help tremendously in planning for new stands.

When planting, it is a good idea to leave shelter trees in clearcut areas. Areas that are exposed to the sun become dry and windy, and will have massive water loss and possible erosion. Shelter trees will lessen this effect by providing shade, acting as water pumps, and holding the soil in place. They also reduce the risk of frost by reflecting heat back to the ground. When harvesting on slopes one should keep in mind that south facing slopes receive more sunlight and are generally warmer than north facing slopes. More shelter trees will be required on north facing slopes. Of course more shelter trees are needed on slopes than on flat areas to prevent erosion.

Chp. 12: *An essay concerning ecological succession and disturbance*

Ecological succession is the natural change of species composition in a site over time. It is independent of seasonal effects. Succession occurs as some species colonize a site and then are forced out as new species take over. It happens with both animals and plants. In terms of time it can take decades, as with a field, or centuries, as with a forest.

Nature follows a cycle of birth, death, and regeneration. This can be seen in how forests develop. Forests may start with an old field, which is then overgrown by shrubs, then hardwood trees emerge and finally, in the case of the Acadian forest, to softwood. Succession also occurs in established forests as well. This chapter will examine ecological succession of which there are two types: primary and secondary.

1) Primary succession: Nature follows a well worn route when building an ecological community. Primary succession begins with a barren rock landscape with no soil. The first to arrive at our 'inhospitable' locale are the 'colonizers'. These are hardy lichens and mosses. They establish themselves in the cracks of rocks. They form the first soil with a poorly developed FF horizon (see pp. 44). Next to arrive are the hardy plant species, whose seed is blown in on the wind. These are the weed species and grasses. They find a home amongst the mosses that provide an anchor for their roots. Some of these plants will be nitrogen fixers. They help improve the soil's fertility by providing nitrogen to the soil. Over time the soil will develop from weathering of the rock and a build up of dead leaves and plants. The now deeper and richer soil will host woody shrubs. These shrubs provide protection from the elements for the small tree seedlings. The deciduous trees will grow and out compete the shrubs and take over. They provide shelter for the shade tolerant coniferous trees. Eventually the long lived coniferous trees may force out the hardwoods. This can take hundreds of years. Finally two or three species will dominate leading to a climax forest, called old growth forest, where trees may be over a thousand years old. (In Nova Scotia there are few old growth forests left. There is an ancient hemlock stand in Kejimkujik National Park with some trees over 400 years old.) The forest will stay in this climax stage until some major disturbance sets the forest back to an earlier successional stage.

Nitrogen Fixation: Nitrogen fixation is the process that turns atmospheric (gaseous) nitrogen into a usable solid form. Some bacteria turn the gas nitrogen (N_2) into nitrate (NO_3). Some of these bacteria are associated with certain tree species. Nitrate is an important compound for plant development. The presence of nitrogen fixers increases the fertility of the soil. Alders are excellent nitrogen fixers.

Primary succession, the soil forming process, is common, but occurs on a geological time scale, such as after glaciers retreat.

2) Secondary succession: This occurs within ecosystems. Ecosystems are constantly changing in terms of species composition, and this change is secondary succession. A linear progression of successional stages is possible, but in nature any given site may move back and forth along that line. For example a field may become overgrown with alders and shrubs, then it becomes forests as trees invade. Then a fire may wipe out part of a forest creating a gap in the forest. Burns, shrub land or forest are all successional stages.

Forests get moved back to earlier stages by *disturbances*, such as fire, insect infestation or cutting. That is, anything that removes the dominant tree cover. This opening up of the stand will cause a backward shift in successional stages. Disturbances can be small or large scale, from a single tree to a whole forest.

Disturbances can happen in all forests in any stage. Fire, blowdown, and insect infestation, are amongst the most common forms of disturbances. A fire may burn down a young spruce stand creating a gap in the forest, suitable for fire weeds, grasses and shrubs. The size and severity of the disturbance will determine if the whole site or just a small area is moved to an earlier successional stage. A windthrown tree will open up a small area for saplings to grow, yet this does not change the forest type.

Disturbances are useful to forest health in many ways. They open up areas in the forest that can be used by different animal species than those that live in the surrounding forest. This promotes biodiversity. Some disturbances help in the reproduction of some tree species. Jack pine cones, for example, need to be heated to open and release the seeds. Fire is part of jack pine life cycle. Other plants, like some prairie grasses, also need fire to crack the hard seed coats. In old growth forests small fires eliminate competing plants by burning the smaller trees. The large trees are protected by their thick bark, and their limbs are high enough that the needles are not burned.

Climax Forest: A climax forest is one that has reached the final successional stage for that region. It is characterized by one or two dominant species (e.g. hemlock and white pine). Almost all the trees are in the same age group and will be mature or old growth. These forests are generally open having little understory or shrub growth. Minor disturbances, like windfall, will create small gaps is in the canopy allowing new growth to take hold. Barring a large scale disturbance, like fire or cutting, the forest will stay in this state. Many species of animals depend on climax forests for habitat. In Nova Scotia a climax forest is not necessarily a steady state. Trees will die and decay allowing new growth. Also climate affects this stage, such as a coastal spruce old growth stands. The trees are short with undergrowth of varying age classes.

While succession may seem like a constant directional march to a climax forest, it is not that simple. Many factors affect successional development. The linear progression model, from an early successional stage to a climax forest, is, for the most part, a human construct. The model is useful in helping us understand how the forest community develops. In nature, though, there are very few instances where succession follows an uninterrupted path to a climax forest. In a natural forest we may find many different sites at different successional stages. This is because the nature of nature is to be chaotic, not linear. Chance, environmental conditions, soil and history all influence the stage that any given forest area will be in at any given time. As a result some ecosystems will remain at one successional stage for centuries. This is because the plants that are established manage to out compete the new arrivals. We may classify secondary successional strategies as follows (any or all may be present in a site at any given time):

1) Facilitation: Each successional stage prepares the site for the next stage. Hospitable conditions are created by previous stages for the succeeding stages. For example, the shrubs will improve the soil through nitrogen fixation and providing organic litter, such as dead leaves. The shrubs will draw water up through their roots making more water available. The shrubs keep the ground warmer at night by reflecting heat and cooler in the day by providing shade. All these conditions make it possible for the young hardwood saplings to survive. At the same time the plants of one stage make conditions worse for themselves. Plants will over crowd each other. Sun loving plants will shade each other and their offspring hindering growth, meanwhile taller growing trees are able to reach the light. This is one of the reasons the forest moves from one stage to the next.

2) Inhibition: This is the opposite of facilitation. The early stage species create conditions that make it very hard for new species (the next stage) to establish themselves. One such condition is the result of leaf structure. Early successional tree species, such as hardwoods, have broad leaves which form a dome shape around the tree. This leaf structure captures most of the light thus inhibiting the growth of some competing species. Thus a mixed wood may prevent white spruce from establishing for quite some time.

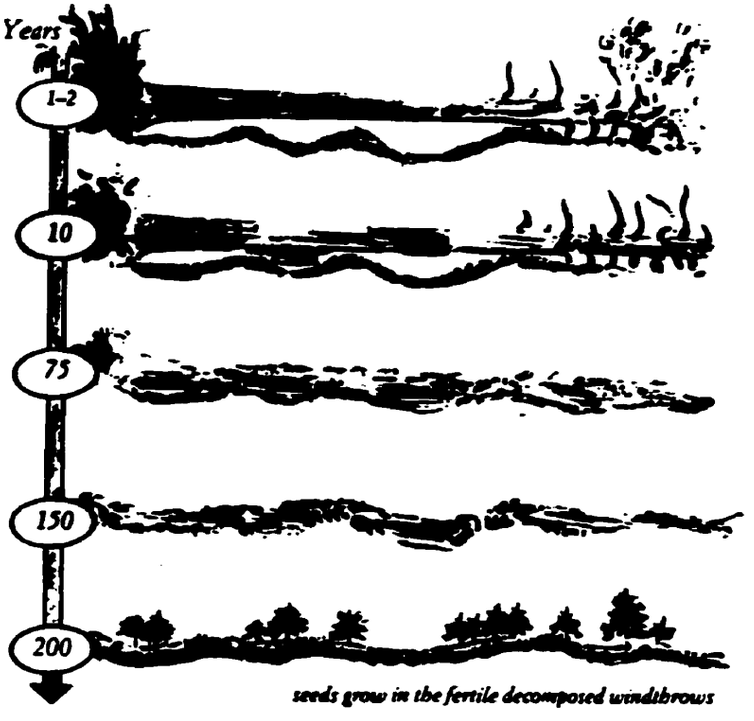
3) Tolerance: The early successional species adapt to the presence of the newly established next stage species. They do this by adapting to the lower levels of resources available to them. Which may result in lower population levels of the older species. Plus, their growth and reproduction rate slow down. Eventually they will mature and, if conditions permit, may out compete the new species.

So when do these changes occur? Well, as mentioned earlier, major disturbances will alter a forest structure. But small disturbances occur as well. Gaps are an example of small scale disturbances.

Gap dynamics: Gaps are holes opened up in the canopy by a tree falling over from wind or decay, or from being cut. Larger gaps are caused by small fires or disease. Gaps are a major catalyst of forest succession and are a rich area for new life to take hold. Many species will compete for the space created by the gap. The size of the gap and the surrounding vegetation will determine what species will eventually survive there. Large gaps, caused by fire or disease, will become overgrown with shrubs and vines. These will eventually give way to the slower growing trees. The seeds of which will come from the surrounding forest. Small gaps, such as a single tree blowing over, re-seed from the surrounding trees. Many seedlings of different species may start out in the gap. Eventually one or two will establish themselves in the gap. Survival depends on many factors including the gap size, light and availability of water.

Degradative Succession: Succession can occur on an individual level too. Trees that die and fall over go through several stages of decay. Each of theses stages supports a variety of life. When the tree dies other organisms, like fungi and bacteria, use it for food. These organisms break down the fibers of the wood. The breakdown of the dead tree is called decomposition. As the tree decomposes it provides habitat for different creatures (see figure 6). The process ends when the tree is completely decomposed.

Figure 6: Succession on windthrow[15]



Animals and succession: Along with changes in vegetation with each new stage, there is also a change in the kinds of wildlife that use the vegetation as habitat. A cut over will be home to meadow voles and shrews, the shrubs to Ruffed grouse and certain other birds, the woods to deer and bear. An area that has many different successional stages will also have a wide variety of wildlife. Forests with a mixed age class, that is several successional stages, will have higher biodiversity because the variety of age classes supports a wide range of animals.

Animals also affect successional change in the plant community. They may eat the arriving species thus keeping the successional stage at an intermediate stage. This is an example of successional inhibition. The animals associated with the vegetation of one stage prevent the vegetation of a later successional stage from establishing.

Management and succession: Forest management interrupts natural succession. Generally we try to grow only commercial species and discourage the rest. Until recently it was common to plant mono-cultures of one or two tree species in clearcut areas. This insures marketable timber and easy harvesting. Yet this type of stand is not natural in the Acadian Forest; it does not fit into the successional scheme. The Acadian Forest has many characteristics that make it healthy. A wide variety of tree and animal species is the most obvious. This species variety (biodiversity) insures the health of the ecosystem and provides stability and resistance to blow down. The many tree types provide habitat for a smorgasbord of wildlife.

A mixed forest is more resistant to diseases. For example, a case of beech root rot. In that case only the beech trees will be affected leaving the rest of the forest intact. In fact some beech may be spared because they were not in contact with other infected trees; as other tree species separated them. Genetic variation within species also strengthens the health of the forest. Some trees may die from root rot but others will be resistant and live to pass their resistant genes to the next generation of trees.

A tree plantation lacks some of these features. A tree plantation is a site that has been cleared and planted. The trees are usually all the same species, from the same genetic stock, planted in rows and all the same age class (because they were all planted at the same time). Yet this is still a forest, but one not nearly as rich in wildlife abundance as the natural forest. Because of the conditions in a plantation, some problems arise. Since trees on the site are of the same age class and species, there is less biodiversity. Many animals and birds require many different types of trees. An all spruce forest will be suitable only for animals that use spruce exclusively, and the other animals that live off them. Such stands are usually much less stable than a mixed forest. As a result plantations are prone to blowdown. They are much more prone to insect and disease, and the effects are frequently more devastating, because trees in a plantation are all the same species. Any disease or insect that arrives will literally attack all the trees, since there is no barrier of other

tree species to stop the spread. Thus the whole plantation may be destroyed. For these reasons the plantation must be intensively managed and cared for. This adds an extra major expense to the forestry operation. In contrast a more diverse forest is healthier, stable, and does not require a high degree of maintenance.

Harvesting can interfere with the natural flow of succession, but can also simulate succession as well. A cut can have the same effect as fire or disease outbreak, but only if the cuts are the size, and in areas, prone to those conditions. Most fires in the Acadian forest are not very large, so cuts should be kept small as well. Also keep in mind when making harvesting plans that a mix of age classes and sizes maintains biodiversity.

Chp. 13: *An essay on seasonal effects*

When planning a woodlot it helps to keep seasonal effects in mind. Conditions in the woods change dramatically throughout the year. The changing of the seasons has many repercussions for plants and animals alike. They also affect woodlot maintenance and harvesting. Thus this chapter will review the seasonal effects on the forest community.

Winter: Winter is a harsh time in the Acadian forest. Often we do not think of animals as 'feeling the cold'. We figure since they live in the wilderness, it must not bother them too much. Animals do get cold, in fact some freeze to death! Yet animals have adapted to winter life in the forest. Many animals find a den and go into a state of **torpor**. **Hibernation** is a form of torpor used by chipmunks and flying squirrels as well as other mammals. The other animals, the ones that stay active, have evolved to survive the cold by taking advantage of the forest. Many animals stay in evergreen stands during storms, where they are sheltered from the wind. One such animal is the white tailed deer...

Deer wintering Areas: these are areas used by deer during the winter. They are usually located on south facing slopes. In the summer and fall deer eat grasses and green leaves. In winter the hardwoods have no leaves and there is no shelter for them. So in the winter the deer move to evergreen stands. The evergreen stands offer shelter from wind, and they are warmer (from reflecting heat back to the ground). If other food is scarce the deer will eat the needles, although they much prefer hardwood browse (browse is the young shoots or branches on a tree). Mixedwood stands also offer protection from predators like coyotes. Deer cannot move quickly in deep snow, so in open areas they are more vulnerable. The evergreens collect most of the snow in the crown, branches, and needles, so the ground has relatively little snow on it. In these areas they can still out run predators, and the hardwoods provide browse for food. When making management plans it is important to make every effort to find out if deer use your woodlot as a wintering area. If so, these areas should be protected, otherwise the deer may not survive the winter.

Plants as well as animals are affected by the seasons, for example annual plants die at the first frost. Frozen ground can stunt the growth of evergreens by preventing water uptake.

Another obvious effect of winter is that the ground freezes. Frozen ground is much more resilient to machines and skidding than soft earth. If possible, it is a good idea to harvest in the winter for the impact on the soil will be greatly reduced. The draw back to winter harvesting is that any animals dislocated by the harvest will have even less of a chance to reestablish in a new area, than in summer, due to cold conditions and food scarcity. If extracting in the summer, wait untill the ground is dry. Harvesting decisions should be made on a site to site basis taking into

account the particular conditions of each stand. Management decisions are covered in sections 5 and 6.

Summer: During winter hardwood stands are desolate, very little lives there. But in summer the deciduous forest is rich in life. Flowers appear in spring while snow still lies under evergreen trees. The leafless open canopy of the spring hardwood forest allows direct sunlight through to the ground, so it thaws more quickly. This allows plants to grow on the floor of the hardwood stand before the snow has melted in the evergreen stand. Once the leaves are out many of the animals move back into the hardwoods. The birds return from the south and the hibernating animals emerge. The forest is once again buzzing with activity.

The story picks up...

In her room Emily sits back and surveys the notes she has made, things she hopes to discuss with her father. The notes concern forestry and ecology.

"Wow!" Emily scratches her head. "That's a lot of stuff to get across to Dad."

"What are you doing Em?"

"Oh, It's you John. I'm just trying to organize what I think Dad should consider when he makes plans for our woodlot."

"Like what?"

"You know, things to keep to mind when they make harvesting plans. Things like climate, animal habitat and seasonal variation."

"And what *does* that have to do with planning a cut?"

"Cutting will affect the microclimate and habitat in the forest."

"How?...and keep it brief."

"Well, clearcutting opens up the forest. The soil gets more light, becomes drier, and is prone to frost in the winter. The absence of trees could cause erosion due to wind and rain runoff, since there are no trees to hold the soil in place. The other thing I wanted to point out is that its really important to make sure there are many different stand types all over our lot. Different age classes and tree composition provide different types of habitat. Animals need a variety of habitats. Not all can use the same habitat.

"And what about the seasons?"

"Oh, I was just gonna mention that its better for the soil to harvest in the winter than in the summer."

"Why?"

"The frozen ground is more resistant to impact caused by the machinery."

"You study too much," he laughs. "Well you're wasting a perfectly beautiful day out there. Let's grab the munchkin and head out."

"Sure," she laughs, "I've been thinking too much anyway." They head for the door.

Section 4: Geophysical makeup of the Acadian Forest

The type and quality of a forest are directly affected by the physical environment. So far we have talked about forest processes and functions in general terms. This section will go into detail about the kinds of forest and geophysical formations found in Nova Scotia, and the effect of these geophysical conditions on the Acadian forest. Understanding the process by which our forest came about will greatly aid in making good management plans.

"You were right, John, today is too nice to waste indoors," Emily says emerging from the house into the warmth of the late afternoon sun.
"What did I tell you."
"Did I mention that a friend of mine is coming to visit over the Christmas break."
"No," John says with surprise.
"Yeah, my friend Kara, I've mentioned her before."
"Oh yeah, your Indian friend."
"Aboriginal Canadian!, sometimes I think you say stuff just to piss me off, John."
"I do enjoy getting you fired up, and you make it sooo easy."
"Anyway, Kara will be staying over the holidays." She surveys the forest from their garden.
"She's Mi'kmaq, her people understand the land. They've been here a lot longer than us."
"True, but the rocks and trees have been here even longer. I wonder what they would tell us if they could talk..."
"Hey, look you two," says Peter who's been listening to them tease each other, "here comes Aunt Marie".

Chp. 14: Geology: From Pangaea to the glacial beginnings.

The geological history of Nova Scotia is not only interesting - no, really it is! but, also important to forestry. The physical forces of the earth and glaciers shaped the land in such a way that there is considerable geographic variation in our small province, which is only 55, 000 km^2 or 21, 000 mi^2 in area. This chapter will discuss the effect of those forces on the Acadian Forest.

The theory of plate tectonics holds that about two billion years ago, all the continents were attached forming a super continent called 'Pangaea'. The theory also holds that the super continent broke apart due to forces under the earth's crust. These forces are created by plate tectonics.

The surface of the earth, including the oceans and ocean floor, rests on several huge tectonic plates. These plates 'float' on the molten semi liquid magma that forms the layer between the crust and the earth's core. These plates shift and move causing pressures on the other plates. If two plates move in opposing directions there can be a massive build up of pressure that may be released all at once, in the form of an earthquake.

A fault line is the area where two tectonic plates meet. The shifting of these plates can cause the ocean floor to open up or split along a fault line. Hot molten lava pours up through these splits. This lava cools to form more rock. As the lava builds up it forces the ocean floor on either side of the split to move away from the split. In other words the new rock material forces the ocean floor to spread apart and make room for it. As the ocean floor moves it moves the continents with it. This is called continental drift. The amount of drift is really quite small, at best only a couple of centimeters or more a year.

It is the force of continental drift that forced Pangaea apart. Slowly over millions of years the sections of the super continent drifted further away from each other. Today we see the results of that drifting in the form of the seven continents.

What does this have to do with Nova Scotia, you ask...?

"...But what does continental drift have to do with our woodlot, or even Nova Scotia in general, Mom?"

"Well, John, quite a bit. You see Nova Scotia was formed from two different sections of that super continent. That means that the bedrock varies throughout the province. Also we're located where some tectonic movement takes place. 'Marginal' activity is where the earth's crust movement is evident. This crust movement causes the formation of several different types of rocks. So Nova Scotia has a wide variety of rock formations for a small province. This means we have a variety of soil types. Different parent rock materials produce different soils, and soils affect forests - such as ours!"

"Wow...," sighs Emily, "...I didn't know that."
"Amazing! something she didn't know," John roles his eyes.
"Oh shut up, John. How else is the soil affected by these plates, Mom..."
"And how do they affect the trees?" Peter exclaims.
"Well, as you may already know: up until ten thousand years ago Canada was cover by glaciers, huge sheets of ice, that were miles thick. But it was different here in Nova Scotia, we were on the edge of one of these ice sheets. Mind you a hundred thousand years ago that sheet extended 40 kilometers off our present coast. Since we were on the edge the ice shifted a lot and that made a great impact on the land.
"So what did the glaciers do to the land?"
"Well Peter, instead of telling you, how about I show you."
"You're gonna show us a glacier!?"
"No, I'm going to show you what they left behind. Come on I'll explain while we walk....When the glaciers spread over Nova Scotia they tore up the soil and underlying bed rock. This debris remained in the ice sheet and moved with it for a while. Eventually the debris would be deposited as the glacier moved and melted. Those deposits are called 'glacial till'. Then once the ice started melting the water eroded some of these glacial deposits forming ridges and dams called 'Kames'. The original hill of earth that was moved and compressed is called a drumlin."
"What do they look like?"
"How big are they?"
"Well," Marie says laughing, "look around, that'll answer both questions."
"What?!" the three exclaim
"We're standing on one. This hill is what is left of a glacial drumlin. Over time the pile of debris has eroded and now has smooth contours, and plants and soil have developed."
"I see," says John, "but how does this affect our woodlot?"
"Well, look around. What type of trees do you see?"
"Ah...there's some red spruce, and balsam fir, and white pine, and over there are some sugar maples and yellow birch."
"Now, look down below in the low area, what do you see?"
"Well some of the species are the same, like there're some red spruce. But I also see some black spruce near that swamp, and Gray birch too."
"So, what does that tell you?"
"Ahhh, I see. The drumlin makes a well drained hill, so some trees will grow here that normally wouldn't like the wet conditions in the valley."
"Right, I hope that answers your question."

Chp. 15: Climate

"Hey, what's that...it feels like rain."
"Pete, I think your right."
"Lets get going before it pours."
"Well that's Nova Scotia for ya: 'If you don't like the weather, wait five minutes'," Emily and John say in unison.
"Gee, why does it rain so much around here?" Peter yells over the rain as he pulls his shirt up over his head and runs home in the newly arrived down pour, Marie-Claire, Emily and John follow behind.

The answer to Peter's question is quite involved. Our climate stems from our geographic position, wind patterns, and ocean currents. Sound confusing? Well its not that bad.

Nova Scotia is situated between 43° and 47° north latitude. That puts us in a cool temperate region (as you well know if you've spent a winter here). Yet our climate is not as extreme as the climate inland, such as in Ontario or Manitoba. This is because of the influence of the sea and air masses on our weather. Three major air masses meet over eastern Canada and, depending on the time of year, these air masses greatly influence temperature and precipitation. The Atlantic ocean affects our weather by tempering the extremes of hot and cold. It does this because of the Gulf Stream and simply because it is a large body of water.

Water takes more energy to heat up and releases more energy when it cools down, than air or earth. So water stays warmer for a longer period of time in the winter, and cooler in summer. So the effect of the ocean is to make our winters more mild, than inland, because the ocean is releasing heat during the winter months. The warm Gulf Stream from the south also plays a role in making our winters mild by bringing warm water from the south that will release heat. Yet the ocean makes our spring come late and our summers cooler because more heat is used warming up the water.

Looking at these influences together, the ocean, wind, and air masses, the main features of Nova Scotian weather are: wide temperature ranges, but not extreme, ranging from lows of -20°C in February and highs of 30°C or more in July and August; plentiful and regular precipitation (55 in., 138 cm. on average per year); mild winters, a late spring, and a short summer; frequently overcast and lots of coastal fog.

Mean Annual temp.	Mean temp. (Jan.)	Mean temp. (July)	Mean Annual Precipitation[16]
6.4°C	-4.8°C	17.8°C	1379.9mm

The effect that climate has on woodlots will vary throughout the province. The coast will favor hardy species that can withstand the salt and storms, species like balsam fir, white spruce and jack pine. Whereas inland, species that prefer drier less humid conditions will flourish.

Chp. 16: *An essay on the soils of Nova Scotia*

This chapter will deal with the soil types found in Nova Scotia. As mentioned in section 3, soils are formed in part from the weathering of parent rock material. This can be influenced by climate, decaying plants and animals, precipitation, and temperature (freezing). The present soils of Nova Scotia were formed after the last glacial period, approximately ten thousand years ago. The retreating glaciers tore up the previous soil and bedrock. Once the ice had fully retreated the soil formation process began anew.

In Nova Scotia the predominate soil forming process is podsolization. Podsolization occurs in cool climates with high precipitation on coarse glacial deposits, usually in coniferous or mixed forests. The temperature and high acid content slow the rate of decomposition of dead organic matter on the surface of the ground. Podsols are characterized by leaching due to heavy rain, high acidity, slow decomposition, and few soil animals, like earth worms. The texture, sandy, clay, or loam, of these soils is as varied as the parent material they come from.

Other major soil forming processes are: Luvisol which is formed from fine glacial till and old lake bottoms; Gleysols which spend part of the year covered by water; and Brunisols which form on lowland till plains.

In Nova Scotia the soil classification has been broken down into 23 soil families. Each of these varies in size, pH, soil type, and parent material. We will not discuss all the soil families here, but we will use the MacKenzie's woodlot as an example.

The Mackenzies live in the Tobeatic region in south western Nova Scotia. Their woodlot is situated in the Gibraltar soil region. The soil here is characterized as:
Soil Family: Gibraltar
Dominate subgroup: Podsols and Gleysols
Texture: Moderately coarse sandy loam.
Drainage: Well drained
pH: Ranges from extremely acidic: less than 4.5 pH, to strongly acidic: 5.1 - 5.5 pH.
Parent material: Moderately coarse too very coarse glacial till.
Productivity: 6 m^3/ha/yr.

With this information the MacKenzies can plan regeneration with trees suitable to this type of soil. Information about all Nova Scotian soil families is available from the Department of Natural Resources.

In terms of forestry, the Acadian forest has two major soil types: 1) Coniferous and mixed: the soil of these forests are characterized by a thin, dry, and acidic humus layer (the first

soil horizon), matted plant material and slow decomposition; 2) Deciduous: This forest type is characterized by a thick, moist, rapidly decomposing humus layer. The hardwood soil is usually more productive. Since it is less acidic it contains more soil animals, bacteria and fungi, all of which aid in decomposition producing more soil. This creates a deeper rooting depth, allowing for more effective recycling of nutrients.

Chp. 17: *An essay describing the forest regions of the Acadian forest*

The Maritimes are a transition zone between the warm southern deciduous forest and the colder northern boreal forest. Thus our forests are a composite of forest types. Nova Scotia has many mixed forests with some pure coniferous or deciduous stands. Yet in a few small areas the forest make up of Nova Scotia is more like that of the boreal forest. One such area is the northern portion of Cape Breton Island. This area is dominated by fir and spruce forests. The trees, ground cover, climate, and age class in this area are quite different than in the rest of Nova Scotia. This chapter will examine this variety of forest types found in Nova Scotia.

The main tree species in the Acadian forest are: 1) Coniferous: red and white spruce, balsam fir, red and white pine and eastern hemlock. 2) Deciduous: yellow, white, and gray birch, sugar and red maple, red oak, white ash, trembling aspen, and large tooth aspen (poplar). These species are found in varying degrees of abundance throughout the Acadian forest. There are, of course, other trees species that are less common.

Eighty percent of Nova Scotia is covered by the Acadian forest. To make inventory and record keeping easier the Department of Natural Resources has divided the province into six forest regions. Each region was created on the basis of similar tree type, understory, climate, and soil. The six forest regions are[17]:

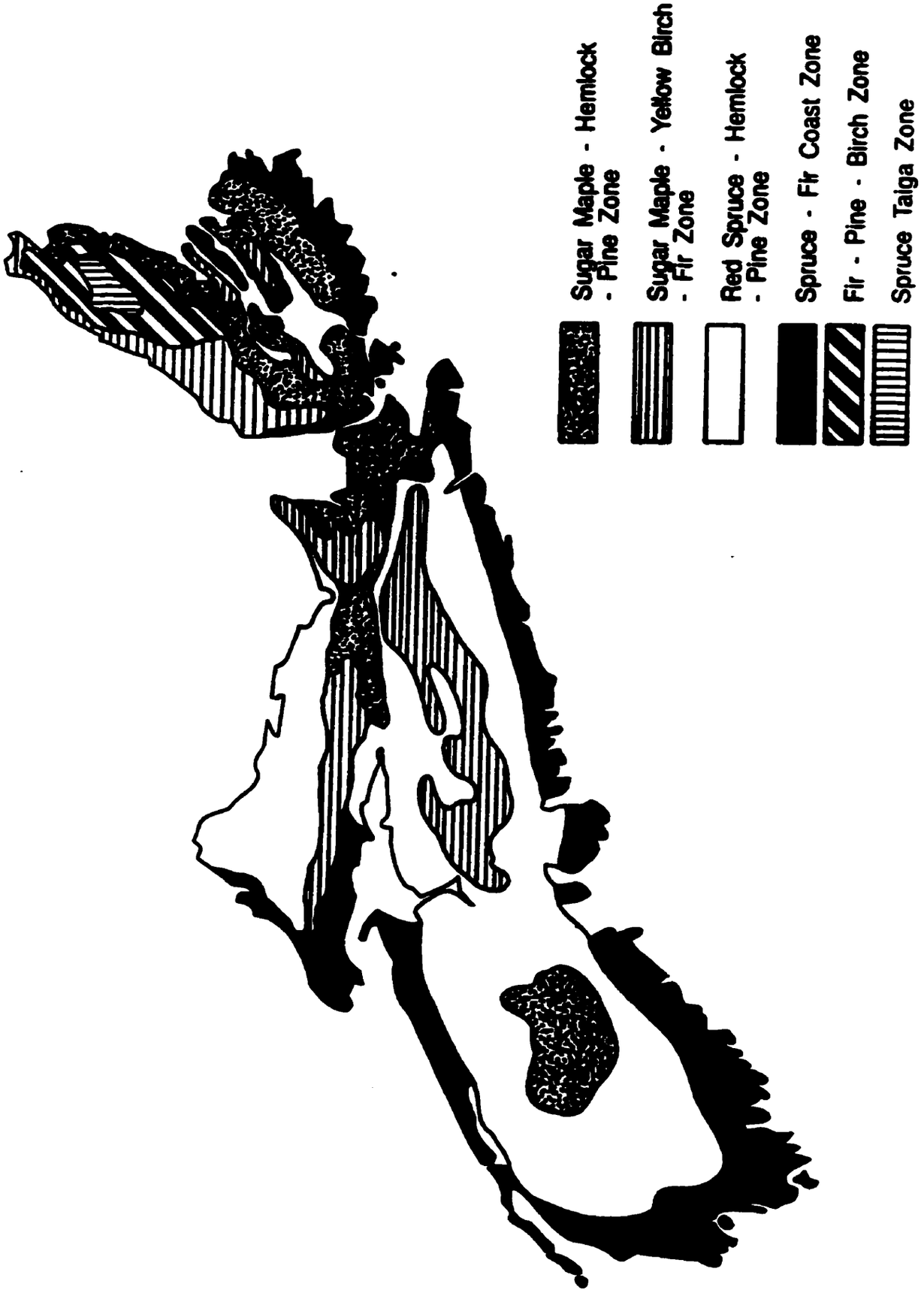
1) Sugar Maple - Hemlock - Pine Zone

Tree types: Dominant: sugar maple, eastern hemlock, and white pine.
Other common types: Coniferous: balsam fir, white spruce, black spruce,
and red pine, tamarack (larch) and red spruce in the south.
Deciduous: beech and yellow birch.
Understory: Sorrel, Wood fern, *Maianthemum*, and Bunchberry.
Beaked Hazel is the dominant shrub.
Climate: Generally low summer temperatures (16°c), though warmer in the south western part of the province, with moderate precipitation.
Soil texture: Sandy loams to silt loams.

2) Sugar Maple - Yellow Birch - Fir Zone

Tree types: Dominant: sugar maple, yellow birch, and balsam fir
Other common types: Coniferous: white spruce and red spruce
Deciduous: beech
Understory: Wood - sorrel, Wood fern, and Shinning club moss

Figure 7 : The Six Forest Zones of Nova Scotia[24]



Climate: Highly variable
Soil texture: Stony loams to silt loams

3) Red Spruce - Hemlock - Pine Zone

Tree types: Dominant: red spruce, eastern hemlock, red and white pine
Other common types: Coniferous: balsam fir and black spruce
Deciduous: red maple, red oak, grey birch, ash, sugar maple, yellow birch, and white birch in the low lands
Understory: Approximately seventy five species of shrubs including Witherod and Rhodora. Some of these shrubs are not found anywhere else in the province.
Climate: Warm moderate temperatures, (17° - 18°c), with high precipitation in the low lands and low precipitation in the southern portion of the region.
Soil texture: Ranges from coarse loam to sandy loam in the south, and sandy loam to sandy clay loam in the low lands.

4) Spruce - Fir Coast Zone

Tree types: Dominant: This Zone is predominately softwoods such as red spruce, white spruce, and balsam fir.
Other common types: Coniferous: tamarack
Deciduous: red and sugar maple, white and yellow birch, and beech
Understory: Mountain ash, Crowberry, and Raspberry
Climate: Cool summer temperatures with high precipitation, also frequent fog and winds.
Soil texture: Loam to coarse sandy loam to clay loam, exposed bedrock is common.

5) Fir - Pine - Birch Zone

Tree types: Dominant: balsam fir, white pine, red pine, yellow birch, and white birch
Other common types: Coniferous: black spruce and tamarack
Deciduous: red maple
Understory: Mountain Maple and Hobblebush
Climate: Seasonally low temperatures with high precipitation
Soil texture: Well drained sandy loams

6) Spruce Taiga Zone

Tree types: Dominant: black spruce and white spruce
Other common types: Coniferous: balsam fir
Deciduous: white birch and mountain ash

Understory: Many mosses and shrubs including Sheep Laurel and Rhodora.
Climate: Cool summer temperatures with high summer precipitation.
Soil texture: Well drained sandy loams

The MacKenzie woodlot is located in Zone 3, The red spruce - hemlock - pine Zone.

Meanwhile...

Speaking of the MacKenzies, we last saw Duncan and Arthur in a hemlock / pine stand marking out a new road.

"Damn Nova Scotia weather," Arthur grumbles as the rain pelts down.

"Well we're pretty much through the preliminary work, Arthur. Lets head back and see if there's a pot of tea on... before we get drenched."

"That's the best idea you've had all day, Duncan." He looks at the gray sky. "Sometimes I wonder how the animals can stand it."

"Oh well, at least these old pines will keep the rain off us."

"Thank God for that," Arthur grumbles as they head toward the main trail and home.

Chp. 18: Parks and Protected Areas

In 1994 the provincial government released a plan to increase the number of protected places in Nova Scotia. The plan is called: A Proposed Systems Plan for Parks and Protected Areas in Nova Scotia. The plan aims to identify 'typical' Nova Scotia landscapes, special features, and rare and unique ecological sites. DNR has identified 77 distinct natural landscape types in Nova Scotia. Each of these landscape types represents one of the many ecosystems, rare or interesting areas in the province. Of the 77 representative landscapes of Nova Scotia only 7 presently receive adequate protection under the old parks system. The plan selected 31 new areas which are recommended to be designated as protected areas. This will increase the number to 26 out of 77 landscapes types that receive adequate protection. In terms of land mass the new plan will increase the area of protected land from 160,616 hectares to 447,616 hectares, or from 2.9% of the total land mass of Nova Scotia to 8%[19].

What does this have to do with a woodlot ?...

"Look at what the cat brought in," Emily chuckles as Duncan and Arthur enter the kitchen soaked to the skin.
"A couple of drowned rats," answers Marie-Claire.
"Any tea on?" Duncan inquires.
"Pot's on the stove."
"What have you lot been up to while we were WORKING," grumbles Arthur.
"I was listening to John and Emily start a fight over parks and ecology."
"So what else is new...what is it this time?"
"Well...," Emily starts, "..we were discussing the plan the government has out for parks and protected areas."
"Oh yea..., I picked up a copy of that. I thought you'd be happy with it, Emily."
"Well you'd think...," John butts in, "...but she won't be happy until the whole province is turned into one big park."
"That's not true!..."
"That's enough you two," interrupts Duncan pouring a cup of tea. "Keep the conversation civil."
"Well, Emily, tell me what you think of it," Arthur asks sitting down with his fresh cup of tea.
"Well there are some things I really like about it. First off I like the approach. The plan aims to protect landscapes instead of individual species or small sites. This way they'll manage for ecosystems. That means that the ecological process that supports the natural community will be protected. That way more than just a few species are taken care of, but rather the whole

ecological community. Which means that species we may not even know about are being protected."
"Well that makes sense to me," Arthur agrees. "Then what's the problem?"
"Well, in the report they identify 77 distinct landscape types. These landscapes represent typical and rare features as well as unique ecosystems and animals in Nova Scotia. Presently only 7 of the 77 are adequately represented in protected areas. The new plan only increases this number to 26. Twenty six! that's not even half. If these landscape are so 'distinct' then how come we're not protecting a representative of all of them!"
"Wait now, Emily," John joins in, "that's not quite fair."
"How's that?" asks Arthur.
"Don't encourage them, Arthur," Duncan warns.
"No, no," Marie says rising to Arthur's defense. "I want to hear this. I think its important. Go on John."
"Right now our parks systems protects about 160,000 hectares, that's almost 3% of the whole province. This new plan proposes to include 31 new sites. This will increase the area of land by over 280,000 hectares. That puts it at almost half a million hectares! That's a lot of unproductive land."
"Its not 'unproductive'!, its just protected from exploitation. There's a difference you know. The ecosystems will still continue quite happily without your cutting the trees down!"
"It has yet to be decided if resource development will be allowed in the new protected areas. I imagine that decision will be made on a site by site basis," Duncan interjects.
"Well I don't like that. A protected area should be 'protected' from all exploitation, otherwise what are we protecting? What's the sense of designating protected areas if we allow business as usual? Especially since the new proposal only increases the area being protected to 8% of the province."
"Actually, Duncan, the provincial report recommends that there be no forestry, mining or commercial development in the new protected areas," Marie-Clarie adds.
"There! What's the big deal about 8% anyway," says John.
"The Bruntland report states that at least 12% should be set aside as protected areas."
"That's 12% of each country. To remove 12% of our productive forest would hurt the forestry industry and people like us. Besides just because you harvest the trees doesn't mean you destroy the land. A properly managed forest will maintain its ecological integrity."
"O.K., hold it you two," Marie says calming them down. "Lets look at the whole picture. What I like about the proposal is the attention to endangered species. There are about 36 species of animals and plants on the endangered list for Nova Scotia. What I'd like to see is some protection

guaranteed for those species."
"But you can't protect a species if you don't protect their habitat," insists Emily.
"...But species have been going extinct since time began," John interjects. "Its not all our fault. It's part of the natural process of evolution."
"Sure, but since humans have come onto the scene the rate of extinction has increased by ten thousand times."
"Yes, Emily...and you too John. So what we need is a system that protects the ecosystems in which these creatures evolve. That way nature will select which ones survive and which ones do not. AND that is exactly what the proposal calls for, Right Emily?"
"Yes, Mr. Cormier."
"But, we're part of nature too. You can't expect nature to operate in a vacuum isolated from us." John continues. "We need to interact with nature, we need to use it to survive. Not just for economics, but everything."
"The problem is we over exploit" Emily cuts in. "Look at our current situation in forestry. Less than 1% of Nova Scotian forest is over 100 years old..."
"..and," John continues, "most of it is between 40 and 80 years old, they're not all saplings out there you know. Besides over 2000 hectares of old growth forests are already protected and the plan calls for protecting a lot more of it...I understand the need to protect whole systems so that the communities that depend on them will survive. I also understand that rare and endangered places should be protected. But why isolate all that forest. If we manage it right..."
"Time out you two...," Arthur says putting down his tea cup. "I think I get your points. John is concerned that a lot of good productive forest may be taken away, which means a loss of money and jobs, which affects the community in more ways than just money."
"Right, if the land is properly managed then the ecology of the area will be preserved."
"My point exactly, my boy. If the land is properly managed...' I think what Emily is saying is that if the land was properly managed we wouldn't need protected areas, because there wouldn't be a problem..."
"Right!, and the problem is: it hasn't been properly managed and we need more protected areas."
"The problem...," Duncan says looking up from his tea, "...is people won't listen too each other. What both of you are saying: is that we need to be good stewards of the forest. That is government, forestry companies, and woodlot owners like ourselves. A hundred years ago foresters did not have the technology or know how to manage as we do now, nor did they understand ecology nearly as well as we do now. Besides the onus isn't just on 'them'. Who are 'they'? the government? - Pulp and paper? Emily, you can't understand why DNR doesn't include more sites in their proposal. Well the answer is 'us', and the other thirty odd thousand people like us who own small woodlots. Less than thirty percent of the forest of this province is

owned by the government. The rest is privately owned by people like us and the pulp companies. From that point of view your 8% is a lot larger. It's over a quarter of the crown land in Nova Scotia. A lot of those typical 77 landscape types reside on private property. Think about that...The thing that must be done is to give us woodlot owners the incentive, tools, and know how to manage our land in a way that is ecologically sound. The government needs to work with us so we can preserve our natural heritage."

"Oh, you mean like that home study course put out by DNR* ," John adds.

"Right, if *all* the land owners in Nova Scotia were good stewards, then there wouldn't be much of a problem. All those interested in our forest should work together instead of arguing." Then he adds laughing "Arthur I warned you not to get them going. They're like night and day, those two."

"Oh, I don't know," Marie interjects. "I think they're a lot more alike than they realize."

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* There is an eight module home study course put out by the Department of Natural Resources and the federal forestry department entitiled "Woodlot Management Home Study Course", available from DNR in Halifax, Nova Scotia.

Section 5: Management: The Forest and You, a series of essays

Now we will leave the Mackenzies for a while. I'd like to take some time out to give you an overview of the Nova Scotian forest community. This section will explain the history, politics and management techniques that the Mackenzies, as woodlot owners, must live with. By understanding a bit about forestry management we will be better able to grasp the problems and challenges faced by the Mackenzies as they make management plans for their woodlot.

Woodlot management is a controversial topic. Within the forestry community there are varying opinions on how to best manage a woodlot. First there is a matter of scale; managing a small woodlot and managing a 300,000 hectare forest are two very different things. Yet, I believe, there are some guiding principles of management that apply to any forestry operation. They are economic viability and ecological integrity, which will lead to sustainability.

Foresters, ecologists, government, and woodlots owners all share a common goal of preserving our forest heritage (though sometimes we need to be reminded of that fact). All those concerned with our forest must continue to work together to preserve our forest in perpetuity. Now that's a pretty tall order, for often the concerns of one group are in conflict with the needs of another. That is why a holistic approach is needed. That way all concerns are considered.

In this section I will present some of the history of forest management, management techniques , and the future direction of forestry in Nova Scotia. A variety of harvesting and regeneration techniques will be presented and critiqued according to *their* ability to maintain the forest values outlined earlier in this book. It is important to remember that the forest site itself will largely determine the treatments best suited for that particular area. I believe that management should be site specific. Nature is very diverse and there are few general techniques that apply to all situations. So let the land determine the best course of action. I hope to show that there are many options for management that can be integrated and rearranged to fit any situation. For the owner I hope to present options to accommodate your particular needs, or more to the point, the needs of your particular woodlot.

So what , exactly, is management? What are we managing for? These are two fundamental questions that need to be addressed to insure good management practices. If one were running a clothing store they wouldn't operate it as a factory. Retail requires certain skills and techniques to be successful; the same applies to resource management.

The first thing to keep in mind is that renewable resources, like trees, do not *need* to be managed to survive. Unlike the clothing which needs people to weave the cloth, design the

garment, cut the pattern and sew the cloth, a tree can grow and flourish without any help from us. So, what are we managing? We are managing our *use* of the trees. Through management we can manipulate a forest. We can establish stands of species that we prefer and control the forest so that it produces the kind of trees that we need to satisfy our needs. Yet forests, as we have seen, are part of an inter-related ecology that affects all living things, so we must be careful to manage in a way that does not damage this ecology.

Humans have used forest products since the beginning of our race, and we will continue to do so. What we must keep in mind is that our consumption affects our environment. We are managing a resource that does not need us, we *need* it. Thus our management should reflect respect and care giving on our part to ensure a viable, continuing, forest industry.

How much is too much? There is a point where human interference causes problems. It is one thing to manipulate the forest, but quite another to so alter it that it is no longer viable or healthy. This section will discuss various techniques for management. It is up to the owner to decide which methods are appropriate for their woodlot. Though too little management, such as a lack of planning and using only one harvesting treatment for a whole woodlot, can lead to lost profits and a poor quality unhealthy forest; over management can be just as detrimental. Over management, such as managing for a single use, can alter the natural forest structure. As managers we must find that balance between neglect and dominance. We must learn to live *with* and *from* the trees.

Chp. 19: *An essay on the history of forest management in Nova Scotia*

To understand how the forests came to the state they are in today we must understand some of the history of forestry in Nova Scotia. For we can only know where we are going if we know were we came from. The history of forestry in Nova Scotia is long and diverse - but not boring! This chapter will give a short account of the history of forest management and mismanagement in Nova Scotia.

Living with the Forest: traditional aboriginal views of nature:

The Acadian forest has been used by people long before Europeans landed on the shores of Cape Breton. The native Mi'kmaq had been living from and with the forest for countless generations. By the time Europeans arrived in the early sixteenth century (1500s) the Mi'kmaq had been living here as a nation for thousands of years. Contrary to popular misconceptions the Mi'kmaq were not disorganized scattered tribes of people. They had an organized social, political and religious life, all of which was centered on the forest and oceans. The Mi'kmaq nation encompassed Nova Scotia, P.E.I, eastern New Brunswick and the southern Gaspe'. This Mi'kmaq nation was part of the greater Wapna'Ki confederacy which encompassed what is now called the Maritimes, New England and Quebec. It consisted of many different native nations including the Mi'kmaq. The Mi'kmaq nation was divided into seven districts at the time of European contact had a population of ~ 35, 000 people[20].

The Mi'kmaq culture was based on hunting and gathering. They were opportunistic hunters who depended largely on the forest to provide for all their needs. They relied on animals and plants for all their food, clothing and tools. All their first aid and medical knowledge also came from the forest. This complete direct dependence on nature spawned an intimate understanding of how nature works. The native peoples became in tune with nature. They understood, respected and lived with the laws of nature. This respect for nature was incorporated into every aspect of their lives. They wasted nothing, using all parts of the animals that they killed. The sharing of food and utensils was considered one of the highest virtues. There was no hoarding, and therefore fewer animals were needed to meet their needs. Their respect for nature lead to an understanding and effective use of nature, preventing exploitation. For example, hunting for pleasure was considered disrespectful to their animal brothers.
"Aboriginal people consider themselves to be part of all life that surrounds us, we are not above any plant, animal or creature life."[21]

Figure 8: The Seven Mi'kmaq Chieftaincy Districts[28]

1. **Wunama'kik**
2. **Piwktuk, Epekwitk**
3. **Eskikewa'kik**
4. **Sipekne'katik**
5. **Kespukwitk**
6. **Siknikt**
7. **Kespek**

The Mi'kmaq were not alienated from their source of life. This connection with nature is seen in their spirituality. The land was believed to have supernatural powers. Animals, as well as people. had souls. It was believed that when an animal died its soul went to the land of the dead, as do human souls. Here they co-existed and neither human nor animal starved or wanted. This egalitarian view of wildlife was reflected in the native peoples treatment of wildlife. With certain animals, after an animal was killed, its body had to be treated with respect. The bones were not thrown to the dogs or burned, for fear that the soul of the dead animal may return and find its bones treated with disrespect. This insult could offend the animal soul and it may decide to make itself scarce. This meant that type of animal, e.g. woodland caribou, would be scarce. Thus the Mi'kmaq would suffer hardship (a lack of food and materials) as punishment for their disrespect.

It is clear that the Mi'kmaq were as much a part of nature as they were dependent on it. But what does that have to do with forestry? Well I hope the answer is obvious. The Mi'kmaq developed a relation with the forest that sustained both themselves and the wildlife. They used the forest, but did not exploit it. An example of their conservation is the division of the seven districts. The Mi'kmaq were aware of the fact that they had to control the harvesting of animals to ensure that there would always be enough available. So each district had a regional government which determined which bands of people could hunt and fish in that district. This was the first application of conservation in the Acadian forest. The Mi'Kmaq practiced long term management. As part of their tradition they planned for seven generations in the future.

Animals, plants and people were considered as equals and so must be treated as equals. This respect and consideration created a mutually sustaining relationship between the Mi'kmaq and nature.

The arrival of Europeans radically changed the Mi'kmaq culture. There was much cooperation between the early French colonists and the Mi'kmaq. The Mi'kmaq bartered for goods and food, thus reducing their dependence on the forest around them. The Mi'kmaq taught the French how to survive our harsh winters. Yet, in the end, European settlement and diseases reduced the native people's population and disrupted their traditional relationship with the forest. The influence of Europeans changed their life style forever.

In summary, the Mi'kmaq saw themselves as part of the natural world around them. They respected the forest that provided for them and treated it with reverence. They were the first stewards of the Acadian Forest.

An endless resource: European settlement.

In stark contrast to the native view of the forest, the early Europeans settlers saw the forests in a different light. The early settlers saw the forest as a challenge. Coming from a feudal capitalistic society they saw the forest, and its native inhabitants, as something that had to be

conquered. In the 16th century England and France were in a race to secure land in the new world. Each side wanted to out compete the other. In this rush to settle North America the land lost out. Political intrigue and power in Europe dictated how land was used. So when the settlers arrived they did not see a provider or possible source of wealth in the forest, instead they saw an obstacle to establishing settlements, and building an empire.

The forest became the enemy. It had to be cleared to build farms, grow crops, and raise live stock. The wild beasts had to be hunted to protect the settlements. The forest had to be tamed in order to build civilization. With limited technology and given the vast expanses of forests these settlers could not even conceive of a wood shortage. As far as they were concerned the Canadian forest was an endless resource and therefore no thought was given to protecting this resource. Perhaps if they had adopted some of the Mi'kmaq' views the history of forestry in Nova Scotia would have been much different.

The first waterpower mill in Canada was built in 1612 at Lequille on the Allains River (2 km south of Annapolis Royal, Nova Scotia). By the end of the seventeenth century there were a half dozen 'pit mills' throughout the province.[23] During this time the French and English were at war, each trying to secure the Maritimes for themselves. In the 18th century, with the second recapture of Louisburg by the English and the treaty of Paris, England and France stopped warring with each other (of course they would resume hostilities in the 19th century). Also in the 18th century the colonies began to think about their own welfare. Gradually the forest was seen as a source of wealth. The wood was used for ship building and our best customers were the West Indies and England. Imports from the Maritimes were more reliable than those from Europe. By the nineteenth century the forest was a commercial venture, and lumber barons controlled most of the forested land.

Forestry was now a tradition in Nova Scotia. Much of the land was held by the Crown. This land was leased (and still is) to lumber companies who paid a fee, called stumpage, to cut the crown land trees. Yet in most instances these powerful companies managed to get away with paying next to nothing. One reason is that the government was desperate for investment in the province. Also, provincially, there was high unemployment (some things never change). So the government waived its usual fees to bring in the investors and create employment. It also granted very long leases to the companies. A 99 year lease was not uncommon in the Maritimes. Some are still in effect today. The end result was companies cutting public lands, reaping the profits, and paying little if nothing back to the province.

From the eighteenth century through to the beginnings of the twentieth century forest 'management' was virtually non-existent. Companies, mills and ship builders all practiced **high grading**, which is the felling of the best trees and leaving the lower quality trees. The companies were only interested in immediate profit. They would go into an area, harvest it as quickly as

possible and then leave for the next area. The result was that the low quality trees left behind would re-seed the area with inferior stock (inferior in terms of commercial value). In terms of ecology the damage caused by high grading was a loss of vertically diversity. Since the tallest trees were cut the average height of the forest was lowered. Since environmental conditions in the canopy are harsh (wind and dryness) it takes a long time for a forest to get taller.

At this time no money or effort was put into reforestation, or Silviculture. Even today the forestry companies invest less than 1% of their earnings in reforestation and site rehabilitation. The tax payer pays for tree planting. This slash and burn forestry lasted for two hundred years while no mind was paid to the future of the resource. In fact it wasn't even seen as renewable. As far as the companies were concerned the forestry industry was temporary, eventually it would give way to other business.

Though this irresponsible and reckless mentality persisted, there were a few individuals who could see the impending doom. These few tried to alter the popular view of the forest. Bernard Ferrow, an American forester, started the first forestry university and created the concept of forest management in North America. Another was John Langton who, in 1862, warned that the lumber trade must make steps to preserve what was left or the industry would collapse. The destruction of our forests and the attitude of government and industry in the nineteenth century is summed up in this quote by the Canadian historian A.R.M Lower:

> "The sack of the largest and wealthiest medieval cities could have been but a bagatelle (of little importance) compared to the sack of the North American forest and no medieval ravisher could have been more fierce and unscrupulous than the lumberman. His lust of power and wealth have changed the face of the country, built cities and railroads, and created a sort of civilization... If in the process of growth, the forest had to be sacrificed, what matter? No one, after all, except a 'crank' here and there, expected it to be any more than a temporary source of wealth, to give place in due course to the settler."[24]

With new technology and two hundred years of cutting, the forest was beginning to look exhaustible. Industry and government recognized that in order to maintain a forestry industry some management had to be employed. Thus in 1926 the Department of Lands and Forests was born, a merging of the Nova Scotia departments of Crown Lands with Forests and Game.[25]

The early part of the twentieth century saw many changes in the forest industry in Nova Scotia. One of the most important was the shift from lumber to pulp. In the 1920s demands for newsprint in the American market combined with a depression in the lumber market in the Maritimes, caused Nova Scotia to begin a switch in production emphasis from lumber to pulp. Over the decades many new pulp mills were built across the province to meet the growing American demand for pulp and paper. The lumber market never recovered from the depression.

So from the sixties on, pulp was king. Today pulp and paper are the mainstay of the Nova Scotia forest industry.

With new markets and management one might think that forestry was headed in the right direction, but sadly this was not the case. Industry and government still operated on short term economic goals. Still, very little attention was paid to managing the forest since their energy went into managing a business. In light of this, combined with two hundred years of highgrading, it is no wonder that the forests of Nova Scotia were in poor shape. The prospects for a sustainable industry were dreary.

By the late fifties and early sixties a new way of thinking about forestry was emerging. The concept of 'allowable annual cut' (AAC) came into practice. The concept is to cut only as much wood as the province can grow; this way the forest would not be depleted. Yet problems with inaccurate inventory techniques and harvesting statistics made this problematic. Powerful industry lobbies and hungry markets meant that the pillage of our forest continued, although at a slower pace. Though still shortsighted, the new management was a great deal better than the old 'cut and run' practice of the nineteenth century.

By the 1970s it was clear to industry and the government that more needed to be done. Thus the concepts of sustained yields and integrated forest management were born. Also another powerful voice was starting to take interest in the forest - the public. The people wanted to know what was happening on public lands. They demanded responsible forestry.

Today there are many groups looking into the problems and solutions for Nova Scotia forestry. Government, industry, the scientific community, and the public are all contributing to the improvement of our forest resource. Yet more needs to be done, and we must all work to preserve our most precious resource - the forest.

Chp. 20: *An essay on present day forestry practices:*

Forestry in the eighties and nineties is very different from that of the turn of the century. There have been technological leaps that enable foresters to extract wood faster and easier than ever before. There is also new technology that enables us to monitor ecological impact and help us prevent and repair environmental damage. The question is: how will we use this technology? Here we will discuss the impact of technology on the forest and forestry practices.

Today Pulp is still king. There are three major players in the Nova Scotia forestry industry: Government, pulp and paper companies, and private woodlot owners. In Nova Scotia 2,941,000 m^3 of **roundwood** was harvested for pulp and paper products in 1994; compared to 1,270,000 m^3 of roundwood for lumber. In terms of money pulp sales were over 700 million dollars in 1989, compared to 358 million dollars (1989) for lumber.[26]

It is widely recognized that in order to maintain a sustainable forestry industry we must practice sustainable forestry. Sustainable forestry is the practice of harvesting only as much wood as the forest can grow. This way we can harvest wood and the forest can regenerate itself without depleting the resource. It is like living off the interest and not spending the principal. This sounds easy in theory, but is hard to put into practice.

With new aerial photography, satellite imaging and computer programs we can now determine the species in a stand and the growth rates of stands. These growth rates are measured by the amount of wood that grows on a hectare of land per year, measured in cubic meters per hectare per year (m^3/ha./yr.). Each site is given a classification based on the amount of wood grown each year. So a stand of site class 5 would grow 5 cubic meters of wood per hectare per year, or 5 m^3/ha./yr. Site class 4 would grow 4 cubic meters of wood per hectare per year, or 4 m^3/ha./yr. The average for Nova Scotia is site class 3, 3 m^3/ha./yr., but with proper management this can be increased, in the more fertile areas, to 13 m^3/ha./yr.[27] Knowing this we should only harvest the amount of wood grown on a site per year. That way the forest and all its functions and values are left unharmed.

With modern technology we can monitor our forest more closely and accurately than ever before. Yet we must be careful not to rely on technology too much. It is a double edged sword. Though technology may make it easier to understand the forest, it also makes it easier to destroy our forests. We must use reason and caution as well. To practice sustainable forestry we must learn to treat the forest with respect. We must spend more money and energy on rehabilitating the forest that we harvest. We must give back some of what we take. We should adopt some of those native values that were frowned on by our ancestors. We must respect the forest.

In the past wood production was treated like a mining operation. Harvest the wood and leave. No mind was paid to the future forest that would grow there. No plans were made for reforestation or management. No care was given to protecting the wildlife, streams, or other natural values of the forest. We can no longer mine the forest. With a new found understanding and respect we can treat the forest as a renewable, but potentially exhaustible, resource. Sustainable management can ensure a forest industry in perpetuity. Reckless short sighted cutting will destroy the forest and all that depends on it - including industry.

Silviculture: harvesting and extraction methods.

So far I have talked about management plans and so on. But I have yet to explain how these plans are implemented. This section will deal with the cutting, called 'felling', of trees on the woodlot. There are three main systems of harvesting: Clearcut, Shelterwood, and Selection harvesting. First, though, I will begin with the **silviculture** techniques of cleaning and thinning.

Before wood is ready to harvest on a woodlot some pre-harvesting preparations may be necessary. If a site is overgrown or badly damaged one may wish to clean or thin it. This will increase secondary growth because new space will be opened up. One must keep animal habitat requirements in mind while planning a cleaning or thinning operation. You should aim for a balance between wildlife needs and commercial objectives. There are two types of thinning: precommercial thinning; and merchantable thinning.

Cleaning is the removal of 'undesirable' species that compete with crop trees when the crop trees are saplings. (Undesirable species are non-commercial species. These species are only undesirable in economic terms. In nature there are no undesirable species.) Cleaning also deals with the spacing of trees and stocking the optimum number of trees per hectare. Stocking is having the best amount of commercial trees per hectare, not the most trees per hectare. A balance must be struck between numbers and growing space. If a site is overstocked the trees will be crowded and that will slow their growth. If there are too few trees the crowns will spread and excessive branching will occur, causing knotted wood. Also there will be fewer trees to harvest. In commercial terms stocking is based on maximizing fiber growth. With integrated resource management (IRM) stocking must provide for other needs as well, such as a diversity of tree species and wildlife habitat. Thus the site may not reach 'optimum' stocking in a commercial sense, but will be optimum in a IRM sense.

Thinnings are done to increase the secondary growth rate of the trees left on the lot. This can shorten the time between harvest. Tree stands that are between 1.5 - 9m tall are suitable for thinning. Merchantable thinning should be carried out in the fall or winter when the sap of hardwoods is drawn down into the roots and the bark is tight. This will cause less damage to the

cut tree during the felling. Precommercial thinning is done in the summer when the root reserves are depleted. This reduces the chance of regeneration of the unwanted trees.

Precommercial thinning is the spacing, by cutting, of a young stand. The trees removed in this phase are not big enough to sell. Merchantable thinning is the removal of marketable size trees. The trees removed are then sold. Thinning is done to increase the value of the crop trees by promoting an increase in secondary growth. To be effective the overall increase in secondary growth of the crop trees, at final harvest, should be greater than the volume of wood removed during the thinning.

When a woodlot is ready to be harvested the owner must decide which harvesting method to use. This is a very important decision. The operator needs to consider the regeneration of the site and the micro-climate effects such as water availability and light. Harvesters must also consider the impact on the soil, ecosystems and wildlife uses, not mention other human uses.

Put simply, clearcutting is the harvesting of all the trees in a given area. It is claimed to be the most economical and easiest method. It can be employed with natural regeneration using the 'strip', or 'patch cut' methods; or with artificial regeneration which involves planting nursery stock after a cut. The Shelterwood method is the removal of trees over several years usually involving three cuts. Over a 10 -20 year span all the mature trees in an area will be harvested. The regenerating species are shade tolerant trees. Both clearcutting and shelterwood methods are forms of evenage management. This means that all the trees on a stand are in the same age class. Selection harvesting is the removal of individual trees or small groups of trees. This is unevenage management; all age classes are represented in a stand. This type of harvesting allows for continuous extraction of trees from the woodlot for one never harvests more than the growth rate (wood volume grown each year) of the stand. It requires more skill and planning than clearcutting.

Clearcutting: A clearcut is the removal of all trees in a given area. Clearcut management is done on the individual stand level, where each stand of trees is treated separately. This can have repercussions to the landscape in which the stands are located. Clearcutting is most effective for stands that consist mostly of shade intolerant tree species. Thus the regeneration will not be encumbered by shade from neighboring trees since there will be no neighboring trees. It is recommended for balsam fir and white spruce. Clearcutting is the most common harvesting method in Nova Scotia. This is largely because it requires little planning, is easy and is cheap in the short term. Yet in the long term it can prove to be very expensive with increased management cost for site preparation, regeneration, and maintenance of a plantation stand. The end result of a clearcut is an evenage stand. The new trees will be roughly the same age and size. They will be ready for harvest at the same time.

There are several types of clearcuts. Strip cutting, either alternate or progressive, or patch cutting. **Strip:** The stand is measured into strips. Each strip should be no wider than twice the height of the mature trees in the stand. In an alternate cut, every other strip is cut. This leaves half the strips uncut. They should be at right angles to the prevailing wind to reduce dehydration from

the wind. Once the seedlings are well established in the cut strips (knee high) the uncut strips are then cut. In a progressive strip cut, the strips are divided into three or four cuttings. This will take longer with each set of strips being cut after the previous strips have established seedlings. This could take up to twenty years. **Patch:** This is where a large area, like a whole stand, is cut at once. This is the most common form of clearcutting in Nova Scotia. It is recommended that a patch cut not exceed 3 ha. for adequate natural regeneration. A block cut is a very large clearcut. They can be hundreds of hectares in size, though in Nova Scotia the maximum size is 50 ha.. In B.C. there is one, Hagens creek, so large that it can be seen from the moon. These size clearcuts will not naturally regenerate in a short period of time and are associated with many environmental problems. They must be planted with nursery stock. Block cutting is uncommon in Nova Scotia. Patch cuts that are planted are usually planted with one or two species of commercial trees. This is called 'plantation management'. There are many problems associated with it (see section 3 for information on plantations). To help with the regeneration scarifying the ground will promote seedling growth. Leaving the slash (tops and branches) will provide nutrients. Two thirds of clearcuts in Nova Scotia regenerate naturally with commercial species. Regeneration takes place by stumps sprouting, **root suckering, layering** or seed germination. **Seedtree:** This is a variation on patch cutting. Mature high quality trees are left, uncut, on the patch (at least 10/ha.). These are left to provide seeds for the cut over area. They also provide erosion protection and shelter for seedlings. They are cut after the seedlings are established.

Clearcutting is very controversial. Though clearcuts can reap high short term economic gains, they *can* also cause considerably environmental damage. It is this potential for ecological damage that causes so much controversy. It has been said that a clearcut block is just a forest in a different stage of development. Well, I feel that in order to have a forest there must be tree species present (called an overstory), if there are no trees there is no forest. That is *not* to say the habitat is destroyed, it is merely changed. The cut area will not be able to support the species that depended on the forest that was once there. The area will, however, be able to support different species that thrive in an open habitat. So one *must* be careful in planning a clearcut for if you wish to preserve species already present, then some areas must be left uncut to support them.

Clearcutting has the potential to cause more ecological harm than any other harvesting method. A clearcut destroys the wildlife habitat present at the time of cutting. It also affects micro-climate. The removal of trees will increase the amount of light reaching the ground. This can cause dehydration of the soil which can kill seedlings. It can also cause increased growth rates of seedlings since there is more light available. Temperature will also increase with increased light exposure. The open area is more susceptible to erosion and dehydration from the wind. The water table is affected. In poorly drained areas the surface water may increase because there are no trees there to draw it up out if the soil, this may drown the regeneration. In well drained areas the opposite may happen; new seedlings may not get enough water. The water level drops because there are no large trees drawing the water from deep within the soil. Patch cutting causes fragmentation of habitat. Studies have shown that as habitat areas for animals get separated by cuts their ability to support animal populations is reduced. As can be seen clearcutting has a lot of impact on the affected ecosystems. That is why it is important to plan a clearcut properly. A well executed cut will minimize ecological damage. Small cuts have fewer problems, such as blowdown and erosion.

Shelterwood: A shelterwood cut can be described as a clearcut over time. All the trees in a stand are cut, but not all at once. It removes the stand through a series of partial cuts, every 5-15 years. There are two or three phases; Seed or Prepatory cut, Release cut and Final cut. This method is best suited for shade tolerant trees, such as hemlock, white pine, red spruce, sugar maple and yellow birch. Like clearcutting, this type of management results in evenage stands. The main difference between a shelterwood and a clearcut is that there are 2 crops at the same time. There is the mature overstory and the regeneration underneath. Restocking of trees is by natural regeneration.

In a shelterwood cut 30% -50% of the stand is taken out during each cut. The remaining trees provide seed for the cut areas, shelter for seedlings and they also help control erosion and

freezing. The shade promotes the growth of many commercial softwood species. Many non-commercial species are shade intolerant. Thus the shade helps reduce competition from these non-commercial species.

Seed cut: This is the first cut, the damaged, and dead trees are removed (of course leave enough cavity trees for wildlife - at least 10/ha.). This is to increase the quality of wood on the lot. This will also increase secondary growth and crown coverage of remaining trees. **Release cut:** several years later is the release cut. The intermediate and co-dominate trees are cut and sold. This will spur growth in the remaining dominant trees. Most trees are removed in this phase to avoid damage to saplings from future cutting. **Final cut:** the remaining mature trees are cut. This is the final harvest. By now the saplings from the release cut are about 10 years old. A complete shelterwood harvest can take up to 20 years.

The result of a shelterwood cut is much the same as a clearcut. Yet there is more seedling establishment time. From release cut to final cut the impact on the soil is not as severe as for a clearcut. Micro-climate change is more gradual. Yet habitat impact is the same as for clearcutting.

Selection: Selection harvesting is the removal of single trees or small groups of trees from a site. This is done to ensure a constant supply of wood products from a woodlot. Selection harvesting is like living off a savings account. Only the interest is taken out and the principle is not touched. One never harvests more wood in a year than can be grown on that site in a year. Thus the harvest can be perpetual, barring any major disasters like fire. This is a form of unevenage management, for all age classes and sizes of trees are represented in the woodlot. This form of management is suitable for shade tolerant trees, such as red spruce, hemlock, sugar maple and yellow birch, all of which are abundant in Nova Scotia. Regeneration is through natural seed germination.

In a selection harvest, trees from at least three age classes are cut at the same time. That is; some mature trees and some immature trees. By removing more than one age class a diversity of classes is left on the woodlot. This should not be confused with **selective** harvesting, also called highgrading, which is the harvesting of the best quality trees and leaving the rest behind. Selective cutting lowers the quality of wood on a lot, which the history of harvesting in Nova Scotia has shown. It is important to cut a mixture of trees, some good quality tree for sawlogs, and lower quality trees for pulp or fuel. High quality trees must be left behind for seed production. On a selection managed lot there will be more younger trees than old trees. This is to maintain a constant future supply.

The effects of selection harvesting on the forest community are minimal. Firstly, there is no immediate large scale habitat destruction. The forest community present before harvesting can continue after the harvest. Since there is a diversity of tree species and ages the woodlot will provide a variety of habitat for wildlife. Selection harvesting is conducive to maintaining a diversity of plants and animals on a woodlot. The effects on micro-climate are also minimal. Light, water, and wind variables change only for the gaps opened up by the felling of the individual trees. This allows for quick regeneration. The surrounding forest provides seed and protection from frost, wind and erosion. The water table will be unaffected. Also it is economically beneficial. Though not as much money is made from a selection harvest versus a clearcut (since not as many trees have been cut) money is saved by not paying for: planting, clearing out competition shrubs and grasses, and from herbicides. Yet there is, however, a higher cost for maintaining roads and/or trails for extracting than for a clearcut.

The pros and cons of the harvesting methods: Each cutting method has advantages and disadvantages. These advantages and disadvantages must be measured in terms of their effect on the forest values and functions, as well as economic gain.

Clearcutting advantages:

1) Tree quality: Clearcutting will remove undesired trees so that commercial trees can be replanted. This can be appropriate in lots that have an excessive amount of damaged or deformed trees.
2)Light: Regenerating trees are exposed to full sunlight, without any canopy restrictions. This is good for shade intolerant trees which require a great deal of direct light, such as white spruce and balsam fir.
3)Cost: Clearcutting is argued to be the least expensive method of harvesting. It requires less planning, roads and logistical planning than other methods. Yet this is only a short term economic advantage. In terms of stewardship and IRM, the ease of clearcutting is not considered an advantage since it eliminates the present forest type.

Disadvantages:
1) soil: The clearcut exposes the soil. This can dry out the soil due to exposure to direct sun light and wind. In the winter the exposure increases ground frost which can kill the regeneration. The cold winds can also harm the new trees. Also the water table tends to rise. All these factors tend to degrade the soil, making it less fertile. This will lower the site productivity.
2) Erosion: Since the trees are gone rain water runs off causing soil erosion.
3) Plantations: The plantations that are sometimes planted after the clearcut are more susceptible to disease and insect infestation than natural forests. Also these plantations have less biodiversity than natural forests. They will not provide suitable habitat for the forest community that was present before the cut.
4)Ecological damage: A poorly planned clearcut may not give attention to SMZs (special management zones). Some soil types, like rock outcroppings, can be destroyed by a single harvest. Clearcut harvesting provides no protection to these sensitive or rare ecosystems.
5) Aesthetics: A clearcut is an eyesore.
6) Evenage management: Since all the regeneration will be in the same age class the overall biodiversity will be less than in an unevenaged forest.
7)Habitat destruction: Most importantly, clearcutting destroys the habitat present before the cut. A clearcut block is no longer a forest! All the wildlife dependent on that forest will either fight to establish themselves in a new area or die. It will take decades before a forest will re-establish itself in a clearcut.

Shelterwood advantages:
1) Regeneration: There is a higher chance of quick regeneration since there is an abundant seed source and good seedbank already present. The seedlings are better adapted to the area, than nursery stock, because they have evolved to live in that area. The residual trees offer shelter and protection from the elements to the seedlings. This means there is minimal regeneration establishment cost.
2) Increased utilization: Prepatory and release cuts utilizes wood that would normally die before a clearcut. This increases the amount of wood you can extract from the lot.
3) Increased secondary growth: Since there is more space in the stand, compared to selection cutting, the residual crop trees will increase their rate of secondary growth. This means more wood production for the owner.
4) Seedbed: The logging activity can create a more favorable seed bed by disturbing the ground. Yet one must be careful not to compact the soil with heavy machinery. This will harm the soil and retard seedling growth.
5) Habitat: the forest ecosystem is intact for a longer period of time. This provides habitat for wildlife.

Disadvantages:
1) Blowdown: There is a higher risk that the residual trees will blow down than for a selection cut.
2) Roads: The roads and extraction trails will have to be maintained for a longer time than for a clearcut.

3) Habitat: eventually the forest is removed decreasing biodiversity.
4) Evenage management: Since all the regeneration will be the same age class the overall biodiversity will be less then in an unevenaged forest.

Selection advantages:
1) Habitat: With selection cutting only a small percentage of the trees are removed. This means that the forest ecosystem stays intact, thus providing for many forms of wildlife and maintaining high biodiversity. Also the forest community as a whole remains healthy, providing ecosystem stability. The forest is not destroyed! This promotes IRM and forest stewardship.
2) Utilization: Since the forest stays intact, forest products can be extracted in perpetuity. This is important for small woodlots, for once all the wood is removed (as with a clearcut) the owner has no more trees to harvest. With selection cutting there will always be trees to harvest. This type of harvest is sustainable over a long period of time, unlike clearcutting.
3) Regeneration: There is a continuous supply of seeds for regeneration in the gaps created by cutting.
4) Windfall: The forest structure provides stability to all the trees reducing the risk of blowdown.
5) Slash: The damp conditions in the forest promote the breakdown of the slash. This reduces the risk of fire and increases soil fertility.
6) Soil: Since the forest stays intact the soil is protected from environmental extremes such as wind, heat and freezing. This also reduces soil erosion.
7) Uneven age management: A mixed aged class stand provides more habitat types for a wider variety of wildlife. This promotes higher biodiversity.
8) Mixed wood management: The mixed forest is less susceptible to disease and insect infestation.
9) IRM: An intact forest provides for other economic activities such as recreation and is more in tune with forest stewardship.
10) Cost: Since there is less maintenance, spacing, and ground treatment, money is saved that would have to be spent in a clearcut.
11) Aesthetics: An intact forest is pleasing both visually and spiritually.

Disadvantages:
1) Regeneration: Since the regeneration is scattered throughout the woodlot it is difficult to determine how well the stand is regenerating.
2) Silviculture: Thinning and spacing are hard to carry out since the same age trees are scattered throughout the stand.
3) Cost: Costs are higher to maintain roads and extraction trails than for a clearcut.
4) Growth: Trees tend to be more tapered and there is less self-pruning as compared to evenaged stands. This means lower secondary growth than for a shelterwood cut.

Once the trees have been cut there is the problem of getting them from the stump, or cut site, to the road side where they will be loaded onto trucks and taken to the mill. The removal of trees from the stump to the roadside is called 'extraction'. When the tree is cut the owner should already know what products the wood will be used for. This knowledge helps him/her decide on the best method of extraction. There are three main types of extraction: whole tree, short wood, and tree length.

Whole tree: In this method the whole tree is taken from the cut site (go figure!). The limbs and crown (top) are left on the tree. This can cause nutrient depletion problems in a clearcut for there is nothing left on the ground to decay. The cut site has lost its main source of nutrients,

fallen branches, leaves and dead trees. This will affect the fertility of the site, and over time may even lower its growth site classification.

Tree Length: Once the tree is cut the limbs and top are cut off and it is then extracted. Leaving the limbs behind at the cut site will help replenish nutrients in the soil.

Short wood: In this method the tree is de-limbed, the crown cut off and the tree is 'bucked' (cut) into the desired lengths for various wood products. All this takes place at the cut site. For example a 22 meter red spruce, the first nine meters could be one section for sawlogs, the next 4 meters is another section for smaller saw logs, and the remainder could be used for pulp. All the left over scraps, the limbs and crown are left at the cut site. Here they will decay and provide nutrients for next generation of trees.

Once the trees have been bucked into the desired lengths the operator must get the trees to the roadside. Hauling trees (extraction) from the cut site to the road is done either by forwarding or skidding. Forwarding: is carrying the wood to the road side. The wood is loaded onto a large machine called a forwarder or onto a wagon pulled by a tractor, horse or oxen (small lot owners will most likely not use a forwarder for it is more costly). The wood is kept clear of the ground during transportation. Thus the residual (left over) trees and seedlings will not be damaged by the extraction of the felled trees. This also protects the wood from damage. Skidding: is quite literally the dragging of trees from cut site to the roadside. It is usually used in whole or tree length methods. The trees are attached to the back of a tractor, horse, oxen or skidder and hauled along extraction trails to the roadside. This method cannot only harm residual trees and seedlings, but also the log itself. It is usually done for pulp wood. Skidding can also **scarify** as the logs will disturb the ground. This is useful for the many forms of clearcuts where there are few residual trees. Scarifying the soil creates a seed bed to produce the next crop.

Extraction Machines: Extraction vehicles are used to haul the wood out of the cut site to the road side where the wood is loaded onto trucks to be taken to the mill. Each type of extraction system has different hauling methods available: 1) Shortwood: shortwood (wood that is bucked into marketable length) can be hauled on a wagon attached to tractor. This method is inexpensive. A skidder is a tractor attached with a winch to haul the wood. It also has a plow to pile the wood at the road side. A forwarder is a vehicle that has a grapple loader to load the wood and flatbed to hold wood. 2) Tree length: a tractor or horse are ideal for this system. The log is pulled behind the tractor or horse. This requires little extra machinery and small trail widths, compared to the skidder or forwarder. 3) Full Tree: a tractor is good for hauling out whole trees. So are forwarders and skidders, but they are large and expensive. This type of machinery is usually employed in large scale operations.

Both systems break up the debris left from cutting by driving over and crushing the limbs and crowns. This helps increase the rate of decomposition. Another option is to chip the left over limbs and crowns. For this a chipper is required (Da!). A chipper grinds the wood into small - you guessed it - chips. This option is very expensive. These chips will decompose faster than whole branches. They will also pose less of a fire hazard since they can be spread out and mixed into the moist ground. When leaving slash (the waste from cutting, such as branches) behind it is important to watch out for fire hazards. Too much dry wood piled in one spot is a fire waiting to happen. Slash should be broken down as much as possible and spread over the cut site. This not only reduces the fire hazard, but also increases the nutrient recycling and spreads the nutrients around the site.

A greener industry

The realities of the Nova Scotia forest industry are very complex. This section will give a brief account of the present situation. As mentioned earlier, pulp and paper are still king. In Nova Scotia there are several pulp and paper companies. The largest and most influential are Bowater, Scott (Kimberly Clark), Stora, and Irving. Some of these companies lease land from the provincial government for a fee and harvest the trees. Most own their own land which they also harvest. Bowater has not leased land from the province since the 1950s.

Most of the wood harvested is used for pulp, which is used for making paper products. Pulp is an expensive way to process wood. It adds high value to the product so the profit margin is potentially quite high depending on market demands. Besides being processed here, much of the wood harvested in Nova Scotia is shipped as pulp to other countries. Our exports are sent mainly to the U.S. where they are made into finished products, usually paper. As well Nova Scotia exports newsprint and other paper products.

In addition to harvesting wood, pulp companies also buy wood from private woodlot owners (like Duncan and his family). Sometimes the owner will harvest the wood, or a contractor is hired to harvest the wood. The contractor can be independent or an agent of the company that is buying the wood. Independent contractors would have a contract to sell wood to the company.

Once a company makes a contract with the government or land owner, the land can be harvested. The owner gets a stumpage fee from the company or contractor who cuts the trees. This stumpage fee is negotiated before the cutting starts. An owner can harvest his/her land themselves. They must then secure a market and pay for transportation fees. Many owners do not have the time nor the means to harvest their land so they contract the work out for stumpage fees. Stumpage fees in Atlantic Canada are the lowest in the country.

Unless negotiated in the contract, the cost and responsibility to replant, clean up, or other cut site preparations are left to the owner. On provincial land the government pays for site preparation. Though the companies make the profit from the lumber or pulp sale, it is the public that pays for the clean up. Some tree planting operations are paid for out of tax dollars on provincial lands. Yet the private owner must pay for it him/herself. It costs over $600 per hectare ($250 per acre) to replant with nursery stock seedlings. There have been several assistance programs for small woodlot owners. These provide money for planting and maintenance, e.g. the federal/provincial cooperative agreement and the forest renewal fund. These programs ended in 1995 - 96. Current negotiations are underway to develop a program that shares reforestation costs amongst the government, industry and small woodlot owners.

Though unsustainable tree harvesting has, in the past, gone on with impunity this is starting to change. Public pressure on government and industry has brought about many changes

in forestry practice. The provincial government has created guidelines for harvesting on public land. The Forestry/Wildlife Guidelines must be followed by contractors or companies who wish to harvest public (provincial) forests. These guidelines ensure greenbelts for rivers and streams, standing deadwood, and wildlife protection. Another important factor in changing forestry practices is a well informed market. Much of our wood is sold to European and American markets. The European public wants wood products that have been managed and harvested in an ecologically responsible manner. Many nations in Europe have strict legislation concerning what kind of wood can be imported. Companies that do not meet their standards of ecological care cannot sell wood to those countries. This has forced a change in *our* industry. Companies are eager to look 'green' so they can sell to these European markets. Some companies in Nova Scotia, such as Bowater, have qualified for international 'ratings'. To get these national and international ratings the company operation must satisfy ecological guidelines. The ISO 14,000 and CSA standards for sustainable management are two such rating systems. The public is aware of the issues, the market in Europe has responded. It is the market (the customer) itself that is demanding that wood be harvested in a sustainable manner. This 'green' awareness by the consumer is the first step toward a truly sustainable forestry industry. For we must manage our consumption as well as our production. Once again it would seem that Europe is, at least partly, controlling our forestry industry. Only this time, I feel, it is for the benefit of the Acadian forest.

Value added

Though pulp is the mainstay of industry, lumber and veneer wood are still important. Throughout the province there are many mills that use hardwoods to make flooring and other finishing materials. In the fifties and sixties most of these mills closed due to the depressed lumber markets. There are also specialty businesses such as musical instruments and furniture making. All of these are called value added industries. Each metre of wood used generates more money in resale, taxes and employment than if the tree is harvested and then sold unprocessed. The wood is cut, milled and made into a finished product in Nova Scotia. The final product is either sold here or exported. This is the best way to get the most economical benefit out of our forests. More people are employed (the cutting, milling, and crafting) and more taxes are paid as the wood moves from each stage of production (tree, to lumber, to wood flooring). The question remains as to why more value added industry isn't operating in the province. The answer begins in the history of our industry.

From the colonial times the Maritimes were used as a resource state. Wood was harvested and then shipped to England, and other countries, for ship building. Eventually the shipbuilding was done here in such places as Lunenburg where the famous Bluenose was built. This attitude of a resource suppler has never been completely shaken. It is simpler and less

expensive for companies to simply harvest wood and sell it. It requires a great deal of capital (money) to build mills and secondary industry such as furniture making. If a company can make a profit by simply selling the roundwood (unprocessed) or lumber, there is little incentive to invest money to build the secondary industries. Approximately 10% of Nova Scotian wood exports is roundwood, the rest is lumber. Finished products are made elsewhere and sold back to us. The advent of the steamship made it more economical for industry to produce finished products abroad. It cost less to ship than to build infrastructure here. Thus it is up to the government and the public to demand that more money be generated from each tree that is cut. In the long run it would be better for the provincial economy, tax revenue, and the forest if we created more value added industries.

An example of the importance of valued added industries is Switzerland. Switzerland is a small alpine country in central Europe. The Swiss forestry industry must endure very strict regulations. This is because it is a mountainous country. In the past, excessive cutting led to erosion of precious farm lands. Now a forester must have a special permit for each tree that is to be cut. Also these trees must be extracted by cable so as not to disturb the soil. This is very costly compared to Canadian operations. Even so the Swiss forestry industry does very well. Consider this: compared to British Columbia (which has much more forest than we do) the Swiss have only 10% of the available forests to cut. Yet the Swiss forestry industry makes about the same amount of money as the B.C. forestry industry! How? - value added industry. The trees in Switzerland are harvested, milled, and made into finished products in Switzerland. This creates more employment and generates more money per tree than harvesting wood and selling it as roundwood. The finished products are then sold either domestically or exported. In B.C, as in Nova Scotia, most of the trees are sold as lumber, pulp or roundwood. Thus with only 10% of the resource Switzerland can generate as much money as the B.C. forestry industry.[28] Now imagine what we could do with more value added industry.

Big or small

It would be an understatement to say that the private woodlot owners and the companies do not always see eye to eye. The issues and politics of forestry are very complex. Put simply the small woodlot owner and the pulp companies have different operating philosophies.

The pulp companies such as Irving or Bowater are in business to earn a profit. Yet that is not to say that is all they are interested in. The old adage of 'the business of business is business' has proven to be faulty. Companies are social institutions and as such have responsibilities to the society in which they operate. It is important for a company to be a good and responsible corporate citizen. This is particularly true with natural resources. The companies have many responsibilities and give benefits to the community. They provide stable employment for

thousands of people from loggers to mill workers. They pay into provincial coffers in the form of corporate taxes, many also donate money to local environmental groups. For example Bowater has set up its own series of pocket wilderness (walking parks) for the public. Stora has voluntarily released some of its leased land for the Parks and Protected areas plan.

Yet the goal of the company is to turn a profit. The companies secure wood at the cheapest stumpage fee possible. They then harvest the wood in the most efficient and cheapest manner (usually clearcutting, see pp. 81 'clearcutting'). This ensures a high retail value for the wood with low overhead. After all, the bottom line for any business is money. Short term management plans are made to maximize profit.

The down side to these short term management plans is that there is no mention made of ecological functions or wildlife. Historically, since much of the land that is harvested does not belong to the company , but to the public or small woodlot owners, they have no vested interest in taking care of it. The companies move from cut block to cut block. The management plans do not consider wildlife or other forest values.[29] But recently, as mentioned above, the companies are beginning to see that care must be taken to secure markets and to guarantee a resource in the future. But, unfortunately, this recognition has not yet overpowered the short term economic strategies. This is demonstrated by the fact that clearcutting is still the most common form of harvesting in Nova Scotia today.

The small woodlot owner , on the other hand, has a different view. Woodlot owners have, or at least should have, a personal relationship with the land. Their woodlot is the only land available to them. Those trees are the only ones he/she can harvest. Many owners live on their lots and often these lots have been in the family for generations. This helps develop a personal tie, a spiritual connection with the forest. Owners must plan their harvest carefully, for if they harvest all the trees at once there will be nothing left for future harvests, not to mention the woodlot would be devastated. Because of this relationship with the forest, the owner respects the forest. This respect, hopefully, will manifest itself in the management plans for the woodlot. Such plans should include protection for wildlife, streams and ecologically sensitive areas. Since the owner knows his/her land well they also know the locations of the animal feeding sites, deer winter areas, bogs and other sensitive ecological sites. This knowledge enables them to plan a harvest while protecting these areas.

Yet there are problems with private ownership. Owners do not have to follow the provincial guidelines on forestry, and many do not. In times of economic need some owners sell off large areas of trees, and clearcut their land. If several private owners in a given area clearcut their lots the result can be one large clearcut. This short sighted economic plan will only hurt the forest and the owner in the long run.

The over 30,000 land owners in Nova Scotia are not very well organized. There is no unified province-wide organization representing their interest. They seem to be fractionalized into regions that compete against each other for market access. This combined with the availability of cheap crown land to large companies explains why stumpage fees are so low in Atlantic Canada. Woodlot owners need to form a united provincial confederation to have an effective voice.

So the question remains: which philosophy promotes sustainable forestry and the values and functions of the forest? I believe both can, if we cooperate...

Integrated resource management and stewardship in the Acadian Forest:

The past few decades have seen many changes in the forest industry. With a recognition that, to maintain a healthy industry we must also maintain a healthy forest, many management tools have been developed. The most notable are the concepts of allowable annual cuts (AAC) and sustained yields. As mentioned earlier the idea behind sustained yields is to only harvest as much wood as can grow each year. The allowable annual cut is the method of determining how much wood can be harvested in the province, and what general area the wood can be taken from. Of course, sustained yields and AAC's only pertain to fiber extraction (wood cutting). They are only concerned with sustaining the harvesting of wood. They are not concerned with sustainable wildlife or recreation. Yet we all recognize that there is more to the forest than just harvesting trees (which has been a central message of this book). So how do we account for and provide for all the other concerns? Part of the answer is Integrated Resource Management (IRM).

IRM is the inclusion of at least two economic resource bases in all levels of management for an area - pretty dry eh? So what does that mean? For example when developing management plans for a forest the owner might include economic values other than wood in the management plan. Values such as wildlife habitat for game, waterway boundary protection for fish, wetland protection for moose, and camping sites for backpackers. All these values are 'resource bases'. Instead of using just one and ignoring, and possibly harming the rest, we can include and use all these values in our management plans. All of these resource bases can have economic spin-offs. For example, one might pick berries on a woodlot to sell. This opportunity would be lost if you planned solely for harvesting trees.

The most important aspect of IRM is that it can provide for the health of the forest community. In a good IRM plan many forest values are provided for. One value, e.g. fiber (wood) extraction, should not dominate or impede the use of the other values, e.g. hunting and nature tourism. By balancing the plans to accommodate a variety of resources the whole forest community can be looked after. This is important because if we want to continue using the forests resources we must ensure that the forest remains healthy, we must maintain the diversity

in our forests. By maintaining diversity the forest community will be more stable and able to resist disturbances such as harvesting operations.

As a forest management tool IRM can be very effective. Combined with conservation measures we can form a provincial management strategy. IRM is important because conservation and restraint management can only go so far (restraint management is making regulations to cover specific situations, e.g. leaving a buffer strip of trees on river banks). It is impossible to make regulations or guidelines that will incorporate every possible situation in a forestry operation. That is why IRM is so important. With an integrated resource plan all aspects of the forest can be taken care of. The solutions to the particular problems in an operation will come from the over all objectives of a well balanced plan and from conservation guidelines. Unfortunately IRM is not a reality on private lands in Nova Scotia. Even with the larger companies it is just beginning. To date we don't have many integrated forestry/wildlife plans. These must be developed in order to have sustainable forests and industry. This is an opportunity for the public to get involved in issues concerning our public lands. Discover all you can on forestry and wildlife, and then contact government and industry and let them know how you feel about forestry in Nova Scotia. In Nova Scotia the 'Roundtable on the Environment' has public meetings and workshops where you can express your views. These workshops help shape government policy on the environment.

The other part of the solution for providing for all the forest values is the concept of forest stewardship. Forest stewardship is taking the best possible care of a woodlot, and the Acadian forest as a whole. It means sometimes putting the interest of the forest community ahead of our own interests. Of course for the most part the interest of the forest and the steward are the same - a healthy viable forest community. Stewardship involves providing for all those values and functions of the forest that have been discussed through out this book. It is recognizing that the forest has interests (its own survival) and intrinsic value. It recognizes that people are not the only creatures that have a right to use the forest. It demands that we treat the forest with respect and do not selfishly over-exploit it for human greed.

Forest stewardship means looking after the forest with the best possible care. This may sound similar to IRM, but there is one important difference. In IRM one could manage for a few resource bases, e.g. wood extraction, game hunting, peat mining. This could lead to a single tree species forest (where it was once mixed) with only a few game species, and a devastated wet land (from digging up the peat). This, of course, is an example of a non-sustainable management plan. The point is IRM does not *necessarily* include non-commercial forest values; things like aesthetics, recreation or wildlife habitat. The unscrupleless could carry out unsustainable forestry under the banner of IRM. Forest stewardship, on the other hand, is caring for the forest, making

sure that habitat and ecological considerations are included in harvesting plans, and keeping spiritual and aesthetic values in mind. Where IRM is still anthropocentric (human centered), that is to say it is concerned with managing for human uses, stewardship is concerned with providing for the whole forest community needs as well as our own. It is recognizing that we are part of the forest community, not masters over it. Stewardship involves a mutually sustaining relationship based on understanding and respect for the forest (does this sound familiar?, see 'traditional uses of the forest'). Stewardship is *integral* to sound and sustainable IRM.

By combining IRM techniques and stewardship ideals to a woodlot management plan, or a large regional plan, we can accommodate both our interests and the forest's needs. This is holistic forest management. It will allow the forest to become healthy and vital and in so doing the forest will provide for us, so long as we treat it with respect.

Chp. 21: *An essay concerning the future of forestry management in the Acadian Forest*

Our forests are presently in poor condition from past mismanagement. Vertical structural diversity, species composition, and tree quality have all been affected by these past practices. Thus our management plans must not only maintain present forests, but also restore them. This can only be achieved through the co-operation of the public, industry, government and private owners. We must develop and implement an IRM strategy for the whole province. To this end, the Nova Scotia government has drawn up the "Nova Scotia plan for a national forest strategy". It calls for integrating our resource management plans with the rest of the country. It also calls for the development of IRM in our forests, the development of integrated forestry and wildlife guidelines and more co-operation between industry and government. To date the department of Natural Resources (DNR) has published several documents aimed at improving forestry practices in Nova Scotia; two of which I have previously mentioned, the Forestry/Wildlife Guidelines, and Living with wildlife: a strategy for Nova Scotia. The former is a restrictive conservation measure for harvesting practices set up to protect ecologically sensitive areas. The latter is a discussion of wildlife issues in Nova Scotia and a list of initiatives that the government hopes to undertake.

Crucial to good future management is the co-operation of industry, private owners, the scientific community and government. To respect and care properly for the resource those who manage it must co-operate and work together. Also the public should take an active interest in how our forests are managed. After all they belong to all of us. Lastly, on going research in forest ecology must continue in order to improve our understanding of how forest ecosystems function.

Historically, forests were managed on the stand level. Stand management is the practice of applying a single treatment, e.g. harvesting and extraction method, to each stand. Thus each stand of trees is treated as a separate unit. This stand attitude beguiles the variety and complexity of tree and soil types that can be found in a single stand. Stand management is now being challenged in other parts of the country. Recently forestry has developed new management strategies. One emerging management style is site-specific management. Each stand on your woodlot has different features. These require varying management strategies. For example: a slope with white pine, a bog with black spruce, and hemlock along a river would all be managed differently. The operator would plan for each of these ecosystems separately, even if they are all in the same 'stand'. Each of these three areas may require a different harvesting method (see chapter 20), different site preparation and soil treatment. This attention to specific ecological needs promotes the health of the whole forest. It is consistent with forest stewardship.

It is much easier for private owners to operate using site specific forestry, than for large companies. Since private owners own a specific area they can get to know it quite well. A company with hundreds of thousands of hectares would be hard pressed to 'know' every hectare of forest.

Another management option, more suited for large scale implementation, is landscape management. Instead of managing stands as unconnected individual units, one would manage for whole landscapes. Landscapes can be small, a single stand or a few hectares, or quite big, a whole river valley. The boundaries of landscapes are set by nature, not by lines on a map. It has been shown that watersheds make good natural management boundaries.[30] A watershed forms a landscape, the area fed by the same water source is the landscape.

By managing for watershed integrity we can ensure the ecological integrity of the whole forest community. This will ensure the health of the forest. By managing at the landscape level we can assess the effects of harvesting on the whole forest community, thus making it possible to protect the whole forest community and still reap the benefits of the forest. Landscape management is generally done on a large scale. This should be easy for forestry companies to incorporate into their management plans.

The major difference between landscape management and stand management is that landscape management is concerned with the ecology of a whole watershed as well as economics, stand management is generally short term economic planing. The challenge is to plan at the landscape level, yet implement those plans at the stand level.

With new approaches like site specific forestry and landscape management, and with more public involvement in planning, and with more co-operation between all parties involved in forestry we can, hopefully, for the sake of our forests and the creatures that depend on them, create a sustainable IRM strategy for Nova Scotia.

Section 6: Bringing it all Together

The nice thing about being an author is that you can do anything you like in your book. For instance while you were reading the last section a considerable period of time has gone by. It is now mid December, schools are out for vacation, and Peter is back in the city.

"Say, Emily...," John says staring through the living room window, admiring the ice coats on what is left of the Dutch elms lining the driveway. "Didn't you say that your friend is supposed to stay with us over the holidays."
"Yeah" she answers not looking up from her book. "She should be here in a couple of days."
"What was her name again?"
"Kara."
"Is she about 5' 7", slim, with long dark brown hair?"
"Yeah...why?"
"Does she wear a hand tooled brown leather jacket and combat boots?"
"Ahh...yes" she says starting to take interest. "Why?"
"Prepare to be surprised," he says with a wry smile.
"What are you talking about?" Emily jumps out of her chair and heads for the window.
"Is that her walking up the drive?"
"Oh my God!" sighs Emily excitedly. "She's not suppose to be here yet. She..."
"Surprise!" John smiles.
Emily throws her book on the chair and rushes out of the living room toward the kitchen and the back door.

Chp. 22: Good Neighbors

As part of his management plan Duncan discusses extraction trails, harvesting, and general woodlot upkeep with Arthur. In keeping with IRM and forest stewardship they are making plans for this year's harvest. To run an efficient and sustainable woodlot it is important to have a well thought out management plan. We find them in the kitchen talking over the ever present cup of tea (it is the Maritimes after all).

"Well, Arthur," Duncan says unfolding the newly updated woodlot map on the kitchen table.
"How long do ya think it'll take us to complete that new trail from my lot to yours?"
"With a crew... about two weeks I'd say."
"This new road is sure gonna help me access those old hemlock stands."
"Help us, Duncan, in the long run we'll save a lot of money compared to each of us making separate roads."
"Yeah, sharing the cost makes it much less expensive for the both of us... more tea?"
"Sure, I've only had two cups," Arthur laughs.
"By managing that old Hemlock stand together we can treat it better than if we each managed our sections of it individually."
"Cooperation, my good man."
"Yeah, by treatin' the hemlock forest as a landscape, instead of individual units, we can preserve the old growth, while makin' some good money off those good sawlogs that are there. I just wish that the other owners in the area would go in on a management venture with us. That stand is pretty big. Must be near thirty odd hectares. It's important to treat them all together, not as patches of property simply because they're owned by three or four different people."
"Oh well, you can't tell a body what to do with their land."
"Well if they clear it, they'd better not touch any of my property."
"Your boundaries are marked pretty good, aren't they Duncan?"
"Sure, but sometimes other people don't mark theirs so well. Not you, of course, your boundary markers have always been well kept."
"That's why we're friends Duncan," Arthur laughs again." Hell, if I hadn't kept such good markers you'd of cut half my woodlot by now."

Boundary Markers: Property lines for a woodlot should be surveyed, and can be found in the title deeds for the property. Property boundaries on a woodlot are designated in two ways: 1) A line of bright paint, called Blazes, are painted at breast height on the trees along the boundary line. Traditionally blazes were made by notching the tree with an axe cut; 2) numbered posts are placed at the corners of the property. These post are set into the ground and held in place by piling rocks around the bottom of the post. Traditionally these posts are made of wood, but metal posts are becoming more popular since they last longer.

"Now now Arthur, you know I've always respected other owner's wood."
"I know, I know," Arthur says taking a sip from his fresh cup of tea. "Say, have you decided which stands you'll harvest this year. Ground's almost froze. Soon be time to start haulin' the wood out."
"I've got some fuel wood that's ready to haul, it's well seasoned." He looks at the map. "I figure there's about a dozen stands I'll work on over the next few years."
"Un-hun, where'bout?"
"Well that stuff up in the north west section is still inaccessible - no trails. Besides it's mostly hardwood and I have plenty of that elsewhere. I figure I'll stick near the trails, and that new road."
"How you gonna haul it? Thinkin' of renting a skidder?"
"Nope, I thought about it and thought against it. I'll be doing tree length and short wood extraction so I don't need a skidder. My tractor and horses will do just fine. So why bother with the added expense of a skidder. I got a new wagon attachment for the tractor, though, that'll make hauling those bucked logs a lot easier..."
"Hi Dad, Mr. Cormier," John says entering the kitchen. "Have you seen Em?"
"You mean her friend, eh John," Arthur teases.
"No!, I just wanted to know if they wanted to...ah...go into town and do some shopping. It's almost Christmas ya know."
"Of course son, I saw them heading toward the barn about half an hour ago."
"Thanks," he waves as he heads for the door.

Forest Roads and Bridges: Building roads and bridges on a woodlot is very complicated. There are many environmental and engineering rules that one must follow. Some of the most common environmental problems with road construction are: 1) Poor road construction has been associated with soil run off and erosion; 2) Poorly designed bridges can cause siltation and water blockage in rivers and streams. Both erosion and siltation can degrade river habitat, and lower soil fertility. For detailed information on road construction and stream crossings contact the Nova Scotia Department of Natural Resources.

Chp. 23: Winter in the woods

"Wow, you never told me that you had horses, Em," Kara says as they walk through the woods along one of the many trails. The snow is only a few inches deep.
"Those are nice animals. What kind are they?"
"The dark one, Briggs, is a Percheron and the other one, Stratton, is a Clydesdale."
"Briggs and Stratton!" Kara rolls her eyes. "Cute."
"Yeah, I know, ... Dad uses them for haulin' logs out of the woods."
"Does he cut a lot of trees?"
"Quite a few, I guess."
"Man, I'm sure glad the snow isn't as deep in here as by the house," Kara sighs, as she notices walking has gotten a lot easier since they entered the woods.
"Well, the pines here catch most of the snow in their branches."
The trail leads the two up a hill. At the top is an open area, with only a few trees, over looking the marsh and lake.
"Shit, snow is sure deeper here," Kara says falling in up to her waist.
"Stick to the trail," Emily laughs. "Come on there's something I want show you. "
As they reach the top the view opens up. To the south west is a lake, snow glittering in the light. To the south east they can make out smoke rising from the house.
"It sure is beautiful up here, Em."
"Yeah, this is one of my favorite places. Mom says its a drumlin."
"A What?"
"A drumlin. This hill was made from the earth that was moved and compressed by a melting glacier." She announces in a mockingly serious tone, then pauses. "I like to come here and think... and get away from John."
"Ahh, come on he doesn't seem so bad."
"That's because he's not YOUR brother."
"He's kinda cute."
"KARA!"
"Hey! look, what's that?" Kara says pointing at a form protruding from the snow. "It's a skull." She picks the remains from the snow and examines it.
"Lets see, looks like a deer or something."
"Probably. Too small to be moose. Much deer around here?"
"Lots, they winter around here - probably eaten by coyotes," Emily adds eyeing the skull.
"We've got *them* in Cape Breton too. Do ya like them? - coyotes I mean."

"Sure, nothin' wrong with them. They gotta eat too. John hates them, though. Says they're killing all the deer."
"Are they?"
"Not that I can tell. They usually just take the old and weak, I guess. In fact I'd say the herd is better off, fewer of them around, but the ones I've seen seem healthier. I suppose there's more food available for the ones that survive."
"Do you think your Dad will cut over that nice spot," Kara says pointing across the river. She waves her hand at a hill of exposed granite bedrock sparsely populated with old white pine. The jagged rocks and majestic pines form a beautiful vista.
"No, That rocky area is too sensitive to be cut. The soil is very thin there."
"How about this spot?" She asks surveying the beauty of the hill they are on.
"Not if he knows what's good for him" Emily smiles. "Besides, You know that hill we just came up? Well that side of this whole hill is a deer wintering area."
"Whata you mean?"
"During the winter months the herd tends to stay on the slope of this hill. The older evergreens here provide them with shelter, and there is food nearby. The trees trap a lot of the snow, so its not too deep. That way the deer can out run predators - like coyotes," She says pointing at the skull.
"Guess he wasn't so lucky."
"Deer can't run very well in deep snow, it slows them down."
"O.K., but why this hill?"
"Well, the hill is south facing, so it gets a lot more light. Its warmer than on the other side. The trees also provide shelter from the wind and cold. The deer graze the hardwood shoots in the next stand, down by the river. They only eat evergreen needles when they're desperate."
"Whys' that?"
"I guess cause they don't taste too good, the needles have tannic acid which must leave a bad taste in the deer's mouth."
"Funny, guess I never thought about: deer worrying about taste, the cold or how deep the snow is," Kara says thoughtfully. "There's not many deer in Cape Breton. Lots of moose though. They don't need wintering areas...Say what's that clear spot over there, near the lake," she adds pointing to the south.
"Oh, that's a marsh?"
"A marsh, do you have any moose around here. They like marshes."
"Very few, John said he's seen a couple, but very rarely."
"Does your father think about animal habitat when he cuts trees?"

"Most of the time. I've talked to him about special management zones like marshes, riverbeds, that rock outcropping. He's pretty good. Besides Mom would kill him if he ruined the lake or something."

The two quietly take in the beauty of their surroundings as they bathe in the light of the sun.

"What's that noise?" Kara says cocking her head to the southeast.

Emily stands quietly, straining her ears. Through the cold crisp air she can hear the whine of a motor. "That's John on his skidoo. Sounds like he's comin' this way. So much for OUR peace and quiet."

They sit on rocks and watch. Through the trees they catch glimpses of John on his yellow and black skidoo winding through the trail, up the side of the hill. Spotting them he stops on the trail, and shuts off the engine. Removing his helmet he walks toward them.

"There you two are," John smiles.

"...and idiot makes three," Emily adds.

"That's not a very nice way to greet the guy that's gonna drive you into town." He turns to Kara. "Hi Kara."

"Hi John," she smiles.

"So what've you guys been up to?"

"Just takin' a walk."

"Thought maybe after lunch you might want to go shopping. Say, I was wondring do you call yourself 'Indain' or 'Aboriginal Canadian'?..."

"John!," exclaims Emily.

"Emily says 'Indian' is offensive."

"The only people 'Indain' offends is you white people," Kara laughs. "I call myself a Mi'Kmaq. Say, that your Skidoo?".

"Yup, its a couple years old. Plenty of power though," he says proudly.

"I've gotta Tundra - Longtrack back home."

"You go off roadin'?!" Emily and John ask at once.

"Sure, its a blast."

"Tell me you don't go tearing up the bogs, like John and his buddies."

"No, I stick to the trails," she reassures Emily.

"I don't tear up the bogs, Emily!"

"Yeah, what about that friend of yours, what's his face. He almost lost his ATV in our bog."

"Yeah, that was funny. We had to pull him out - and it took three of us to pull his Honda out of the muck."

"Well its not funny! Bogs are very sensitive to disturbance. The ecosystems there are very fragile. Driving through them can destroy them."

"I know, I know. Look it wasn't me. I don't drive through the swamps. Besides after you got through with him I doubt he'll ever drive in one again. The crash scared the shit out of him. I think he learned his lesson."
"Well I'd rather he learn at his own expense, not the bog's! People should have more respect for nature."
"Look, I know, already. I don't like them tearing up the bogs any more than you do. It destroys perfectly good moose habitat, and God knows we got precious few moose as it is."
"That's not the point. The point is those ecosystems have a right to survive even if there were no moose. It's not fair that they get ruined just so your friends can go joy riding. You should have more respect for our environment."
"Don't worry Em," Kara interjects comely. "I'm quite sane on *my* skidoo. They're a lot of fun if you use them properly."
"A waste of fossil fuel."
"That's not true," John counters. "I use mine for more than just fun. I use it for hauling out deer when I hunt."
"You hunt?"
"He sure does."
"You hunt?" He asks nodding toward the skull in Kara's hand.
"Sure. I go hunting with my father near the reserve in Cape Breton all the time. It's great being back in the woods, and moose meat is great. My family has lots of old recipes for it."
"Cool."
"Great, two against one."
"Told you hunting wasn't so bad, Emily" says John jibing her.
"Well hunting is a big part of my heritage. We try to use all the parts of the animals we kill. My brother tans the hide for leather. I even made these mittens from some rabbit fur that my father got."
"Well I suppose if nothing is wasted it's O.K." Emily concedes.
"Told ya."
"Oh shut up, John. It's not like you've ever tanned a hide or made a fur hat for that useless head of yours."
"Look Emily," Kara butts in, "I know you're against hunting and that's fine. But different people have different opinions. To me its a part of life. Hunting doesn't bother me, it's people that are disrespectful that bug me. It's one thing to live from nature; it's another thing to be greedy and think it's all yours. Hunters should respect their prey and the other people who depend on it. We should be careful not to over hunt and drive the populations down. It really pisses me off when

someone kills more than the limit, or just leaves the animal to rot. If you're gonna kill it, then eat it!"

"Well, speaking of eating," John says defusing the tension, "...it's almost lunch time. I'm heading back home. You guys comin'?"

"Yeah, we'll walk back, see ya there."

With that John heads back to his skidoo.

Chp. 24: Nature's give and take

Nature not only provides the forest we want and enjoy, it also gives us some things we may not want. Some of these things can harm the woodlot; things like pests and fire. Forest pests and diseases such as some fungi, bacteria and insects can destroy whole stands of trees; sometimes whole forests. In the sixties and seventies spruce budworm wiped out huge tracts of forested area in Cape Breton . It is important, though, to recognize that these forest pests are an integral part of nature. They are neither good or bad, they are simply part of the forest community. These 'pest' species are as much an important part of the forest community as are the trees they live on. All members are part of the structure of the community, and are necessary for a healthy forest community. In small numbers these 'pests' do not cause too much of a problem, but when there are large out breaks they can cause a lot of economical damage by ruining a tree harvest. Thus these members of the forest community become pests when their interest and ours come into conflict. For example, it's in the interest of the budworm to flourish and expand in population size, yet this can kill the trees they feed on. The killing of a woodlot is not in the interest of the owner who depends on a constant supply of wood products from the forests. So often there is a conflict between the forester and some of nature's creatures. The following is a discussion about ways to manage forest pests.

Though we often blame insects for damage done to a woodlot, often the blame lies with us. Some of our management strategies actually promote insect infestation. A mono-culture plantation is a prime example. If we replace a mixed forest (after a clearcut) with a mono-culture, say a fir plantation, *we* are creating the conditions for a budworm infestation. (The spruce budworm's favorite food is balsam fir. So why not call it the fir budworm?). In a mixed wood the budworm can only feed on those tree species which it has evolved to use. The other species, hardwood species for example, will be left unharmed. By growing all fir we are inviting disaster. When the budworm arrives it can (and will) feed on *all* the trees. Our artificial forest created the conditions for an artificially high budworm population. The results could be the loss of the whole plantation. These conditions would not normally exist in the Acadian Forest.

There are many ways to manage for these 'pests', some of these management tools are more effective than others. There are three main management techniques to control forest pests. They are chemical controls, biological controls and mechanical controls.

Chemical controls usually involve aerial or ground spraying of **pesticides**, **insecticides** or **herbicides**. These are chemical poisons designed to kill a specific range of undesirable species. Often, though, the target species becomes immune to the poison and the chemical agent is no longer effective. These poisons can also kill other species and infect the ground water. Sometimes these chemicals build up and end up in the food web.

Biological controls are parasites and viruses that already live off the pest species. They can be released into an infested area where they will only attack the species that they have evolved to use as a food source. These can be very effective in reducing the numbers of pests and control their population size in the future because the biological control establishes itself in the forest community. An example of this are parasitic wasps. Parasitic wasps lay their eggs in the larvae of other insects. When the wasp larva hatches it eats the host larva from the inside out. This can be very effective in controlling insect species.

Mechanical control is the removing of infected trees, or limbs of trees, by cutting. Utilizing these methods, in their appropriate situations, in a woodlot management plan is called integrated pest management (IPM).

Fire is another concern for the woodlot owner. A wild fire can destroy an entire forest in days, leaving the owner with nothing. Fires are not all bad, though. Fire can play many vital roles in ecology. In the prairies the seeds of indigenous grasses need the heat from a fire to soften the seed casings before the new plants can germinate. Fire also prevents trees from establishing on the prairie. In the Boreal forest fires are common. Small fires will burn the competing undergrowth, leaving the old growth trees intact. These small fires are not hot enough to burn deep into soil causing soil damage; nor are they hot enough to penetrate the thick bark of the old growth trees. The flames are not high enough to reach the bows so the trees are left relatively unharmed. In the Acadian forest fires do not play a major role. Our damp climate and wet soils usually prevent small fires from turning into wildfires, yet each year we lose thousands of hectares to fire. Even though fire is a minor player in the Acadian Forest, it does have an important role. Species like black spruce and jack pine both use fire for reproduction. The heavy cones of these trees protect the seeds inside during a fire, and the heat helps open the cone to release the seed after the fire. That is why these two species are amongst the first trees to regenerate after a fire.

There is, of course, always the danger of wildfire, especially in the spring and late summer. DNR and many volunteer organizations are on a constant lookout for fires in Nova Scotia. Woodlot owners often dig fire ponds on their property as a source of water in case of fires. These ponds should be located near roads or trails for easy access. Also there should be fire stations on the woodlot. These are caches of tools such as a shovel, hoe, rake and a water backpack. When a fire is spotted these caches can supply the tools necessary to put out a small fire before it spreads. It is important to keep these tools in good repair and make sure the water pack is full. For more detail on fire prevention contact DNR.

"What are you two looking so concerned about?" Marie-Claire asks as she enters the kitchen, covered in snow.
"Good skiing, hon?"
"Beautiful day for cross country skiing. Those extraction trails of yours come in pretty handy. Just don't ruin the scenery," she smiles at Duncan.
"Well we were just discussing that," Arthur points out, hoping to get Duncan in trouble.
"What? why what's the problem," Marie-Claire pours a cup of tea.
"We're just discussing what treatment to use for the stands we're gonna harvest in this management plan," answers Duncan.
"Is there a problem?"
"Well," he says pointing at the map, "... those hardwoods by the river are pretty bad off, especially near the bog. - Ahhh stand number 31 on the map. Remember the bad infestation of leaf miners it had? Well it never really recovered. Now it's got some kind of rot. I'm gonna have to cut the whole thing if I'm gonna salvage any wood at all. It's still good for fuel wood, might get some sawlogs out of it."
"Are you planning to clearcut the whole stand?"
"Yup, but I'll leave a strip along the river. Hopefully that'll hold the soil in place until the new trees grow."
"But that's right next to another old clearcut. There's gonna be a large area left open to the wind. Won't that cause erosion and dry out the site? It could stunt the growth of the regeneration that we're depending on to stop the erosion."
"Well the old cut is coming back nicely - the trees are near three meters tall, they should hold the soil in place, beside there's not much I can do about it. I'll leave some snags for animal use. If necessary I'll **girdle** some healthy trees to make sure there's enough standing dead wood.
"That's such a shame. There's a lot of sugar maple in that stand. So much for starting up a maple sugar operation."
"I'm disappointed too."
"What you gonna do about them pines, Duncan," Arthur asks moving onto the next problem.
"Pines?" queries Marie-Claire.
"Yes, there's pine weevil in some of our good pine. I saw some damaged pines off the ski trail, stands 13 and 11."
"You're *not* thinking of clearcutting... are you? That's the deer wintering area."
"No, don't worry, I'm not gonna clearcut. I wouldn't destroy the deer habitat. Besides the infestation isn't too bad yet, so I thought we'd try to control the weevil. What do you think?"
"How are we going to control them?"

"Well, John was telling me about some biological control experiments at the Agricultural College. Seems that they release 'parasitic wasps' into the infested area. The wasps lay their eggs in the larvae of the weevil and the wasp larvae eats the weevil larvae from the inside out."
"Sounds gruesome. Will it work?"
"Seems to, past trials have been very successful. It's less expensive than spraying and the wasps will control the weevil for a long time to come. If the wasp population gets established in the first year then we only have to do it once, instead of spraying each year."
"And these wasps only attack this pine weevil?"
"That's what they say."
"Sounds good to me, Duncan."
"Say...," Arthur looks up from the map...," have you thought about puttin' a fire pond by the new road we're making."
"Well, I guess we could. I've already got the lake and the river, and I've got several fire stations. Not sure if I need any more."
"Well those stands that the road runs through are pretty far from the lake. I'm puttin' in one on my lot."
"Well, there you go - I don't need one then," Duncan laughs. "I'll give you a hand with yours, though, Arthur."
"Thanks," he responds sarcastically.
"I think I hear John coming on his skidoo," Marie-Claire says looking out the window above the sink. "Looks like it might snow some more."

Forest Pests: There are many types of organisms, both animal and fungal, that attack trees. For the most part these 'pests' do not do severe damage. Often, though, outbreaks of a particular species may severely weaken or destroy a forest. One of the best preventive measures against forest 'pests' is to have a mixed forest, and avoid large mono-culture plantations. Particular species of insects tend to live off one or two species of trees, or close relations of those trees, in the case of insects a mixed forest limits the food supply. This will limit the spread of the insect and will protect the owners investment. Only some of the trees will be attacked (i.e. all the larch in the case of the larch sawfly) yet all the other species of trees, such as the spruce, pine, and maple will be left unharmed. Tree species diversity is insurance against insect infestation. A plantation of all white spruce that is infested with spruce budworm may be completely destroyed, yet if the woodlot was mixed then the hardwoods, hemlock and larch would be spared since the spruce budworm does not favor these species.

Rusts and fungus are hard to control. They often spread underground, from root too root. Fungi are also airborne. Some attack many different tree species. Some, like Dutch elm disease, attack only one species. If you want more information on particular species the department of Natural Resources has detailed literature concerning all of Nova Scotia's forest pests.

Chp. 25: Stewardship, IRM, and making it work

Not long after John arrives at the house Emily and Kara show up. Hearing Duncan and Arthur talk Emily decides not to go to town. The management of the woodlot is very dear to her. The six sit around the kitchen table and discuss the woodlot and their management strategy.

"What's that," Kara asks pointing at the woodlot map on the table. She'd just come into the kitchen after changing into some dry clothes.
"That's called an inventory map," John answers. "It's a map of our woodlot. It shows all the different tree types, and size of each stand..."
"...and it marks all the ecologically sensitive areas too," Emily adds.
"What do all the numbers mean?"
"The first is the stand number, the next line is the percent of dominant tree species in that stand, such as 80% red spruce. The next line is the height of the stand and percent of crown closure. The next line is the site growth classification and the size of the stand. And the last line is the amount of marketable timber available per hectare in that stand," answers Duncan.
"Do you mark wildlife areas too?"
"Yup, the little evergreen, here, indicates a deer wintering area. We were there this morning," says John." These little plants indicate a swamp..."
"... another biologically sensitive area," Emily interjects looking at John.
"And these must be roads and a bridge," Kara says pointing at the bridge symbol on the map.
"Right."
"Ahh, I get it, neat."
'With this information we can determine how much wood there is to harvest," Duncan adds.
"... and how much we *should* harvest. From this we can calculate sustained yields for our woodlot," Emily points out.
"That's right, I've calculated that our lot grows over two thousand cubic meters of wood a year. That means we could cut that much every year and never deplete the forest."
"But sometimes circumstances demand that you harvest more than one area can grow in a year," adds John.
"So...," says Duncan," since we're updating our management plans I'd like to find out what each of you would like to see done with our woodlot." He looks all around the table. "John, tell me, what do you think we should do."
"Well, I'd like to grow Christmas trees. The birch stand by the highway, stand number 1 on the map, is perfect. The overstory is mostly yellow birch and the regeneration is fir. The fir are big enough to start trimming."

"Go on."
"Well, we should clearcut the birch..." He glances at Emily.
"You know what I think about that," she sneers.
"Let John continue, Emily," Marie-Claire says sternly.
"...there's a market for yellow birch for hardwood flooring. Some mills are buying - prices are good. Then I'd space the fir. With increased light the fir should take off. I'd say we could start harvesting Christmas trees in three or four years."
"But what's that gonna do to the habitat?" asks Emily.
"Well, the fir is already well established, so it shouldn't affect the water table. The stand isn't very big, about seven and a half hectares I think. Me and a couple of friends be able to tend that."
"What about the wildlife there?"
"The fir will provide good habitat, though it will be different than the birch. Besides there's plenty of mixed wood near by that some of the animals can emigrate to."
"But they may not survive."
"True, Em," Marie-Claire interjects. "Some of the animals may not be able to re-establish themselves. But what John is saying is that there are still plenty of mature mixed wood stands in our lot, and stand number 1 will not be devastated, it will still provide habitat for other species."
"Yeah, thanks mom," says John happy for the support. "I don't see a problem with this plan."
"Me either," says Duncan. "In fact it sounds pretty good. What do you think Marie?"
"Sounds good to me."
"O.K. John, you can do it." He turns to Marie-Claire "What would you like?"
"Well I just want to make sure there's plenty of mushroom patches and wild berries."
"O.K. we'll leave the old field alone. That's where most of the berries are, and there's plenty of mixed wood for mushrooms." Then to Emily, "how about you."
"I just want to make sure that all the different habitat types are maintained, and those ecologically sensitive areas don't get destroyed. I want to have a place that I can enjoy. "
"We all want that," Marie-Claire assures her.
"Well we're not gonna touch the deer wintering areas at all this year, That way we'll have plenty around. Also we'll leave the bogs alone - as always. The rest we'll have to see how things shape up." As Duncan talks he marks these places on the map.
"Duncan?" Marie-Claire says, getting his attention.
"Yes, Marie?"
"What do you want to do?"
"Well, I want to increase our income from the lot. Use more of it, make it more profitable."
"I agree," adds John.
"So what are your plans, Dad?" Emily asks.

"Well, I've continued to selection cut stands, 4, 22, 23 and 25 for fuel wood, and veneer wood as markets permit."
"I have no problem with that," Emily says looking over the map.
"I wanted to start a shelterwood cut in stand 15, but I'll need wider trails for the new wagon I got, so that will be put off for a while. Also I'll continue the shelterwood cut in stand 11 that I started ten years ago. This year I'll start the second phase, the release cut."
"Should we, Dad?" Emily asks. "That stand borders the bog, what about protecting the bog?"
"We'll leave a buffer strip around the bog, besides a lot of the pines there are infested with pine weevil, I want to cut them now before they get deformed." He looks at Arthur. "As you know Arthur and I are extending our roads. I'll be building a new road on the other side of the river, through stand 30. This will open up those old hemlock stands."
"No, Dad, you can't cut those old growth hemlocks. Some of those trees are over four hundred years old; they're so beautiful. Some of the animals that live in that forest depend on it, they can't survive anywhere else. - There is so little old growth left in this whole province, please...," pleads Emily.
"Well, we had originally planned to selection harvest stands 27 and 28..."
"But we've already cut over stand 26, where a lot of the old growth was."
"I thought a selection cut would make you happy."
"She won't be happy until we stop cutting altogether." John says with frustration.
"John, be civil," Marie-Claire scolds.
"Well, Em," Duncan continues...,"we have to make up the cost of this new road." He looks at her, she looks defeated. "Tell you what, I'll leave stand 27 alone, it's smaller but it contains most of the older hemlock trees. But I'm going to harvest stand 28 in conjunction with Arthur. We'll manage the old growth landscape together. That way it won't get **fragmented**. How does that sound?"
"Fair enough," Emily agrees. "What about fragmenting stand 30? That spruce stand will be split in half by the new road."
"Well I plan to start a shelterwood cut there anyway. Lots of good mature spruce. I'll begin the preparatory cut this winter, after the road is finished. I wouldn't worry about fragmentation since the habitat will be changed in ten or fifteen years."
"How much wood will you remove this year?"
"About thirty percent of the stand, the forest will still be intact."

Management Plan

The proper and efficient management of a woodlot involves writing and updating a woodlot management plan. The following is the MacKenzie's management plan for the next two to three years. Many of the terms used in the plan are abbreviations and are explained in the key.

Plan Key:

The first row contains the headings for each column, they are:

Stand #: is the reference number of the stand on the inventory map.
Size ha.: is the size of the stand in hectares.
% Species Composition: gives the dominant and co-dominant tree species and the percent of each, i.e. TL8 / F2 (tolerant hardwood 80% and fir 20%).
% Crown Closure: gives the area of the canopy that is filled by the crowns of the trees, i.e. 100% (completely full, no gaps in the canopy).
Height M.: is the average height of the dominate trees, in meters, in that stand.
Site class: The productivity (growth) classification given in m^3/ha./yr.
Merchantable Timber: The amount of marketable wood per hectare in the stand .
Sustained Yield: The calculated secondary growth for that stand which can be harvested without depleting the stand. This is based on the site classification and stand size.
Notes/treatment: gives the silvicultural notes and the recommended treatment for the stand.

Tree species:

TL: Tolerant hardwoods. These are trees that can grow in shady conditions, such as sugar maple and yellow birch.
IH: Intolerant hardwoods, These are trees that cannot tolerate shade conditions, such as red maple and white birch.
oH: other hardwoods, usually means a mix of young hardwoods.
Be: beech
yB: yellow birch
S: spruce
F: Balsam fir
eH: eastern hemlock
wP: white pine
jP: jack pine

Abbreviations:

CC: clearcut
New rd: new road
N/T: no treatment
Pine We: pine weevil
Pre-com: pre-commercial thinning
Prep: prepatory cut (shelterwood)
sap.: sapling
SC: Selection cut
SMZ: special management zone
SW: shelterwood cut
w/: with

Stand #	Size ha	% Species Composition	% Crown Clousure	Height M.	Site class	Merchantable Timber m3 / ha	Sustainable Yield m3 / stand / yr	Treatment / Notes
1	7.7	TL8 / F2	50	20	6	231	46.2	yB w/ F understory CC yB for flooring and grow xmas trees
2	32.3	S7 / F3	60	7	10	28	323.3	Immature SW. 20 - 30 yr Leave to mature
3	21.5	S7 / wP3	70	18	11	252	236	Old CC Immature 40 - 50 yr leave to mature
4	7	IH8 / oH2	75	17	7	164	49	SMZ river, SC fuel
5	9	S6 / IH4	70	17	6	230	54	SMZ river, future SC
6	2	S6 / IH2	35	15	6	138	18	understocked, old CC, N/T
7	2.4	wP6 / TL4	40	18	6	192	14.4	SMZ river, leave for seed
8	13.9	wP5 / IH5	30	19	7	158	97.3	SMZ river, berry field, N/T
9	3	wP7 / S3	60	20	5	270	21	SMZ lake, future SC
10	2.5	N/A						SMZ bog, N/T
11	6	wP8 / S2	45	19	5	169.2	30	SW release C, Pine We
12	19.9	S8 / F2	60	8	5	45	99.5	Plantation, Pre-com.
13	19	wP7 / S3	70	20	5	277	95	SMZ rock-out, Deer winter, N/T, Pine We
14	3	S5 / IH5	80	13	7	158	21	SMZ Lake, Deer winter, Immature, N/T
15	17	S6 / F4	75	18	6	215.7	102	Build trail, future SW
16	13.5	S7 / IH3	70	16	7	202.5	94.5	Future SC
17	8.9	IH6 / S4	80	14	6	137	53.4	Inacessable, N/T
18	9.1	IH6 / TL4	85	15	6	164	54.6	Inacessable, N/T
19	2.2	wP10	50	22	7	325.7	15.4	SMZ river, Pine forest N/T
20	1.5	S8 / IH2	65	12	5	110	7.5	Island, N/T
21	10.5	IH7 / S3	80	14	6	137	63	Immature, N/T
22	7.7	TL7 / S3	70	16	7	161	53.9	SMZ Lake, SC fuel
23	7	IH6 / TL4	70	15	6	191	42	SMZ river, SC fuel
24	16.7	S7 / wP3	N/A	1	7	0	0	Plantaion, sap. N/A
25	5.4	Be7 / TL3	75	13	6	132.6	32.4	SMZ wildlife, Fungus, SC fuel
26	6.1	eH5 / Tl5	50	15	6	156	36.6	Immature, N/T
27	7.1	eH8 / S2	70	20	7	303.8	49.7	SMZ old growth, N/T
28	10.9	S6 / eH4	75	20	7	292.5	76.3	SMZ old growth, New rd, SC w/ Auther
29	6.7	jP1 / bS1	10					SMZ bog, N/T
30	32.1	S6 / IH4	70	19	6	257	192.6	New rd, SW Prep.
31	14	IH6 / TL4	50	16	6	130	84	SMZ river, Rot CC Salvage
32	17	S9 / F1	35	3	10	N/A	0	Plantation, Juvinle N/A

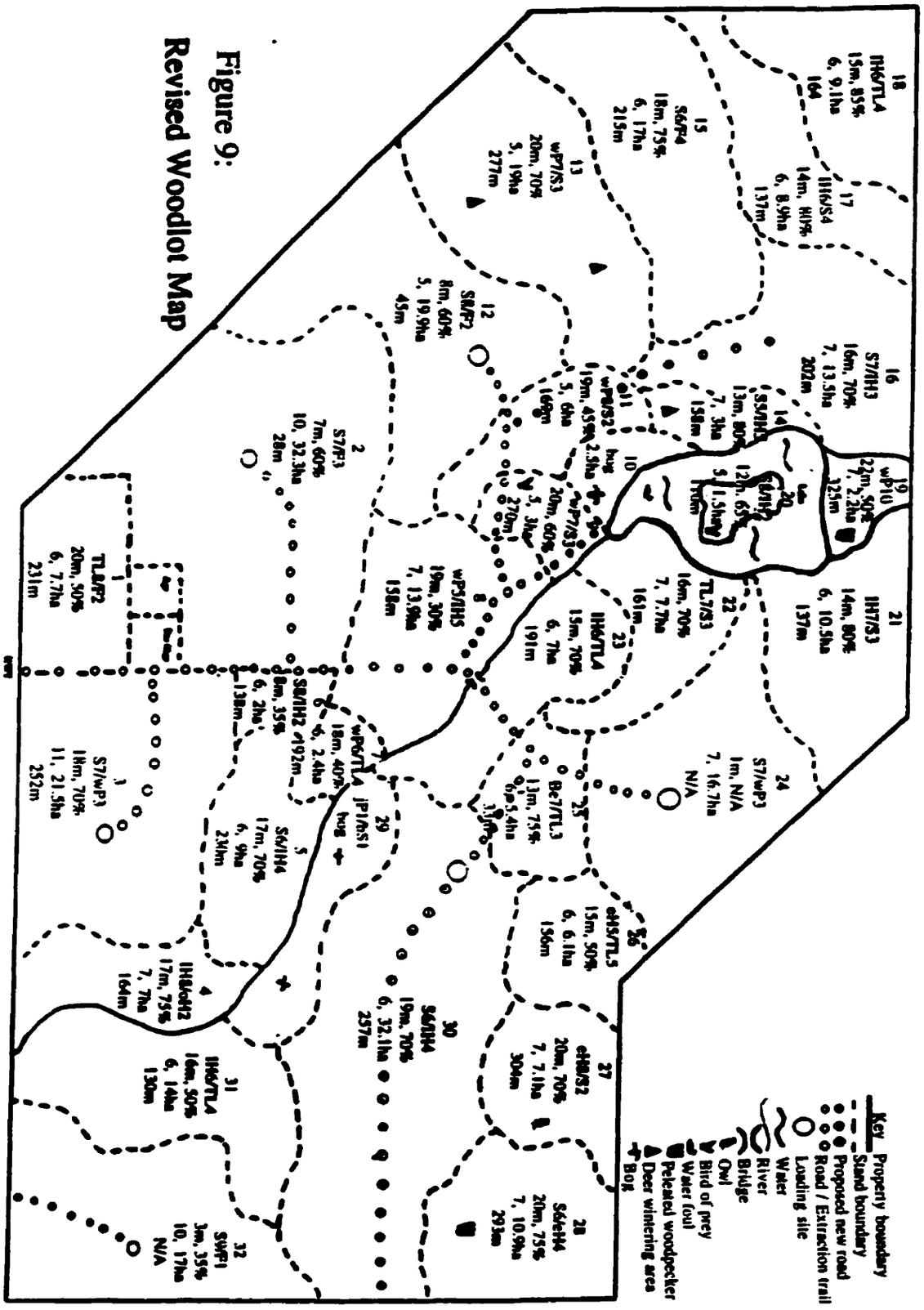

Figure 9:
Revised Woodlot Map

"Just a lot less of it," huffs Emily.
"Is that it Dad?" John asks.
"No, there's one other area I want to get at. Stand 31, by the river, it's in pretty bad shape. After the infestation with leaf miners the trees were weakened and a wood rot set in. If we're gonna salvage anything from there at all then we'll have to cut it soon. So we'll start a clearcut this winter."
Emily looks angry.
"Now I've already discussed this with your mother and we agree. I'll leave buffer strips along the river and bog. They should hold the soil and protect the river while the new growth takes over. That stand borders the main road into town so we won't need any new trails." He scans the table. "How does that sound to you."
"Sounds good to me Dad," John agrees.
"Yea, its O.K.," Emily concedes. She calms herself as she sees the logic behind the salvage cut approach.
"I think it'll work," Marie -Claire says with great optimism. "Some good debate and compromise on all sides, you should all be proud."
"I agree, Marie," Duncan adds. "We're maintaining all the habitat types that are present on our woodlot. The special management zones are looked after. We're not cutting near the lake or river, and we should get some fine pulp and saw logs, not to mention the birch for the hardwood flooring. All in all a pretty fine plan don't you think?"
"Very well rounded Duncan," agrees Arthur.
"Mr. Mackenzie?"
"Yes Kara."
"How come some of the stands are replanted, and some are not," she asks pointing at a clearcut symbol on the map.
"Well, when you clearcut an area it leaves the soil open to erosion by wind and rain. It also makes good habitat for shrubs that compete with the tree saplings that we want to grow there. By planting nursery stock the trees get a head start. That way they will hopefully out compete the shrubs. You see the planted trees are already around five years old. Also these planted trees will quickly establish their root systems which will prevent soil erosion."

Buffer strips: Buffer strips, or green belts, are areas along waterways that require special consideration. They are special management zones. The Nova Scotia Forest/Wildlife guidelines require a SMZ of 20 meters (66 feet) on all sides of a waterway, or lake. The size may increase due to the slope of the land and/or soil conditions. In these SMZ's there can be only selection harvesting. The goal behind the SMZ is to prevent soil erosion and run off into rivers, streams and lakes which adversely affect aquatic ecosystems. It also reduces soil degradation in the cut site by reducing erosion.

"Then why not plant in all the cut areas, Mr. Mackenzie?"
"Well, there are several reasons for that. First off it can be expensive. It costs over two hundred and fifty dollars per acre to replant, and there is no guarantee that the planted stock will survive. Also in a shelterwood or selection cut there are enough trees left behind to prevent soil erosion. Lastly, and most importantly, planting can lead to many problems. When an area is planted, it is planted with one or two species of trees. That is called plantation management. Plantations need a lot more care then a naturally regenerating forest. That is an extra expense as well. There are also many ecological problems associated with plantations, which I'm sure Emily will gladly tell you about..."
"That's right, dad," Emily butts in. "Plantations, or mono-cultures, are inferior to natural forests. They are more susceptible to wind blow down. They are less resistant to diseases and pests. And they don't offer the same quality of habitat for wildlife..."
"Thank you, Emily," Duncan interjects taking back the conversation. "Mind you silvicultural work does increase the productivity of a site. By spacing the trees we can get the right stocking. Stocking is the number of trees per acre, or hectare. If there are too many trees then they will compete with each other for light and water, this will slow their growth rate. If there are too few trees then the crowns will sprawl, and they may grow many limbs causing knotted wood. But a properly stocked stand produces high quality fast growing trees. This increases the amount and rate of wood growth. That means a shorter **rotation** time and more money per stand. Silvicultural work can greatly improve our harvests."
"How much wood will you be harvesting, Mr. Mackenzie?"
"A good question, Kara," Marie-Claire adds.
"In this plan about seventy-five hundred cubic meters."
"But didn't you say that the lot only grows over two thousand cubic meters a year."
"Yeah, dad," Emily butts in.
"True, but some of these stands have to be harvested now, its called a salvage cut. If we don't cut the trees now we won't be able to sell them."
"So, the animals will still use them." says Emily acidly.
"So," John butts in..., "we need them too."
"In most of the areas we're cutting," Duncan continues, " we're only fellin' less than what that area can grow. The reason the numbers are so high are the two clearcuts we're doing. But even in these clearcuts we'll leave buffer strips and seed trees, if they're healthy. Besides it will take more than a year to harvest all those stands. We have other silviculture work to do as well, like thinning and spacing. To increase the productivity of the stand we're opening up some of the stands. That is we're removing some of the trees so the remainder will grow faster and bigger.

Those cleaning jobs will take a bit of time. Even with a small crew it will take a couple of years to complete this plan. Don't worry I'm not gonna take too much wood as to weaken the forest."
"I hope not, Dad," Emily says. "Remember the forests provides us with more than money, it is part of our life."
"True enough, Em, true enough."

Glossary of terms:

A

Aldo Leopold: see box, p. 21

Atmospheric water: Water that is in the air in the form of vapor or droplets. This water vapor forms clouds. There may be droplets of liquid or solid (ice) in the upper atmosphere. The transpiration of water from trees and other plants greatly contributes to the amount of water in the air around a forest.

B

Basal area factor (BAF): Foresters use a BAF prism to determine the amount of wood in an area. This prism has a set ratio. The total diameter of the trees sampled is multiplied by this ratio giving the square metres of stumpage. This is multiplied by the average height and a tapering factor of the trees. This gives the volume of wood in the area.

Biodiversity: see box, p. 15

Boundary Markers: see box, p. 97

Buffer strips: see box, p. 114

C

Canopy: the collection of all the crowns of the dominant and co-dominant trees in a forest.

Cavity Tree: These are trees used by cavity nesting birds and animals. The animal burrows out a nest in the trunk of the tree, or uses an abandoned nest. Often these trees are dead or dying and are quite tall.

Chlorophyll: is a chemical compound found in plants that absorb light for use in photosynthesis. There are many types of chlorophyll. Each type absorbs different wave lengths of light. They are located in the chloroplast of leaf and some stem cells. The chloroplasts are located in **mesophyll tissue**.

Clearcutting: see box, p. 80

Climax Forest: see box, p. 48

Crown closure: is the measure of how close together the crowns (tops) of the trees in a stand are to each other. It is measured by the percent of sky visible from the forest. 90% crown closure means that only 10% open sky is visible. It is used in determining the amount of wood in a stand, and for determining the silvicultural treatment for a stand.

Cruising: see box, p. 7

D

Diameter at breast height (DBH): is the measurement of the trees girth (diameter) at 1.5m from the ground. It is used to calculate the total volume of wood in a woodlot.

E

Ecology: see box, p. 9

Ecosystem: see box, p. 9

Ecotone: is the edge where two different types of habitat meet, such as where a field and the forest meet. Ecotones are associated with high biodiversity. Many species of plants and animals will be present in the ecotone that are not present in either the field or the forest. When planning a clearcut the edge of the cut should be irregularly shaped to increase the amount of edge. A straight boundary with the forest will offer the minimum amount of edge.

Edge: see **Ecotone**

Energy flow: see box, p. 32

Extraction machines: see box, p. 85

Extrinsic value: see box, p. 18

F

Final cut: see box, p. 82

Forest pests: see box, p. 107

Forest roads and bridges: see box, p. 98

Fragmentation: is the splitting up and sectioning off of wildlife habitat. When we clearcut we create holes in the forest. The more we cut the more holes we create. The patches of forest that are left become isolated from each other. This is the fragmentation of wildlife habitat. Fragmenting habitat seriously reduces its ability to support wildlife populations. Many animals need large continuous areas to search for food. Though the forest area may be large enough to support these animals, if it is fragmented, the animals may not survive. When considering forest management it is better for some animals to leave large continuous tracts of forest. The problem of fragmentation in Nova Scotia is a great concern for wildlife managers.

G

Girdle: is the killing of a tree by removing a strip of bark and cambium all around the circumference of the tree. This creates a break in the vascular transport system. The tree becomes unable to move water or nutrients up and down the trunk.

Greenhouse affect: see box, p. 12

Ground treatment: also called site preparation, is to prepare the soil for planting. It is usually only done on clearcut sites where artificial regeneration, by plating nursery stock, will be employed. There are many machines and tractor accessories designed to break up and spread the **slash** left over after cutting. By using various forms of ground treatment the site can be suitable for planting.

Ground truthing: is the surveying of sample plots on a woodlot to test if the woodlot maps are correct. It is done by cruising the lot and selecting several sample plots. Using a prism the plots are sampled recording tree species composition, **DBH**, spacing and **crown closure** amongst other factors. The information is compared to that given on the forest inventory map.

H

Hardwoods: see box, p. 26

Harrow: a mode of **scarification** that involves carving a shallow grove in the soil. It is performed by attaching a blow type blade to the back of a tractor or skidder. The tractor is then driven across the replant site leaving rows of furrowed soil.

Height m (metres): see box, p. 111

Herbicides: are chemical poisons designed to kill a specific range of *plant* species. They are used to eliminate competing vegetation that take resources from crop trees.

Hibernation: is a form of **torpor**. It is a physiological state that some mammals use to endure long periods of cold and little food. The metabolism of the animal decreases. It's heart and respiration slow down and its temperature is lower than normal. Many mammals stay in this state for several months during the winter.

Highgrading: is the practice of cutting the best quality trees (in terms of commercial value) and leaving the inferior trees to restock the area. It causes a decrease in forest health and results in lower quality trees for future harvest. It was practiced in Nova Scotia well into the twentieth century.

Holistic forest management: is managing for all the forest values and functions. It means taking into account wildlife requirements, ecosystem stability, recreation, biodiversity, aesthetics, and commercial goals in a management plan. It is the result of combining forest **stewardship** and **IRM**.

Humidity: is the measurement of moisture in the air or soil.

I

Insecticides: are chemical poisons designed to kill a specific range of *insect* species. They are used to eliminate predators that eat crop trees.

Integrated forestry: see **Integrated resource management (IRM)**

Integrated Resource Management (IRM): is the managing of a forest for several economic resource bases. Such a plan may include fiber (wood) extraction, game

hunting, sport fishing and camping. Management plans must include provisions to maintain all these resource activities.

Intrinsic value: see box, p. 18

Ionic: or ions, is an atom or molecule which has lost or gained electrons giving it a positive or negative charge. For example a H^+ ion is a hydrogen atom which has lost an electron and thus has a positive charge. Some atoms may be found with no charge. These are not ionic.

L

Layering: is a form of plant reproduction. The lower branches of a tree get covered by moss and eventually develop roots. The branch tips turn upward to form a new tree. The tree can do this due to **meristem** tissue in the branch. Black spruce will layer in swampy areas.

Leaching: see box, p. 33

Leaves: see box, p. 28

M

Management plan: see box, p. 111

Merchantable Timber: see box, p. 111

Meristem tissue: Plant tissue that remain in an embryonic state, called undifferentiated. This tissue may remain in this state as long as the plant lives. The plant can call on meristem tissue to become any kind of cell the plant needs, i.e. vascular or mesophyll. It is from regions of meristem tissue that plants engage in primary growth. It is because of meristem tissue that plants can grow all their lives.

Mesophyll tissue: are plant tissues that contain photosynthetic pigments called **chloroplasts**. It is in the mesophyll that the process of photosynthesis takes place. The green tissue of plants contain mesophyll.

Metabolic processes: are the functioning of the cells in plants and animals. It involves cellular respiration, heat, consumption of food and waste disposal. It is the life

process of cells. Metabolic activity also takes place at a larger scale as well. Our body functions such as breathing and blood circulation are examples of metabolism.

N

Nitrogen fixation: see box, p. 47

Notes and treatment: see box, p. 111

P

Patch cut: see box, p. 81

Percent crown closure: see box, p. 111

Percent species composition: see box, p. 111

Pesticides: are chemical poisons designed to kill a specific range of species. **Insecticides** kill animal species, while **Herbicides** kill plant species.

Photosynthesis: see box, p. 31

Primary growth: see box, p. 27

Podsols: Soils in temperate regions with high acidity and leaching (see pp. 60).

R

Regeneration: are the trees that grow, or are planted, in a site after a cut.

Release cut: see box, p. 82

Respiration (cellular): is were oxygen and organic fuel (sugars) are consumed in a reaction to produce ATP. ATP is the energy source for all cells.

Root suckering: a form of asexual plant reproduction were buds on shallow roots sprout new growth. This new growth grows upward into a new tree. These buds contain **meristem** tissue.

Rotation: is the time it takes for a new stand of trees to regenerate and grow to merchantable size after a cut .

Roundwood: is the whole log that is cut in the forest. It is unprocessed wood.

S

Salvage cut: is when a section of the forest is clearcut to salvage the wood. It is done on stands that are severally infested with insects or badly damaged by disease. The goal is to salvage as much marketable wood before all the trees die and rot from the inflection.

Scarification: is to break up the forest floor and soil to prepare it for regeneration, usually planting. There are many methods of scarifying the soil.

Secondary growth: see box, p. 27

Seed cut: see box, p. 82

Seed tree: see box, p. 81

Selection cut: see box, p. 82

Selective cut: same as **highgrading**.

Shelterwood cut: see box, p. 81

Silviculture: is the science and practice of managing forests. In its broadest sense it includes how we treat the trees, soils and ecosystems. It should be the practice of: using and protecting the whole forest community. In Nova Scotia the term usually applies to cleaning, spacing and harvesting techniques. The practical goal of silviculture is to increase the yield and quality of forest products.

Site class: see box, p. 111

Site specific forestry: is a management technique where management decisions are made on a site by site bases. Instead of treating each stand as an individual unit it looks at the whole landscape. Consideration is given to the impact a cut will have on surrounding ecosystems. With site specific forestry there may be several different harvesting methods employed on a woodlot, or even in a single stand depending on the conditions of that site.

Size ha. (hectare): see box, p. 111

Slash: Slash is the left over stumps, tops, branches and leaves of cut trees. Slash can interfere with replanting and if piled can be a fire hazard.

Softwoods: see box, p. 26

Special management zones (SMZ): are biologically sensitive areas. The ecology of these sites could be destroyed by harvesting practices. There are special rules to follow when cutting near or in a SMZ. An example is a river near a cut site. A buffer strip should be left along both sides of the river to protect it from siltation and soil runoff.

Stand: see box, p. 8

Stewardship: is a management philosophy that incorporates the needs of the forest community with human needs. It emphasizes caring and respect for the forest resource. See also p. 92.

Strip cut: see box, p. 80

Sustainable forestry: see p. 3

Sustained yield: is the practice of harvesting only as much wood as the forest can replace. This will allow a continuous harvest and leave the forest intact. However it only involves wood extraction. No other interests are addressed.

Symbiosis: is an ecological relationship between two organisms that live in contact with each other. It can be beneficial, neutral or harmful.

T

Torpor: a set of physiological states that some mammals use to endure cold temperatures. They vary in time length from a day to many months. All torpor states involve the slowing down of metabolic functions such as heart rate and breathing.

U

Understory: The plants, shrubs and smaller trees growing on the forest floor beneath the main forest canopy.

W

Water transpiration: is the release of water through the stomata of plants. The water is first absorbed through the roots and then follows the vascular transport system to the leaves.

Wildlife: see box, p. 14

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Chapter 4: Validation Test

Introduction:

The information in the book deals with the ecological, managerial and technical aspects of forestry. To assess the accuracy of the information, a validation test was conducted in the summer and fall of 1996. The test was designed to evaluate the book in terms of: effectiveness in reaching the target audience (high school students); the comprehension level of the information presented; and the accuracy of that information. A draft of the book was given to 12 experts in the fields of forest ecology, forest management and ecological education. These experts represent the forest industry, academia, private woodlot owners, aboriginal groups and government. A series of questions was asked of these selected experts in an interview. The goal of the interview was to find common themes, suggestions and a consensus, if available, about the book from the forest sector, which includes industry, government, private owners, and academics. These have been compiled and analyzed in this chapter of the thesis; the results have also been used in editing the book. One final note, the terms forest sector and forestry sector are not synonymous. The forest sector includes industry, government, private owners, and academics, whereas the forestry sector consist solely of industry and business.

Validation Test design:

Each of the 12 reviewers was interviewed after they read book. The interview consisted of a questionnaire divided into three sections (Appendix 1). The first section is an overview of the book. It deals with readability, interest and biases inherent in the book. The second section concentrates on accuracy of information, depth and the participant's area(s) of expertise. The third section deals with the style and flow of the book, as well as the book's effectiveness as an educational tool.

The suite of questions are concerned with,
Section:

1) Overview:

1.A: Readability: the flow of the book and how well the book holds the interest of the reader.

1.B: Comprehension and Concepts: the book's ability to cover issues in forestry/ ecology and forest management at the high school comprehension

level.

1.C: Biases: identifying any biases or prejudices inherent in the book.

2) Accuracy and Depth:

2.A: Information Accuracy: the accuracy and depth of information in the book, as well as thoroughness in covering topics in...

2.A.i: Forest ecology

2.A.ii: Recreation

2.A.iii: History

2.A.iv: Silviculture/management

2.A.v: Industry and small woodlots

2.B: Wildlife and Forestry: the integration of wildlife and forestry issues, and management

2.C: Integrated Resource management: the creation and implementation of multi-use management.

2.D: Forest stewardship: the philosophy of care and respect for the forest resource.

2.E: Major issues in forest ecology and management : the issues that are felt to be of utmost importance by the forest sector.

2.F: Education: the concepts and ideas the forest sector feels needs to be taught in our high schools.

2.G: Common themes throughout the forest sector: issues and ideas raised in the interviews that are common throughout the forest sector.

3) Style and approach of the book.

3.A: Story and boxes: the format of the text.

3.B: Family setting, characters and dialogue: the book's approach and style.

3.C: Educational potential: overall effectiveness of the book to reach the target audience and the book's ability to fulfill its goals as an education tool

3.C.i: Style and learning

3.C.ii: Goals

Methods:

A group of 12 reviewers was selected from the following categories: government, including the Department of Natural Resources (both forestry and wildlife divisions), and the Department of the Environment; forestry companies; aboriginal groups; university researchers (ecology/forestry); small woodlot owners/organizations and high school

educators. Each reviewer was asked to read the entire text. Each had the book for at least four weeks, after which a date for an interview was arranged. These interviews were designed to focus on each reviewer's area of expertise. The interview included the questionnaire (Appendix 1) and was set up so that each interview covered the same topics, but it is important to note that not all the participants were asked or answered all the questions in the questionnaire. It should also be noted that not all the reviewer's read the whole book. In cases where a question was not asked, not answered, or where the reviewer felt unqualified to answer, that question was omitted from the analysis of that reviewers interview. It is also important to note that the terms 'reviewer' and 'respondent' are not interchangeable. 'Reviewer' is an inclusive term meaning all the participants, whereas 'respondent' refers to those that answered that particular question.

The goal of the interview was to elicit an opinion on the text as a whole. The suite of questions was designed to elicit honest, non-biased answers. The time and place for the interview was set up at the convenience of the participant. Three of the interviews were conducted over the phone, while nine were conducted in person.

Each interview was recorded openly using a mini-recorder. The reviewers were not required to submit any written comments, but some did send additional written comments. These comments were also used in the analysis of the validation test. The results of each interview were transcribed. The transcriptions of the interviews were then analyzed to find general consensus concerning the topics of each of the three sections of the questionnaire, as well as to find common themes about the forest sector. The analysis also provided common suggestions, from the forest sector, to improve the book in terms of style and accuracy. These results are listed and discussed later in this chapter. Each interview took approximately 1 - 1.5 hours.

The validation test was subjected to a qualitative analysis (Looker, pers comm.), in which the opinions and comments of the participants have been analyzed in a way that expresses general consensus and themes about the book's accuracy and effectiveness as an educational document. I will also present the major issues in forestry as perceived by the forest sector in Nova Scotia. As part of the analysis I divided the reviewers into four broad groups representing the forest sector: government, industry, private and academic. These groups represent the major interest groups in the forest sector. Much of the analysis involves a group by group comparison of opinions and attitudes.

The validation test was analyzed section by section. Each section was subdivided into groups of related topics, i.e., interest, readability and style. All the questions that pertained to any given topic are analyzed as one group. This accounts

for the questions not being listed in sequence in this chapter, because the questions concerning any one topic are scattered throughout that section in the questionnaire. Each topic was given a sub-heading in the results section of this chapter and all related questions are discussed under that heading.

The results of the validation test are analyzed by comparing each reviewer's response for each question. This comparison gives a general consensus of opinion for each topic in a section. Often this comparison reveals a consensus amongst groups in the forest sector; this is noted in the results. In cases where there is no consensus, the contrasting opinions are noted. These controversial topics have been given special attention in the discussion; for it is in these controversial topics we find the heart of the debate over forestry issues in Nova Scotia.

The results of the analysis are then addressed in the discussion section of this chapter. A list of suggestions by the reviewers is examined and critiqued. From the analysis and the critique, a list of recommendations to improve the book is made.

List of participants:

1) Greg De' La' Les: high school teacher, J. L. Isley High School, Halifax N.S. Award winner in environmental education. Involved in model forest projects as well as other environmental field projects for high school students.

2) Jim Drescher: private forester, New Germany, N.S. Trained in forest ecology and economics. Woodlot and mill owner/operator and director of the Windhorse Eco-forestry school in New Germany N.S.

3) Eric Hundert: pollution specialist, Environment Canada, Halifax, N.S. (MSc) woodlot management, past manager of North Mountain Woodland Group Venture, activist in non-government organization conservation groups in N.S..

4) Dr. Ian Methven. Dean of Forestry, University of New Brunswick, Fredricton, N.B. A specialist in landscape management. Past experience includes forest ranger (warden) and fish/wildlife manager.

5) Ian Millar. District Manager Canadian Forest Service, Truro, N.S. A generalist in forestry issues, works with industry and private woodlot owners.

6) Randy Milton. Nova Scotia Department of Natural Resources, Kentville, N.S. (MSc) Biology, Wetland and coastal habitat manager of wildlife resources, Stewardship program developer, activist in NGO conservation groups.

7) Dr. Vilis Nams. Professor of ecology, Nova Scotia Agricultural College, Truro, N.S..

8) Gerry Parker. Forest/wildlife ecologist, Canadian Wildlife Service, N.B. Involved in the Greater Fundy Ecosystem Project.

9) John F. Prosper. Director of the Mi'kmaq Wildlife Commission, Afton Reserve, N.S. Forest Engineer, involved in native issues in natural resources rights and management.

10) Russ Waycott. Vice-President of Woodlands, Stora Inc., Port Hawksbury, Cape Breton, N.S.

11) Dr. Martin Willison. Department head, Biology Department, Dalhousie University, Halifax, N.S. Professor of ecology.

Magean Willison. Grade 11 high school student, J. L. Isley High School, Halifax, N.S.

12) Jim Verboom. President of the Nova Scotia Woodlot Owners and Operators Association, Truro, N.S. Silvicultural contractor and woodlot owner/operator.

Results:

Section 1: general overview of the book. It is designed to elicit responses about readability and interest, comprehension level, coverage of topics and biases inherent in the book.

1.A: Readability: [Questions 1, 2 and 3 of section 1] All of the respondents agree that the text of the book is generally clear and easily understandable, with some exceptions. These exceptions either have been dealt with in editing, or are listed as suggestions for the book later in this chapter (p. 16). Likewise, all those reviewers feel that the book held their interest, though several mentioned that the second half of the story is more interesting then the first half. Some suggested that this is because there are more interaction and conflict in the second half, whereas the first half of the story primarily provides definitions and explanations.

1.B: Comprehension and Concepts: [Questions 4 and 5 of section 1] In terms of the comprehension level most feel it is written at the high school level. One reviewer believes it is written at a level too low, and the other too high, for high school comprehension. Four of the reviewers feel that the book spans both junior and high school comprehension levels. All of those involved in academics, including the grade 11 high school student, believe it to be written at the high school level.

All of the reviewers feel that the book covers, or at least touches on, the major concepts of forest ecology and forest management. Some think there should be more information on management, while others feel there should be more focus on forest ecology issues. Some members from each group of the forest sector wished to see more on management, while others wished to see more on ecology.

1.C: Biases: [Question 6 of section 1] It was almost unanimously agreed that there are biases inherent in the book. Yet there is no consensus on what those biases are. About half feel it is biased in favor of the ecological point of view. This opinion was reflected across the forest sector. Two reviewers feel I am biased toward the holistic approach to forestry. Three reviewers feel that I am biased against industry, yet these do not include industry people. About half believe the book is biased against clearcutting and plantation management. This group spans the forest sector, with the exception of the academic group. One reviewer (private) thinks I am biased in favor of clearcut management. Only one reviewer (academic) feels the book is well balanced on all issues. Yet this reviewer also thinks that industry will perceive the book as biased against industry.

Section 2: This section focuses on the accuracy of general information, integrated forestry/wildlife management, integrated resources management and forest stewardship.

2.A: Information accuracy: [Questions 4 - 13 of section 2] This group of questions deal with the accuracy and depth of the information in the book, as well as the comprehension level.

2.A.i: Forest ecology: The reviewers are unanimous in that the information in the book concerning forest ecology is both accurate and at the right comprehension level for high school students. Two of the reviewers feel there should be more information on soils. It is also overwhelmingly felt that the information on wildlife and bio-physical functions was accurate and at the targeted comprehension level. Two reviewers feel that the chapters on bio-physical functions are not in-depth enough, and two think that wildlife issues should be covered in more depth.

2.A.ii: Recreation: All those who answered agree that the information concerning recreation is accurate, and only one thinks it is not sufficiently in-depth.

2.A.iii: History: It is agreed that the information concerning history and natural history is accurate and in depth. Four reviewers feel that more depth should be given to the natural history of Nova Scotia. One reviewer feels that my presentation of history is biased against pulp and paper companies. In terms of M'kmaq representation, half of the reviewers feel that my treatment of M'kmaq culture and history is 'romanticized': that I do not examine M'kmaq culture in the same critical light that I use for the rest of the forest sector. The aboriginal reviewer feels that this is not the case.

2.A.iv: Silviculture/management and the forestry sector: One fourth of the reviewers believe that my treatment of silviculture is not quite accurate, the rest think it is accurate enough for the purposes of the book. Two think I miss represent the concept of silviculture; this will be discussed later in the 'suggestions' section (p. 16). As mentioned earlier several reviewers feel that my treatment of clearcutting and plantation management is too harsh, unfair and biased. In terms of management only one respondent feels that the information is not accurate or in-depth enough for high school comprehension. Several reviewers feel that I should include more discussion on the different scales of management: small woodlot management versus industrial management.

2.A.v: Industry and small woodlots: In terms of my treatment of industry and small woodlot owners, less than half of the respondents feel that the information is accurate. Most of those in disagreement with the book's position are government and industry people. This group feels I leave the impression that industry is still only interested in short term economic goals, and that I do not discuss the important changes in the industry over the past fifteen years in sufficient depth. Also, they feel my treatment of

small woodlot owners is too idealistic. They feel I leave the impression that all woodlot owners are as responsible and interested as the MacKenzies. They think I should point out that many owners are not very concerned about their property, and many are only interested in money.

2.B: Wildlife and Forestry: [Questions 14 - 17 of section 2] These questions focuse on integrated wildlife and forestry issues. Given the current problems and challenges of managing for wildlife habitat, in a forestry dominated Paradigm, I feel that this issue should be given particular attention.

It is unanimously held by all groups in the forest sector, that wildlife and forestry management need to be integrated in order to maintain biodiversity, wildlife populations and sustainable forestry. All but one reviewer feel that the book integrates wildlife and forest management. All believe that the Mackenzie family demonstrates, or at least attempts to demonstrate, integrated wildlife/forest management.

The reviewers were asked to comment on the obstacles facing the integration of wildlife and forestry management. The consensus is that more coordination is needed between wildlife managers, foresters and private land owners. To achieve sustainable integrated wildlife/forest management, there needs to be input and cooperation from all three groups. This cooperation is essential to achieve sustainable forestry and to maintain healthy wildlife populations. Also, private owners, foresters and wildlife managers need to understand how forest harvesting effects wildlife, by causing a loss of or change in habitat. More education is needed. Private owners need to understand wildlife habitat needs, foresters need to understand the impacts of harvesting on wildlife, and wildlife managers need to understand the necessities and realities of forestry. In short, the main obstacle to integrating wildlife and forestry management is a people management problem. The wildlife and forestry sectors must integrate and cooperate.

2.C: Integrated Resource Management (IRM): [Questions 18 - 20 of section 2] As part of a holistic approach to forestry, IRM is supported in the book as a way to provide for all the economic interests in the forest sector.

The first question asked was to define IRM. The majority of the reviewers believe that IRM is providing for all the interests in the forest, both economic and ecological. It is managing for the sustainability of biological diversity in a forest ecosystem. Two said they could not define it. Two feel that IRM is already outdated, that we need to recognize landscapes as more than a resource. All but the same two agree that we need IRM in forest management in Nova Scotia. All but one reviewer agree with my definition of IRM (see Chp. 3, p. 126), including the two who said they could not define it.

2.D: Forest stewardship: [Questions 21 - 26 of section 2] The concept of stewardship is a central theme of the book. Therefore it is a focus of the validation test. Again, the first question asked of the reviewers is to define stewardship. Most of the responses deal with the issue of responsibility to the forest community; that is to look beyond our own needs and not take more than the forest can provide. Other common themes include a balancing of our use of the forest by not allowing one interest to dominate all other interests. By implementing these themes we will provide for all the interests and values in the forest. Also, several responses deal with the issue of our responsibility to provide for future generations.

All of the reviewers feel that stewardship should be part of the forest management strategy for Nova Scotia. As well, all the respondents agree that the book presents the values of forest stewardship. They all also agree that the book successfully combines the philosophy of stewardship with the management tool of IRM.

The reviewers were asked to reiterate the book's position on IRM and stewardship. The consensus is that the book promotes the message that: Foresters, private owners, government, and industry must recognize and manage for all values of the forest. That is we are responsible to ourselves and the forest community as a whole, and therefore we need to manage in a way that insures the sustainability of the forest community.

2.E: Major Issues in Forest Ecology and Management: [Question 2 of section 2] As well as eliciting responses about the book the validation test also asked questions about the participant's opinions concerning forestry related issues in Nova Scotia. I have arranged the responses by group: government, private, industry and academic.

The common themes running through the academic community are: 1)to get forest managers to view the forest as more than wood production; 2) we are managing on the edge of disaster and must reduce our impact on the forest; the question is: how do we step back from the edge without social and economic costs? 3) We must manage on a ecosystem (landscape) level in order to develop sustainable forestry, but we must understand the forces that shape that landscape in order to manage at a landscape level.

Government reviewers also have some common themes in their responses. They saw the major issue in forestry as a human/ forest relationship question: 1) we must understand how our harvesting (and other impacts) affect the forest ecosystem; 2) we must get all parties (private owners, industry, the public and government) to cooperate in order to achieve sustainable forestry.

Both industry and private owners shared some views on the major issues in forestry. They saw the major issue in forestry as being a question of: 1) how do we

maintain our forest ecosystem while maintaining ourselves?; 2) we must develop a way to sustain the forest while sustaining industry and our standard of living.

There was one theme that crossed the whole forest sector: the need to understand the importance of scale when managing a forest or a woodlot. This includes habitat (edge zones and patches versus large homogeneous tracts of forest) and scale in terms of management, managing a whole forest versus managing a woodlot.

2.F: Education: [Question 3 of section 2] The reviewers were also asked their opinion on what high school students should be taught about forest ecology and management. The main themes in education are: 1) that high school students need to be taught basic forest ecology; they need to understand how the forest works; 2) how the forests affect our environment; 3) the variety of plants and animals in the forest; and 4) they also need to be taught how we impact the forest by using it. Some secondary themes are: 5) that the forest is renewable, that it can be used and not destroyed, that there can be enough for us and future generations; 6) the difference between preservation and conservation; 7) scale, both spatial and temporal, that trees operate on a much longer time frame than we, and we must manage for the long term.

2.G: Common themes throughout the forest sector: Throughout the interview process many themes, biases and issues were discussed. Most of these are ideas that were brought up by the reviewers without prompting. I believe that these themes show how the forest sector groups see themselves, for these are the issues that preoccupied the forest sector. These themes, listed in no particular order, paint a portrait of the present state of Nova Scotia's forest sector.

1) All of the reviewers feel that we need sustainable forestry in Nova Scotia. In order to maintain ourselves and the forest industry we must maintain forest ecosystems. Of course there was much variation on how sustainability should/can be implemented.

2) All of the reviewers agree that forest stewardship should be part of the forest management strategy for Nova Scotia. We must care for and respect the forest. We must also respect, and include, all those who have an interest in the forest in our management strategy. Cooperation amongst all the interested groups is the key to achieving stewardship.

3) Over half of the reviewers expressed that to achieve sustainable forestry we must manage at a landscape level, but act at the stand level.

4) Half of the reviewers, including all groups, feel that clearcutting and plantation management have a role to play in managing the Acadian Forest. They believe that clearcutting mimics the natural disturbance patterns in the Acadian forest. Others argue that there is no place for clearcutting and plantation management in the Acadian Forest. They feel that clearcutting does not mimic the natural disturbance patterns in the Acadian Forest.

5) Another controversial topic is that of the objectives of industry. Almost half of the reviewers, including all groups, feel that industry no longer operates on short term economic plans. They feel that industry is changing to sustainable management and planning in the long term. On the other hand some feel that industry still operates in the short term, and although they may want to change, is bound by their responsibilities to their shareholders. This obligation to business overrides any commitment to sustainability.

6) About half agree that the key to achieving sustainable forestry is managing people. Once again, cooperation amongst the interested groups is the key to successful sustainable management.

7) Several reviewers stressed the importance of recognizing and dealing with the issues of scale in management. Included in this are spatial and temporal scale problems. In comparison to trees or a forest humans are short-lived. Therefore we must learn to operate on a forest time scale if we hope to manage sustainably. We also must manage on a forest spatial scale which means we must manage at the landscape level.

8) Half of the reviewers made direct reference to the need for more education and research in forest ecology. In order to implement sustainable management we must have a better understanding of forest ecosystems. As it stands, we do not know enough about forest ecosystems to safely manage them as intensively as we do.

In summary the main themes in the Forest sector today are: sustainability, landscape management and cooperation. Yet there is no consensus on the means to achieve these.

Section 3: This section focuses on the style (story and layout), approach (family setting etc.), and the book's effectiveness as an educational tool.

3.A: The story and boxes: [Questions 1, 2 and 7 of section 3] All but two of the reviewers feel that separating the story from the essays (text) makes the book easier to read. In fact most think that this separation is necessary. Two of the reviewers feel it would be a good idea to drop the chapter headings at the beginning of the dialogues. It is felt that these would be more effective at the end of the chapter. As well, all of the respondents find the story interesting. Over half suggest that I should include a crisis to add focus and spice to the story. This will be discussed later in the suggestions section (p. 16). With respect to the boxes, or cameos, all but one of the reviewers feel that they are an interesting feature of the book. The one objector thinks that the information in the boxes should be incorporated into the text. The rest believe that the information in the boxes should be kept separate. Four commented that the boxes should be kept short. Long boxes, e.g. harvesting methods, should be either added at the end of the chapter or included as an appendix. Two of the government reviewers feel that I editorialize in the boxes, and that this is inappropriate.

3.B: Family setting, characters and dialogue: [Questions 3, 5, 6 and 8 of section 3] All of the respondents agree that the story, set in a family run woodlot, is an effective medium to convey the concepts of forest ecology and forest management. Two reviewers feel that the family members were too nice to each other. They thought more conflict and argument would add realism. One thinks the family to be too old-fashioned and suggests Emily and John reverse roles.

The vast majority found the characters to be realistic, if not as people then as personifications of real points of view. The general consensus is that the characters are stereotyped and not very deep, but realistic enough for the purposes of the book. The dialogue was found to be realistic by all but one respondent. Several reviewers suggest that the profanity be dropped. They found it distracting and not conducive to the educational process. The high school student found the profanity appropriate and feels that high school students in general will appreciate the realism.

All but one reviewer agree that the woodlot situation is realistic, that is, that the MacKenzie's woodlot, with the situations and problems presented, reflected woodlots across Nova Scotia. Four reviewers found the woodlot to be large in comparison to the average private woodlot in Nova Scotia, but recognized the necessity of a large lot to demonstrate the different types of harvesting regimes and to show a variety of habitat types.

3.C: Educational potential: [Questions 4, 9, 10 and 11 of section 3] These questions look at the book's effectiveness as an educational tool for high school students. They also look at whether the book fulfills its own educational goals.

3.C.i: Style and learning: All the respondents agree that the style of the book (the story format, the boxes and essays) facilitate learning. Two suggest adding a 'further readings' list to each chapter or section to give additional information. The book should also have exercises and problems at the end of each section. As well, all the respondents feel the style was appropriate for high school students. It is felt that the students will relate to the characters in the story. Again, all the respondents think the book will be an effective tool for teaching high school students the concepts of forest ecology and forest management. Several mentioned that this is a positive addition to education literature. One called it a: "different kind of text book, the type kids might actually want to read".

3.C.ii: Goals: All the respondents agree that the book, with editing, fulfills its own goal as an educational tool for the high school level. In fact their main concern is how to get the book into the curriculum. One reviewer even went so far as to say: "[The book] should be required reading; forget Animal Farm, read this!".

DISCUSSION:

Much of this discussion will centre on my suggestions on how to incorporate the results of the validation test into the book.

From the beginning of the project it has been my goal to write a book that is as neutral as possible. It would seem by the results of the validation test that this is impossible (see discussion p. 14). In fact one reviewer said: "It is impossible to be objective about a subject of which you are so passionate about". I tend to agree with this statement. At best I can aim to write a well balanced book, in which the biases are clearly stated. To achieve this some difficult decisions concerning the direction of the book will have to be made. Many suggestions made by the reviewers are controversial. To embrace one group's ideal means we must alienate another. Thus we must find that fine line where all parties are represented, but none dominate the direction of the book. With that in mind, this is my assessment of the results of the validation test:

Section 1: The reviewers were unanimous in that the book is clearly written and interesting. This goes a long way in reaching the target audience, high school students. All reviewers agree that the book covered the major concepts of forest ecology and management. This alone shows that the book is a partial success, for that was one of the main goals.

The results show that the comprehension level varied throughout the book, ranging from junior high to high school or above. This is due to the varying ages of the characters in the story. The cousin, Peter, is 13 years old. His questions and their

corresponding answers are perceived to be at a lower than high school level. Thus the comprehension level in the book fluctuates.

In terms of biases I was not successful in eliminating my prejudices. All but one reviewer feels that the book is biased in one form or another. The main biases pointed out are: a) toward the ecological side of forestry issues; b) against clearcutting and plantation management; and c) against industry. Biases b) and c) will be discussed later in this section (see 'suggestions directional' # 2 and # 3). As for a) the ecological point of view, I hardly consider this a 'bias'. Holistic management demands that all values and functions in the forest be provided for in a management regime. So, naturally I included discussions on maintaining forest ecosystems as part of a sound management plan. I believe that this point of view is seen as a bias because it has never been given equal weight before. In a fiber-dominated paradigm, ecological issues were seen as constraining. In holistic management the maintenance of the forest ecosystems *is* the goal and all other interest must flow from that goal. It is my belief that this new prominence of forest integrity has been mistaken as a bias toward 'preserving the forest'. For sustainable forests and sustainable forestry are not a bias, but rather the main concept of the book. After all, promoting holistic management is one of the main goals of the book.

Section 2: This section deals with information accuracy and level of comprehension. The overwhelming opinion is that the information in the book is accurate and at the right depth for high school students. There are some obvious exceptions such as the book's treatment of silviculture and industry. These will be discussed later in this section.

The rest of section 2 deals with integrated wildlife/forestry, IRM and Stewardship. Once again the overwhelming opinion is that the book successfully demonstrates and defines these issues. The reviewers agree that wildlife and forestry issues need to be integrated, and that IRM and stewardship are necessary for sustainable forestry. This supports the success of the book, because promoting IRM and stewardship are also part of the main goals of the book.

Section 3: This section deals with the style of the book, its appropriateness for high school students and its effectiveness as an education tool.

Once again the overwhelming consensus is that the style and format of the book are appropriate for the target audience. The story format, family setting and characters are a new and effective medium to aid in the teaching of forest ecology and forest management. More importantly it is agreed by the reviewers that the book, with revisions,

fulfills its own goals as an education tool. This consensus helps fulfill one of the primary goals of the thesis, that is, to write an effective educational text at the high school level.

There are, of course, some problems; some reviewers take issue with some of the dialogue and style in the book. Most notable are problems with language and editorializing by the author. Many feel that the profanity in the book is inappropriate for a high school text. Yet the one high school reviewer thought it was real and appropriate. Since the target audience is high school students, the opinion of a high school student should carry some weight. On the other hand the Department of Education may, for reasons of regulations, support the objection to the language.

It is felt by some that I editorialized in the boxes, which are to give specific technical information, and text component of the book. These reviewers feel that a book such as this should be as neutral as possible. Thus all reference to my views on any given subject should be eliminated. Quite frankly this is impossible. One can not be completely objective. I should strive to present balanced views, I agree, but to eliminate my views altogether is not possible. Because I am the author my opinions are going to be expressed either explicitly or implicitly. It is far better to state my views clearly where they can be examined and debated, rather than disguise them as fact. To hide my views would be deceitful and only serve to unduly influence young impressionable minds with my biases. To state them clearly is to open the way for debate and learning. So long as all sides of an argument are equally presented, then stating my views should not cause a problem. To ensure that all sides are clearly and equally presented, the book must be critiqued by representatives of the whole forest sector. That critique has already been done by the validation test. Another should be conducted after the book is finished.

Suggestions: Throughout the interview process each reviewer made many suggestions about how to improve the book. These have been compiled into a list of common suggestions. The suggestions are broken down into two categories: A) specific suggestions to improve the accuracy, style and flow of the book; and B) directional suggestions that affect the concept and focus of the book.

Specific suggestions: This is a list of suggestions made by all groups. It is important to note that often the suggestions made by one group were countered by another group. There are many more suggestions than the ones listed here, but most of those were suggested by only one or two people. Often those suggestions were countered by opposing suggestions of other individuals.

These suggestions are, for the most part, straight forward and self explanatory. It will be up to an editor to decide which, if any, will be included in the book. The only one found to be controversial is the issue of the dialogue; this has already been discussed under 'section 3'. The list of specific suggestions follows, in no particular order:

1) Natural history and forest ecology: The ecology of the Acadian Forest should play a more prominent role in the story. The characters should make more observations and point to specific Acadian Forest examples when explaining forest functions.

2) Forest structure: The story needs more description of the physical structure of the forest. Some reviewers feel that I assumed that the reader would be familiar with a forest setting.

3) Dialogue: Many reviewers feel that the colloquial and profane dialogue should be eliminated. They find it distracting and inappropriate. Yet, others find the profanity to be realistic and thought it should be kept; this group includes the high school student (the target audience). Some reviewers also feel that the 'off hand' comments in the text should be removed. They are found to be sarcastic or out of place.

4) Forest health: A clear distinction should be made between a healthy and unhealthy forest. An unhealthy forest can still produce quality wood. The book should point out the difference between quality forest ecosystems and quality wood production.

5) Secondary forest product industries: Secondary industries such as berries and mushrooms should not be portrayed as the norm, as in Scandinavia. They should be presented as new market potentials.

6) Kara: Many feel that the M'kmaq character, Kara, should know more about the forest and even answer some of the questions about wildlife. The M'kmaq reviewer found no problem with Kara's character saying that many young M'kmaq would know more, but many would know less, about nature.

7) Story: Rewrite the first half of the story so that the dialogue flows as easily as in the second half, that is more 'story' and less definition.

8) Examples: Use Acadian Forest examples only when discussing wildlife and forest issues, i.e. replace references to spotted owls and British Columbia with Nova Scotia examples.

9) Podsoliztion: Define podsolization, perhaps in the glossary.

10) Research: Explain that we do not fully understand the interrelationship of wildlife and habitat.

11) Fir: There needs to be more explanation of the special situation of fir trees in the Acadian Forest. In the southern part of the province they are at the southern limit of their range. Due to this, they die young and are prone to blowdown. Clearcutting is considered by many to be the only management option for fir in Nova Scotia, not to mention that there are natural fir plantations in Cape Breton, showing there are natural monocultures in Nova Scotia.

12) Paying for site preparation: Planting and site preparation on crown land is not always paid for by the province. Stora, for example, spends a great deal of money on site preparation. Also, some saw mill operations with private land get provincial money for reforestation.

13) Planting: Survival of planted trees is much higher than I state in the book. In Nova Scotia 80 - 90% of planted stock will reach the 'free to grow stage'. This high survival rate is due to our climate.

14) Habitat destruction: In the harvesting box I should not promote the idea that clearcutting, and other harvesting methods, destroy habitat. Rather the book should say that the habitat is changed. Neither do these harvesting methods destroy ecosystems, once again they are changed.

Directional suggestions: The following is a list of suggestions concerning the direction, focus and concepts presented in the book. Most of these suggestions are the consensus of all the reviewers, though some particularly astute suggestions by individuals are also listed. Some of these suggestions are controversial and by no means are a consensus of

the reviewers. That in itself is interesting, so I have listed the major controversial suggestions as well.

Due to the impact that these suggestions could have on the book they must be considered carefully. Many of these suggestions I agree with and have included in my list of recommendations (see p. chp. 4 , p. 25).

1) Silviculture: Several reviewers feel the book does not adequately define silviculture. It is felt that my use of the term is too provincial. They suggest that: a) I define silviculture in its broadest sense, as the science and practice of managing a forest, and not only as harvesting and thinning methods; b) silvicultural systems such as clearcutting, shelterwood and selection are regeneration methods, not harvesting systems; c) these are used to plan various gaps sizes across a landscape. They are points on a landscape management continuum, not separate harvesting treatments.

It is true that I use silvicultural to mean harvesting techniques as well as other stand management techniques; this is how the term is used in Nova Scotia. Yet I also agree that the broader, general use of the word should be explained to the reader. I feel it would be wise to include the definition of silviculture as the science and practice of forest management, as well showing how it is used in Nova Scotia. This will have one major repercussion. In the broad sense clearcutting, shelterwood and other 'harvesting systems' are considered regeneration methods, points on a management continuum. All these regeneration methods are used to plan gap size and distribution throughout a landscape. Harvesting is done by tree length, short tree, whole tree etc., what I call extraction methods. My use of these terms reflect the provincial use. To alter the discussion on silviculture is to change the use of all these terms. This runs the risk of confusing the reader who may be familiar with those terms in the provincial sense. Furthermore, to adopt those changes into the discussion on silviculture means we must assume a landscape management approach. Although I support landscape management, it does not reflect the realities of woodlot management in Nova Scotia. The book could explain both meanings of these terms while showing how different definitions affect management strategies. This will have an impact on the book's treatment of clearcutting.

2) Clearcutting and plantation management: Many reviewers across the forest sector feel that the book's treatment of clearcutting and plantation management is unfair or misleading. This group believes there is a place for clearcutting and plantation management in the Acadian forest. They suggest that I rework my discussion on clearcutting and plantation management to include: A) a description of clearcutting as a

tool of management giving examples of where and when it is appropriate, i.e. fir plantations; B) as a tool clearcutting is not the cause of ecological damage or habitat destruction. Rather, ecological damage is caused by improper planning and/or implementation. In short it is the contractor/logger's fault; C) that clearcut management mimics the natural disturbance patterns in the Acadian Forest and therefore is an appropriate silvicultural system; D) that as a landscape management tool clearcutting is just one form of creating gaps; E) that clearcutting has changed in the past 5 years or so to include SMZ's; F) that plantations are not mono-cultures and most have natural regeneration that allow other species (non-commercial) to grow as well; G) that there are natural plantations (Fir) in the Acadian Forest, i.e. the northern plateau of Cape Breton and Christmas Mountain.

On the other hand many other reviewers feel there is no place, or little use, for clearcutting and plantations in the Acadian Forest. This cluster of reviewers also crosses all the groups of the forest sector. They believe that: A) clearcutting by its very nature causes environmental damage; B) clearcutting does not mimic natural disturbance patterns in the Acadian Forest; C) clearcutting is the most expensive form of management. When social, ecological and future economic costs are considered clearcutting becomes economically non-viable; D) any management system that destroys whole forest habitats is not good management, and can not (by definition) be part of an IRM plan; E) the new standards for forestry practice being developed by the 'Forest Stewardship Council' will call for very small clearcuts. Therefore the book should be even more critical of clearcutting and plantation management.

These results indicate that clearcutting is the most controversial issue in the book. If we view clearcutting as a regeneration method then it becomes one of many options on a continuum of management strategies for landscape management. In this light one could argue for the use of clearcuts at the appropriate scale on the appropriate species. Yet this does not reflect the realities of harvesting practices in Nova Scotia. Clearcutting is the most commonly used 'harvesting method', in fact 80% of the cuts in Nova Scotia are clearcut. Clearly this not a 'continuum' of management options! At best it is a misuse of a potentially damaging harvesting technique. This reality must be brought out in the book. It would be irresponsible to do otherwise. Perhaps the discussion of clearcutting could be changed to reflect both the reality of woodlot management with the over use of clearcuts as well as the ideal use of clearcuts as part of the landscape management continuum. It should also mention that there is a wide difference in opinions concerning the merits and pitfalls of clearcuts.

As for plantations, similar arguments abound. Some large homogeneous areas may be necessary in a landscape. But this idea must fit into the realities of small woodlot management. Can private owners manage at that level? As for the definition of a plantation, it can be altered to reflect that plantations can include more than one species and often regenerate naturally. Also, when planted, the nursery stock used is no longer genetically identical. Whether or not they occur naturally in the Acadian Forest depends on whether or not one includes the boreal-like regions of Nova Scotia in the Acadian Forest.

3) Industry: The book's treatment of industry is another contentious issue. As mentioned before, many reviewers feel the book's treatment of industry is biased and unfair. The main objection is that the book leaves the reader with the impression that industry is short sighted and only interested in making money. Instead of focusing on the negative aspects of the forest industry, I should present it as a changing entity. One that is an integral part of society, and is now practicing sophisticated landscape management to the best of its ability within the constraints of limited ecological understanding and economic realities.

However, many other reviewers feel that the book should point out the historical fact of industry mismanagement in Nova Scotia. Industry, after all, is in the business of making money and profit motives dictate management plans.

Though I may have some biases against industry the book should reflect its importance to the province both economically and socially. Yet this discussion should not be seen as a 'carte´ blanc' endorsement of the industrial view point. To incorporate some of industry's concerns the discussion could be expanded to explain that: A) industry has been, and is, changing to find and practice economically viable sustainable forestry techniques, but also that this is due to market and public pressure as well as a change in the philosophy of the industry; B) there are many good managers in industry trying to effect this change at the management level; C) the book's segments on history should be put into historical perspective; that is, that everyone involved in forestry, not just industry, contributed to the mismanagement of the forests. A more critical account of private woodlot management will also give greater balance to the discussion on forest management.

4) Management and scale: Many feel that the book did not adequately explain the fundamental differences between managing a small woodlot and a whole landscape; the greatest difference is a matter of scale. It is a very different challenge to manage a 200 hectare woodlot and a 100,000 hectare forest. Given these differences the book should

focus on landscape management. The management objective is to maintain the landscape; all other interests, such as fiber production, recreation etc., flow from this objective. In an effort to support landscape diversity the book should also discuss gap sizes and patterns. It should also mention the need for large tracts of homogeneous forest as well as edge zones. An important question to be raised is whether these concerns can be addressed at the woodlot level?

The issue of scale is one of the few themes that pervaded all the groups of the forest sector. There are many aspects to this issue, time, space, habitat size and management regimes are only a few. The issue is: should the book promote a landscape management approach that, although ecologically sound, may not be appropriate for private landowners? Landscape management by its very definition entails managing for large areas, i.e. whole forests or watersheds. Small woodlot owners do not and can not manage at this level. As individuals, they simply do not own enough forest to even consider planning at that level. At this point one must consider for whom the book is written. Are we promoting industrial management, or small woodlot management. Besides high school students, I believe it is the woodlot owner that the book is trying to reach. It is these private owners that need educational material. It would make sense, then, to gear the discussion on management and scale toward them. Now, that is not to say that landscape management should not be discussed, just not as a practical option for the independent private owner. Landscape management could apply to private owners if they formed group management ventures or co-ops. It might be worth while for the book to discuss private owners forming these management co-ops, wherein a large area that is owned by many individuals is managed under one plan. Under this scheme each member would share in the cost and profits of a large scale management plan. The discussion could also include group marketing for their products, which already exists. Group management is a new concept in Nova Scotia and may be seen as too 'communal'. Private owners may see this as a way to restrict their rights to their land. But if discussed clearly, it could be seen as beneficial. On the group management level the private owners could address managing at the landscape level.

5) M'kmaq culture and history: Most reviewers expressed reservations about the discussion concerning M'kmaq history and attitudes toward the forest. They feel that the book's description was romanticized. They suggested that the book be revised, pointing out that the M'kmaq impact on the forest was primarily limited by their small population, rather than their ethical and spiritual connection to the land.

Although the general opinion is that the discussion concerning M'kmaq history and culture is romanticized I would not recommend any changes. The argument that with sufficient population size the M'kmaq would have had the same impact as European civilization is pure conjecture. It assumes that the Mi'kmaq cultural view of the forest and natural resources is the same as the early European cultural view. It also assumes that given enough time, in isolation from European contact, the evolution of M'kmaq culture would follow the same course of European cultures. Though it is possible, there is no evidence to suggest that it would certainly happen. It is just as likely that the M'kmaq would develop quite differently from European cultures. Since we have no way of knowing what would have happened we should not present our guesses as fact.

The information presented in the book is based on the oral history of the M'kmaq as interpreted by Peter Christmas, a well recognized authority on M'kmaq culture. Oral story telling is the accepted form of teaching history for many aboriginal groups. It is just as legitimate as our own. It would be an euro-centric mistake to discount the use of oral history simply because it is not the way we keep our historical records. Therefore I would not alter the discussion on the relationship of the M'kmaq and the forest.

6) Forest definition: It was noticed by some reviewers that I do not define a 'forest' anywhere in the book, though I do mention that a forest has to have an overstory. Some feel that this lack of definition leads to some confusion, especially in the management section. They suggest that I clearly define a forest, as opposed to a woodlot or a stand. Of course the definition of a forest varied greatly by group.

I intentionally avoided defining a 'forest' in the book. This was to avoid argument on the very foundation of the book. I felt it would be conducive to the education process to allow readers to define a forest on their own, after reading the book, instead of giving them my opinion. Yet this lack of definition has apparently caused some problems. Many reviewers feel that there is no distinction made between a 'stand', 'woodlot' or a 'forest', and that this lack of separation could cause confusion for the reader, especially in terms of management techniques. To alleviate this problem and maintain a balanced book I suggest adding a box with several forest definitions. This will provide a distinction from terms like 'stand' and 'woodlot' which will allow readers to form their own opinions on what makes up a forest.

7) 'Our' forest: Some reviewers expressed concern over use of the term 'our forest'. When I use the term 'our', in the book, generally I mean 'the public', the people of Nova Scotia. However I sometimes use it in an inclusive sense, meaning all the creatures that use the

forest. It is felt by these reviewers that the term is anthropocentric. Instead of reinforcing the idea that the forest belongs to us we should endorse the idea that the forest belongs to the whole forest community, including the trees and animals that live in the forest. This biocentric view is much more in keeping with the philosophy of stewardship. Though I agree with this philosophical view of the forest, presenting it in the book may be problematic. The argument centres on the idea of ownership. Can a forest be 'owned'? I believe that all the wildlife and plants in a forest have a right to use it, though I am not sure that right *is* ownership. I believe nature cannot be owned.

Ownership is a human construct and is a figment of our socioeconomic paradigm. But to deny ownership of the forest, in the human sense, will radically alter the context of the book. If we deny human ownership then the distinction between private, industrial and government lands is eliminated. That would have drastic effects on the book, since the book is set up to educate about the differences between private, industrial, and government management of the forest. It would also deny the realities of forest management and politics in Nova Scotia. Also, I believe it would alienate many of the readers who might otherwise gain some valuable information from the book. It might be too overwhelming to completely embrace the idea of communal sharing of a forest resource that has been partitioned since the arrival of the Europeans. I believe it would be a great improvement for the book to present this view point as an alternative view that is worth consideration, but not as the main stream view which, unfortunately, it is not.

8) Comprehension: Most reviewers feel that the book should be written at a consistent comprehension level. This comment referred mostly to the dialogue, which they think varied from junior high level to high school level.

Since the comprehension level seems to span both junior and high school levels; the question arises: what should be done about it? I believe there are two options: a) re-write the dialogue to be consistently at one level or the other and target that group for use of the book, or b) develop the book so that it can be used throughout the school system. Starting in junior high the lower comprehension level information is presented, then in grades 11 and 12 the higher comprehension level information is taught. Each section will be increasingly more complex as subject difficulty increases and as the student moves through the grades. This would entail using the book in several different grades and in several different subjects, which can be accommodated by the present school curriculum.

9) Regional versions: Some reviewers, mainly from outside Nova Scotia, feel that I should either write a New Brunswick version of the book or incorporate the whole Acadian Forest region into one book, instead of focusing on Nova Scotia.

Though this is a flattering endorsement of the book, it is also problematic. To write a Maritime version would be a vast undertaking. The social, political, economic and ownership histories of forestry vary greatly in each of the Maritime provinces. To adequately represent all of them would involve concentrating on the history of the region to the point that it might overshadow the rest of the book. That would change the whole focus of the book. It would also make the book much longer. This would not be conducive to reaching the target audience. The book must be short and to the point to maintain its educational potential. On the other hand, to write several provincial versions fragments the concept of the Acadian Forest. Thus, the whole picture may be lost in an attempt to explain its parts. Furthermore the education department has indicated that a regional approach would be in keeping with its goals for environmental education. Both options are problematic and have their advantages and disadvantages.

10) Private woodlot owners: Many feel that the book left the reader with an undeservedly good impression of private woodlot owners. It should be stressed that not all owners are as responsible, or interested, as the MacKenzies. It should also be mentioned that much of the 'bad' management taking place in the forests today is on private lands.

11) Story crisis: It is almost unanimously suggested that some conflict, such as a financial crisis, be introduced to the story to give the story a plot and realism. The story could centre around the MacKenzie's trying to make ecologically sound management plans in light of the financial realities of their situation.

12) Editorializing and biases: It is felt by many reviewers that I editorialize in the boxes of the book. Some think that this was inappropriate, while others feel it is unavoidable and necessary. It is also felt that I am biased in my treatment of silviculture, industry and small woodlot owners. It is suggested that I be neutral when discussing these topics. On the other hand many others feel that it would be impossible to be objective and to state my biases clearly. This issue has already been discussed.

13) Fragmentation: Several reviewers feel that the book's discussion of the effects of fragmentation was inadequate. They feel the effects of fragmentation on habitat and wildlife populations should be a focus of the book.

14) Carrying capacity: Some reviewers feel that the book does not emphasize the importance of natural limits. That the book is so concerned with management that it loses touch with the idea that we are part of the natural system. They feel it must be emphasized that there are limits to how much impact we can have on the forest and we must learn to live within those limits.

15) Preservation versus conservation: It is felt that I did not define preservation and conservation clearly. Many felt that my definition of preservation is the generally excepted definition of conservation. The book should be clear on this issue and state which form of action I endorse.

The book should make clear the distinction between preservation and conservation. Yet I do not believe the book should present one as better than the other. It should be shown how each can be used in a sound management strategy.

Recommendations: After careful analysis of the validation test I have come up with a list of recommendations to improve the accuracy, flow and objectivity of the book. These recommendations are based on the results of the validation test and include the suggestions, the major issues and themes, and will increase the book's ability to fulfill its main objectives. The recommendations follow, in no particular order:

1) Silviculture: Include in the discussion on silviculture both provincial and general definitions of the term. Make a clear distinction between the two and show how they are applied to forest management in Nova Scotia.

2) Clearcutting and plantation management: Expand the discussion on clearcutting to clearly present both sides of this debate. Show it as a management tool and its present use in Nova Scotia, while discussing where and when it is appropriate, and how it can be misused as well as possibly environmentally dangerous.

3) Industry: Expand the discussion on industry to reflect its importance to the province; this should include: A) industry has been, and is, changing to find and practice economically viable sustainable forestry techniques, but also that this is due to market and public pressure as well a change in the philosophy of the industry; B) there are many good managers in industry trying to affect this change at the management level; C) the book's

segments on history should be put into historical perspective; that is, that everyone evolved in forestry, not just industry, contributed to the mismanagement of the forests.

4) Management and scale: Make a clear distinction between 'stand' and 'landscape' management. Present landscape management as an option mainly for industry, and stand management for private owners. Add a discussion on group landscape management for small woodlot owners.

5) Mi'kmaq culture and history: Maintain the present discussion concerning M'kmaq culture. Change dialogue to allow Kara to answer questions and give some information on wildlife/ecology. Flesh out her character to include what she is studying at university. Perhaps replace Peter with Kara (see option A of #8).

6) 'Forest' definition: Add a box with several definitions of a 'forest' and identify the part of the forest sector from which each definition comes.

7) 'Our forest': Continue to include ownership as part of the book's philosophy, while pointing out that it is anthropocentric. Also include an explanation of the biocentric point of view.

8) Comprehension: A) re-write the dialogue to be consistently at the high school or junior high school level. Given the complexity of the subject matter I would strongly recommend the high school level. This could be achieved by dropping the character of Peter, since he requests and provides most of the lower level information. The topics that include him could be rewritten using only the older characters.

or

B) Develop the book so that it can be used throughout the school system. Starting in junior high the lower comprehension level information is presented, then in grades 11 and 12 the higher comprehension level information is taught. Each section will be increasingly more complex as subject difficulty increases and as the student moves through the grades. This would entail using the book in several different grades and in several different subjects.

Consultation with the education department will aid in deciding which is the best option.

9) Regional versions: Only after completion of the second validation test and with consultation with the Education department can a decision be made concerning which option, if any, is best to expand the coverage of the book (#9 of directional suggestions p. 24).

10) Private woodlot owners: It should be made clear that the MacKenzies are the 'model' woodlot owners, not the norm in Nova Scotia. Many private owners care little about their land or forest stewardship; also, some of the mismanagement in Nova Scotia's forest is being done by these private owners, and not just industry.

11) Story crisis: Add a crisis to the story. Present a crisis, perhaps financial, that the MacKenzies face and must deal with in the management plans for their woodlot. This will demonstrate the tradeoffs between ecological concerns and the financial realities of a family.

12) Editorializing and biases: Biases in the book should be stated clearly, and other view points should be represented as equally as possible. Debate on these subjects should be encouraged.

13) Fragmentation: Expand the discussion on fragmentation to show impacts on wildlife and forest structure. Perhaps use Kara to explain fragmentation.

14) Carrying capacity: Stress the limits of natural systems. We must learn to live within those limits if we wish to practice sustainable forestry.

15) Preservation versus Conservation: Clearly define both terms. Show where both are applicable in terms of forestry and protected areas, but do not present one option as better than the other.

16) Profanity: retain the existing profane language until the results of the second validation test are received. If there is strong objection from the education sector, then the language will be changed.

17) Asides: Off hand comments and asides in the text should be removed.

18) Second Validation test: Continue with the second validation test. This should look at balance and educational effectiveness.

19) Editing: After the book is completed a professional editing of the text is strongly recommended.

Conclusion:

The success of the book depends on its ability to satisfy the goals set out for itself, which are write an educational text book that: 1) teaches the major concepts of forest ecology and forest management at the high school level; 2) demonstrates and teaches holistic forest management, including IRM and forest stewardship; 3) is written in an unbiased and well balanced way, giving the reader the necessary information to form their own opinions concerning forestry issues.

Given the results and analysis of the validation test; including the themes, suggestions, and specific responses, I conclude the following:

The results indicate that the book satisfies the first goal. The overwhelming consensus is that the book teaches the major concepts of forest ecology and forest management. It was also found to be appropriate for, and at the comprehension level of, high school students.

It was also felt by the vast majority that the book covered and explained the concepts of IRM, forest stewardship and holistic forest management. This satisfies the second goal.

As for biases (the third goal) the book was not so successful. The presence of personal biases throughout the book seriously impedes its ability to be objective and present neutral discussions on forestry issues. I believe that by incorporating the recommendations listed above, the concerns of the reviewers will be alleviated, and the problem of biases will be eliminated.

Overall, the results show that the book fulfilled most of its primary objectives, and with revision will achieve all of them. Also, with the incorporation of the recommendations I believe that all groups in the forest sector will endorse this book as an excellent educational tool for high school students, for most of the reviewers already feel that it fulfills its goals as an educational tool.

I recommend that the book be revised to include the recommendations listed above, and that a second validation test involving high school teachers and students be conducted to assess the book's effectiveness as an educational tool.

In conclusion the book has succeeded in achieving most of its objectives, and with the recommended revisions will achieve all of its objectives and be supported by the forest sector as an educational tool for high school students. Therefore the book Acadian Forest Stewards: living with and from the trees in Nova Scotia, and the validation test of the book are a success. Thus the goals and objectives of this thesis have been fulfilled.

Appendix 1: Validation Test Questionnaire

Interview

State name and occupation / position.
Give the three sections of questions: 1) book overview; 2) Information accuracy; 3) approach and style

- The interview will be approximately one and a half hours long, 47 questions in total.

Questions:

Section 1: Overview:

Please answer the following questions as a member of the general public.

1) Overall, was the text clear and understandable?

2) Do you feel the text reads easily?

-No: Why do you feel the text does not read easily? was it disjointed?, fragmented?

-Yes: What attributes made the text easy to read?

3) Did the book hold your interest? explain

4) Do you feel the book is written at a high school level?

-No: What level do you feel the text is written for?

-Yes: What grade?

5) As a professional, do you feel the book covered all the major concepts of forest ecology?

b) Forest management?

- No: Please list the concepts not presented in the book.

6) Do you think there are inherent biases in the book?

-Yes: please list and explain them.

Section 2: Information:

1) What is your field(s) of expertise concerning forest ecology and forest management?

2) In your opinion what are the major issues facing forest ecology today?

b) forest management?

3) In your opinion what are the most important concepts of forest management that we should teach our high school students? - what do they need to know to be better foresters, citizens, and caretakers of the forest. (car analogy, what degree of detail is important.)

b) forest ecology?

Keeping in mind that the text is written at a secondary school level, answer the following questions.

4) Do you feel the information on forest bio-physical functions is accurate?

b) is there enough information?

5) Do you feel the information on wildlife is accurate?

b) is it enough?

6) Do you feel the information concerning recreation is accurate?

b) is it complete?

7) Do you feel the information dealing with the natural history of Nova Scotia is accurate?

b) is it enough?

8) Do you feel that the books account of history is accurate?

b) is it enough?

9) In your opinion, do you feel that the books representation of aboriginal culture is accurate?

b) is it enough?

10) Do you feel the information concerning the general concepts of forest ecology is accurate?

b) is it detailed enough?

11) Do you feel the book accurately represents the forestry industry, large companies?
b) Small woodlots?

12) Do you feel the concepts of silviculture were adequately represented?
b) were they accurate?

13) Do you feel that the information on forest management techniques is accurate?
b) is there enough?

Please answer the following questions as a professional.

14) Do you feel that forestry and wildlife management need to be integrated?
-No: explain. *go to question 18.*
-Yes: explain

15) In your opinion what are the major obstacles facing the integration of forestry and wildlife management?, if any.

16) Do you feel the text was successful in integrating forestry and wildlife issues?

17) Did the text demonstrate integrated forestry / wildlife management on the Mackenzie's woodlot?

18) Define integrated resource management (IRM) as you see it.

19) Do you feel that IRM should be part of forest management in Nova Scotia?
No: explain. *go to 21*

20) Do you feel the books account of IRM is accurate?

21) In your opinion, define stewardship?

22) Do you feel that stewardship should be part of the forest management strategy for Nova Scotia?
No: explain. *go to 24*

23) Do you think the book presented stewardship values?

24) What do you feel is the book's position concerning forest management, and IRM?

b) Do you agree with this position?

25) With respect to stewardship, what was book's position?

b) Do you agree with this position?

26) Did the book combine the philosophy of stewardship with the management tool of IRM?

27) Are there any other comments concerning the accuracy of the information presented in the text that you wish to make?

Section 3: Approach and style:

1) Do you think that separating the story from the essays makes the book easier to read?

2) Do you feel the cameos (boxes) are an interesting feature?, or merely distracting?

-No: should they be integrated into the text or eliminated

3) Do you feel that using a family setting and a story format is an effective medium to convey the concepts of forest ecology?

- forest management?

4) Do you feel that this style of book facilitates learning?

5) Do you think the characters are realistic?

6) Do you feel the small woodlot situation is realistic?

7) Did you find the story interesting?

8) Do you feel that the dialogue was realistic and natural?

9) In your opinion is the book's style (dialogue, presentation, organization) appropriate for high school students?

10) In your opinion do you feel the book will be an effective tool for educating high school students in forest ecology ?

b) forest management?

c) the general public?

11) Do you feel the book fulfills its goals as an educational tool for high school students?

b) the general public?

12) Do you have any other comments you wish to make concerning the book, or this validation test.

Thank you for your co-operation.

References

Sudman, Seymour, and Bradburn, Norman, M. *Asking Questions: A practical Guide to Questionnaire Design*. Jossey - Bass Publishers, San Francisco, California, U.S.A., 1983